CHAPTERS ON THE HISTORY OF BOTANY IN INDIA

I. H. Burkill

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INTRODUCTION

The CHAPTERS ON THE HISTORY OF BOTANY IN INDIA now presented to the public, made their first appearance as separate articles in the Journal of the Bombay Natural History Society from December 1953 onwards. As soon as the first Chapter appeared in print in the above mentioned journal there was a general request from India and elsewhere for the republication of the same in book form. The Executive Committee of the Bombay Natural History Society has given its sanction to the Botanical Survey of India for the publication in book form ; the Botanical Survey takes this opportunity to acknowledge its indebtedness to the Bombay Natural History Society, and to render thanks to the same in the name of all the Botanists of India, who will benefit from the Society's generosity.

It may not be considered out of place to give a few details of the story behind the *Chapters*. As Vice-President of Bombay Natural History Society and its botanical editor, in November 23rd, 1951, I wrote to Mr. I. H. Burkill from Bombay: "Next August we are celebrating the publication of the 50th volume of our Journal of the Bombay Natural History Society. At a recent meeting of the Committee I was requested to ask you for a contribution for the August number of the Journal. The subject mentioned was a sort of Biographical Index of 'Indian' Botanists, *i.e.* British and foreign botanists that have worked in India from the beginning of the xixth Century onwards. As for the length of the

Index, no limit has been set...." To this proposal, Burkill gave an answer that was most generous : "You shall have all that I can give you" (27th Nov., 1951). "I propose to separate from my slip index all the names of botanists in India which belong to those deserving of mention in the proposed account of Botany in India 1800 forward. When I have done that I will see if I can find time to write an account and I will communicate with you." (16th Dec., 1951). On Sept. 18, 1952 he writes again : "I assure you most appropriately the work I am doing on the history of Indian Botany is absorbing my energies.... My undertaking is larger than I expected ; but I am getting on with it" Finally on March 25th, 1953, he could write that the MS of the first chapter had been posted to Bombay. Later on when asking about chapter 2, I received the following answer : "I shall get down to part 2 as soon as I can. At the moment I am entwined by African Dioscoreas. When last year something went wrong with my inside-machinery and I could not get over to Kew or to the libraries in London, I lost way. But I am able to get about again—at any rate I get over to Kew ; and I am in better fettle on the eve of 84 than I was on the eve of 83". Chapter 2 was finally ready for the press in August 1956. At that time I wrote to Burkill : "From all over India and beyond I have heard great appreciation of your first chapter, with requests that when the series is over, it may be published in book form." At the beginning of 1960, I had a letter from Burkill's son, Dr. H. M. Burkill of Singapore, in which he writes : "I would like to add that I arrived back here from a visit to England but 4 days ago, and I left my father in good health. He was busily engaged in typing the final text of Chapter 3 of his History of Botany in India."

Originally the whole series was supposed to consist of three chapters ; but in the end it was decided to divide Chapter 3, so that finally there are now six chapters and an Epilogue. After the publication of the series in the Journal of Bombay Natural History Society, the author has once more checked his original contribution and made extensive changes, particularly in Chapters 1 and 7.

The author of these Chapters, I. H. Burkill, has omitted to mention his own activities during his period of service in India, 1901 to 1912. Burkill was born on May 18th, 1870 ; after graduating with Honours in Natural Science in Cambridge, he came to India, after three years in Kew. His service in India began in 1901 as Assistant Reporter on Economic Products to the Government of India ; Burkill was posted to the Indian Museum, Calcutta, under Sir George Watt as the Reporter. During the absence of Watt from India in 1907, Burkill acted as Officiating Reporter. In the Report of the Botanical Survey of India for the years 1911-1912, we read : "The Director was absent on privilege leave from 21st April to 2nd July, 1911, during which time Mr. I. H. Burkill officiated in addition to his substantive duties as Economic Botanist of the Botanical Survey of India. Up to the 31st January, 1912, Mr. Burkill

was Assistant Reporter on Economic Products officiating as Reporter, and thereafter on the abolition of the Reportership, became Economic Botanist to the Botanical Survey, which post he held for the remainder of the year".

In the introduction to *The Botany of the Abor Expedition,* Burkill himself writes : "It fell to me in the middle of the Hot Weather of 1911, when acting as Director of the Botanical Survey of India, during the leave of Col. A. T. Gage, to propose to the Government of India that a Botanist should be told off to accompany the Abor Expedition ; and to my gratification, after Col. Gage's return, I was sent".

During his time of service in India, Burkill made a number of major collecting expeditions of which the following are the more important :

The Sikkim Expedition of 1906. "Mr. Burkill. ..paid an autumn visit to Phallut in 1906 in search of Aconite tubers" (*Kew Bull.* 1907 : 175). Burkill himself writes: "I amused myself by the wayside making flower pollination notes and am now writing a short paper...". Several papers in fact were published by Burkill on the subject, and this would indicate that he had made detailed excursions to many parts of India, as his published notes on flower pollination concerned flowers of Bengal and Assam, North-West Himalayas, Simla Hills, Central Provinces and Behar, etc.

Journey into Nepal, 1907. An account of this trip is given by Burkill in Records of the Botanical Survey of India 4(4): 59-140, 1910. The first paragraphs of this account read as follows :

"On November 28, 1907, after marching along nearly one hundred miles of the Nepalese frontier between Jainagar and Raksal, I turned, with the permission of the Nepalese Darbar, into the kingdom of Nepal and reached Khatmandu by the usual route on December the second. Thence... I visited the Trisuli valley, in the neighbourhood of Naikot. I returned from Nepal to the plains by a route through Pherphing, which diversifies the first seventeen miles of the way. My dates almost coincide seasonally with the dates of Wallich's march to Khatmandu, and we seem, he and I, to have gathered at a period 87 years apart the same plants in the same spots ... It is ill gleaning for novelties after a botanist with the keenness of Wallich ; so I got no more than three species of *Impatiens* and apparently one of *Eriocaulion*..."

The *Notes from a Journey to Nepal,* based on the observations made in just a fortnight, cannot and do not claim to give an account of the flora of Nepal ; "what is written.. .is, indeed, but a superficial account of the features of the vegetation between Raksal and the Himalaya of Central Nepal as far back as 35 miles in a straight line from the skirts of the plains and not higher than 7,000 ft. There was but one excuse for writing it, *i.e.,* the great want of knowledge of the Botany of that part of the chain" This account has always been of

particular interest to me personally, and lately this interest has been enhanced by the fact that one of my students had been doing research for several years in an area of Nepal that includes the whole part visited by Burkill and previously by Wallich. Burkill in his *Notes* lists about 400 genera of plants collected in his short trip, and this, to say the least, is by no means a negligible result.

The Abor Expedition. As stated above, it was at Burkill's suggestion that a botanist was assigned to the expeditionary force that went into the Abor Hills ; it was certainly lucky for us, his successors, that Burkill was selected for the job. His account is one of the most carefully complete papers that have been published for any botanical expedition of the last two hundred years in India with the exception of Hooker's Himalayan journeys. Burkill and his two collectors remained attached to the expeditionary force from November 29th, 1911, till March 11th, 1912.

The methods of work followed by Burkill during this trip were determined by the type of terrain and by the fact that for the safety of the botanists they had to betake themselves to one of the camps before nightfall. "The plants low in the natural system of classification could be of little use to me in my particular object, because their geographic distribution is yet so little known. I collected them as I was able. Material of tall trees was collected by the aid of a shot gun. An anaeroid barometer and a camera went with me everywhere ; and for a time I had wet and dry bulb thermometers in camp, though to little good effect... To obtain as many plants in flower as possible, I moved backwards and forwards along the line, and I stationed my experienced collector about two marches behind me, that I might have a pair of eyes on the watch for that which had not been in flower when I passed. Having a collector behind me gave another advantage, for thereby there was an economy in transport, as it was easy to send to him down the line by the food supply coolies half-dried plants for finishing ; but the carrying up the line of full supplies of drying paper over two marches that could be avoided, was a consideration. It was at all times necessary to keep the weight of the collections down, and under these circumstances my Dairy was made to serve as much as possible. It became a record of 8,000 observations supplementing the notes with the specimens." Much living material was sent directly from the field to Calcutta and thence to Darjeeling ; dried plants were also sent, when ready, to Calcutta, where Col. Gage placed them in the hands of assistants for a preliminary examination. The final study of the materials collected by Burkill on this occasion was only made prior to the publication of the report in 1924. *The Botany of the Abor Expedition* is an excellent account, a model of how such expeditions should be organised, collecting done and materials studied ; the presentation of the results is remarkable for conciseness and completeness.

Burkill and the work on Dioscorea in India. The genus Dioscorea has always held special attraction for Burkill ; the yams have been known in India for centuries as important food plants ; it is only natural that the Reporter on Economic Products would sooner or later devote his attention to *Dioscorea.* His first paper on the subject was published in Calcutta in 1904 ; later on he became associated with Colonel, later Sir, David Prain in a revision of the Asiatic species of this important genus ; several papers were published jointly with Prain. The corwning glory of the Dioscorea work is *An Account of the Genus Dioscorea* published in four large volumes in the Annals of the Royal Botanic Garden, Calcutta, in 1936 and 1938. Burkill to-day stands out as the greatest authority on the genus *Dioscorea* ; this is why he was chosen to write on the Dioscoreaceae for the *Flora Malesiana ;* one of his latest scientific contributions has been the preparation of an account of the Dioscoreas of Africa and Madagascar.

It is a matter of gratitude for all Indian Botanists that I. H. Burkill has continued to work with great energy up to now ; these *Chapters* have been complete during his 93rd year of age. Our debt of gratitude is greatly enhanced by the fact that the last part of the work has been done under very hard conditions. In a recent letter, he writes "I get blinder and blinder and am already very dependent on my wife for reading to me half of the letters that come. I can read but part of the newspapers and I cannot read the papers that kind correspondents sent me. This blindness has come very rapidly but the seeds of it have been in the right eye for some years. It is by the left joining the right that the rapidness becomes noticeable"

Burkill throughout his life has been a sincere friend of India and of the Botanical Survey of India. The Chapters now published are the finest testimony of this friendship.

Calcutta, 20th, April, 1964.

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Director, Botanical Survey of India, Calcutta.

The area within which the System of Botany originated is enclosed within the broken line. The names within this line are of the places at which botanical works were printed before the date of Kaspar Bauhin's *Pinax* in more numbers than two, and numerals indicate all the other helpful places, those where 1 or 2 books were printed:

1 to 4 successively Leiden, Arnheim, Middelburg and Louvain; 5, 6 and 7, Leipzig, Bautzen and Gorlitz (each 1); 8 and 9, Augsburg and Nuremburg, (each 2); 10 Antorp (1); 11 to 15, the Italian University towns—Bergamo, Mantua, Padua, Ferrara and Bologna. Besides these, one work issued from Salamanca.

CHAPTER I

FROM THE BEGINNING TO THE MIDDLE OF WALLICH'S SERVICE

I. INTRODUCTION

This is the first chapter of an attempt to put on record the names of *all* who have earned recognition by playing a part in the introduction into India of the Natural Science commonly spoken of as Botany. The science is exotic to India as a system of knowledge; and on that account I shall not attain clarity without indicating where and when it originated. The possibility of rival systems is not denied: the fact is this—that a system emerged out of the Technology of Healing in a particular part of Europe, was accepted and clad there with a vocabulary of precision, as Sciences must be, and that this system has been spread over the World, India included, without meeting a rival. Its origin was, as it were, by a sublimation in which 'Man' was displaced from the focus of thought that 'the plant' might be placed there.

I have prepared a map of Europe wherein the area of its origin is delimited by a broken line. The time was the 16th century; and I endeavour next to connect the event with the contemporaneous state of

the parental technology. The invention of printing in the 15th century was not without great influence ; for the diffusion of information by print bound the literati into a thinking community when a great deal of agreement was needed to lead up to a corporate method of expression. Printing was developed at Maintz, near Frankfurt (rather central on the map), and was not long in spreading over the Alps to Venice. My map is a map of all the places at which botanical books were printed from about 1500, the beginning, to the date of Kaspar Bauhin's *Pinax* (1623). The place-names on the map are two ranks, the important in full, the places at which only 1-2 books were printed as numbers. All the works referred to by Bauhin are accounted for, and the reader will readily agree with me that the printing of a book is reasonable evidence of writing such in the neighbourhood ; the map, as it is based on all the botanical books printed to Bauhin's time, represents the whole area of producing botanical work to 1623. Salerno and Naples are taken together on the map, where Salerno is the name entered : one small book is credited to Salamanca which is outside the broken line. The delimited area covers land occupied by Italians, French, Flemish, Germans, Dutch and English, and they in intercommunication used Latin ; Latin consequently provided the vocabulary of precision.

All the first work was Classification and Morphology. The time for Phytotomy was not to come until the microscope had been made more serviceable, and the time for Vegetable Physiology awaited the establishment of laboratories. In a way it eases my task that the botanists named in this first chapter were neither phytotomists nor physiologists.

I come now to the question of the spontaneity in this movement which drew Botany out of its first technology. It was autochthonous, not immediately Greek. The classical Greeks had been conspicuous in the healing art in their time. They monopolized the profession of physician wherever they spread in the Mediterranean ; Cato grumbled that they filled all the places in republican Rome. Dioscorides was a Greek in military employment with Roman armies. Clever Greeks travelled far ; they made Alexandria famous as a medical school and its teachers filled the Alexandrine libraries with their writings. Then came the Arabs, taking Alexandria in 641 A. D. They were destructive ; yet also they preserved. An Arab in power, greedy to find out how an alchemist could make gold, summoned the literati, expecting the secret to be in their manuscript, and bade them translate these into a language that he could read. This Arab was Al Mansur, the second Caliph to govern Egypt after the Arabs had conquered it. He helped in the destruction of local medical knowledge by scattering the manuscripts still assembled there. In a way he scattered knowledge by selecting what he had fancied. The work of improverished literati being cheap, the work went forward and soon extended from the hunt for riches to a hunt for health. Baghdad followed the example of Alexan-

dria and so too did other centres of Arab rule. From Baghdad the Arabs reached out to the Indus, and in the reign of the Khalif Al Mansur (754-775) they caused the Charaka Samhita and the Susruta Samhita to be translated from Sanskrit. I do not know of any return of the compliment by which a work on medicine passed from Arabic or Persian to Sanskrit; but adoption of medicaments demonstrates contact.

Europe meanwhile, threatened with uncompromising conquest, was sinking to the darkest days of its Dark Ages. These came towards 1000 A.D. What turned the tide as far as medicine went was faithful observation. Then a dim dawn followed. In 1016 the Tunis-born Constantinus Africanus attached himself to the medical school of Salerno; and after that physicians of the school would quote from Arabic. Between 1148 and 1187 the greatest product of the Arabs, the *Kanun of Avicenna,* based on the Greek of Galen, was translated in Sicily into Latin. So southern Italy came to renew northwards various of the Greek ideas of therapy that had once ruled, and refreshed a little the lands whose medical ideas had become despicable. But the written word did not bring with it the healing herb; what it did was to stimulate enquiry regarding the healing herb, and set moving an inquisitiveness which so put the herb into the front as to create Botany. This the best physicians recognised and one of them at least, if not also others, journeyed to Vienna to consult the illustrations by which the great *Codex Aniciae Julianae* showed what were the herbs used by Dioscorides.

As the Renaissance developed in northern Italy, universities appeared in a group near trading Venice. At first they taught Law, then they went on to Medicine; and to teach the latter they devloped teaching gardens and also the preparing of 'books' of mounted dried plants, which they called *Horti Sicci* or *Dry Gardens*. Padua had a live garden in 1545, Pisa in 1547, and Bologna in 1567. It is very easy in a garden to allot places to small plants so that like is with like and easy, too, to arrange Horti Sicci with like following like so that affinities are respected. From this botanical classification resulted. The teaching method at once spread northwards; Leiden had a garden in 1577, and Heidelberg in 1597. Montpellier had a garden from 1593. The origin of botanical systematy is obvious.

I beg to my reader strictness of thought in keeping apart the natural science Botany from the generality of objects which are quite properly termed botanical. A writer in Calcutta claims that those who wrote in Sanskrit possessed the natural science, on the ground that they applied Sanskrit names to plants. The argument is false. Apply the test, namely, which is at the centre, man or the plant; when applied it will be found that man maintains his post at the centre.

I have an observation to add to this section. The invasion of eastern Europe and the destruction of Constantinople by the Ottoman Turks

under their Sultan Mohammed II in 1453, though it drove the learned in Greek into Italy, came after Europe had taken the more technological work via Arabic ; where after Theophrastos's *Historia Plantarum* for instance was translated into Latin in 1483.

A second observation is that Botany, the natural science, reached India through Arabic by two lines. It came direct from Baghdad and indirectly from Portugal. In 1336 Lanzarrotte Malococce, of Genoese origin, now employed by Portugal to explore, sailed out of Lisbon and discovered the Canary Islands. After him, enterprise led to the discovery of Madeira, the Azores, the Cape Verde Islands, the harbours of the whole of the West coast of Africa, and finally the reaching of Calicut in southern India, the year being 1500. What I wish the reader to note is that the discovery of 1336 was the first of a long series of advances extending up to the time when Garcia went as a Physician to India. During this time the material condition of the Canary Islands was so advanced that when Columbus began his great work they provided a place where West Indian plants could be acclimatised and Old World plants exported. At this time, Persian physicians up and down northern India represented the botany of Galen, and Garcia came to southern India and into contact with them.

II. GARCIA DA ORTA AND OTHERS OF THE XVI CENTURY

There was born about 1490 at Elvas in Portugal near the Spanish border a great pharmacist—Garcia da Orta. He was sent to study medicine in Spanish Universities, first to Salamanca and then to Alcala de Henares, which is a little to the east of Madrid. A few years after qualifying he was appointed lecturer at Lisbon (1532) ; but after two years there, an offer reached him to go to Goa in the train of Martin Affonso de Souza, a future Viceroy of the Portuguese Indies; and this offer he took, spending the rest of his life from the age of about 44 to his death when near 80 (about 1570) in practice in India. He saw military service from Diu to Ceylon, and once was invited inland to the court of the ruler of Ahmednagar ; but he never left the western part of India. He had a garden in Goa where he grew plants that interested him. He studied the native drug shops, knew the ways of the local physicians and discussed treatments with the Persian physicians who were maintained at native courts. He could read Arabic and tells us that he would set the Arabic text against a translation by way of testing the latter. He had an active enquiring mind. When he was advanced in years a brother physician of Goa, Dimas Bosque, suggested to him that he should record his knowledge in writing and so it was that he wrote his *Colloquies*. They are between himself as the young student fresh from the schools, and himself the experienced physician,

and so constructed that he tells us what he did not exactly know when he arrived in Goa. The book is entitled *Coloquios dos simples e drogas he cousas medicinais da India compostos pelle Doutor Garcia da Orta* and appeared as the third work that issued (1565) from a press that had been set up in Goa. The poet, Camoens, then an exile in Goa, wrote an ode which I quote from Markham's translation (Markham's edition of the Colloquies, p. xi; 1913) for the sake of the evidence in it of the lovable nature of the old man. 'The lore which Achilles once valued I studied with thee ; you opened my eyes to its charm. In your garden of herbs each flower, each tree, were seen in your time by your friend. The fruits of that garden collected from far, were unknown to the learned of old. See how in thine age thy wisdom and care brought many new simples to light. Unknown to the ancients but revealed to our sage are the plants in this garden of herbs. You have opened to us an inspiring page. To the neighbours like magic it seems. Taught of yore by the Muses of Ganges and Ind, full of learning, as of years, in all that is known of the true healing Art, old Chiron must bow before thee.'

The information that Garcia had to give turns (i) on the eastern drugs that the Arabs sent westwards in trade, and (ii) on simples used in India that were new to the man from the West. Beyond this Gracia enlivens his book (iii) by information on local fruits, on borax, the betel quid, the narcotics from hemp and Datura, etc. The author he quotes most frequently is Avicenna whose work had been available in Latin from the 12th century and known through the mediaeval schools of Europe. It had been rendered into Portuguese just before the time of Garcia. Second to Avicenna he quotes Dioscorides whose work, available in Latin, had been translated into Spanish during Garcia's life. Thirdly Serapio, whose *Liber aggregatus in medicinis* had also been rendered into Spanish (1947). He quotes other writers in Arabic less frequently, and only once quotes the *Charaka Samhita,* and that at second hand. Simples that Garcia adopted from local sources included the bel fruit (*Aegle marmelos* Corr.), the nirgundi (*Vitex negundo* L.), the nim (*Melia azadirachta* L.), the harsingher (*Nyctanthes arbor-tristis* L.) and the conessi bark tree (*Holarrhena antidysenterica* Wall.).

Garcia's work had not been out of the press for long when Clusius (Charles de L' Escluse, 1526-1609) travelling in Spain, met with a copy, and from it compiled a digest, too extensive to be called a summary, which was printed at Antwerp under the title *Aromatum et simplicium historia.* Eleven years later a well travelled priest, Christobal Acosta, produced a much shorter summary with the innovation of illustrations. Garcia's results became well known from Clusius's work, for there were many editions of the digest.

The 16th century called out a few travel books with incidental mention of plants in them. Ludovico Varthema's *Itinerario* (1510) was a very early one, the work of an adventurer who resided for a short

time at Cochin and Cannanore. A better work than Varthema's was that of Jan Hughes van Linschoten (1596). Linschoten as a young man had gone to Lisbon and there he obtained permission to go to Goa in the train of an Archbishop ; next he resided in Goa from 1583 to 1589. Having repatriated himself and written an account of life in Goa, he got Bernard Paludanus, a physician of Enckhuysen who had travelled in the Levant, to add botanical notes.

III. THE DUTCH TAKE A HAND

Linschoten was a cog in the wheel that transferred possession of the coastal waters of Malabar from the Portuguese, who had overshot their bolt, to the Dutch. We get a change with this ; for Garcia had in a large measure severed himself from his country, living from his 44th year in India, publishing there and owing his recognition in Europe to Clusius who by birth was a Flamand ; but with the coming of the Dutch the work was carried to Europe for a finishing. The Dutch had discovered very considerable interest in Botany ; their Universities were equipped with Botanic Gardens ; and at Leiden, which is close to Amsterdam, there was heated house from the year 1600 for the cultivation of tender plants. Their interest in Botany was so nation-wide as to reach a high administrator, Heinrich van Rheede tot Draakenstein (1637-1692) who had been made Governor of the Dutch possessions in Malabar in 1667. Rheede had the friendship of the Dutch surgeon Willem Ten Rhyne (1647-1700) who aided him in editing ; Ten Rhyne visited Java and Japan. Rheede pre-deceased him by eight years.

The Professor at Leiden of this time was a man little known to Science, Arnoldus Seyn (1640-1678). Perhaps his early death was a cause of the forgetting of his name. But to him came a student of Halle in Saxony who had been to Padua in Italy to obtain a medical degree ; this student was Paul Hermann (1646-1695) ; and Seyn recommended him to Rheede with the result that a post was found for him in Ceylon whither he went in 1670, and where he remained until 1677. He collected and dried plants making for himself a *Hortus Siccus* in four volumes and sending duplicates to Jan Commelyn, who was in charge of the Amsterdam Medical Garden. As Hermann pasted down into his own collection the plants as they came to hand, the collection roughly records his journeyings. He was at Colombo for a long time and later contrived to make the journey down the coast to Galle, but was unable to go inland. He collected drawings to the number of about 450. Seyn died, and Hermann, returning to Holland, succeeded him and was too occupied thereafter with the garden and presumably with teaching to complete a study of the collections that he had made. The two collectors of Ceylon, Hermann and Grimm, who immediately followed him,

worked there while Rheede was yet alive, and only along the Colombo coast. After them almost a century passed before the next collecting—Thunberg's.

Just after Hermann's departure from Ceylon another surgeon was there, Hermann Nikolaus Grimm (1641-1711) a Swedish surgeon who between 1678 and 1681 collected a little. Rheede certainly was responsible for Hermann's opportunities and probably also for Grimm's ; but he operated in a larger way on the mainland of India, obviously because he inherited there an organized administration. Natives of the country about Cochin, chiefly Malabar medical practitioners, were engaged to bring in living plants that they might be drawn ; and with the plants they submitted whatever information they could give. An artist-missionary named Matthaeus drew the plants, and a Portuguese interpreter translated the accounts into Portuguese whence they were rendered into Latin by another, Hermann van Doner, who held the post of Secretary to the local government. Next drawings and descriptions were assembled in the hands of the missionary Johannes Casearius and were sent to Holland. Seyn then added a determination, or Commelin, chiefly Commelin on account of the early death of Seyn. The printing press got to work, and the first part appeared in 1678 (not 1686 as the title page suggests) ; the last of the twelve volumes appeared in 1703. The figures are commendable ; the descriptions indifferent ; the annotations of Seyn and Commelin introduce Botany in a way that will be appreciated best if I give a few illustrations:—(i) against a figure of *Ficus religiosa* 'this may not inappropriately be called *Ficus malabarica folio cuspidato fructu rotundo parvo gemino*' (the Ficus of Malabar with cuspidate leaf and small round fruits in pairs) ; (ii) against a figure of *Emilia sonchifolia* 'this is not matched and may be called *Planta indica Erucae folio, caule ambiente, flore piloso*' (the Indian plant with a leaf as Eruca, embracing the stem and with pappose flower) ; (iii a very bad shot) against a figure of *Euphorbia pilosa* 'this appears as if a Veronica and one may name it *Veronicae similis indica .albicante flore*' ; (iv) against a figure of *Portulaca oleracea* 'this is sylvestral Portulaca, though it seems to differ from ours'.

Hermann's drawings were in number almost as many as the species in his collections, showing that he aimed at figuring all ; for the value set on a drawing was then so much above that of a specimen as to make collectors endeavour to get drawings. William Sherard played a part in Leiden affairs on the death of Hermann, collecting some of the manuscripts that he had left and using some of his drawings in the *Paradisus batavus,* for the printing of which he paid. Linnaeus, when later he obtained the use of Hermann's own *Hortus Siccus,* made 429 species out of the specimens. Trimen (in *J. Linn. Soc. Lond.. Bot.* 24, pp. 129-155) critically reviewed the nomenclature.

Sherard about this time financed a collector, J. Hartog, to collect in Ceylon ; and Jan Burman in time had the use of some of his speci-

mens. Engelbert Kaempfer (1651-1715), a German serving as a surgeon on a Dutch ship, touched in Malabar, at Colombo and on the Ganges deltaic coast in the journey to Japan that resulted in his *Amoenitates Exoticae,* but left nothing on record regarding these visits. His reputation was made by his work in Persia and Japan.

IV. LONDON TAKES A HAND

While Rheede was stimulating the study of the plants of the Malabar Coast, certain British were doing a little preliminary collecting on the Madras coast under a stimulus coming from two men of the city of London. These were James Petiver and Charles Du Bois, neighbours, for the one had a business in Aldersgate and the other worked about half a mile away in Leadenhall Street in the offices of the East India Company. As relations between Britain and Holland were intimate, it is apparent that Petiver and Du Bois got some inspiration from what the Dutch were doing. William of Orange was on the British throne in association with Mary; and Mary promoted cultivation of exotics at Hampton Court, certainly obtaining some of them through the Dutch gardens which had been receiving plants and seeds from Rheede and from the botanically minded who worked under Rheede. The British effort was much smaller than the Dutch, involving little expenditure in the East; it consisted of requests to ships' captains and surgeons at sea or on land in the East that they would bring home curiosities. Du Bois had a half-brother in the East who sent dried plants to him. Petiver was very diligent in making requests and very prompt in acknowledging favours. Surgeons were in particular qualified to help him. The earliest of them seems to have been Richard Sambach, whose period of service on the Madras coast is not exactly recorded but we know that he returned from India and was living in Worcester in 1698. Petiver calls him 'humanissimus' or, may we say, most kindly. Another surgeon of his time who did more was Samuel Browne; he died in 1698 and appears to have gone to Madras about 1688. Over some years as the season of voyaging approached he prepared a packet of dried plants, a *Hortus Siccus,* and sent it to London. It would come from one village in one year, and from another village in another year, even to 70 miles from Madras, but most of the packets were from nearer Fort St. George. A little information regarding the specimens was added but no study of them made. Samuel Browne was indeed no student, and was a source of trouble to Authority from being quarrelsome, arbitrary and a dueller. Once he found himself in jail from which he got early release because he was needed to look after his patients. Once he had the misfortune to poison a patient with arsenic because his apparatus for preparing his medicines was not kept as it

should have been—and the patient was of high standing. Crawford (*Hist. Ind. Med. Service* 1, pp. 88-93; 1914) records these and other facts about him. Samuel Browne was relieved of his post by a better man than he who had been on leave; this was Edward Bulkley (c. 1651-1714) who rose in the Company's service to the post of a Member of Council at Fort St. George. He, like Sam Browne, sent packages of dried plants to London; and he caused to be attached information regarding uses and names, using bamboo slips on to the surface of which the information was scratched in Tamil. Doubtless he used native agents for the preparing of his specimens. Some of Bulkley's plants came from Burma; they had reached London by 1699, they may be connected with Bowyear's visit to Syicam in 1697. There was another Brown, a collector, Alexander Brown, a ship's surgeon; and a few more names could be added. None were more than collectors; and the botanical value of their specimens was an attribute given by Petiver or Du Bois, printed in reports by Petiver but written up only by Du Bois.

James Petiver (c. 1658-1718) was an apothecary in business in central London, a leader in his Technology and from 1709 a teacher of it at Chelsea. He maintained a museum on his premises, open to the curious, the Museum Petiverianum, for which he accepted all manner of objects that excited interest. Charles Du Bois (1656-1740) was a servant of the East India Company and their Treasurer from 1702. He had a house and garden at Mitcham, about 10 miles from his office, to enjoy in the freedom of his week-ends and for the growing of plants that interested him. In that house accumulated a *Hortus Siccus* of 74 volumes. He corresponded with the best botanists and as a friend of Sherard ultimately bequeathed his collection to Sherard's institution at Oxford. There is a pleasant chapter on him in William Foster's '*The India House*' (pp. 113-124, 1912).

Petiver who had exchanged specimens with Hermann, undoubtedly missed no opportunities of getting more. Some came to him through the India House, and would do so with Du Bois's knowledge. It is impossible to disentangle his official receipts from those he got through correspondents. The India House received seeds and distributed them to such as could grow tropical plants and separated the consignments of dried plants which were sent to Petiver for report; and this Petiver made with promptitude.

Living when Petiver and Du Bois lived there was in Westminster a physician, Leonard Plukenet (1641-1707), a friend of both. He began to publish in 1697 small copper-plate illustrations of plants under the title *Phytographia.* This was two years after Rheede's first illustrations and 7 years before his last; and the idea of illustration might have been borrowed but the scale was much reduced and the accompanying letter-press meagre. It has been suggested that Plukenet had not the means for more. Petiver supplied materials to Plukenet which Plukenet used while Petiver, having reported on the same to the Royal

Society, was awaiting the Society's ability to print the report. This the Society did in 1699 (*Phil. Trans. Roy. Soc.* 20, No. 236, pp. 313-353). Plukenet printed no acknowledgments to Petiver. Petiver and Plukenet quarrelled; and it may be that this was the cause. Later Plukenet publicly acknowledged indebtedness, but to Du Bois. When Petiver reported on the largest of the consignments that Sam Browne sent him, he as he says, 'has embodied the whole and entire observations of Mr. Browne without any abridgement'. Plukenet and Petiver continued their irregular reporting; then Plukenet died and Petiver bought his collection. Petiver grew old and the labour of curating his Museum against normal corrupting forces outweighed his ability so that there was some deterioration; but he kept on until his death when Sir Hans Sloane bought the whole and added it to the accumulation that he bequeathed to the British Museum. Between Oxford and this Museum it remains possible to see what London could learn of the vegetation of Madras.

With Petiver's death the brief days of this early enquiry into the flora of India came to an end.

The Dutch having much more material to encourage research, proceeded from Hermann's *Paradisus batavus* (1698) to Johan Burman's *Thesaurus zeylanicus* (1737) and Nicolaus Laurentius Burman's *Flora indica* (1768); while Jan Commelin's *Horti medici Amstelodamensis rariorum plantarum descriptio et icones* (1697) provided an opportunity for dealing with a number of eastern plants.

Another collector may be conveniently mentioned here—Laurent Garcin (1682-1752) who as the result of three voyages to the East, supplied specimens from Ceylon to Herman Boerhaave, the successor to Paul Hermann in the professorship at Leiden.

V. BENEFACTORS, BOTANISTS AND COLLECTORS

Those who advanced Botany may be classified under the above three names. Linnaeus with his passion for classification called the first and last botanophils. Sloane as a young physician showed himself a brilliant botanist; later in life when rich, he became a benefactor, spending his income in curating collections that he added to his own. Petiver was benefactor and botanist on a smaller scale. Samuel Browne and Bulkley were not more than collectors. When the first British essay in exploring the flora of India came to an end, it was from lack of botanists; the collectors could have been procured and Sloane would have given his aid. There was something wrong in the attraction of Botany as a discipline.

VI. THE STUDENT'S DISCUSSION BY AN ATROCIOUS UNINSPIRED NOMENCLATURE

When Johan Burman had finished with Hermann's *Hortus Siccus* and published his *Thesaurus zeylanicus,* the Hortus disappeared. It was discovered in Copenhagen and sent to the illustrious Linnaeus who, recognizing what he had, worked through it and published his *Flora zeylanica* (1748) using the nomenclature of the time which consisted of a generic name with a descriptive phrase added. In 1753 Linnaeus put forward the enormous betterment of a fixed adjective in the place of the phrase. I will illustrate the change that this brought about in the nomenclature by quoting the displaced names for the first eight species of the *Flora zeylanica* against the same species in the *Species Plantarum* of 1753 :

Names as they are in the *Flora Zeylanica*	Names as they appear in the *Species Plantarum*
Cannoacorus latifolius vulgaris (adopted from Tournefort)	*Canna indica*
Zingiber latifolium sylvestre (adopted from Hermann)	*Amomum zerumbet*
Zingiber angustiore folio, femina utriusque Indiae alumna (adopted from Plukenet)	*Amomum zingiber*
Cardamomum ensal dictum (adopted from Burman)	*Amomum cardamomum*
Costus indicus, violae martis ordore (adopted from Hermann)	*Costus arabicus*
Curcuma radice rotunda (adopted from Hermann)	*Curcuma rotunda*
Curcuma radice longa (adopted from Hermann)	*Curcuma longa*
Aro-orchis tuberosa platyphyllos (adopted from Burman)	*Kaempferia rotunda*

As many of the phrases were much longer than these, the reader will appreciate the benefit to a student in particular and to every one in general of the binomial nomenclature. I would have the reader agree that botanical study must have been discouraged by the clumsiness of the old names. I would have him be aware also that with the new nomenclature a new era in teaching came in and an apparent increase in the number of those inclined towards the discipline of Botany. The investigation of the flora of India was recommenced under the better conditions that came with the reform.

VII. A NEW APPROACH IN MADRAS

Of course the East India Company continued to engage for service surgeons who had been taught to recognise a certain number of useful plants and could be relied on to collect plants if they were asked, but the new approach came from outside the Company altogether; though from surgeons. The first of them was the missionary-surgeon Johan Gerhard Koenig (1728-1789). He had been born in the little duchy of Courland, which at the time was a bone of contention between Poland and Russia. He had gone to Uppsala in Sweden to learn medicine, then travelled in Iceland, and had brought back to Linnaeus a collection of Icelandic plants which were described in the *Mantissa* (1767). At the age of 44 he joined the Tranquebar Mission (1768) with the title of surgeon and naturalist ; and 'more covetous of fame than fortune' (Patrick Russell), he threw himself with great energy into a study of the flora of the Madras coast that Sam Browne and Bulkley had sampled. It happened that the librarian to Sir Joseph Banks was a student from Uppsala, Carl Solander (1736-1782), and it was natural for a correspondence to spring up between Koenig and him. Then followed the sending of dried plants by Koenig to Banks, but not to Banks alone, for Koenig loyally sent specimens to his master Linnaeus, and he sent also to Anders Johan Retzius (1742-1821), then professor at the Swedish University of Lund. Vahl seemed also to have received plants. I do not know of any list of what Banks received, but what Koenig sent to Linnaeus is recorded in Savage's *Catalogue of the Linnaean Herbarium* (1948) and what he sent to Retzius in C. E. C. Fischer's list in the *Kew Bulletin* (1932, pp. 49-76). The lists show the characteristic flora of the coastal plain of Coromandel.

Koenig, after 10 years with the Mission, transferred his services to the Nawab of Arcot, and after 4 years transferred them again, this time from the mismanaged affairs of that ruler to the East India Company which gave him the title of Botanist or alternatively Naturalist, not absorbing him into their service of surgeons though it seems that he was paid from military funds (Crawford, *Hist. Ind. Med. Service*, 2, p. 42; 1914). The purpose of engaging him is evident from his immediate departure for Siam and the Malay Peninsula in order to trace to their origin Siamese cardamoms, gamboge, and such like useful materials. The Madras Government did at that time make great efforts to ascertain if the plants yielding these could be grown in the extreme south of India. Koenig's diary of this trip has been translated and printed by the Straits branch of the Royal Asiatic Society (*J. R. As. Soc. Straits Br.* 26, p. 58 and 27, p. 57; 1894). Conditions went against him; he became ill; and he was disappointed in his quest; but the Company must have felt that the appointment was a proper one for they retained it for Koenig's life-time and during the service of several successors; the holder might be more a zoologist than a botanist,

but all botanists were expected to understand zoology and inversely zoologists to understand botany. Those who held the post were: Koenig to 1785 ; Patrick Russell to 1789 ; William Roxburgh to 1793 ; Benjamin Heyne to 1819 (though unconfirmed until 1799) ; James Shuter to 1826; and after that for two years Robert Wight. Then the post was done away with. All the holders were surgeons and all except Koenig and Russell of the regular service. The dates of arrival of these men in India of course differ from dates of entering into Government Service. There are two errors to be corrected. Koenig is said to have been in Pulicat, which is a little to the north of Madras city, in 1786, but in that year he left Europe for India and the date should be 1789. The other error is in the date of the arrival of Benjamin Heyne in Tranquebar. This date should be 1792. He and the younger Klein joined the mission together. Koenig's introduction to the post has been given. Patrick Russell had retired from a post at Aleppo where he had won golden opinions, when a younger brother was appointed to the charge of the District of Vizagapatam, and Patrick resolved to go thither with him. It so happened that Koenig's death opened a way for his appointment and while collecting plants without as far as one knows any deep interest in them, he threw himself with real success into a study of the poisonous snakes of India both terrestrial and marine. Zeal prompted him to ask the Government to circularize their officers with advice on the useful employment of their leisure, meaning by research. Roxburgh, who followed Russell as Botanist, had arrived in Madras in 1776 whence his first printed communication recorded weather observations, and had shortly been sent to Samalcottah (Samalkot) on the north side of the delta of the Godavari. There he explored, discovering wild pepper, was enabled to establish an experimental plantation, studied the local flora and, employing artists, had the plants figured. The Government watched his work with an approval so real that when he lost his books in a flood they replaced the loss. Heyne had reached India as one of the Mission at Tranquebar and like Koenig had passed into the service of the Company to take over Roxburgh's work and to travel considerably. Shuter collected, but, as far as one sees, with little discernment of its purpose, while the absence of localities on his specimens leaves no room for guessing whither he went. Wight, the last holder of the post, manifestly accepted it as a means of travelling; he had made one very extensive collecting trip and had planned a second, even longer, when the Governor of Madras, apparently looking on collecting trips as a luxury, did away with the post and sent Wight back to duty as an army surgeon. Wight seems to have received this kick with rather unexpected philosophy.

I would have the reader note that the post was a Madras post and that the earlier holders held it as economic botanists. When they collected, and all of them did, their activities met with no interference and the disposal of their collections was their own affair. Koenig, we

know, sent dried plants to at least three correspondents; and he must have sent plants to Retzius on at least two occasions separated by his visit to Siam.

It happened that Koenig had cause in 1785 to visit Calcutta; and when returning southwards down the coast, he was taken ill at a place not remote from Samalcottah whence Roxburgh hurried to his bedside. Koenig feeling death approaching and not having published anything regarding his collections, then willed them to Banks as the best means he could devise of preserving them for others to use; and Roxburgh saw that they reached Banks. Russell divided his collections into two parts, one he sent to Banks and the other he retained in his own possession for about 20 years. Wight placed his collections where he thought that they would be used. Each endeavoured according to his way of thinking to act in regard to them, for, as Griffith wrote later, the Company was not interested in the means but in the results, and dried plants counted as means.

VIII. BENEFACTORS

While Banks's collections were growing with a wisdom that was his particular property, the Company was employing as their Historiographer Robert Orme (1728-1801). Orme urged the Company to become a benefactor in regard to manuscripts, by providing a place of safe keeping for them, and to join with it a library that students could use. Orme died with his proposal unaccepted, but acceptance so nearly in sight that he left his own collection of manuscripts to a friend with a proviso that when the depository had been formed they should be passed over to it. Soon afterwards Charles Wilkins (later Sir Charles, 1749-1836), a Sanskrit scholar invalided from India, begged permission to arrange the Company's manuscripts, the end of which was the creation of the depository with Wilkins in charge. By a natural development this store for manuscripts became also a store for other things from India, and was used by collectors of plants for material of no decided destination and by the Company for whatever it received. Russell, for instance, having kept half of his collections for a time, decided that the best thing he could do was to send it to the Company; and others might send their dried plants to the Company as a matter of loyalty; but the Company did not require dried plants from those who, serving it, collected the same. Broadly it was a mistake to send bundles of them to the India House for it made sure that no one would bother with them; there were better courses possible. Heyne when he came on leave with considerable collections was so fortunate as to find the German botanist Albrecht Wilhelm Roth very anxious to work on them.

The story is well-known of Banks entertaining Sir James Edward Smith (not then knighted, nor indeed with his doctorate in medicine) and handing over to him a letter which offered for sale the herbarium and library of Linnaeus, and of Smith's purchase of these. Thus he became a benefactor, the greatest benefactor after Banks at the time in Britain and in that position recognized. The times and conditions gradually brought forward other benefactors whom it is convenient to list here as their names will recur : Aylmer Bourke Lambert (1761-1842) ; Sir William Jackson Hooker (1785-1865) ; John Lindley (1790-1865) ; George Bentham (1800-1884) ; and Charles Morgan Lemann (1806-1852). But making global collections as these did, was a costly hobby and it grew in time too costly for private benefaction. Every one of these was a botanist first. Smith having founded the Linnean Society, by selling the Linnean collections to the Society, passed the latter into the band of benefactors ; but after a time the costs outgrew the Linnean Society's ability, and finally became too great for any private effort whereon they fell to Governments in general.

IX. ON THE ACTIVITY OF THE MADRAS BOTANISTS VERY PRAISE-WORTHY IN ITS SIMPLE HONESTY

It is erroneous, I believe, to state that a Society of Botanists was formed in Madras under the title of the United Brethren or The United Brothers. This name is a name that the Moravians give to themselves. Collectively the Moravian Brothers of Tranquebar contracted to sell dried plants to Banks and carried out their promise, sending 500 between 1775 and 1778. Out of this transaction arose the idea of a Learned Society. It seems that there was none, but there was good companionship into which others might be admitted. Any one of the Brothers helped another or any other of similar interests. Early in Koenig's years in India, a surgeon, George Campbell, was his companion in a botanising trip northwards to Pulicat. When Roxburgh arrived in India Koenig piloted him through his first lessons in the flora.

It will help the reader greatly if I put before his eyes the names of the Madras and Tranquebar botanists of the time, in the order of their arrival in India, as this shows which was able to help another. The list runs thus :

1768 Koenig arrived and lived with the Tranquebar missionaries' Royal Danish Mission.

1774 Koenig entered service of Nawab of Arcot.

1778 Koenig was engaged by the Hon. East India Company or perhaps by the Madras Government (which would need permission) that he might go to Malacca and Siam for economic plants for introduction.

1776 Roxburgh arrived in Madras as an Army surgeon in British Service.

1777 Roxburgh is keeping meteorological records and that shows him to be in Madras city.

1785 Patrick Russell accompanying a brother to Vizagapatam. One can easily understand his interest in the sea snakes which he could satisfy in Waltair. He found a wild pepper.

1793 Russell left India.

1785 Roxburgh sent to Samalcottah in charge.

1785 Koenig died when travelling towards the end of June to Calcutta.

1792 Benjamin Heyne arrived at the Danish Settlement of Tranquebar, in the company of John Gotffried Klein.

1793 Roxburgh ordered to Calcutta to succeed Kyd. He then consulted John of the Tranquebar mission who recommended Heyne for the post at Samalcottah.

1793 Heyne is accepted though in an irregular way.

1796 Heyne arrived in Samalcottah.

1799 Heyne was on tour to Hyderabad.

1800 Heyne was at Coimbatore; then in charge of the Bangalore Garden.

1806 and 1809 Heyne again mentioned as in charge.

1812 Heyne returned to Europe with considerable collections.

1814 Heyne asked leave to return and did so.

1814 Roxburgh left the East.

1819 Heyne died at Madras.

Koenig seems to have been a very lovable man, and his knowledge was at every one's service. An illustration of mutual help can be drawn from the naming of *Dioscorea tomentosa.* Patrick Russell had found it when collecting in the Circars and misnamed it *Dioscorea triphylla;* soon afterwards Roxburgh found it and brought it into his garden in Samalcottah. It flowered—a male plant—and Roxburgh made a description. Then Koenig came and seeing it, agreed that it was new, suggesting as a name that which we use, namely *Dioscorea tomentosa* Roxburgh agreed; and as *Dioscorea tomentosa* it was drawn in duplicate that one copy might go to the India House along with a dried specimen. Banks after seeing the drawing, would send it back, as was the custom, keeping the specimen. In time Heyne came to Britain with his collections and matching his specimens—he had both sexes—with the male from Roxburgh, he wrote it up. Then he handed over his plants to Roth, who finding the name but no author's name with it, assumed that Heyne had devised *D. tomentosa* and attributed it to him. Thus it came about that Koenig's name became ascribed to Heyne.

A statement about the Tranquebar botanists will be useful. From before Koenig brought the botany of Linnaeus among them, there was at Tranquebar the elder Klein (Jacob Klein) and Dr. Christopher Samuel John. Rottler joined in 1776. The younger Klein (Johan Gotfried) had been sent to Germany to study medicine, and returned to India along with Benjamin Heyne in 1792. When Roxburgh arrived at Madras and the missionary Johan Peter Rottler in Tranquebar (1776) Koenig was in Coromandel, and with some years of experience would supply names of plants to the newcomers. In 1777-78 Thunberg, returning from Japan, spent six months in Ceylon apparently without contact with the fellow-botanists in Coromandel. Slow, indeed, was the gathering of knowledge ! When Roxburgh had received his orders to proceed to Calcutta (1793), he asked Dr. John, who seems to have been a warden for the Mission, if he could find a successor to take his place at Samalcottah, and he suggested Heyne as well fitted, and, one may add, not needed at Tranquebar, as J. G. Klein was able to look after any sick at the Mission.

Johan Peter Rottler (1749-1836) was the last of the Tranquebar group but not the last of the missionaries who in Madras about this time found a pleasure in seeking plants. Two of the Company's surgeons associated with the missionaries were James Anderson (- 1809) and his nephew Andrew Berry (-1819). Each of these laid out a garden and in particular experimentally grew Opuntias for nourishing cochinelle. Maria Graham (nee Dundas, and by a second marriage Lady Callcott, 1785-1842) described Anderson's garden as she saw it in ruin shortly after Anderson's death, and commented on the large sums that had been spent on it (*J. of a Residence in India*. p. 125, 1812). Rottler described Berry's garden which was in the quarter of Madras city called Marmelong.

Rottler had joined the Tranquebar Mission in 1776 while Koenig was still alive ; he did not, however, owe his inspiration to Koenig, being already a botanist and was soon sending dried plants to Erlangen in Germany. In 1796 the Government found employment for him, sending him to Ceylon. He returned to India and remained in India until his death in 1836, but he had transferred his work to other fields than those of the Tranquebar Mission, leaving it in 1803. Wallich knew him and stated that he had seen him in 1812 and again in 1813 ; he calls him 'a devoted missionary and ardent botanist'. The contact resulted in Rottler sending dried plants to Wallich. His personal collection ultimately came to London, where after serving as a reference collection at King's College for a considerable time, it was transferred to Kew. Rottler was botanist enough to be able to find means of publishing his own results; and moreover there is to his credit an account of the vegetation between Madras town and Tranquebar. Heyne records his trust in Rottler's knowledge for the correct naming of his plants. Rottler influenced Ainslie, whose book is usually quo-

ted as *Materia Medica*; its more expressive sub-title is *Artisans' and Agriculturists' Nomenclature*. Its date was 1813; it is a dictionary, not a Pharmacopoeia.

A missionary of Madras, also a botanist, but not of the Tranquebar Mission, was Bernhard Schmid (1787-1857). He had gone to India in 1817 and laboured in the coastal area of Coromandel collecting material for a tamil-english dictionary which he left unfinished, until 1835, when illness drove him to take leave. On his return he resided in the Nilgiri Hills; but as the date shows, his Nilgiri collecting belongs to my next chapter.

Heyne deserves a further notice, as he, though not a botanist when he entered India, became one of the best of the Madras Brethren. He had joined the Tranquebar Mission in 1777 and had passed into the service of the East India Company in 1793, following Roxburgh in directing the experimental station for pepper, sappan, tobacco and cardamoms at Samalcottah and travelling considerably. In 1813, having done nearly 20 years of work in India, he took the three years' leave that was customarily granted after 10 or more; and being desirous of adding to his experience he accepted passage on a ship from Calcutta that did not proceed direct, but was to visit Bencoolen in Sumatra. He carried with him duplicates of his collected plants and in London was granted access to Banks's collections to name them. The leave drew towards its close and he would have liked to submit the worked over collection to Willdenow in Berlin, but Willdenow had died. As an alternative Heyne sought the help of Albrect Wilhelm Roth (1737-1834) who while earning his living as a physician, had made a great reputation in Botany. Heyne found him not only willing but very glad to publish an account of the plants. Roth's biographer says that Roth was singularly fortunate in obtaining the gift of the plants; on the other hand Heyne was fortunate in finding so ready a help-mate. Roth published in 1821 his *Novae plantarum species, praesertim Indiae Orientalis* as a digest of Heyne's collection, together with additions from elsewhere. Conscientiously he gives all the credit to Heyne that was Heyne's and on an analysis one finds that about 200 of the 430 species involved bear names originating with Heyne. But there is scarcely a single precise record of locality from back to back of the book. This circumstance reflects the narrowness of the vision of botanists at the time, for most of them could look at nothing but nomenclature.

With Roth's book appeared the first approach to a Flora of any considerable part of India; but, one adds, 430 species amount to little more than a sampling.

Robert Wight (1798-1872), the last of the Madras botanists, was the greatest accumulator of material of all; but like Schmid in his later years, he belongs in a very large part to my Chapter II. Wight had arrived in India in 1819, after making a few voyages across the

Atlantic as a ship's surgeon. The East India Company sent him to the northern part of the Madras Presidency where almost from his arrival he began to collect plants vigorously with the aid of native plant-collectors. After four years he made up a set of dried specimens and directed it to the successor to his former teacher, Robert Graham; but they were lost at sea. The results of the next years he directed to Sir William Hooker whose rising reputation justified the change in destination. The following remark may be intercalated here: in that very year Francis Hamilton (formerly Buchanan) had written in a letter 'Dr. Hooker of Glasgow I see frequently,....he is more active than Graham'. Wight's collecting areas had been from Madras city back to Vellore, which is 87 miles inland, and about Samalcottah and Rajamundry, *i.e.* where all the Madras botanists from Roxburgh forward had worked.

When Wight succeeded to the post of Botanist he immediately made the long collecting trip which is traced in the map at the end of Wallich's *Plantae Asiaticae Rariores*. Thereafter the post was terminated and Wight, stationed on military duty with a regiment at Negapatam, explored the flora of the Tanjore district. Illness enforced leave, and he proceeded homewards taking two tons of packages of dried plants. Arriving in London with these he endeavoured to make them useful to Wallich who was also on leave. But Wallich was scarcely in a position to use them ; and Wight betook himself to Edinburgh with his material ; then joining himself to George Arnott Walker Arnott, a former school-fellow and later professor at Glasgow, the two together wrote their most excellent *Prodromus Florae Peninsulae Indiae Orientalis* (1834). Unfortunately Wight's leave ran out and the work was arrested at the family Valerianaceae in De Candolle's sequence of families, though there was collaboration beyond this and a couple of joint papers. Wight had left his artists and collectors at work, and resumed the direction of their services. The Company put a regiment stationed at Bellary into his medical charge, then ordered the regiment to march from Bellary to the very south of India. What Wight records of this march is interesting ; six bullock carts were required to move his impedimenta including the 2,000 specimens that he had collected and his library. He indicates that he would have been happy without the necessity of moving these and hoped to be without the collection before required to move again.

X. CONTEMPORARIES IN PONDICHERRY AND IN CEYLON

It is time to mention various collectors of the southern flora who were not of the Madras group. One of the earliest of them was Carl

Pehr Thunberg (1743-1828), Linnaeus's most famous pupil and his successor in the Uppsala professorship ; he spent the months from July 1777 to February 1778 in Ceylon when returning from Japan. From Colombo he journeyed down the coast to Galle and northwards the short distance to Negombo. What he collected can be gathered from Juel's *Plantae Thunbergianae* (1918).

French collectors went to Pondicherry and enriched the National Museum in Paris. The first of them was Pierre Sonnerat (c. 1745-1814) ; but he was actually a zoologist ; he was at Mahe, Pondicherry, Surat and in Ceylon at various dates after 1781. Next came Louis Theodore Leschenault de la Tour (1773-1826) who reached Pondicherry in 1816 as a Research Officer in Natural Objects. He travelled widely and did excellent work. The third was Francois Louis Busseuil who as a surgeon on the ship 'La Thetis' reached Pondicherry in 1824. Like Sonnerat he was at heart a zoologist. The fourth was Charles Belanger who arrived in India at the end of 1825 where he collected at Mahe for a few months and whence he crossed leisurely to Pondicherry. After that he went to Chandernagore, then to Pegu and forward to Malaysia in the ship 'La Chevrette' which about this time was a coasting vessel in the Bay of Bengal and was based on Pondicherry. In 1829, he returned to Paris with most extensive collections and published his *'Voyage aux Indes Orientales'* (1834). The fifth was A. A. M. Reynaud, surgeon on 'La Chevrette' at the time when Belanger voyaged about the Bay and he obtained plants at similar places. The sixth was Georges Samuel Perrottet (1793-1870). His occupation was acclimatization ; and collecting was secondary ; but over his extended time in India he made large collections. In 1834 Alphonse Delessert, having travelled with Perrottet, went to Malaysia, to Calcutta and to Serampore, etc. but was mainly occupied in collecting animals. However he collected plants in Pondicherry, Gingee and the Nilgiri Hills.

Leschenault wrote a couple of very interesting papers on the Madras flora and Perrottet various valuable economic papers. Both had worked back from the coast to the Nilgiri Hills ; and Perrottet's collections are said to have reached 1500 species. *Alphonse de Candolle* profited greatly by French collections which, it may be said, covered rather effectively a longitudinal slice of India from Mahe on the one side to Pondicherry on the other. If the reader will look at a map of India he will observe that the Nilgiri Hills fall within this slice.

In 1812 William Kerr (-1814), a Kew Gardener, was selected by Banks for the charge of the Government Garden in Ceylon and proceeded thither ; but his life in Ceylon was very brief.

XI. CALCUTTA TO THE FRONT

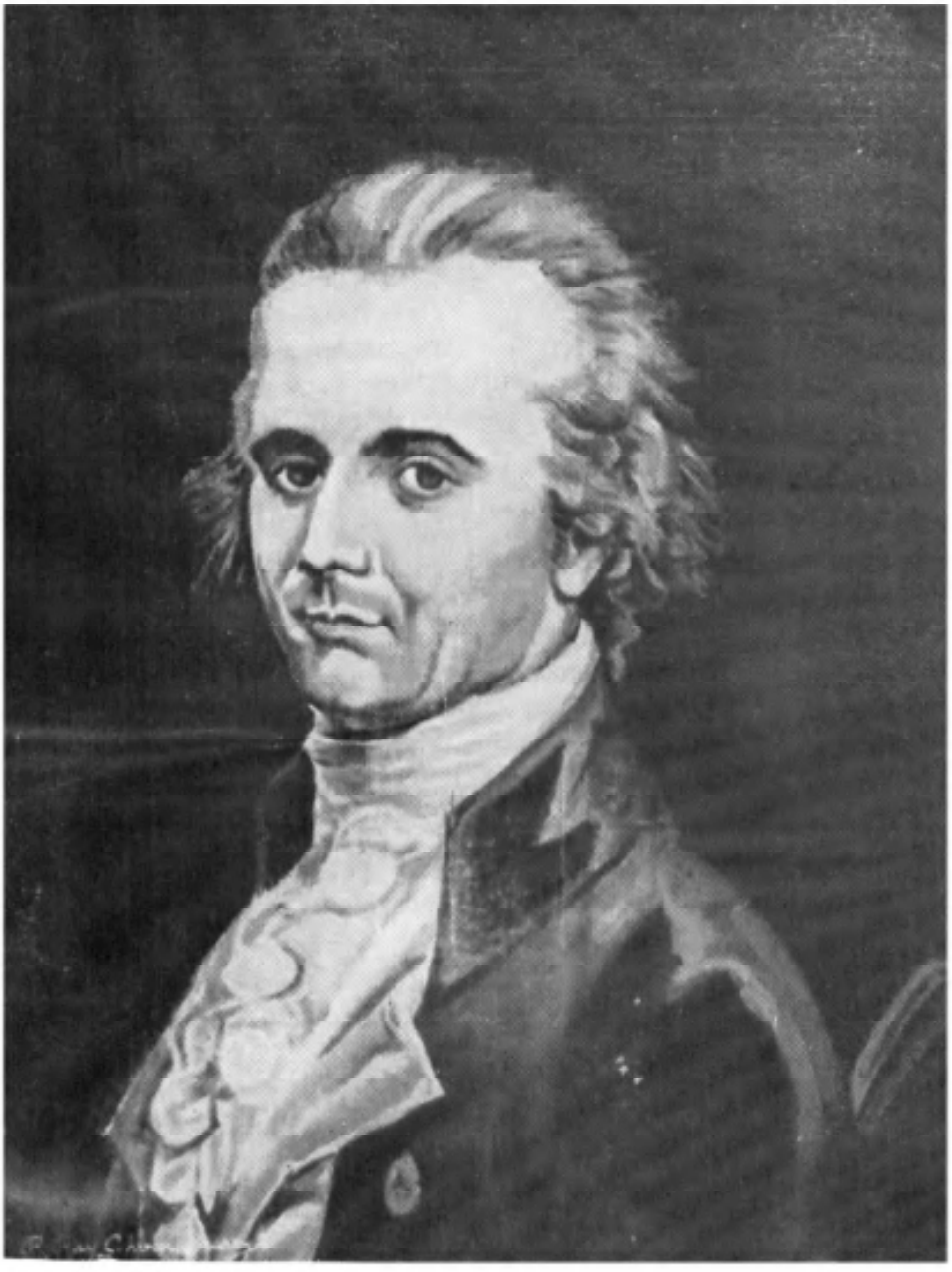
The reader may remember that there was a time when Madras took place over Calcutta and sent to Calcutta its orders; then, in the 18th century, the Company decided to promote Calcutta and moving in that direction made it the place of residence of a Governor-General supported by four Councillors, a Crown Court, a Chief Justice and three Puisne Judges, all selected in London. When a little later the ecclesiastical dispositions were organised, Calcutta received a Bishop, Madras and Bombay Archdeacons. One may express this in the equation:

Bishop : Archdeacon : Calcutta : Madras (or Bombay) for it illustrates the new relative importance of the three Presidency cities. By reason of the appointments being made in London a new leaven was brought into Calcutta, and paths of intellect were created in its community where the saying had been common that no one had leisure for the affairs of the mind, or any affair that did not bring financial benefits. Trade was booming in Calcutta at the time; the demand for shipping exceeded the bottoms available, and vessels of many nations found profit in being chartered to take goods in and out of the Hoogli. The building of new ships was carried on with Malabar teak which was used in Bombay to build a man-of-war of 74 guns; while it was Burma teak that was used in Calcutta to build a freight vessel of 1400 tons. In ship-building Calcutta was at a disadvantage by having to seek its teak at a distance across the Bay of Bengal. At the same time the East India Company was growing increasingly apprehensive regarding supplies of oak timber for their dockyard at Deptford on the Thames. With ships' timber in this state Robert Kyd (1746-1793, about to be gazetted Lieutenant-Colonel), Secretary in Calcutta to the Military Department of Inspection, suggested (June 1st, 1786) that it would be well to ascertain if the teak-tree would grow in the vicinity of Calcutta, and he added, being an ardent gardener, that this might be done in a new Botanic Garden. Then as Calcutta was metropolitan, the garden should be commensurate with the city's dignity; and he pointed to an area of some 350 acres on the side of the river below Calcutta, separated from his own garden by no more than a ditch, which he recommended as suitable for it. His suggestion found such support that the garden was impatiently founded without waiting for sanction from London, and put under Kyd's charge as an addition to his duties. His administration must have been vigorous; drainage work was done; planting was commenced and the area chosen for a trial of teak was the 40 acres nearest to Kyd's property. It is possible to pick out by the use of his successor's *Hortus Bengalensis* the names of some 300 species of plants that Kyd introduced. Kyd died in 1793 and William Roxburgh was

summoned from Samalcottah to succeed him. In passing it is of interest to recall that two of Kyd's sons went into ship-building in Calcutta. (See Pl. I).

For a moment one may trace in Roxburgh's achievments the causes of his promotion ; (i) after a few voyages as a ship's surgeon ; (ii) he entered the service of the East India Company and arrived in Madras, where, (iii) he found Koenig and studied the flora with him; then (iv) he was sent to Samalcottah on regimental duty and (v) explored, finding wild pepper and establishing an experimental plantation where a trial was made of pepper and cardamoms, sappan wood, indigo and other possible crops ; at the same time (vi) he studied the wild plants and accumulated a large collection of drawings of them. The Company appreciated that part of his activity which had a technological bearing and on it chose him for Calcutta. When they did this, Banks called the Company's attention to the drawings and at his suggestion it was agreed that he should select 300 to be engraved and published, coloured, with appropriate letterpress. This was Roxburgh's *Plants of the Coast of Coromandel* in three volumes which were published in these years—1795, 1798 and 1818. The delay in printing the last left it unpublished at Roxburgh's death. Roxburgh's collecting extended from the coast back to the hills, and up them to about 2,000 ft. ; but like others of his time he troubled little about localities.

Roxburgh brought his way of working to Calcutta ; he saw to the cultivation ; he continued the study of the wild plants and extended his collections of drawings. He dried plants, but seems to have given them away with great freedom as soon as they had served his immediate purpose. The Company accepted this procedure ; and his influence was high in administrative quarters. He kept touch with the Madras botanists ; and the garden received plants from James Anderson. But there is little to suggest that he was able to get plants from Ceylon and Bombay, though he had one correspondant as far away in the direction of Bombay as Ujjain. But plant exchanges on the eastern side of India appear to have been abundant and Christopher Smith engaged in obtaining useful plants from Malaysia used Calcutta at various dates ; also we find a gardener, Peter Good, at Calcutta in 1796 for the purpose of conveying living plants to Britain. We find another, John Potts, at Calcutta for the same purpose in 1822, but that was after Roxburgh's departure. Cultivation of beautiful woody plants, including palms, seems to have been an early feature ; and there were wide borders for smaller plants and an effort was made to make these borders attractive. Roxburgh's successor had to complain of visitors from the city interfering with the showy plants in them. Nurseries must have played a large part in the original plan as the garden had to meet a big demand for plants to send to correspondents.



W. Roxburgh

To Face Page 22.

Roxburgh's position was decidedly favourable. Ten years before his transfer an outlet for publication had been produced in the founding of the Asiatic Society. This issued out of the establishment of the Judiciary sent from England, for as the minutes of the meeting which founded the Society show, the strongest support for it came from the learned Judges with Sir William Jones, one of the Puisne judges leading. It was he who called the meeting for January 15, 1784, whereat he proposed the formation of 'The Asiatic Society' (the words 'of Bengal' were added much later) ; and by the time of Roxburgh's transfer it was well established. It had then printed three volumes of its journal, *Asiatic Researches,* the text being of a high quality. Roxburgh was able to publish his work through the Society and moreover membership brought him very desirable contacts. Contemporaneous enterprise by missionaries of the Serampore Mission in the field of printing greatly forwarded publication. In 1799 these missionaries had been joined by William Carey (1761-1834), whose botanical interest closely attached him to Roxburgh. Carey's biography is fully given in Marshman's *Life and Times of Carey, Marshman and Ward* (1850).

The Government built for Roxburgh in 1795 a house on the bank of the river— an airy house such as he had asked for with three storeys that he might live much in the uppermost storey. Methodical Roxburgh, settled in, kept a Plants-inwards record. In 1814 when ill-health drove him to leave India, this record was easily transformed into his *Hortus Bengalensis* which was issued from the Serampore press under Carey's care. As a garden catalogue it presents to us the names of about 60 donors of friends of the Garden who sent plants or their seeds to Roxburgh either because their showiness or usefulness made them desirable or as something unfamiliar which might be studied. We have a pleasant picture of Roxburgh at work :— enter a messenger with the information that the shrub from so-and-so had come into flower ; Roxburgh puts his work aside and is taken to see the plant, by palanquin if at the further end of the garden ; and he returns with what material he desires for dissection, determination, description if necessary and figuring. The descriptions accumulated in his working rooms on one pile called *Flora Indica* and drawings on another, but the drawings were duplicated and one copy went to the Court of Directors in London. Roxburg's friends could have copies of the *Flora Indica* on paying the cost of clerical labour ; Buchanan, for instance, obtained a copy (see Prain in *Ann. R. Bot. Gdn. Calcutta,* Appendix to 10, p. xi ; 1905). Roxburgh had two copies made when about to depart from India ; one he put into Carey's hands and the other he took with him. When delayed in Ceylon he found material to add and sent the manuscript to Carey for insertion. He would have added more had he lived to do so, for after reaching Edinburgh he requested that some material

then in London should be sent to him for study ; but the additions from Ceylon seem to have been the last that he made so that the *Flora Indica* lying with Carey, can be defined as descriptions of plants seen by Roxburgh in his days at Samalcottah and his days at the Calcutta garden. The illustrations had grown to 2,583 in number, presumed to represent the same number of species, the artists having orders, as they told Hare, not to draw a plant a second time. James Hare was a surgeon of the Company in a relatively high position and later, as will be seen, had charge of the Garden for a short time.

Roxburgh's immediate successor was the very distinguished scholar Thomas Henry Colebrooke (1765-1837) who, after a considerable period of service in the Gangetic plain eastward of the river Kosi, had been called to Calcutta to preside over the Sudder Courts. By this he became Roxburgh's neighbour ; and in freindship he offered to add to the *Flora Indica* the vernacular names of the plants described. The agrèement that he should do so was made before 1803, for on the 5th of October of that year Colebrooke wrote to his father that he was supplying the names but unable at the moment to work at them from a pressure of other affairs ; but, he added, Roxburgh's work 'is in great forwardness' (*Life of T H. Colebrooke by his son.* 1, p. 213 ; 1873). Colebrooke and Roxburgh were also joint authors of a paper on *Melaleuca* tardily published by the Medical and Physical Society of Calcutta in 1828.

Roxburgh did not travel from Calcutta ; but he had on his staff those whom he could send exploring, two of them being his own sons, William and John. The initials W. R. and J. R. in the *Hortus Bengalensis* are theirs. John is recorded to have sent dried plants to Lambert and he remained in the Garden's service for some years after his father's departure from India.

A very good friend of Roxburgh was the surgeon John Fleming. He had charge of the Garden during one of the periods of leave of Roxburgh ; and we read that he took Maria Graham to breakfast with Roxburgh on November 30th, 1810, that she might see the Garden. She recorded her delight with the order and neatness of every part and was impressed by the size of the collection of living plants (*J. of a Residence in India,* p. 145 ; 1812).

Immediately after Roxburgh's appointment to Calcutta Francis Buchanan (1762-1829) arrived in India and was sent to Burma with Captain Symes's mission to the Court of Ava. Like Roxburgh he had been a pupil of John Hope who held the professorship in Edinburgh from 1761 to 1786. The two cherishing the memory of that excellent teacher, united rejoicing in dedicating the genus *Hopea* to him. Buchanan had been a collector of plants from boyhood ; and the novelty of the flora that met his eyes in Burma stimulated him. He dried plants, secured drawings and gathered seeds. The seeds he sent to Roxburgh, so opening a correspondence with him, asking

in sending them that what was not wanted might be redirected to Sir James Edward Smith who had been a fellow student in Edinburgh. Doubtless Smith would have distributed the seeds to such as had means of growing them ; but the result of the request seems unrecorded. At the end of the Burma mission part of Buchanan's work on the flora went towards Symes's report, his dried plants went to Banks (see Prain, op. cit. p. xxxv) and he himself was stationed at Noakhali in south-eastern Bengal ; and there during the following year he worked up his Burmese collections and notes. In 1797 he was sent to Chittagong to report on its vegetable products. Dried plants thence also sent to Banks. In 1800 he was moved to Baruipur 16 miles south of Calcutta and so within a day's journey of the Calcutta Botanic Garden and Roxburgh with whom a great friendship had arisen. Next he received orders to join a mission going to the Nepalese court at Khatmandu ; and he had proceeded as far as the border when recalled to make an economic survey of the districts of southern India taken over from the Sultan Tippoo—to report on the agriculture, vegetable and cattle farms, the natural resources such as cotton, pepper, sandalwood and cardamoms; mines, quarries and minerals ; manufactures ; climate ; seasons and forests ; the condition and character of the people. The catalogue is comprehensive enough ; it is a guide to what henceforward became the work to which the Government dedicated him. He was instructed to send seeds and living plants to the Calcutta Garden, and the Madras Botanist, Benjamin Heyne, was partly a colleague but specially instructed to see if he could make Tippoo's garden at Bangalore into a centre for the spreading of economic plants. Unfortunately Buchanan was sent on his mission in the height of the dry season of an unusually dry year. 'I have got absolutely nothing' he wrote to Roxburgh ; 'Almost every plant that I have got has been already described by you ; and of the few that appear to be new I have not been able to get the seeds.' However Buchanan reached the evergreen western coast and a short experience there gave him a lasting interest in Rheede's *Hortus Malabaricus*. Roxburgh had been sending to him extracts from that work such as he desired.

When the Mysore survey was over, the visit to Nepal which had been called off, came up again and he resided close to Khatmandu from March 1802 to March 1803. He had, it seems, heavy professional duties, and restrictions on his movements imposed by the Nepalese were irksome to him, so that he was very glad when the Mission was recalled. Next he had leave ; and with the dried plants, which he had collected, and with the drawings, which he had had made, he came to London. He made up a complete set of his dried plants for Sir James Smith and a second set for Aylmer Bourke Lambert. When leave was over and he had returned to India he was detailed to make his great economic survey of northern and western

Bengal which occupied him from 1807 to 1814. A short period of control of the Calcutta Garden followed and then retirement. During the survey his work took him along the Nepalese border and from Nathpur in the District of Purneah he was able to detach some trusted members of his staff to seek economic plants in the Nepalese Himalaya. They procured the plants, but the time was before flowering and Buchanan's efforts to bring them into flower in the plains were fruitless. Thus while Buchanan procured material of the exceedingly poisonous aconite, the tubers of which are an export from the mountains, he was defeated in his attempt to complete an identification. Ultimately in retirement with what he had learned when on duty near Khatmandu and what he had learned when at Nathpur, he wrote his *Account of the Kingdom of Nepal and of the Territories annexed to this Kingdom by the House of Gurkha* (1819).

The best way in which I can convey to the reader how the Survey of Bengal proceeded is to list in consecutive order the stations at which Buchanan spent the rainy season. The time in between each enforced halt was occupied in moving about the villages between these stations: 1808 in Gauhati; 1809 in Rungpur; 1810 in Nathpur; 1811 in Monghyr; 1812 in Patna; 1813 in ascending the Jumna to Agra and the Gogra to Gorakhpur; 1814, back to Calcutta. He had with him artists; and they made for him a considerable collection of drawings. When stationed earlier among the big rivers of the Gangetic delta he had occupied himself considerably in a study of the fish; and we may be sure that the trip up the Jumna and Gogra was taken as an opportunity of extending the study.

Roxburgh had left Calcutta in the hot weather of 1813 and Colebrooke had taken over charge of the Garden; then Colebrooke asked leave to retire and Buchanan just down from Shahabad was told to take over. But Buchanan was ill and indeed he remianed ill for a year or so after reaching Britain; and Buchanan begged leave to retire. A bit of trouble followed. Buchanan asked leave to take with him his drawings that he might continue his work on the fishes, and the permission was given but then withdrawn. The withdrawal angered and alienated Buchanan because it stopped work on which he had set his heart; and for the time being he cast aside his immediate interest and allowed all the collected plants that were in his possession to go into the India House. His earlier collections, as will be recollected, had been given in the main to Sir James Edward Smith with a second set to Lambert. The set given to Smith was said to hold 1,500 specimens and it has been estimated that there were with them 400 drawings. The set given to Lambert must have been very much smaller.

Smith expressed the greatest gratitude to Buchanan for the gift and made scant use of it. He gave places to 13 plants in his *Exotic*

Botany and buried the rest in his cabinets. Buchanan in 1821 referred to those collections as 'in a sort lost'. He was writing to Wallich who had suggested to Buchanan a joint study of the Nepalese flora, and declining to return to his work on Nepalese plants. In the next year David Don, as Lambert's curator, commenced work on specimens of the second set and in 1825 published his *Prodromus Florae Nepalensis*. Wallich had been giving Nepalese plants to Lambert, and Don had these also for his work.

For a moment we may ask ourselves how far from utilizing all the available materials was Don's *Prodromus*. Don's descriptions amount to almost 700, but 50 of them are not of Nepalese plants. The sum of 650 is only 1/5 of the number of species credited to Nepal in Wallich's lithographed catalogue; and Don's title rightly holds the word *Prodromus*.

Diversity stimulates a collector: it required more of a botanist's zeal to lead to collecting in the uniform Gangetic plains than in the diversified mountains; and therefore the more praise to the two soldiers who collected about Lucknow and Kanpur in early days. They were Claude Martin (1731-1800) and Thomas Hardwicke (1757-1835). The first was the generous philanthropist who founded the two Martiniére schools, the one in Lucknow, the other in Calcutta. The second was a zoologist chiefly but an active botanist also; he was the first European to collect in the north-western Himalaya. This he did on a political mission to the ruler of Garhwal at Srinagar in the Alakananda Valley—a journey which he described in the *Asiatic Researches* (6, p. 309; 1799).

Martin and Hardwicke are the first soldiers that I have had cause to mention. A soldier's schooling does not contain, as a surgeon's does, an introduction to a knowledge of plants; and when a soldier becomes a botanist the inner urge is probably more considerable. I have assembled the names of the men who studied the vegetation of India in India up to the year 1840 and I find among them 28 surgeons, 7 army officers, 4 missionaries (not being surgeons at the same time) and 3 administrators of high position. The Edinburgh medical school was the chief recruiting ground for the Company's medical service and obviously the efficiency of the professor of Botany determined the zeal of the botanist that he produced and their way of expressing it. Roxburgh and Buchanan were pupils under John Hope; and Hope offered yearly a gold medal to the student who showed up the best collections of dried plants. Thus did he prepare for collection those who might go out to India. Hope's successor was ineffective, but the next in the professorship, Robert Graham, poor in the lecture room, was an enthusiast in the field who organized plant hunting for students on an extensive scale. We may call Robert Graham a trainer of collectors. He trained several of the surgeons who have been named.

Buchanan's restless life was in great contrast to Roxburgh's quiet life in the Calcutta garden. Roxburgh would not have achieved so much had he been required to travel at the same time ; but remaining at his Garden limited his ability to make his *Flora Indica* representative of more than a tittle of India excluding the Himalaya which no one knew in his time ; and as Carey pointed out, no little good-will was demanded of Roxburgh's up-country helpers, for the cost of sending things to him was high. Some of those helpers, such as M. R. Smith of Sylhet, obviously spent freely in sending living plants to Calcutta. Buchanan called him a faithful friend. Holding a magisterial post under the Khasia Hills he maintained for 50 years a garden and sent out collectors to bring plants into it ; and of these he would give to the Calcutta Garden. He died in 1819. A few years earlier he had been sending plants at the rate of about 50 species a year. The missionary Klein, who was one of the Madras botanists, likewise seems to have been generous. Buchanan was a constant donor of plants. William Carey made a garden in Serampore of 5 acres so intensely gardened that Jacquemont, who visited it, said that it needed 50 gardeners.

When Buchanan left India the Government was in perplexity how to replace him, for he had been destined to be Roxburgh's successor. The way out was by the selection of Wallich. In 1807 Nathaniel Wallich (1786-1854) a young Danish surgeon, a pupil of Martin Vahl, professor at Copenhagen, had gone to Serampore, fourteen miles up-river from Calcutta, as a surgeon in that Danish settlement. In that year the new Governor-General arrived in India bringing news that war had broken out between Britain and Denmark ; it was therefore his duty to take over Serampore which was done without any disturbance. Wallich, for a short time a prisoner of war, was almost immediately released and taken into Roxburgh's house where he lived for a while, his friends hoping that an appointment as assistant to Roxburgh might be obtained for him. But that did not come about ; and Wallich returned to Serampore as a medical practitioner. Then he was taken ill and made a voyage to Mauritius for the sake of his health. On his return he entered into practice in Calcutta and at this time made a suggestion to the Asiatic Society that the Society should form a museum, offering materials and saying he would curate it. The proposal was accepted but affairs fell contrary, yet beneficial to Wallich, for while the Council of the Society was deliberating, Wallich's friends had induced the Government, unknown to Wallich, to accept him for their medical service, and on appointment Wallich had to tell the Society that he was in difficulties regarding taking charge of the Museum. However, in the end he was able to do so for some years. The Council had decided that Botany should not be accommodated in their Museum as it was provided for at the Garden. Wallich, recommending that it should, had presented some volumes

on plants to the Society and these they sent to the Garden. Six months later Wallich got the use of these books for he was appointed Superintendent. Next the Government, vacillating, replaced Wallich by James Hare, who at the time was a junior member of the Calcutta Medical Board; and then again Hare by another surgeon, Thomas Casey ; dispositions which the court of Directors in London overruled, so that Wallich returned to the Garden. He had been ordered to proceed to the Nepalese frontier in the meanwhile, but did not go. There was one botanist who went with the column advancing on Khatmandu ; that was William Jack (1773-1822) who made some observations in the terai and then by going to Sumatra with Sir Stanford Raffles when the Nepalese War was over, passes out of this history.

If the Asiatic Society had decided that Botany should have a place in its Museum, would a Herbarium have been started? It looks probable (see *Centenary Review, Asiatic Society*, 1, p. 34 ; 1885).

There was no provision made in the Garden's Service against leave. During Roxburgh's service the surgeon James Fleming on one occasion held charge. When doubting whom to put in after Buchanan's departure, the surgeon James Hare was put in. Both of these had the medical student's knowledge of plants but this was doubtfully a qualification for the Superintendent's botanical work.

On leaving India ffor Penang in 1822 Wallich suggested that the Judge William Leycester should act for him; on going on leave in 1828, the administrator Sir Charles Metcalfe took charge. These changes suggest that Wallich was obliged to let botanical work cease entirely during his absences. We know that certain aspects of it did cease.

XII. THE UNSATISFIED ALLURE OF THE HIMALAYA

No active man likes to be debarred from knowledge; and the fact that the Himalayas were closed to visitors from Europe had only intensified the desire to explore them. A few intrepid priests had penetrated or collected information regarding them, the way closing again. Towards the end of the 18th century the barriers seemed to be giving way a little and Thomas Bogle was able to travel in 1774 through Bhutan to Lhasa ; William Kirkpatrick in 1793 was received at Nayakot in Nepal, and Thomas Hardwicke went in 1796 on a mission to the ruler of Garhwal at Srinagar in the Alakananda Valley. These occurrences were far apart in place and time ; and they did not make it clear which barrier was weakest ; but the plains depended so enormously on rivers from the hills for irrigating crops that there was a demand for exploring in particular to the sources of the Ganges and

Jumna. War ultimately opened some of the barriers, and opportunity determined which part of the Himalayas should be botanized.

Buchanan, as already mentioned, was attached to a mission to Khatmandu in 1802 which was withdrawn in 1803. Next under the pressing need of knowing whence the Ganges and Jumna came, arrangements were made to send surveyors into the mountains of Garhwal and a permit obtained from the Nepalese who had overrun that part of the Himalayas. The expedition fell to William Spencer Webb, an officer of Engineers and a surveyor of the first rank. He with two companions, Hyder Jung Hearsay and Felix Vincent Raper, succeeded in reaching Jumnotri where the sources of the Jumna spring and in fixing the position of Gangotri where the sources of the Ganges are, but they were hurried out of the mountains by the Nepalese. The expedition scarcely had direct botanical results ; but it showed William Moorcroft (c. 1765-1825), the Bengal Government's Veterinary Officer, what might be done. Without permission, with Hearsay as a companion, he passed beyond the sources of the Ganges, over the Niti Pass and right to the sources of the Sutlej in the Manasarovar Lakes, and endeavoured to bring back with him a flock of the best shawl-wool goats. Beyond that he brought back a bundle of dried plants which was sent to Robert Brown in London, the first plants obtained from far back in the mountains. War followed, and when peace came again (1816), the Nepalese had withdrawn any claim to the mountains west of the Kali and had consented that a Resident should live at the Court in Khatmandu, and these were immediate preludes to plant-collecting.

As soon as peace was declared, Webb proceeded with his survey of the mountains west of the Kali, and Wallich from Calcutta begged him to receive and take care of his collector Kamrup with a collecting party ; we discover that from this party Wallich had dried specimens to send to Sir James Edward Smith as early as 24th May, 1819.

The Government placed a Resident at Khatmandu ; and Wallich sent two collectors to work under him ; one was named Bharat Singh ; the name of the other is not recorded. They seem to have been those who obtained the first seed of *Rhododendron arboreum* sent to Britain (1818). The Residents also employed collectors ; three Residents are named as sending plants to Calcutta, Robert Stuart, Sir Robert Colquhoun and Colonel Edward Gardner. They must have followed each other closely, for it was the last of the three who arranged for Wallich to spend the year 1821 in the Nepal valley. Edward Gardner had won laurels along with a cousin of the same surname in the fighting to the west of the Nepal Kingdom. Wallich sent to Khatmandu also his collector, Robert Blinkworth, but seems to have moved him very soon to the north-western Himalaya where he apparently spent most of his life. Moorcroft visited Nepal when Wallich was there, but not botanizing. Wallich suffered as Buchanan had done

from severe restrictions on his movements, but was able to send native collectors deep into the mountains on the pilgrim route to Gossain Than.

Residents were placed where trade routes emerge from the north-western Himalaya, one at Dehra Dun, another at Nahan and a third at Sabathu. The station of Dehra Dun gave birth to the more elevated station of Mussoorie and the station of Sabathu to the station of Simla, just a little higher. In 1827 the Governor-General, Lord Amherst, set his approval on the last named by deciding to spend the hot weather there—an act which marked it as delectable beyond any other. In 1820 Lord Hastings had visited Saharanpur. There he had been shown a garden of native foundation but decayed. It had been founded by the capable son, Zabita Khan, of an eminent administrator, Najib-ud-Doula, with the revenue of seven villages for its maintenance. This revenue had been cut by 3/5ths by the Marathas when they established a footing in north-western India. The function of the garden was manifestly encouragement of economic plants particularly fruit-trees. Lord Hastings restored it. The Survey, this Garden and the attraction of the hill stations worked together to promote the knowledge of the flora of the hills.

XIII. THE SURVEYORS

Few know anything of the forests of the Himalayas without knowing the coniferous trees— *Abies webbiana* and *Pinus gerardiana*. The first commemorates William Spencer Webb (1784-1865) who has been named; the second commemorates the three brothers (i) Alexander Gerard (1792-1839) who did much arduous travelling in remote places, particularly about the watershed of the Sutlej but collected plants from the front range of the mountain in 1819, (ii) Patrick Gerard (1795-1835) who like Alexander was an Army Officer; and (iii) James Gilbert Gerard (1794-1828) who was a surgeon serving with troops in the Sutlej Valley. Later came the two Stracheys—Henry Strachey who surveyed the upper Indus valley and Richard Strachey (afterwards Sir Richard) (1817-1908), a great collector who carried the accuracy of his topographical work into his plant labels. An outline of the Survey may be read in Sir Clements R. Markham's *Memoir on Indian Surveys* (ed. 2, 1878) and a much more detailed account is now in preparation. The survey began at Saharanpur, that little station which Jacquemont, writing in 1830, called 'truly a pleasant place .... one of the pleasantest English stations in India'; there the base-line was measured. Saharanpur gradually became the depository of many of the collections of plants that came out of the hills from those who had business in them.

XIV. WALLICH AND ROYLE FROM 1821 TO 1828

It has been recorded that Roxburgh, when leaving India for the last time, put into Carey's hands a complete copy of his manuscript *Flora Indica*. He was to go to the Cape to see if that change restored his health ; if it did not, which happened, he was to try St. Helena ; and failing that to proceed to Britain. There he died in 1815. Carey waited for more than a year and then consulted Wallich in regard to publication. 'Publish', said Wallich, 'and I will edit it and bring it up to date'. So printing was commenced. Wallich little knew then that he could not be Roxburgh and Buchanan in one—the office man and the field man. Wallich was a competent, indeed excellent, taxonomist of the Linnean school. Here is a way of showing this. Take the *Flora of British India* of Sir Joseph Hooker and count how many genera are credited to him and to others, that is to say, how many genera created by different workers passed the test of effectiveness that they got in that work ; there are 61 to Wallich's credit, 38 to Wight's or Wight's and Arnott's together ; 31 to Roxburgh's ; 20 to Griffith's ; 14 to David Don's and 12 to Buchanan's. Wallich was fully competent, but not master of his time. In 1821 came the lure of the visit to Khatmandu where he stayed nearly a year during which the printing was stopped. Wallich came down from Nepal in November—an unhealthy month, and seems to have picked up a serious infection on the way. At any rate he attributed a long illness which followed to an infection got in the terai. His illness caused him to seek permission for a sea voyage and he decided to go to Penang and Singapore. He had two works on his hands now, the editing and bringing up-to-date of Roxburgh's *Flora Indica* and the determining of his Nepalese collections ; and moreover he was ill. He gathered his most attractive Nepalese material together and handed it to the Calcutta Medical and Physical Society for publication ; but new species to describe were beginning to choke the work of bringing Roxburgh's Flora up-to-date. He reached Penang in August 1822 and George Porter (-1834) head overseer of the Calcutta Garden who had accompanied him, elected to remain in Penang. At Singapore Wallich procured the use of a house which he called Botany Hall on a hillock near harbour (the hillock has been removed) and apparently enjoyed collecting the altogether unfamiliar flora with the obvious result that he had still more novelties for the *Flora Indica*. The printing of the Flora had a second interruption and then it was stopped.

Ultimately at the instance of Roxburgh's sons, James and Bruce, the original *Flora Indica* was printed under Carey's editing in three volumes (1832) ending for some unexplained reason without the Ferns that Roxburgh had included. Griffith later caused the Ferns to be printed.

The Government put the new Botanic Garden at Saharanpur under their surgeon at the station, George Govan (-1833). It was customary to provide a superintending officer in this way. It is said that Govan greatly improved the Garden, which would be easy as it was, so to speak, run down. He collected plants, but his leanings were geological and his only publication is a general one entitled 'The Natural History of the Himalayan Mountains' (*Edinb. J. Sci.*, 3, p. 17 ; 1824). The Garden had about 40 acres. Meanwhile chance brought to the Upper Gangetic Plains Govan's successor. This was John Forbes Royle (1799-1858). He had been destined for the Army in India and was already at the training college of Addiscombe when contact with Antony Todd Thomson, the pharmacologist (1778-1849), gave him so intense an interest in medicinal plants as to make him resolve on a medical career. Therefore he qualified in medicine and went out to India where he was sent to Meerut. When Govan retired, Royle was given Govan's place. Over his first few years he found the station work so heavy that he could not travel at all.

We learn what the Garden was like from a paper that he communicated to the Asiatic Society of Bengal (*Journal* 1, p. 41 ; 1832). Govan and Royle had cleared away most of the jungle growth, had levelled, drained and put down to grass a large part with roads through it and borders along the roads, had brought water in, planted trees and provided nurseries, in fact had made that half-way plaisance which is partly park and partly garden, the 'jardin anglais' of the French. Royle trained collectors and sent them into the hills for seeds and plants and he created special positions for the raising of hill plants. It is good to see that he wanted to know the plants alive. Govan had constructed a 'Linnean Garden', *i.e.* beds arranged to teach Linnaeus' classification ; Royle maintained them but did not like them. He knew and knew well that a plant's affinities are expressible in all its characters, not in one only. He does not seem to have had difficulties in bringing into the Garden the plants of the nearer mountains ; but when he asked his collectors to collect further back in Kunawar under an army officer—Lieutenant Maxwell—they ran away ; but Maxwell had the collecting done and brought to Royle about 100 species that were novelties to him. Royle successfully sent collectors to Kashmir under guidance of shawl dealers when these were returning home. As soon as leave was due Royle took it ; and, dividing his accumulation, he brought duplicates of everything to London with plans for a work on them, his *Illustrations of the Botany of the Himalayan Mountains* (1833-1839). As a centre for horticulture the Saharanpur garden was complementary to the Calcutta garden, serving in a way which Royle pointed out when writing of his work, for the trial of economic plants which Calcutta could not raise satisfactorily. As a centre for botanical exploration both gardens had collectors out in the mountains at the same time, but there was room

for both. When Wallich's were in Kumaon, Royle was sending his to the west.

Royle was clear-minded, very patient and thorough, diligent and of wide views, with a bent towards the economic side.

In 1825 the Government required of Wallich a report on the submontane forests of Oudh, to make which he travelled up the Gangetic plains and reach Hardwar, Dehra Dun and Saharanpur, touching but not covering ground where Royle was at work. In 1826 they required him to ascend the Irrawaddy, his journey ending on the margin of the Shan plateau between Mandalay and Maymyo ; then (1827) he ascended the Salween for a short distance and the Ataran River to its head waters. And at the end of this there were such great collections on his hands that he was submerged under them. It was well that a search for novelties in the north-west had fallen elsewhere.

XV. PENINSULAR INDIA AND CEYLON OVER THE SAME PERIOD

The pursuit of Botany in the south of India was now similarly detached from the leadership of Calcutta as that in the north-west. Wight's intense activities were of Wight's creation, parallel to but not of Calcutta ; and those who took up the pursuit of Botany in Bombay looked to Madras and not to Calcutta. Geography determined this. Roxburgh had not drawn plants from Bombay, nor did Wallich. Communication was too circuitous and Bombay remained confined until the power of the Pindarees was broken in 1818, at which time the Calcutta Garden had its eyes on the Himalaya. Then began a cleavage which was not without its influence on the botanical plant-names used in the two halves. The southern consisted of Peninsular India with some adherence of Ceylon.

The great monuments that crowd the old cemetery in Surat make the visitor expect a little early attention to the plants about that port ; but there is none recorded. Olof Toren (1718-1753), chaplain on a Swedish ship, touched there and, returning home, took seeds to Linnaeus. More one does not know. In 1787 Banks financed a Polish surgeon who had travelled in Africa—Anton Pantaleon Hove—to proceed to Bombay and up the coast to Ahmedabad, accumulating living plants for Kew. And a diary which he kept and made over to Banks, discovered among Banks's effects long after his death, was printed in 1855 as *Tours made in Guzerat, Kathiawar and the Concans in* 1787-88. It is an account of the travelling. In 1825 Alexander Gibson (1800-1867) was taken into the medical service of Bombay. A year later John Sutherland Law (1810-1885) was sent to Bombay in the administrative service. In 1828 John Graham (1805-1839) arrived in Bombay seeking employment and was appointed Deputy

Post-master. A fourth botanist, Joseph Nimmo, was a clerk in Surat in 1819 and later in a post in Bombay which gave him a connection with shipping in the Arabian Sea. Graham was given charge of the Botanic Garden that was controlled by the Agricultural and Horticultural Society of Bombay and this brought him to a prominent position. There was a botanically-minded surgeon, Charles Lush (1797-1845), at Poona with a 'Botanical Garden of Dapuri' under his charge, and a Dr. Heddle in Bombay. All these that I have named corresponded with John Graham, who set himself to compile a Flora of Bombay, Nimmo being in closest contact. The Flora—not descriptive but an enumeration—was ready in 1838 and accepted by the Agri-Horticultural Society for printing under the title *A Catalogue of Plants growing in Bombay and its vicinity.* The setting up had reached p. 200 when Graham died after a few days' illness, whereafter the rest (to p. 260) was seen through the press by Nimmo. Wight had written very appreciatively of Nimmo—his ardour in collecting and his generosity with his specimens (*Madras J.* 3, p. 311; 1837) and from other sources we know that he would take plants into a garden that he had and raise them for the purpose of study. He sent dried plants to Sir William Hooker and generally with apologies for not collecting more.

Graham built his Bombay list on Wight and Arnott's *Prodromus Florae Peninsulae Indiae Orientalis* so far as that unfinished work served him, which was to the Valerianaceae in the sequence of the families of De Candolle. Though Nimmo added a few descriptions, Graham described nothing, but left the user of the list with a reference to Wight and Arnott. When these failed him, he referred the user to that unfinished re-arrangement of Miler's Gardner's Dictionary which George Don issued as *A General System of Gardening* (1831-1838), the whole of which he did not have, and to De Candolle, Roxburgh or Willdenow. His way of working illustrates what I have said of the dependence of Bombay on Wight. For a first list Graham's was creditable.

Of those who contributed to Graham's catalogue, Law was stationed then at Thana, and therefore a student of the flora of the vicinity of Bombay; later he was sent to Belgaum and explored there and about Dharwar. Lush was in the high country and more or less with the same flora to study. Graham was fond of making the journey to Khandala, where he would gather the hill plants. John Vaupel, a merchant, I believe, interested in the cotton trade and a writer on the agriculture of Gujerat, was another helper that Graham had.

Bombay was the first Presidency to make an effort to arrest the wasteful destruction of forests, and indeed was particularly interested in the maintenance of a supply of teak timber. The first attempt was as early as 1806 when powers were given to a seconded police officer—Captain Watson—to arrest felling in Malabar forests (see Ribbentrop,

Forests of British India, p. 640 ; 1900). He was successful, but at the cost of such a clamour from those who profited by the timber that the control was thrown away. The next attempt was when Gibson, who has just been mentioned as communicating with Graham towards the Catalogue of the Bombay flora, was made Conservator of Forests (1847). This appointment belongs to the chapter which will follow ; but Gibson belongs to both chapters and therefore it is convenient to insert here that the creation of his post of Conservator came five years before there was a Superintendent of Forests in Pegu and nine years before there was a Conservator of Forests in Madras.

I shall leave John Ellerton Stocks, who did the first collecting in Sind and Baluchistan, to the next chapter.

A zoologist—an army officer—William Henry Sykes (1790-1872), when stationed at Poona over the years 1826 to 1830, added plant collecting to his other interests and made a collection which he gave to the Linnean Society.

In 1832 the illustrious Victor Jacquemont reached Poona from Delhi, then came down to Salsette and on to Bombay where he died in December. This was the end of a great journey and the gathering of the last plants collected on it. All Jacquemont's collections were forwarded to Paris as was due ; the last plants did not add to Graham's list. And again while Graham and his colleagues were getting together the data for the Catalogue of the flora, two other travellers visited Bombay. One was an officer of the Austrian Army, Karl Alexander Anselm Freiherr von Huegel (1795-1870), his companion a zoologist from Marseilles, Polydore Roux. Roux died in Bombay but not until he had made a collection of local plants. Von Huegel was liberally supplied by the Bombay botanists with collections which later were purchased from him by the Vienna museum. Neither wrote anything regarding the vegetation.

It is time to turn to Ceylon where the first experimental garden was in Slave Island, a part of Colombo. To Ceylon Banks in 1812 sent William Kerr, as has been recorded, his qualifications— a Kew training and travel collecting in Malaysia. He died in 1814. His successor (1817) was Alexander Moon (-1825), of similar training but better qualified ; and under him the Government Garden was transferred from Colombo first to Kalutar down to the coast and then up the mountains to Peradeniya, at four miles from Kandy. In 1824 he published a *Catalogue of Ceylon Plants,* enumerating 1,127, of which 366 are garden plants. He made a collection of dried plants, presumably each entry of the Catalogue represented in the collection, which became the nucleus of the herbarium at Peradeniya today. The catalogue is as correct as one so isolated as Moon would be able to make it. Moon after a short period of temporary control, was followed by James Macrae of like training. He had collected in the Pacific for the Horticultural Society and the obvious reason for selecting him was an anticipa-

tion that he would establish new useful plants in Ceylon ; but he lived only three years, dying in 1830. Koenig had collected in Ceylon in 1777, 1780 and 1781.

XVI. WALLICH'S GREAT BID FOR HELP IN EUROPE

It is time to return to the affairs of Calcutta to take them up again from p. 34 where Wallich's three long journeys to Oudh, to Ava and to Tenasserim for the purpose of reporting on forests, were mentioned. Buchanan, undoubtedly a good judge, had told him as early as 1821 that he had already collected as much material as he could digest. What Buchanan would have said in 1828 might well have been that he had what he could not hope to digest. The way out of the impass was obvious—others must be found to digest it ; and that being the case Wallich, when granted leave in 1828, asked to be allowed to take all his collections with him for the purpose. Wallich, who like other botanists had been sending bundles of dried plants to those who might work on them, now prepared in a masterly way to harness a whole team, on the assumption that the maximum generosity would produce the maximum return ; and to attain this he asked that the stored and sterilized collections at the India House be added. Also he wrote to friends seeking whatever they might have. The last letter from Buchanan (now Hamilton) which Prain printed in his *Life of Hamilton* (*Ann. R. Bot. Gdn. Calcutta,* supplement to 10, p. xxxiv) conveyed permission to handle as he wished whatever Buchanan had had, if he could get it from others. Wallich hired working space, and having advertised his intentions well, at once became the centre of an expectant group anxious to discover the riches of the eastern flora. George Bentham in particular threw himself into the sorting and immediately on observing that the family Labiatae was ripe for revision proposed to monograph it. This was exactly what Wallich wanted. Bentham did not delay ; and before Wallich had to return to India Bentham already had the first part of his *Labiatarum Genera et Species* in printing. John Lindley, who had just become Professor at University College, London, was constantly helpful. Wallich was at the top of his career and Bentham in his diary called him 'joyous Wallich'. All who could help were welcome. Lindley brought his pupil William Griffith who prepared drawings of three very intriguing plants for Wallich. Hugh Falconer, who had been accepted for service in India and was awaiting the time of sailing, was brought to the workrooms. Royle and Wight, returning to Britain on leave, came to Wallich, Wight so impressed with the service in hand that he wanted his own collections to be distributed as Wallich's were. Meanwhile by the side of the ordering of the collections, Wallich got together the plates

for his *Plantae Asiaticae Rariores,* which the grateful Court of Directors at the India House took upon their hands. The best source for information on the carrying out of this work is in Daydon Jackson's *'George Bentham'* (1906) ; and the fullest information as to the workers attracted is in the preface to Volume 3 of the *Plantae Asiaticae Rariores.* The time of Wallich's return drew near. He had attracted from the Continent of Europe the Professors Karl Friedrich von Martius of Munich, Karl Friedrich Meissner of Basle, Christian Gottfried Nees von Essenbeck of Breslau and Johan George Lehmann of Hamburg, as well as Count Caspar von Sternberg and had provided them with the material they needed for what they had undertaken to do. He had promises of aid from six of the most prominent botanists of Britain.

Then came the closing. The organization had been excellent. The vast store had been sorted under 7,693 numbers, the larger part subdivided again by letters ; and Wallich had catalogued them as work progressed, by means of his lithographed catalogue, writing the entries on the stones himself. Gratitude was general for a great work well done. (see Pl. II).

It has been written of Wallich (*Dict. Nat. Biogr.* 59, p. 135 ; 1899) that 'his zeal as a collector was greater than his patience in working up existing material', *i.e.* his collections. It is an unfair conclusion from the fact that he had to call in others to help; that need was a consequence of the vastness of his collections and the vastness a consequence of the way in which the Company employed him. Doubtless his inclinations were ancillary and he showed an impulsive readiness to undertake work. Where, it was asked at the closing, should Wallich's working set of specimens be placed—the set that held all the numbers and therefore the best set. The question was debated and the Court of Directors decided to make it over to the Linnean Society and did so at an official luncheon. It was a natural decision. The Linnean Society had possession of the Linnean Herbarium, a treasure which has been described (Sir George King in his Presidential address to the British Association in 1899, p. II) as 'not merely a national but a cosmopolitan responsibility'. The placing of the Wallichian Herbarium, as it may be called, by the side of the Linnean Herbarium was to do two things, to rank it a great responsibility and to estimate the Linnean Society's keeping as the safest. There was also a profound belief that the climate of Calcutta would impair it. The decision was the grafting of a living scion into a living tree. The Linnean Society faithfully carried out of the responsibility put on it until 1913, and since then the same is being done by the Royal Botanic Gardens, Kew. At leaving Wallich pointed to material still unassigned and asked for a set for Calcutta from it. The set was not actually made up, probably as a consequence of another request which postponed work on it, a request that Royle might have the loan of the unallotted material ; and Royle

N. Wallich

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was a very slow worker. Thomas Thomson in 1856 (*Journ. As. Soc. Bengal*, 25, p. 405) referred to the unfulfilment of Wallich's request; but it seems that in one way or another much was done to supply to Calcutta the desirable material. Wallich on getting back to Calcutta caused to be made a new herbarium from what was available in the Garden and he asked other gardens to contribute. While Wallich was on leave, his artists were at Saharanpur making drawings for Royle. The name of Vishnu Prasad, the most expert of them, will be found consequently on plates in Royle's *Illustration of the Botany of the Himalayan Mountains*.

XVII. THE OPENING OF THE WAY TO KASHMIR

During the first half of Wallich's service, that is to say, during the part with which this chapter is concerned, the leader of French scientific thought was the illustrious Baron Cuvier and he was not satisfied that France had made a sufficient effort to get scientific information from India; he therefore urged the National Museum to redouble its collecting; and Victor Jacquemont (1801-1832), a man of wonderful vitality and attractiveness, undertook a prolonged period of travelling. He arrived in Pondicherry and went forward to Calcutta in May, 1829, at which time Wallich was in London. It is from Jacquemont that we discover Sir Charles Metcalfe to have had the Calcutta Garden under his charge. Jacquemont was given all possible facilities for learning to recognize plants that he was likely to meet, by study in the Garden and its library. Meanwhile he learned Hindustani and Persian, with the intention of being ready to go to the north-west when the rainy season was over. It was been written that he avoided the English; nothing could be further from the truth; he spent his time with them if he was where they were. The Garden he called 'a magnificent establishment' and the letters that he wrote home (*Letters from India*) translated by Catherine Alison Philips (1935), and the Diary printed by the Government of France (1841) are delightfully full of colour regarding Calcutta life. There was a European Head Gardener or Overseer at the Garden whom he does not name supported by 'a magnificent Brahmin', possibly the Buxee of Griffith's report on the Garden; and on the latter's knowledge of plant-names Jacquemont greatly relied, for there were no plant-labels. When the rains were over, Jacquemont proceeded across Chota Nagpur and up-country through Bundelkhand to Agra and Delhi and then to Saharanpur where Royle was very helpful to him. The summer was spent in the mountains. He went through Dehra Dun and Mussoorie to the sources of the Jumna and the Tons;

then to Simla ; then to Spiti, and back to Delhi. This was the round of continuous collecting of his first season.

At this time among the French officers employed by Ranjit Singh was Jean-Francois Allard; and General Allard, reporting to his master that he had a fellow-countryman at work on the British side of the Sutlej, was told to invite him over. Thus it came about that Jacquemont was able to obtain permission to enter Kashmir, being the first botanist to do so. He spent the summer of 1831 in the Vale or in the hills that limit it, and at the end of summer bent his way back to Delhi with great collections. On through Rajasthan he proceeded and so to Poona whence he descended to Bombay, there to die from the consequences of his hard life. A personnel friend, Jacques Cambesséds undertook in Paris the working out of his plants, but was compelled by family affairs to desist ; and on his departure from Paris, Joseph Decaisne took on the work. The collection of letters that I have mentioned was printed in French in 1835, his diary in 1841, and the descriptions of Cambesséds and of Decaisne in 1838-1840, Royle's *Illustrations of the Botany of the Himalayan Mountains* being in the course of issue at the same time. Cambesséds and Decaisne do not show themselves aware of this.

Jacquemont's success in opening the road to Kashmir let two others in. One was Baron von Huegel who has been mentioned as entering India by Bombay. The other was the traveller Godfrey Thomas Vigne (1801-1863). The latter left Britain at the end of 1832 and, travelling through Persia, arrived at Bombay in 1833; then entered the Himalaya from Delhi. He collected plants, but was not a botanist. He and von Huegel met in the Vale of Kashmir at Srinagar. The effects of this opening up of Kashmir will be made evident in the next chapter; when the appearing of new centres of work on Indian plants comes up for notice.

CONCLUSION

Finally it is fitting to mention for the sake of completeness the names of certain others who collected a little, but escaped the biographic record, that my list of those who served may be complete. Captain John Conway brought plants to Petiver. Mr. Dick communicated plants from Sylhet to Roxburgh. John Fox or Foxe brought plants to Petiver. A collector named Mace entered the Circars early in the 19th century and collected plants which are probably conserved in Paris. Nathaniel Maidstone brought plants to Petiver. Benjamin Meaux brought plants to Petiver. Mrs. or Miss Mariott collected plants at Trincomalee which reached Benjamin Delessert. Mrs. or Miss Oltmans collected plants in Ceylon which are conserved at Leiden.

CHAPTER II

THE ADVANCES, AND IN PARTICULAR THE PLANT COLLECTING, OF THE THIRTIES AND FORTIES OF THE 19TH CENTURY

1. INTRODUCTION

My first chapter carried the history of the science of botany in India as far as the time of Wallich's long leave, 1826-32, leave in which he took to London the collection of bundles of dried plants, that had grown up in the Calcutta Botanical Garden, and was allowed to draw from India House bundles that had been deposited there; all the specimens thus assembled he sorted, like to like, *i.e.*, he assigned them to species, made them up into sets, and distributed these sets to, as he said, 20 centres of botanical work in 8 different countries, that they might do the great service of intersting the botanical world in the flora of India and of keeping botany in India in line with the advance of the science by ensuring the necessary international specific nomenclature.

This, the second chapter, carries the history forward a couple of decades. Although it covers a very much shorter time, it requires as many printed pages, and the names of the collectors are as many. That this

should be the case indicates how greatly the two decades make a period of intensification. They make also a period of widening outlook and considerable achievement of reputations made or maintained and of strenuous undertakings. The beginning was in the nature of an awakening, for Wallich's leave extended long enough for Wight and Royle to require absence from India during it, whereby India was deprived entirely of its leaders in the Science.

Who were those left in India when the three were away ? It will aid the reader to form an idea of the situation if they be enumerated. The seniormost was the missionary J. P. Rottler, whose knowledge of the flowering plants of southern India was considerable; he possessed a good reference herbarium and would name the specimens of others; but he was already 78 and losing his vigour. Bernhard Schmid, also a missionary, had moved from Tinnevelly to the Nilgiri Hills, where he was now at the beginning of his botanizings. Lieut. Colonel W. H. Sykes, holding the post of Statistical Reporter, Bombay, was collecting plants in the Deccan; but he was not botanically minded and the collection went without determinations until entrusted to Royle about 1840. In Ceylon, James Macrae by a little collecting was adding to the herbarium at Peradeniya, but probably merely increasing the material without making determinations. The surgeon Alexander Gibson and the administrator J. S. Law were not out of their initial years in India and John Graham arrived in Bombay only in the year of Wallich's departure. On the other side of India, although the scientific membership of the Asiatic Society had strengthened, as the *Centenary Review* of the Society makes evident (p. 17), William Carey alone remained.

While conceding that the contemporaneous absences of Wallich, Wight and Royle created a situation, the pause of which made the years 1828-32 a dividing line, there was an associated circumstance not to be overlooked. It was that every botanist who resided in India, from Koenig to the years named, had been taught, thought and classified in the Sexual System of Linnaeus, a cramping, fettering system, bound to be superseded; and the first signs of supersession by the Natural System reached India after Wallich's departure on leave. The reader will now appreciate my use of the word 'awakening' as a chapter of the period under review.

It is rightly said that a system of classification demands knowledge of everything that is to be simplified by it. The objective justifies the system; and the Linnaean System simplified the arrangement of cabinets of specimens, lulled the born collector for whom it was prepared and was a means of getting on with what was immediately in hand, but raised a cloud of dust against the philosopher. Reynolds Green, writing in his *History of Botany in the United Kingdom* (p. 124; 1914) as a philosopher, condemns the Linnaean System more than it deserves. It was a product of its time, a ready help in assimilating in some order

the flood of new species that emerged from the world-wide explorations of the latter part of the 18th century, a short cut or key. As meeting the situation it was a masterpiece. Not only did it do this, but by its simplicity it popularized Botany. The professors of the medical schools seized it, so to speak, with both hands and spread it out before their classes with the result that all the surgeons who came to India had a knowledge of it. Others joined the surgeons for, being so easy of comprehension, it took Botany to a place in a liberal education and even into the drawing rooms. India was affected by this diffusion in that the proportion of medical men who studied plants in India fell from two in three to one in three. Justifying my allusion to Botany in the drawing rooms, I would refer to the interest taken by three eminent ladies : the wife of the Marquis of Hastings, Governor-General from 1814 to 1825 would ask those who collected plants to give her duplicates that she might send them to a museum in Edinburgh in which she was interested; the wife of the Early of Amherst, Governor-General from 1825 to 1829, was not only a keen gardener who sought out beautiful plants and got them into cultivation, but possessed a small herbarium ; the wife of the Earl of Dalhousie, Commander-in-Chief, spent the warmer months of the year 1829 at Simla, where between Sabathu towards the plains and Mashobra deeper into the mountains she collected about 600 species. The Countess was competent enough to make determinations and very enthusiastic, as Carey who met her in Calcutta on the eve of her departure for Simla, has recorded for us.

The advances of Botany needed a little time before Europe was in a position to spread them to India. Fifty years passed from the publication by Linnaeus of his Sexual System to the publication by Antoine-Laurent de Jussieu of the Natural System, and rather over sixty from Linnaeus's publication to Koenig's bringing the use of it to India, Koenig and A. L. de Jussieu being contemporaries. The Natural System, devised and advocated in France, had to pass to and be taught in Britain, before it could follow to India ; and the first teacher of it in Britain was William Jackson Hooker (afterwards Sir William), Professor of Botany at Glasgow, 1829-41; the second, John Lindley, Professor of Botany in University College, London, 1829-60. I shall have cause to mention both, not as visiting India but as exercising a considerable influence on those who botanized in India. Their influence began at the time of Wallich's long leave, or forty years after the publication of A. L. de Jussieu's *Genera Plantarum* (1789).

I said (in chapter I, p. 2) of my first period that no aspect of botany was studied except classification : the same is nearly true of the second period; but the classification had now a deeper insight.

A single illustration will bring home to my readers why it was so enormously to the benefit of the Science that the Linnaean System, having served for a short time, should pass away. Let us liken each system to a container of sufficient dimensions to hold all the units to

be classified if accurately placed. The container by the Linnaean System would have directions for placing in its lower parts; that by the Natural System directions at all levels. It is obvious which of the two is the better. Could the theory of the origin of species have been arrived at by a Linnaean systematist ? And is it not clear that the theory and the Linnaean System are incompatibles ?

II. WILLIAM CAREY AND HIS CONNECTIONS

William Carey (1761-1834) occupies a somewhat unique position in the history. He was a wonderful linguist. As the son of a village schoolmaster, he sought at first to find a way through life as a schoolmaster ; then, in missionary fervour, he volunteered for a difficult life in India and landed in Calcutta in the year of the transfer of Roxburgh from Samalcottah to Calcutta, *i.e.*, in 1793. To earn a living he became an indigo planter in Malda ; and at that place he mastered the Bengali language into which he translated the New Testament. He had his translation ready when fortuitously a trained printer joined the Mission at Serampore, a printing press was obtained and Carey moved to the press. He had no aptitude for business, but was a born teacher and a perfect editor. He had become a friend of Roxburgh when still at Malda and acquainted with Colebrooke. After moving to Serampore he could easily reach Roxburgh's doorstep by boat ; and the intimacy ended in Carey being Roxburgh's editor.

It has been stated (chapter I, p. 32) that in 1813 Roxburgh, before he sailed from India for the last time, put into Carey's hands a manuscript copy of his *Flora Indica*. A delay in Ceylon gave him a chance of botanizing and he found a little information to insert in the copy which he sent by post to Carey. Though in the two years left to him before his death (1815) he continued to work on another copy of the Flora that he had taken with him, nothing more was added to the copy that he had entrusted to Carey. After his death Carey consulted Wallich regarding publication, and Wallich with characteristic impulsiveness volunteered to bring the MS up to date by inserting his own finds. Carey agreed ; and the first volume was issued in 1820. The second volume was delayed by Wallich's year in Nepal, but appeared in 1824. The third volume was never prepared because Wallich's affairs became too much involved. After Wallich had gone on 1828, the Baptist Mission Press at Serampore holding the copyright, two of Roxburgh's sons approached Carey, asking him to print the whole work from the copy that their father had left with Carey ; and this was done, save that

for some undeclared reason the ferns were omitted ; and the work appeared in three volumes in 1832. There is no sign of Carey in the text save for the editing ; but Carey had become a botanist and was active. Prain in the preface to his *Bengal Plants* (p. 18) says that between Roxburgh and Carey 'little or nothing had been left .... for successive generations of botanists to add' to the list of higher plants that occur in Central Bengal. Carey assuredly sent dried plants to Roxburgh mixed with his own, but proof is lacking.

Carey almost immediately after he had domiciled himself at Serampore (1800) was appointed to teach Bengali in the Governor-General's new College in Fort William. This and a tremendous hunger for books drew him into Calcutta so much so as to make him equally a man of Calcutta as of Serampore. But except for a short paper on the agriculture of Dinajpur (*Asiat. Res.* 10, p. 1; 1808) he published nothing in any way botanical. He cultivated a garden in Serampore assiduously. In the year 1820 he called together a meeting in Calcutta to originate an Agricultural and Horticultural Society. The meeting was badly attended, but getting official support he got his way, and the Agricultural and Horticultural (Agri-Horticultural) Society of India came into existence. It never operated far from Calcutta in spite of the word 'India' in its title. When Carey's move had been made, one of the two Tytlers who at that time showed an active interest in economic plants, R. Tytler, wrote that he had already ventilated in Allahabad the idea of a similar society ; and we may take it that the time was ripe for Carey's move, though it expended its efforts in the introduction into gardens of plants suitable for them and very doubtfully touched agriculture at all. Wallich became its Secretary or one of its secretaries, soon after its foundation and the Society was allowed the use of a part of the Botanic Garden as a nursery, of which it had the use until 1872. Wallich and his successors apparently saw no rivalry, though much of what the Society did was what they also were doing. Wallich wrote appreciatively of the Society's work in *Hooker's Journal of Botany* at a relatively late date (5, p. 137; 1853). The Society started *Transactions* of its own and provided an outlet for papers in economic botany.

Jacquemont on one of his visits to Carey's garden met there Professor and Mrs. Mack (he miswrote the name Mac). John Mack was a scholarly man from Edinburgh who had become a teacher in the College that the Mission had founded. He was not a botanist, but took an interest in some branches of Natural Science ; and when in 1826 he and his wife visited the Khasia Hills on a tour of inspection they made a collection of dried plants which they gave to Sir William Hooker. The excellence of the specimens received commendation.

To Serampore in 1827 a Danish surgeon, Joachim Otto Voigt (1795-1843) went to occupy the post which had been Wallich's 20 years earlier ; and in Serampore he became a disciple of Carey. When

Carey died he took charge of Carey's garden dedicated, as it was, to public service. He formed a herbarium which at his death was given to the University of Copenhagen and duplicates were given to Sir William Hooker which, therefore, are now at Kew. As will be mentioned later, Voigt had charge of the Calcutta Garden for two months in 1842 and the occasion gave him the opportunity of uniting catalogues of the Serampore and the Calcutta gardens into one under the title *Hortus Suburbanus Calcuttensis*. Voigt made more of it than a mere catalogue by embodying economic information, records of failures, experiences of himself and Carey at Serampore, and some information supplied by J. W. Masters, who had served as Head Gardener under Wallich (for Masters see p. 66 & forward).

Henry Piddington (1797-1858) was another who came under Carey's influence. After a few years at sea he settled in Calcutta and made a reputation as a meteorologist. But before he became absorbed in weather observations and after he had allowed himself to be elected a Secretary of the Agri-Horticultural Society, he prepared, manifestly at Carey's suggestion, his *English Index to the Plants of India*, which is a dictionary of vernacular names with botanical equivalents. Piddington calls himself a tyro in Botany; and this was his only publication that directly interests us. He remained for long active in the Agri-Horticultural Society.

III. THE UNOBTRUSIVE LEADERSHIP OF ROBERT WIGHT

Robert Wight (1796-1872) qualified in Medicine at Edinburgh when Daniel Rutherford was the professor. Rutherford fired no enthusiasms, and Wight did not leave the University a botanist. But when in 1819 he had entered the medical service of the East India Company and had found that the amusements of his associations in cantonments did not provide a congenial outlet for his energy, he turned, as he explained later in a letter to Professor von Martius, to the vegetable kingdom for occupation and in the leisure of his regimental duties studied the plants about him. He was soon sending collectors out to bring to him plants from distances beyond the limits of his own excursions. His station being Samalcottah (Samalkot), where successive official Madras botanists from Roxburgh forward had lived, the tradition of employing men of the country-side as plant-collectors was alive, and moreover it is not unlikely that he received help from Shuter. He managed to get three botanical works, an early edition of Linnaeus's *Genera plantarum*, Willdenow's *Species plantarum* and Persoon's *Synopsis*, by which he proceeded to determine his finds. These books kept him working by the Linnaean System which doubtless would not be strange to him. Perhaps it was well for this

lone traveller that he had the easier artificial System to encourage him, though as will be seen, he was not slow in discarding it when his opportunity came.

Wight was transferred successively to Rajahmundry and Vellore. When he had been collecting for about four years, he needed help with his nomenclature, and made up a bundle of specimens which he addressed to Robert Graham, the new professor at his old University ; but the bundle was lost at sea; and it seems as if Wight could not immediately make up another. However, he did so in 1826 and this packet he sent to Sir William Hooker, professor at Glasgow. By way of comment on the change, the reader may be reminded of Francis Hamilton's remark : 'Dr. Hooker at Glasgow I see frequently ..... he is more active than Graham.' Wight doubtless had chosen well and his material got attention. In the same year, Wight was taken from regimental duties and given the post of Botanist that had been successively Koenig's, Roxburgh's, Russell's, Heyne's and Shuter's. Koenig had travelled to Siam on it and the others to various destinations. Wight immediately travelled, going right to the very south of the Indian Peninsula on a zigzag course. Such journeys were of course costly because so much equipment had to be carried, food and a tent, employing a fair number of attendants, including an armed guard. Heyne, journeying from Samalcottah to Hyderabad, had a party of 40. Wight's much longer journey extended over 2½ months ; it took him among other places to the Palni Hills where he found a flora quite new to him. But when in the next year he proposed a much longer journey, he was abruptly brought to earth by the abolishing of his post and by being sent to Negapatam, again in medical charge of a regiment.

Wight had been giving bundles of dried plants to other botanists, not all in Britain. Delessert in Geneva was one of the recipients.

After 2½ years at Negapatam, whence he collected as much as he could by sending out collectors, he took leave and brought all that he had to London in time to find Wallich in the middle of his work of distributing the Calcutta and India House material. The excellence of Wallich's arrangements so pleased Wight that he would have had what he had brought with him absorbed, and indeed Wallich had some of Wight's plants which he had obtained from India House to which Wight must have sent them. Wallich evidently could not take more; and Wight betook himself along with his newer collections to Scotland, where he found a co-adjutor in G. A. Walker Arnott.

George Arnott Walker Arnott (1799-1868) had been a school-fellow and also with Wight at the University ; but while Wight was studying Medicine, he was studying Law. In the end he did not adopt the Law as his profession; instead, as Wight was becoming a botanist in India, he betook himself to Paris and studied Botany there. Returning from Paris, he worked with Sir William Hooker in Glasgow. Having met Bentham, he joined the last named in a tour of the Pyrenees. Could

Walker Arnott, after study in Paris, after work with Sir William Hooker in Glasgow, and after a botanical exploration along with Bentham, have been a follower of the Linnaean System ? That he was not; and he carried Wight into the Natural System, as they wrote conjointly their excellent *Prodromus Florae Peninsulae Indiae Orientalis* on the material that Wight had brought back with him. The first volume appeared in 1834, and then Wight's return to India arrested the work at a point which would have been one-third of the whole. The two collaborated in a couple of supplementary papers and that was the end of their association in work for India.

Wight, while engaged on the *Prodromus* was a welcome guest in Sir William Hooker's house ; and Hooker happened to be engaged in preparing the plates for his supplement to Sowerby and Smith's *English Botany*. The idea of illustrating in a comprehensive way the flora of Britain, as that work did, gave rise in Wight to a desire to illustrate the flora of India in a similar manner, and out or that desire were born all these of his books : (i) *Illustrations of Indian Botany* with plates numbered 1 to 41, reproduced from Hooker's Botanical Miscellany, 1834, (ii) *Illustrations of Indian Botany* with plates numbered 1 to 182 in two volumes, 1840-50, (iii) *Icones plantarum Indiae orientalis* in six volumes, with plates numbered 1 to 2,100, 1835-53, and (iv) *Spicilegium neilgherriense* in two volumes with plates numbered 1 to 202, 1846-51. To effect his purpose, he had to learn the art of lithography, which he did in Sir William Hooker's house, to train his artists, and to secure a printer. The printer worked in Madras city ; Wight suffered from transfers to the Nilgiri Hills and then Coimbatore, as he told von Martius in a letter, at the inconvenient distance of 300 miles from his printer. He bore the expenses himself and the loss which, he says, was made tolerable by the Government taking 50 copies.

Wight on returning to India in 1833 was posted to Bellary ; then his regiment was ordered to march to Palamcottah at the extreme south of the Peninsula. Wight found the transport of his impediment most inconvenient. After arriving at Palamcottah, he was sent on a mission of inspection to the experimental spice-garden at Kuttalam (Courtallam), a pretty place at the open end of a depression in the Ghats through which winds off the Indian Ocean carry coolness and humidity. Wight revelled in this place which gave him his second experience of the southern mountain flora; his first had been when he climbed the Palni Hills in 1826. But he contracted fever and was driven to take a period of leave which he used for a visit to Ceylon. He took with him two of his collectors and met there General G. W. Walker and his extremely energetic wife with whom he botanized.

At this point in my narrative it is desirable to record what had been the course of Botany in Ceylon after Koenig's visit in 1781 (see p. 37 of the first chapter). I commence, therefore, with another mis-

sionary, Johan Peter Rottler. As Koenig was the first of the Tranquebar botanical missionaries, so Rottler was the last. Rottler (1749-1836), after an education at the University of Strasburg, joined the Mission (1776) and lived in India for 60 years, for the first half working from Tranquebar and for the second from Madras city. He travelled and collected plants in many places and co-operated with others in making up sets of dried plants which had various destinations. One went to J. C. D. von Schreber at Erlangen and is believed to have been transferred later to Munich ; another went to Delessert at Geneva ; Wallich received two bundles on his return from his long leave; Wight was able to obtain a set ; and in some way, earlier than Wallich's leave, a set had reached India House which Wallich was allowed to have and distributed as 'Herb. Madras'. It is improbable that one set was like another ; the Geneva specimens, for instance, are not to be assumed as of contemporaneous origin with what entered Wight's collections. Rottler at his death had a considerable herbarium which he bequeathed to the Vepery Mission and the Mission sent it to King's College, London ; this collection, the college gave to Kew in 1872 ; but there is a suspicion that it had ceased to be entire. Rottler's specimens were commonly devoid of any locality of collecting.

Rottler made two visits to Ceylon, one in 1788, the other in 1795. The conditions in 1795 were very favourable for collecting, as he had been engaged to travel with Hugh Cleghorn (1781-1834), private secretary to the Governor of the island and after that the first Colonial Secretary, that he might serve as interpreter in a tour of inspection. The tour over, he remained to continue the collecting. By arrangement, specimens were sent to India House in 1797. Rottler's biographer, Thomas Foulkes, states that he was informed by Cleghorn's grandson that they were subsequently put into the collection at King's College. Rottler's mastery of Tamil led to the preparation of a dictionary. Of its three volumes only one was printed before Rottler's death; the other two were issued in 1837 and 1839. In the dictionary are to be found the first equatings of botanical and Tamil plant-names. Five years after the third part had been issued, the Tamil botanical dictionary of Simon Casie Chitty came out as a further effort at passing the terminology of Botany into southern India.

But to return to Ceylon, after Rottler the next to botanize in Ceylon was William Kerr, chosen by Sir Joseph Banks in 1812 for the management of the Garden in Colombo where he died in 1815, to be succeeded by Alexander Moon, likewise chosen by Sir Joseph Banks. Moon moved the government garden to Peradeniya, where he died in 1825. His successor was James Macrae chosen by Lindley ; he served from 1827 to 1830. Kerr, Moon and Macrae had graduated for appointment by travel in search of plants for cultivation ; and the establishing of such in Ceylon was their first duty. Moon was the best equipped for the work and published in 1824 *A Catalogue of Ceylon*

Plants which holds the names of 366 species that he had alive in the Peradeniya Garden, together with the names of plants found outside that he recognised, bringing the total to 1127. Moon made no acknowledgement of help from Europe, but there are specimens in the herbaria of London indicative of correspondence. Macrae sent specimens to Lindley and added also to the collection of dried plants which Moon had started; but Macrae's time in Ceylon was very short. After Macrae's death Peradeniya had in turn 5 care-taker superintendents; one of these was James George Watson (-1838), accepted on the recommendation of Wallich when on leave in London; another was J. G. Lear, an employee of the horticultural firm of Knight of Chelsea, who being in Ceylon was locally taken into employment. During Watson's service, the traveller Baron Karl von Huegel spent four months in Ceylon. Contact with Watson is not recorded and of the visit little is in print except that he collected and dried plants extensively, as recorded in a privately printed memoir of 1904 wherein the places that he visited are named; and Bentham visiting Vienna in 1839 saw there the Baron's collections.

Almost throughout the years of these caretaker superintendents General G. W. Walker was in Ceylon; and the General was virtually *in loco parentis* to the Garden.

George Warren Walker (-1844) had been Governor of St. Helena and from that island he and his wife had been active in sending plants and seeds to the Glasgow and Edinburgh professors, *i.e.*, to Sir William Hooker and Robert Graham. After a subsequent period of leave, the General was sent in 1830 to Ceylon as adjutant-General, where in unhurried journeys of inspection through all parts of the island, the palanquin bearers who carried him would command his interest by drawing attention to flowers seen by the way, and these the General collected. Wight having gone to Ceylon, as recorded, went on one of these journeys with the General. It is obvious that Mrs. Walker would travel less than her husband ; but she ascended Adam's Peak on one occasion and wrote a long account of her experiences which Sir William Hooker printed (*Compan. Bot. Mag.* I, p. 3; 1835). She did most of the correspondence regarding their plants, but he the business of despatching etc. They looked to Hooker and to Graham for determinations, and sent much to them, enriching at the same time the herbarium at Peradeniya. The General expressed his complete disapproval of J. G. Watson as merely a collector and entirely unable to read the Language of Botany; and he begged that a scientific man should be placed in charge of Peradeniya. Watson certainly collected; and the fact that he obliged Wallich with dried garden plants when Wallich asked for them may be kept in mind in connection with Wallich's selection of him. He sent dried plants also to Lindley. It is not unlikely that the General's protests reached quarters influential

enough to secure the appointment of George Gardner, the first botanist as distinct from horticulturist to be in charge of Peradeniya.

Wight's visit to Ceylon in 1836 and contact with the General led to an undertaking on Wight's part to name up the Peradeniya collection; and these were entrusted to him for the purpose. Wight then proceeded to supplement the Ceylon material, placing again in Ceylon in 1837 two collectors. It, as seems to have been the case, the whole of the Peradeniya herbarium was packed and sent to Wight, its size at the time would not have been great.

In 1838 another botanist of the Army arrived in Ceylon; this was John George Champion (1815-45). He was stationed at first in the centre of the island and later at Galle. He did not meet Wight but they corresponded. Champion was at Galle when Prince Waldemar of Prussia, making a tour of the East, landed at the port of Kalutara which is between Galle and Colombo, bringing with him as his personal physician the young and inexperienced botanist Werner Hoffmeister. Champion took the physician botanizing, while the Prince proceeded to Kandy and was shown round the Garden at Peradeniya by the artist Harmanis De Alwis. At this date General Walker was no longer in the island. Threats of war in the north of India had caused his transfer to Madras in 1837, then to Calcutta, then to Meerut; finally after a visit to Mussoorie, he and his wife ended at Simla. In 1844, Champion, who had taken the unofficial position towards Peradeniya that had been the General's, corresponded with Wight regarding the loaned collection, and saw that it was back in place for the use of Gardner. Wight evidently had had it for a long time.

Before Gardner's arrival another botanist had reached the island; this was William Ferguson (1820-87), a professional surveyor. Gradually he developed a special interest in economic plants, in ferns, and in seaweeds. However, his years of activity really belong to the third period of this history.

George Gardner (1812-49) had been a pupil of Sir William Hooker and, when qualified in Medicine, had travelled for 5 years in Brazil. It is interesting that to have travelled seems to have remained a qualification for the Ceylon appointment. It is doubly interesting that an occupant should have been chosen with a botanical qualification. Unfortunately the seeds of ill-health were in him and almost immediately he was obliged to take leave; this he did by returning Wight's visit; he went to the Nilgiri Hills and botanized there with Wight. In 1846, Wight had joined the editorial staff of McClelland's *Calcutta Journal of Natural History*, and now Gardner was added. Griffith had become an editor two years earlier. Gardner now used the opportunity it afforded him of publishing. An editorial staff including Griffith, Gardner and Wight was a strong one botanically; but the financial support which the journal obtained was inadequate. The Asiatic Society of Bengal a few years earlier, manoeuvring to finance its output

of print by offering for sale separately the scientific and literary papers that it accepted for the *Asiatic Researches,* had observed that it was left with unsold scientific parts when the corresponding literary parts of volumes were sold. This demonstration regarding demand might have pointed to difficulties that McClelland's venture had to face.

Wight's short period on the staff of the journal was almost his only connection with northern India, except correspondence with Wallich and Griffith, so completely did he belong to the Peninsula where his authority in taxonomy extended from Ceylon to Bombay and from Ceylon to the Circars. It was indicated in my first chapter (p. 35) how John Graham accepted that authority ; it will be indicated how it was passed on through Gibson and Dalzell ; Nimmo's friendship with Wight was built on it ; and from what has just been recorded, it is clear how it was established in Ceylon.

Immediately before the illness which led to Wight's holiday in Ceylon, he had had information that his employment was to be changed. He told Walker Arnott that he anticipated a roving life and that it might be for a year or longer. It proved not to be a roving life and it lasted 17 years. He was removed from the Military Department and told to enquire into the state of Agriculture in southern India and to conduct experimental cultivation of cotton, tobacco, senna, sugar, coffee, spices, and madder and to enquire into the possibilities of cinchona. Cotton was put into the front. For a time he resided in Madras city where he undertook the management of a garden started by a new Agri-Horticultural Society and was drawn into the affairs of the Madras Society of Literature and Science, contributing several papers to their Journal, always such as had an interest beyond his own subject of taxonomic botany. From Madras city he was moved to the Nilgiri Hills and then to Coimbatore. Ten bullock carts were required to move his collections and machinery from the one to the other. Without doubt, he collected much in the Nilgiri Hills ; at Coimbatore he was but a short distance from the Anamallai Hills ; but C.E.C. Fischer does not find that he collected in them (see *Rec. bot. Surv. India.* 9, p. 5). In 1853 his retirement came. The collections which he then brought to London for final elaboration were in a very large measure made up of southern hill-plants got by his collectors. These plants were distributed from Kew in 1869.

Wight left India too soon to have any part in the establishment of Cinchona. The first individual plant to reach the East was in Java in 1851 and further plants in 1854 ; it was not until 1860 that planting commenced in the Nilgiri Hills and the establishment there was the work of William Graham McIvor, Superintendent of a Botanic Garden established at Ootacamund.

IV. FURTHER COLLECTING IN SOUTHERN INDIA

When in 1828 Wallich brought together all the collections that he could command, he had a small number of species from the Nilgiri Hills collected by Leschenault and a larger number collected by P. J. Noton of the Bombay Mint. In 1827, an association called 'Unio Itineraria' *i.e.*, the Travel Union, was formed in Germany at Esslingen near Stuttgartt, with the object of maintaining a collector or collectors of plants in the field whose collections were to be divided among the subscribers. Under the guidance of Ernst Gottlieb Steudel and Christian Friedrich Hochstetter, the Union prospered; they handed it over as a going concern in 1842 to the charge of Rudolp Friedrich Hohenacker, to whom it occurred that there might be a market for dried plants from that part of India where Rheede's *Hortus Malabaricus* had been illustrated. Hohenacker sought for but failed to get someone to collect actually in Rheede's country, *i.e.*, near Cochin, but found a missionary, F. Metz, resident at Mangalore, 240 miles further north, prepared to do the collecting. Hohenacker could scarcely have been expected to know that Mangalore is outside the climate of Cochin : it is beyond where the second annual peak of rainfall which characterizes the Equator has died away and is where the months of April and May have a dryness that influences the vegetation. F. Metz of the Basle Mission was not a botanist, but a collector ready to earn as much as he could, that he might put up mission buildings. Hohenacker sought for someone in Britain to name the plants when they had been collected, but in vain; and he accepted the services of Frederik Anton Willem Miquel who was at the very beginning of his career. Miquel naturally was slow. The first dividend came at the end of 1847. The plants distributed then are labelled Kanara and may be assumed to have come from within the District of South Kanara. Next, Metz had a short period of collecting about Mercara in Coorg; he was now at an elevation probably not reached at all by men who brought Rheede's plants together. Then the Mission moved Metz to the village of Keti at a few miles from Ootacamund in the Nilgiri Hills and holding still less of Rheede's vegetation than at Mercara.

However, he had not done much collecting before he decided to cease in consequence of heavy losses between gathering and shipment. He had been a diligent agent whose specimens, indifferent at first, improved as he gained in experience. Some authors quote these specimens as Hohenacker's, which is misleading, for Hohenacker was only an intermediary.

Another missionary was living in Ootacamund when Metz was moved to Keti whose interest in the plants of the Nilgiri Hills was deeper. This was Bernhard Schmid (1787-1857). His first place of residence in India was in the District of Tinnevelly. There his health broke down, driving him to the Nilgiri Hills, where, it seems, his

botanical interests were aroused. Not wholly recovering, he returned to Europe, taking with him or having to follow him a small collection of dried plants and some coloured drawings. He had been trying to determine what to call his plants by the use of Roxburgh's *Coromandel Plants* and Persoon's *Synopsis,* neither work likely to be really helpful. At the end of the year 1831, Baron Karl von Huegel, who has been mentioned already, had reached Bombay, and from Bombay, he worked his way southwards, reaching the Nilgiri Hills in February and botanizing there with Schmid for six weeks. Karl Alexander Anselm von Huegel (1795-1870) was of German ancestry, but Austrian adoption a great collector who enriched the Vienna Museum considerably by what he brought to it. He records that Schmid conducted him about the country-side and put his herbarium freely at his disposal. Doubtless, specimens still exist which Schmid put into von Huegel's hands, Schmid had a list of 471 species which he recognised and might name to the genus and only rarely to the species. In 1836, he returned to Europe and being a native of Weimar which is only 20 miles from the University town of Jena, it was natural that he should make contact with Jonathan Karl Zenker, the professor of Botany in that University. The date and manner of making contact is not known; but the result was that Schmid gave to Zenker the materials from which Zenker published in 1845 a decade of *Plantae inaicae quas collegit Bernardus Schmid,* followed by a second decade in 1847. Zenker died in 1848, and there were no more decades. The botany of the two published was entirely Zenker's; and Zenker had had to build on to the original drawing by dissections and perhaps sundry details. Zenker has been accused of disregarding the work of others assuming novelty for whatever he had.

At the time of von Huegel's visit to the Nilgiri Hills, a resident medical officer was preparing a guide-book, his name R. Baikie. von Huegel helped him by supplying notes on the climate and vegetation, posting them back to Dr. Baikie from Ceylon, to which he proceeded after leaving the Nilgiri Hills. These notes were incorporated by Dr. Baikie in the text of the book *Observations on the Neilgherries* (1834); Schmid provided his list of 471 species and Baikie appended it together, with three coloured plant-portraits. If the three portraits represent, as is probable, the foundation that Zenker had for his plates, a good deal of each of Zenker's plates was due to Zenker. Schmid returned to Ootacamund in 1845 and remained there for the rest of his life. Before returning he visited London and called on Sir William Hooker at Kew. This visit resulted in a promise to give dried plants to Sir William, who provided the drying paper; and it is recorded in the *Kew Bull.* (1901, p. 52) that Schmid sent nearly 1,000 during the next few years. He sent lesser numbers elsewhither; Urban records (*Bot. Jaarb.* I, p. 61 ; 1882, mis-spelling Schmid's name) the receipt in 1848 of 41 specimens; and it is recorded by Thomas Thomson that

the Calcutta Garden received a bundle. In 1857 Schmid, aware that his life was near its end, asked Sir William Hooker what he should do with specimens still in his possession and was advised to offer them to Hohenacker. If Hohenacker received them, they were added to Metz's plants. It is apparent that the greater part of the flowering plants which Schmid collected are now in the Kew herbarium. Schmid had been collecting ferns and mosses. Just before his death he received a list of determinations of ferns that he had sent to Gustav Kuntze, the Professor at Leipzig, and forwarded it to the Madras Society of Literature and Science. It was printed in their Journal (19, p. 79; 1858). His family received soon afterwards a list of mosses determined by Johann Karl August Mueller of Halle; and this list appeared in the same volume (p. 84).

In the year of Schmid's death a second edition of Baikie's guide book appeared, edited and much altered by W. H. Smoult, but Schmid's list was unaltered. Smoult was a man of Calcutta, interested in economic plants.

The following were collectors of plants in the Nilgiri Hills of Schmid's time : Sir Frederick Adam, Governor of Madras from 1832 to 1837; two missionaries, Thomas Foulkes and another named Weigle : and the energetic 'botaniste-agriculteur' George Samuel Perrottet of Pondicherry. The first two sent their collections to Sir William Hooker; the third collected the mosses that reached J. K. A. Mueller; and the collections of the last were on sale in sets in 1853 and 1857. Perrottet's were by no means all from the Nilgiri Hills; he collected widely, even up to Bombay.

Metz's collecting in Coorg has been mentioned. He was not the very first to interest himself in the flora of Coorg, for in 1811 a surgeon named David White published an account of the Cardamom cultivated along the Ghats (*Trans. Linn. Soc. Lond.* 10, p. 228). Rottler in some way obtained plants from Coorg. In 1834, the State was extensively explored by Captains William Munro and George Stevens Gough who made rather large collections. William Munro (1818-80), ultimately a General, began his collecting in India in Coorg and continued it in many other parts of India until 1848, when he took considerable collections to London to work up with the help of Bentham. Previously, he had given specimens liberally to Wight and Griffith. George Stevens Gough, later the second Marquis Gough, appears to have done no more collecting than what he did with Munro in Coorg and in the Nilgiri Hills. There are other collectors of south-western India who need naming. One was Charles Millett, a tea-merchant who yearly spent the tea exporting season in Canton, but between the seasons was able to travel back to Ceylon or Malabar : little is recorded of what he collected in these places, but of what he collected in China much (see Bretschneider, *Hist. European Bot. Discoveries in China,* p. 288; 1898). Another was Thomas Lobb, an employee of the

horticultural firm of Veitch : he in 1848 collected showy plants on the western side of the Ghats and in Mysore. A third was the Rev. E. Johnson, who resided in Travancore and contributed a list of orchids, which he had found, to the *Madras Journal of Literature and Science* (19, p. 215; 1858).

In Ceylon a great interest in the ferns arose, and three men became specialists in these plants. One was Sir William Norris (1793-1859) who had been in Ceylon as Puisne judge, then Recorder of Penang, and lastly in Ceylon again as Chief Justice. He did not confine his collecting to ferns; but they were his greatest interest, and he sent his difficulties to Sir William Hooker for determination. The other two were in business in Colombo, George Wall (1821-94) and Thomas W. Naylor Beckett. They became friends of Thwaites when he succeeded Gardner as Superintendent of the Peradeniya Garden, and worked conjointly at the ferns with him. The collection of Beckett is at Liverpool.

The zoologist Thomas Caverhill Jerdon (1811-72) collected plants in many parts of southern India and retained his collections until his death after which they were given to Kew.

John Campbell, an army officer, brother of William Campbell, who was the first secretary of the Edinburgh Botanical Society, collected during the years 1835-37 about Hyderabad and in the Circars, and sent plants to Wight.

V. 'THE ASSAM DELEGATION' TO ENQUIRE INTO THE POSSIBILITY OF A TEA-INDUSTRY IN NORTH-EASTERN INDIA

For a century before the foundation of the Calcutta Botanical Garden, merchants had known that it was possible to obtain seed of the tea bush and grow the plant, but that the production of commercial tea did not follow. And so it was that the bush was brought into the Garden soon after its foundation as something of interest and then introduced afresh by Lord Macartney's Embassy to China in the year of Kyd's death (1793), certainly then with an emphasis on possibilities. According to Wallich, whose knowledge of the Garden was not contemporary with either of its introductions but began in 1807, the bush as he knew it from that date to 1828 was always sickly ; but did not die. Merchants in India perhaps took no interest whatever in its presence in the Garden ; but they could not forget what large profit would follow successful production of commercial tea in India. Govan, when superintending the Saharanpur Botanical Garden, advocated trying tea there. But India got no further. It was in London that a movement was started; Mr. Walker, a member of the East India Company, moved the Company to action ; he had read in the library of

the Company at India House Francis Buchanan's account of the raising of crops in the Shan Hills and of trade in the leaves to the Burmese; and he had found in a copy of Don's *Prodromus Flora Nepalensis* that Edward Gardner, when Resident in Nepal 1820, had found there a bush in cultivation and had sent a twig to Wallich in Calcutta (see Communications Relative to the Cultivation of the Tea Plant in India, 1839). As Wallich was in London when Mr. Walker moved the Company, he was asked to comment; and along with informing the Company that the bush was unhealthy in Calcutta (he did not diagnose the cause), he suggested that suitable situations might be found in the mountains of India perhaps in Kumaon Sirmur or Garhwal, 'corresponding entirely with those in China and Japan in which the cultivation of the tea shrub is carried to the greatest extent and perfection'. The Directors put the papers, including Wallich's memorandum, into the hands of Lord William Bentinck, who had just been chosen to be the new Governor-General; and he on his arrival in Calcutta in 1833 laid them before his Council with a recommendation for attention. Wallich by this time was back in India and became inevitably one of the members of the 'Tea Committee' which was nominated by the Council to formulate proposals for action. The Secretary of the Committee was a merchant, G.J. Gordon. The merchantile community was further and well represented. One of the official members was Jamse William Grant (1788-1865), a man of wide interests whom I shall need to name again. He was the Grant to whom Griffith dedicated his genus *Grantia;* and he was for a short time, two years after nomination to the Tea Committee, in temporary charge of the Calcutta Botanical Garden. The Tea Committee first of all sought advice at Saharanpur from Hugh Falconer who had succeeded Royle; and Falconer advised exactly as Royle would have done that trials should be made in the near-by Himalaya, 'from Dehra Dun up to 3,000 ft.' Wallich concurring pointed out the presence there of his seed collector, Robert Blinkworth, who could be made available to assist. So he was; and it seems that he was involved in planting in Kumaon or Garhwal to the end of his life. As a second recommendation the Tea Committee asked that seed be procured from China ; and it was decided that Gordon should go to get it. Wallich thereupon volunteered to act as secretary and was appointed to do so, being thus brought to the very centre of the Committee's business. He offered to go to the north-western Himalaya, where he would have made extensive plans for the receipt of what Gordon was to get; but the Government decided that this was not necessary. Plans were made for the distribution of the seed to come from China and most of it was to go to the north-western Himalaya; the Nilgiri Hills were to receive a fair quantity and the balance was assigned to unspecified places in southern India. What arguments were adduced to give second preference to the Nilgiri Hills cannot be stated. Assam was not thought of ; then suddenly it came into view, by the discovery that

a rumour of several years earlier that tea actually occurred there was founded on fact. The story of the discovery is complicated by the number of men who had a part in it.

In 1823, a certain Robert Bruce travelling up the Brahmaputra as others were doing, on the look out for a business opening, was successful in getting into relations with a Singpho chief; and from the Singphos he learned that they prepared for themselves a tea locally. As he told no one, his position remains some what shadowy. In 1824, the first Burmese War broke out. Many an officer during the fighting and exploring would have had a chance of learing as much as Robert Bruce had learned ; and it would seem that it was then that the rumour referred to above reached Calcutta. But the only record of this rumour is in much later circular of the Tea Committee. The Governor-General's agent on the North-eastern Frontier in 1826 was a capable officer by name David Scott; and into his possession came a leafy twig from Manipur, said to be of a shrub which gave tea. This he sent to Calcutta. A statement that it came from Tezpur was an error. Wallich with caution decided that the specimen probably represented a species of the genus that gives tea, but not the tea bush itself; and he put it away as *Camellia ? scottiana*. Scott died without doing more. Pemberton afterwards told Griffith that this plant was only known from one spot, which may well have been true as to the knowledge; but according to Sir George Watt, who explored in Manipur in 1883, there is much wild tea in eastern Manipur.

When the Burmese War broke out, a younger brother of Robert Bruce, Charles Alexander Bruce, arriving in India as part of the personnel on one of the Company's ships, volunteered for war service and was given charge of a gun-boat or gun-boats on the Brahmaputra; and he remained in Assam after the war, policing the upper waters of the river. In 1831, he passed under the orders of a new political Officer, Captain Andrew Charlton. The two from this date took parts in the exposure of Tea in Assam that can scarcely be distinguished. While it is evident that Bruce had opportunities of knowing more than Charlton by reason of longer residence, Charlton had the administration in his hands, and whatever knowledge there was to be passed on passed through him to the Governor-General's Agent at Gauhati. This was Francis Jenkins who had succeeded David Scott in the position. According to C. A. Bruce, the Singphos reminded him of his brother's interest in the Tea. Robert had died. Records show that Charlton had a knowledge of the presence of Tea atleast in 1832, for in that year he wrote to Jenkins regarding it and, more than that he tried to send a living plant to the Calcutta Garden. Wallich presumedly had not yet returned, and Charlton tried to get to its destination by the services of the surgeon, John Tytler, but he failed.

Charlton brought seedlings into his garden ; but this may not have been until 1834. The Singhpho village of Bisa in the Lakhimpur

Frontier Tracts near the Burhi Dihing river is likely to have been the place whence they came, for Bruce appears to have been familar with the growing there. It is 30 miles in a straight line from Sadiya. Charlton who had submitted specimens to Jenkins in 1832, submitted more in 1834. Dr. H. H. Mann suggests (in *Bengal : Past and Present,* 72, p. 11) that Jenkins had asked for them, which is extremely probable, for it is certain that neither Charlton nor Bruce had clear ideas of the importance of the presence in Assam of the Tea bush.

Charlton sent leaves to Jenkins in May and leaves with fruit in November. These Jenkins forwarded to Wallich who determined them as representing *Camellia theifera,* the true source of Tea. He immediately informed the Tea Committee (24 December, 1834), and the Committee recommended that a Delegation be sent to study the conditions under which Assam produced it, Wallich to be in charge with another botanist and a soil expert to support him, the botanist to be William Griffith and the soil-expert John McClelland. Jenkins expected that the area of the Tea bush in Assam would be found to be the margin of the tea-growing area in China and had ideas of using the occasion for ascertaining the nature of the country of northern Burma and towards Yunnan.

William Griffith (1810-46) was mentioned in my first chapter (p. 37) as having been brought to Wallich in London by his teacher Lindley, and as having drawn up accounts and made illustrations which Wallich put into his *Plantae Asiaticae Rariores.* Wallich was so impressed by Griffith's ability that, on learning that he was about to sail for India, he made up for him a small bundle of named plants to help him to recognise species which he was sure to meet. Griffith then reached Madras already with a reputation. From Madras he was sent to Mergui and he was in that distant post when wanted by the Tea Committee.

John McClelland (1805-85) had joined the medical service in India in 1830 and was in Kumaon, when he likewise was wanted. His interest was in Geology ; but at times in his career he turned botanist and collected rather considerably ; in 1849 he did this in the Bengal district of Birbhum and in 1855 in Lower Burma. The two young men, Griffith 24 and McClelland 29, were ill-matched with Wallich, who at 48 was old for his years.

Francis Jenkins (1793-1855, ultimately a Major-General), after proving his ability as an administrator at Nagpur, succeeded to the post of Agent to the Governor-General at Gauhati in Assam. He would have the Delegation cross the Khasia Hills and he would send them from Gauhati up-stream ; but that was not all ; he sought to arrange that a party would come to the Assam border from the Residency at the Burmese Court to meet at the frontier a party that he would send from Assam. As it required a little time to get Griffith

to Calcutta, Jenkins had time for planning. Finally Wallich, Griffith and McClelland left Hugli by boat on 31st August 1835, to thread the Gangetic delta and then the jheels of Sylhet to Terrya Ghat, whence they climbed to the plateau, Griffith both in the jheels and on the plateau meeting a vegetation the like of which he had not seen before and collecting with that intensity which was his, Wallich, to whom the plants were not altogether new, relatively indifferent. Disastrously, Wallich had not brought enough drying paper, and a quarrel resulted when Wallich deprived Griffith of his means of collecting. McClelland seems to have silently sided with Griffith, as he saw Wallich removing Griffith's specimens from the plant presses to make room for his own. Wallich afterwards could write generously of Griffith (see for instance in *Hook. J. Bot.* 1841, p. 192) ; but Griffith never forgave Wallich, though in his private diary he wrote at the time the excuse for Wallich that he was ill, and when ill was irritable. Griffith had already planned his own 'Flora Indica'; and this could have irritated Wallich, for Wallich would not forget his own failure to produce an extended editions of Roxburgh's *Flora Indica*.

During the assembling of the Delegation, Gordon returned from Canton with the first of the several consignments of Tea seed that he was destined to procure. The missionary G. Gutzlaff had helped him and was in a good position to do so, for he served the Chinese Inspector of Trade as an interpreter. Of this first consignment of seed, 20,000 were set aside for Assam and 20,000 for the north-western Himalaya ; the balance, which was small, was allotted to the Nilgiri Hills. An attempt to forward the consignment in a germinated condition was made, possibly with injudicious haste, and the seed for Assam arrived the worse for that at their destination, Sadiya early in 1836. The Delegation must have been in the Khasia Hills when the seedlings left Calcutta ; its three members arrived at Gauhati on 23rd November 1835, and left for Sadiya nine days later, reaching Sadiya 16th January 1836, just ahead of the seedlings. Before that date, Charlton had had the misfortune of being wounded in repelling a raid into the valley, and he was in hospital, Bruce being in charge of affairs. Charlton's garden with the transplanted tea plants in it was a mass of weeds and its fence broken through by straying cattle ; however, the young plants were there for the Delegation to see. Bruce took the Delegation forthwith to Bisa, where two areas were examined. On the way back to Sadiya another 12 miles above Sadiya, was visited. Next, a site for a nursery for the seedlings from China was selected, the position being Saikhoa (*alias* Chykwa) within a few miles of Sadiya. Bruce then took the Delegation to the Muttack country on the east side of where Dibrugarh now is ; and for more than a month they wandered very uncomfortably from one area where the Tea bush was to another. Lastly they went down stream and visited an area in the neighbourhood of Jorhat. McClelland,

whose report on the soil seems to have been excellent, thus got the facts on which to form his judgment. Griffith thought that Bruce's knowledge was superficial and in this doubtless was right ; Bruce grew knowledgeable later. As soon as the Jorhat area had been seen, Wallich, extremely anxious to get away from what he thought would end his life, went down stream, taking Bruce with him, the others of the Delegation thinking that Wallich had left them behind with the intention of excluding them from a hearing. They made a short expedition into the Naga Hills ; and then Griffith passed under the direct orders of Jenkins.

When Bruce had cause in 1839 to report to the Tea Committee on subsequent work, he gave a map showng in how many further areas he had found the Tea bush.

By Jenkins' arrangements Griffith was to join the exploring party for the Burmese boundary in the next cold whether ; meanwhile he was established at Sadiya, and stayed there except for an attempt made with Jenkins' approval to penetrate the Mishmi Hills along the beginning of the route which Wilcox had used when in 1827 he succeeded in establishing the volume of the Irawadi at Manchi and therefrom the not altogether remote position of its origin. Griffith, however, was very soon turned back by want of porterage, but not without considerable collections. Immobilized in Sadiya by the rains, he threw his energy into detailed examinations of the plants about him, carrying his investigations as far as his microscope could take him in accordance with a habit that he had formed either at, or more probably before, coming to India and now, with the lure of his 'Flora Indica' ahead, intensified. At Mergui, his regimental duties had been light enough to have allowed him to commence collecting these descriptions ; at Sadiya he had nothing to prevent him from getting on with them until in February 1837 came the time for joining the party for the Burmese frontier. It was led by Major A. White. Griffith, before he started, examined the nursery of Tea seedlings at Saikhoa and found the last of them perishing. Major White's party ran into great difficulties ; for that reason it could not keep together but trailed out ; and the forward part got to the top of the Patkoi Range with the hinder part unable to catch up. Griffith was in front when a messenger arrived to say that the party from Burma was not far away. This party was led by Dr. George Thomas Bayfield and had been two months on the way. It was to be another two months in getting back. There was a meeting between it and the front of Major White's party on 5th March 1837; but the transport had got into such a state that both parties had to go back, and Griffith's extremely forward position made it expedient that he should join the Burmese party rather than go back as Major White did ; he and Bayfield therefore went to Ava. It was a wonderful journey : the track was not unknown, but was through lawless country and uncivilized

stock, by habit resentful of strangers though perhaps opportunely rather cowed by the tramp of armed men through the hills during the fighting of the Burmese war. Passage had to be bought, Griffith says expensively. A remark by McClelland in an obituary notice that 'Griffith travelled with only one servant' has been misinterpreted into 'travelled with only one companion'. It was not so; but he travelled in a very small party and must have foregone largely the making of collections. Yet he collected even in the Hukawng Valley, which he crossed, then reached the limits of Chinese seeking amber and jade, and so Mogaung, from which place transport by water was available. Griffith got the Tea bush once; and Captain S. F. Hannay, a member of the Assam party, when he had been in Burma earlier had seen it once, so that the journey seemed to confirm Jenkins' idea of continuity between Shah tea growing and Singpho encouragement, the Singphos finding it worth while to fell rival shrubs to increase their limited supplies—the occurrence natural, the local abundance consequently artificial.

From Mogaung to Ava, Griffith and Bayfield used water transport and reached the end of their adventure in May.

Griffith's diary, reproduced as pp. 60-108 of the appropriate volume of his *Posthumous Papers,* gives in detail what he saw on his journey and pp. 115-145 give a report which he made to the Government.

Griffith remained for two and a half months in the neighbourhood of Ava; then he descended the Irawadi to Rangoon, taking along with him considerable collections. He contrived to reach Calcutta by sea in May 1838. After the manner in which Wallich had left him at Jorhat, breaking up the Delegation, he had not expected to be required to make a report on Tea, but he was asked to do so. Complaining that the facts were no longer fresh in his memory and that the collections of the Delegation, which had been for two years at Calcutta in Wallich's possession for study, had not yet been got into such order that he could profit by them, he obeyed the demand and reported to Wallich who sent the report to the Agri-Horticultural Society for publication (*Trans.* 5, pp. 94-180). In it, Griffith, on data much too meagre, sought to argue that the genera associated with the Tea bush in Assam, by occurring also in the tea tracts of China, showed the bush endemic in both places. He was disappointed that Wallich had not cleared the ground for him.

Griffith's connection with Tea ceased with the report. On the other hand, C. A. Bruce had become wholly absorbed; his activities may be judged by a pamphlet printed in 1838, entitled *An account of the manufacture of Black Tea as now practised in Sadiya* and by a report which sent in 1839 to the Tea Committee, which distributed it, and the Asiatic Society of Bengal printed it (*Journal,* 8, pp. 497-526), as also the Madras Society of Literature and Science (*Journal,* 10,

p. 169). The number of patches or plantations under his charge becoming too numerous, they were divided into two groups, half under him, and half under John White Masters who had been Head Gardener in the Calcutta Garden under Wallich. Next, the Assam Company having been established, the Government made over the larger part of the patches to its care, glad to be freed from what was under them a costly undertaking. The Company retained Bruce and Masters until 1843 and then tried new controls. Masters went back into the service of the Government and became sub-assistant under Jenkins in the Nowgong District in which position he made an expedition into the Naga Hills and on it collected plants which were sent to Calcutta. Later he was Extra Assistant Commissioner of Golaghat and, when he retired in 1862, was awarded a special pension for 'his very high character as a public officer'.

Jenkins caused large collections of dried plants to be made about Gauhati. Under him at that place as the Government Apothecary was Charles J. Simons who collected both in the valley and in the Khasia and the Mikir Hills. The earlier of these collections were sent to the Calcutta Garden, the last to Sir Joseph Hooker. Jenkins obviously helped Thomas J. Booth to make his horticultural expeditions from Bishnath into the hills of the Dephlas at the south-eastern corner of Bhutan. Booth had been sent to India by his uncle Thomas Nuttall, the genius (1780-1859) who made his reputation as a botanist in North America (1807-1836) and then in Hawaii, returning to Britain in 1852.

VI. GRIFFITH'S FURTHER SERVICE

Griffith was not allowed to stay long in Calcutta after his return from Burma, but was detailed to accompany the Mission of Captain Robert Charles Boileau Pemberton to Bhutan. Again he left Hugli by water on the last day of the month of August, 1838; this was exactly three years from his earlier departure. He chose to cross the Khasia Hills again, as he had done with Wallich, but varied the route. From Gauhati, he went with the Mission which penetrated the mountains northwards to a depth of about 80 miles, then turned west and crossing high passes, one of 12,500 ft., regained the plains by the Buxa Duars as the rains of 1839 were commencing. Jenkins would have liked to keep Griffith in Assam; but the Governor-General, Lord Auckland, had other work for him and attached him to the army of the Indus which was preparing to march on Kandahar. Lord Auckland expressed the wish that the military authorities would give Griffith every liberty consistent with safety.

So Griffith, leaving Calcutta, went over the northern plains to Ludhiana from which he wrote that he would rather be in Lower Bengal than in a sandy place where the flora was so sparse. He followed the Sutlej to the Indus and the Indus to Shikarpur ; then went with the army through the Bolan Pass to Quetta, botanized all the way Kandahar and from Kandahar to Kabul. When he left Afghanistan, it was by Peshawar. If a map be consulted it will be seen that he went round the central massif, not through it ; but he reached considerable heights in the north-western parts of the country. When the army was being withdrawn, he asked leave to remain with surveyors who were finishing their work ; and this was granted. He stayed until it was unsafe to stay any longer ; and the last part of his exploring was in the latitude of Kabul, which he examined very thoroughly. Unfortunately he had a long illness during this extension of his time, suggesting that his excellent constitution was not completely proof against the strains that he put on it. He made many friends among the officers who were prepared to collect for him; otherwise he engaged local men to collect and bring plants to him. It is noteworthy how many of the officers who collected were men of note for their ability. These he records as giving him dried plants. Firstly the surgeon David Ritchie (1809-66) ; he had been a pupil of Robert Graham in Edinburgh ; his service during this war took him to Herat, whence he brought a collection to Griffith. Griffith whose travels towards Herat ended at Kandahar, was particularly grateful for this, which, he remarked, proved to him that the flora of even the hottest parts of Afghanistan is European in character. Ritchie, though he published nothing, remained a collector through the rest of his Indian career, collecting in Bombay, Sind, the Punjab, and Central India, and the herbarium which he built up was given after his death to the Royal Botanic Garden, Edinburgh. Another co-adjutor was a surgeon on the Bombay staff named Grant who brought plants from Saighan to Griffith. Griffith acknowledges also the services of Captain E. Sanders who continued to collect for him until his death, shortly before Griffith's, and of Lieutenants Thomas Hutton, an excellent zoologist, and Henry Mortimer Durand, afterwards knighted for his eminent services. Sanders had collected for Griffith between Kandahar and Herat ; and these specimens would have linked up with Ritchie's, but were lost in fording a river. Hutton and Durand collected chiefly about Quetta.

Griffith was not a man to miss an opportunity, and on his way back to Calcutta he doubled his easier marches to provide time for diverging northwards to Simla and Mussoorie, and southwards to Jabalpur. But the season was mid-winter and not good for collecting the flowering plants, though both divergings afforded him a glimpse of country that on no other occasion he could have seen. He had suggested travelling within the mountains the whole way from Kabul

to Simla, but that was disallowed. Evidently by visiting Jabalpur, he enlisted the help of Donald Macleod who was at the time Principal Assistant to the Commissioner at Jabalpur ; and Macleod made a collection for him. William Munro, mentioned earlier as having commenced collecting in Coorg, was about this time at Agra whence he sent specimens to Griffith. Griffith, unable to visit Nagpur himself, sent a collector to that place. Further he had material thence from Markham Kittoe. Kittoe earlier had been sent from Orissa to enquire into a report that coal was available inland ; he collected then and at various places at various times between the Circars and Nagpur.

Another illustration of Griffith's intention to get collections from places that he could not visit is his sending of collectors from Calcutta to Darjeeling in 1843. He kept a personal collector for years in the Khasia Hills. All this was done to make his 'Flora Indica' as extensive and complete as possible. He relied on Wight for the Peninsula.

When Griffith had arrived in Calcutta from Afghanistan, he occupied himself in sorting and arranging his collections, eliminating to some extent duplicates from which Sir William Hooker and Lemann profited ; but Lemann passed what he received to Bentham. Meanwhile he was appointed surgeon at Malacca, an appointment which pleased him as promising leisure, and a delightful flora. The forest began only four miles from the town and from his dwelling he would see the alluring outline of Mount Ophir. Within a very short time of his arrival at his station, Sir William Norris came from Penang to botanize with him on that mountain. In 1842 Wallich's health gave way and Griffith was summoned to Calcutta to take charge of the Garden. Wallich's departure was urgent ; and as time was needed for Griffith's journey Voigt was invited from Serampore to bridge the gap. Griffith arrived at the beginning of December 1842. It was a bad day for the Garden when this happened, for he proved to be quite unsuited ; he destroyed its amenities as a pleasure garden because it did not satisfy him as a taxonomic chart ; he declared that the association of the two are incongruous. The consequences of what he did are given in the next section. His acting appointment lasted for exactly two years, save that he was only on his way to Calcutta during the first three months. Wallich returned from his leave in August 1844. Griffith, released by his return, remained in Calcutta, busy with his own affairs, mainly the arranging of his collections, preparing them for despatch to Britain where in the leave which could not be put off much longer, he would work on them towards his 'Flora Indica'. More duplicate material was eliminated to the benefit of Wight and Gardner in Ceylon. He arranged serially his Assam species under numbers 1 to 1,460, his Bhutan species 1 to 1,191, and his Afghan species 1 to 1,275. It would seem that the names

of the actual collectors disappeared in the arranging. What happened to subsidiary localities is not evident. Then in December 1844 he returned to Malacca and had scarcely taken full charge of his duties when he was taken ill; and died (*9th February 1845*) from it would be, those fell consequences of malaria that killed Jacquemont.

VII. WALLICH'S SECOND PERIOD OF SERVICE AND THE DESTRUCTION OF THE FIRST CALCUTTA BOTANIC GARDEN

It is necessary to return to the year 1832, that is, the year when Wallich resumed his post at the Calcutta Botanical Garden. This he did with diminished success, which may be attributed to a loss of health. My preoccupation, consequently, at the commencement of this section is Wallich's health. He had been declared ill at different times; he had been driven out of India in 1812 and in 1822, when he took a voyage to Singapore. His health was given as a reason for his taking leave in 1828. In 1830, Sir William Hooker wrote of him as 'greatly enfeebled by twenty years of incessant bodily and mental fatigue' (*Bot. Misc.* 1, p. 42). Griffith in 1836, when with him on the Assam Delegation, recorded that he could not sleep and was in a nervous state, fearing that he would not return from Assam alive, and that his marches were so short as to be of only five miles. At the end of the Delegation, he almost fled from the country. Minutes of the committees on which he served tend to record absences. In 1842, he was driven by ill-health out of India and went to the Cape. When he returned in 1844, it was for no more than two years of work. Wight in 1845 wrote 'Wallich's botanical day is over'. In 1847, he left India for the last time. During the few remaining years of his life he distributed with Bentham's help a residuum of the great collections that he had handled so well during his leave of 1828-32. He died in 1854. The above justify the conclusion that Wallich, after returning from leave, was not the man that he had been.

I have had occasion to refer to his quarrel with Griffith. Rather unwillingly I have to refer to another, because of its bearing on happenings to the Garden. In the month of August, 1838, Wallich demanded the dismissal of his head gardener, J. W. Masters, accusing him of gross misconduct in abetting attacks on the management of the Garden. Masters protested; but the Government replied that discretion in the matter was with Wallich. And Wallich got his way.

John White Masters (c. 1792-1873) had gone to Calcutta to help in the carrying on of a school; at a date after Wallich's return in

1832, he was engaged by Wallich as Head Gardener in the Botanical Garden. After his dismissal he went to Assam and was given charge of Tea plantations as has been recorded (p. 63). When recording it, I called attention to the high character that he had. It is not possible to judge between Wallich and Masters ; but it is necessary to note that Wallich was under criticism.

A writer called him 'Wallich who goes somewhere every year' implying neglect of his charge by absence ; and the statement at one time was not untrue : in 1826, he had travelled through the submontane forests of Oudh ; in 1827, in the teak forests of Burma ; in 1828 he took leave and was away till 1832 ; in 1835, he was in Assam. But he had not been away between the Assam Delegation and the year of the dismissal of Masters. In the issue of McClelland's *Calcutta Journal of Natural History* of July, 1840 (1, p. 302), Wallich was editorially accused of neglecting the Garden ; it is not said in what way. In the issue of July 1841 (2, p. 228), a more precise accusation is made. Wallich had reported to Government at the end of 1840 on what he called 'the exertions and progress which have been made during the last five years', detailing at great length the number of living plants sent out. The list is long enough to justify a remark that Royle printed at this time (*Essay on the Productive Resources of India,* 1840), to the effect that the influence of the Calcutta Garden had altered the horticulture of Bengal ; but what the reviewer in McClelland's journal wrote was : 'Dr. Wallich seems unfortunately to be impressed with the idea that the introduction of plants into the Botanic Garden and the neighbourhood of Calcutta is the great object of the institution' The reviewer developes only one complaint : it is that the Garden had ceased to have any field parties out collecting seeds and plants ; but he means to say 'whatever the activity in horticultural, there is inadequate botany'. As already recorded, Wallich's health broke down so completely in August 1842 that he left India hastily and Griffith arrived towards the end of the year to act for him. Griffith immediately wrote a report on the Garden ; and we, trying to read history, bringing the two fault-finding statements in McClelland's journal alongside this report and remembering the intimacy between McClelland and Griffith, become convinced that the McClelland-Griffith combination issued the unsigned accusations. We may therefore examine Griffith's report and form an opinion on the accusation that Wallich had 'neglected' the Garden, which, I think, must be that ill-health had taken the energy out of Wallich, who was passing into a condition of marking time. Griffith arrived in Calcutta to act with his mind made up ; he knew what he wanted. Printed copies of the letter that he wrote asking approval for what he would bear the date 1st May 1843. But printed in his *Posthumous Papers* is a letter from him to Wight, dated 23rd January 1843, which must have been written before the other. How-

ever, the month is of small importance. In the letter to Wight, Griffith tells him that he had the sanction of Government for his alterations; turning to the other letter we find the proposals. The Garden, he states, was 'literally choked with trees', some of them mutilated and some fallen. The students of the Medical College came weekly for a lesson in recognizing the sources of their drugs and for them the medicinal plants were labelled in Bengali; but otherwise there was no labelling. It had been a custom to dry specimens cut from plants when they flowered in the Garden and preserve them in a reference collection kept in a seed-shed where they could be looked up if the name of any plant were questioned. The plant names were otherwise retained in the memories of the older and more experienced staff (or misremembered). But Griffith found that the safeguard had been allowed to get into disorder. It had existed from early days, broken up by Wallich when he went on leave, renewed on his return, and then disordered. Griffith, rightly convinced of its importance, had the Garden collected over and not only made up a Garden set, but caused four others to be made which he was prepared to deposit elsewhere. Of the specimens which Wallich had had dried after 1832, Thomas Thomson said the labels showed that Wallich had had trouble in deciding what the names should be, so confused had the Garden records become. Griffith stated that the library was also in disorder yet again, Roxburgh had laid out a Linnaean garden *i.e.*, a border of selected plants spaced to exhibit the Linnaean System of Classification; and it, too, had been in disorder before Voigt took over. It is very easy for such borders, where annuals are likely to be common, to get out of order by the scattering of their seeds with a consequent volunteering in wrong positions. Griffith says so much of disorder that his indictment was serious; and he could scarcely say so much without foundation. He asked for fundamental changes as well as corrections of what had gone wrong. He would gather into one place nurseries that were scattered about the grounds; he would replant so as to get related species in apposition and have a garden of the Natural System to contrast with the Linnaean System, as well as formal flower beds; he would fill the many small tanks with earth taken from one single large tank; the surface left over would be allotted to trees planted like with like; above all, he would build up a working herbarium—a public herbarium, he called it—in the top storey of the Superintendent's house, placing it there because the situation was airy. Roxburgh had asked for that top storey that he might very largely live in it, and it was only accessible through the lower private quarters of the house; Wallich had stored his dried collection in the basement, which one must say was thoroughly unsuitable but completely accessible. As to the reference collection in the seed-shed, Griffith asked that the Government would give 'rigorous orders' for its strict maintenance. Towards the

'public herbarium' he put aside a quantity of his own duplicates. He would increase it by sending out collectors, selecting them out of his staff; and he would do all without asking for additional funds. Of these proposals, he wrote to Wight: 'The Government have approved all my suggestions and plans for improvements of the Garden. My plans are for a Natural Garden (*i.e.*, a border exposing the Natural System) flanked by a garden of medicinal plants and a garden illustrating the useful plants of Lower Bengal. The first will occupy a large circle or ellipse with interior circles or ellipses, the central, the smallest, for Acotyledons; the second for Monocotyledons and the two outer for Dicotyledons. Whatever this arrangement be, the same will be that of the flanking gardens. The situation in front of the Conservatory will be convenient for the Natural garden—trees and large shrubs will not be admitted; but they are to occupy other parts and be in groups of Natural Orders and Classes'. Then he adds: 'I apprehend, however, that all my labour will be thrown away for want of time to complete the work before the period of my acting appointment expires'. Then why did he begin it? His apprehension was right; Wallich returned in August 1844, and the work stopped. Griffith must have had to enlarge the open place in front of the Conservatory to accommodate his circles. Now these were in the full sun, trees excluded; and trees are the natural clothing of the land in a climate as that of Calcutta. Griffith had not thought things out; the shade loving ferns had a central position; and we find him later admitting to Wight that he was short of ferns that would tolerate the position. The impracticability of Griffith is evident.

Griffith found his teaching work heavy. He was of course new to it. He realised the need of a local Flora for the students, and suggested that he would write one. Such a work by Griffith would have been in the Natural System; but the Calcutta students were doomed to the Linnaean System for yet a very long while.

Wallich having resumed charge, Griffith moved into the residential part of Calcutta and busied himself until December completing the arrangement of his collections and packing what he would need in London on the leave that he was anticipating. He had undertaken to get Voigt's *Hortus Suburbanus Calcuttensis* printed and had to see that through the press. His friends noted signs of bodily wear, but his mind was as vigorous as before; he warehoused his collections, married and went to Malacca where at once he reorganized his collecting. Then he became ill and rapidly worse. Alarmed at the prospect of the collapse of all his hopes, he willed the materials, that he had assembled, dried plants, plants in spirits and copious, notes, to the Company whose officers had encouraged him to go so far. It is interesting that transfer by will was required, and very interesting that he was individualistic in suggesting no botanist to take his work up. Wight, as soon as he heard of Griffith's death, suggest-

ed that a full set of Griffith's dried plants should be retained in India at Calcutta and even offered to mount the specimens. Like Griffith, he wished to see a public herbarium at the Garden. The government accepted the printing and ordering of Griffith's notes and drawings and the making available of his collections of dried plants without specific plans for maintenance; and they entrusted the work to McClelland, Griffith's most intimate friend after Wight. Wallich becoming ill again, it was convenient to put McClelland in charge of the Garden temporarily, for he needed the Garden's artists and the Garden's facilities for arranging Griffith's material. Griffith, had he lived, was to be Wallich's successor; on his death the choice fell on Falconer who at the time was in Britain on leave, the length of which was extended on purpose to enable him to finish his examination of the vast supplies of fossil bones that he had taken to London. McClelland, completely infatuated towards Griffith, now is charge of the Garden, resumed the remodelling of it on Griffith's plans. Sir Joseph Hooker, arriving in Calcutta in January 1843, saw the resultant desolation and wrote to Falconer to warm of it (*see Life and Letters,* 1, p. 235; 1918). When he came later to write his *Himalayan Journals,* he put his impressions in this form (1, p. 3; 1854): 'Of the Gardens it is exceedingly difficult to speak; the changes had been so great and from a state with which I had no acquaintance. There had been a great want of judgment in the alterations made since Dr. Wallich's time when they were celebrated as the most beautiful gardens in the East, and were the great object of attraction to strangers and townspeople. I found instead an unsightly wilderness without shade (the first requirement of every tropical garden) or other beauties than some isolated grand trees which had survived the indiscriminating destruction of the useful and ornamental which had attended the well-meant but ill-judged attempt to render a garden a botanical class-book'. The Garden had been and still was a playground for Calcutta, perhaps then more so than later. It seems strange that Calcutta did not protest as the destruction developed; but, Hooker commented, Calcutta seemed to think little of its Garden. It may be recalled that the Garden had been known as 'Wallich's pet' in the twenties of the century. Granted that its condition had deteriorated then, had Calcutta lost enough of its pride in it to be indifferent, though the change in the form which it took must have been distressing? One feels exceedingly sympathetic towards Wallich who saw the ruin, and perhaps through his ill-health, felt powerless.

Wallich published very little during the second half of his service. Griffith, blaming him for not having brought back to Calcutta a set of his plants, said that he had prevented himself from the continuation of his work by depriving himself of the means of recognizing his own species. It has been suggested that Wallich, when

distributing his plants from London, had entertained the idea of not returning to India, in which case he would not need to allot a set for personal use in India. The suggestion is plausible. When he found after returning that he had spoilt his means of recognizing the species that he had in the Garden, as already explained, he had it collected over and then found himself, as Thomas Thomson noted, in frequent doubt as to the proper names. Still more would he find himself in doubt in regard to wild species. Why were the growing plants without labels? Gardeners in Europe at the time used painted wood or stamped strips of lead for labelling what they grew. It had been possible with a larger effort to do something in Calcutta; but there is no record of Wallich having tried to label the species. He seems to have considered quantity of species in the Garden his aim rather than quality, and that would mean retention though unhealthy (as in the case of the Tea bush) of that which did not stand up to the saturated soil and excessive humidity, the trees that Griffith said were 'fallen'.

In regard to the absence of a working herbarium, it seems that Wallich did not wish for one. He told Sir William Hooker how difficult it was to take care of dried plants; he collected sparingly when in the Khasia Hills with Griffith, and he retained no field collecting parties. But he could not avoid collections of dried plants being sent to him, just as they were sent to the India House to be taken care of. Collectors assumed that he ought to do so. On his way back to Calcutta in 1832, Rottler, seeing him in Madras, gave him what would seem to have been the first bundles of a new accumulation. Vicary followed in 1833, in sending plants from Saugor. The Assam Delegation resulted in stimulating Jenkins to collecting. Schmid sent a small bundle. These and other gifts resulted in a collection of collections, which is a different thing from a working herbarium. The quantities increased from Griffith's time forward; and Thomas Thomson inherited charge of a not inconsiderable store when, in 1854, he succeeded Falconer as Superintendent of the Garden: he then made an inventory which he sent to the Asiatic Society of Bengal for publication (*Journ.* 25, p. 405, reprinted in *Hook. J. Bot.* 9, p. 33) and from it we learn what additions had come in to that date. Along with the bundles already indicated, the collection had held one of the three sets which McClelland had constructed from Griffith's material. Kittoe's gatherings had gone into it; there was a small bundle of plants from the District of Jessore presented by a missionary, J. Barry, a larger collection from Birbhum made by McClelland, Khasia Hill plants collected by the geologist Thomas Oldham, a smaller bundle from the same hills from the surgeon Joseph Fayrer (afterwards knighted), and plants both from the hills and the Assam valley from the pharmacist C. J. Simons; H.F.C. Cleghorn had sent plants from the northern districts of the Madras Presidency; and Gibson's herbarium from

Bombay had been given ; also Sind plants from Stocks, Jabalpur plants from R. H. Beddome, and Simla plants from Edgeworth. Vicary gave plants additional to his first gift. Thomas Thomson possessed a large herbarium of his own. It must be obvious from this that the botanists in India in general thought that there should be a working herbarium at Calcutta ; but such a herbarium had never as yet been organized.

McClelland's last act, before surrendering his charge of the Garden in 1847, was to issue a Guide-book with a map, which is very difficult to interpret because there is no permanent feature in it except the great Banyan tree ; even the river banks are not there. The map shows, of since lost features, Griffith's circles and the places allotted to 'orders and classes' in the arboretum, but does not give an idea how far these positions had become occupied. A list in it of species in cultivation is not for the garden as a whole and is in general unhelpful as a historical record.

When Sir Joseph Hooker was leaving India in 1850, he saw the Garden again with Falconer now in charge, 'very busy..., replanting the greater part of the grounds'. It was necessary to fill up tanks that by injudicious cuttings were destroying the most valuable parts of the land, to drain many acres and to raise embankments to prevent the encroaching of the river (*Himalayan Journals*, 2, p. 244; 1854). The Garden had had an internal economy by which its own need in timber, cordage, bamboos, etc. was met ; this economy had been destroyed.

VIII. GRIFFITH AS A BOTANIST

Sir George King in an address to the British Association in 1899 said of Griffith (p. 6) : 'No botanist (of India) ever made such extensive explorations nor himself collected so many species (estimated at 9,000) as Griffith did during the brief thirteen years of his Indian career ; none ever made so many descriptions of plants from living specimens. His botanical predecessors and contemporaries were men of ability and devotion : Griffith was a man of genius'. This will not be disputed. Professor W. H. Lang (in J. W. Oliver's *Makers of British Botany*, p. 179 ; 1913), estimating his calibre, calls attention to his prodigality of labour and to his penetration in search of facts. Griffith worshipped Robert Brown and Francis Bauer, Brown for his refusal to stop in taxonomy short of the ultimate power of his microscope, and Bauer for the faithfulness of his delineation. One may say that what he wanted was the absolute truth, and this from his 'teens'. Thoroughness came to him as a student ; he would let no character escape examination in the plant before him and he would examine every available plant to the limits of available time. Just

before his death, he was seeking what he could do with a more powerful microscope than he had had. I have referred to the opportunities that he used at Sadiya for sitting at a table with pen and pencil, preparing the descriptions to which Sir George King referred, each description supported by drawings. These were material which McClelland had for publication ; they were not, as they stood, ready for his 'Flora Indica', but for reference in writing the Flora when the opportunity should arrive. He condemned in strong terms the basing of a System of Classification, as Linnaeus had done, on a selected character. When Lindley brought into Botany the use of the word 'nixus' or 'inclination towards', its idea caught him ; but Lindley's unremitting attempts at betterment did not. He would not venture a conclusion halfway as Lindley did. Otherwise, he was devoted to the Natural System with the conviction that Lindley would have taught him. His explorations with his microscope took him into fields of reproduction where he would not reach a solution ; but he did his best (for this see Professor Lang's account of him). He was a wider student of plants than any contemporary in India ; none but he attempted the determination of mosses. Ferns he collected with great assiduity, content to leave the naming to Sir William Hooker, who seems to have received more Indian material from him than from any one else. Animals he collected for others and sent them to the India House.

The preparation of descriptions, as at Sadiya, was a continuation of work that he was already doing at Mergui at the beginning of his Indian career. Arduous travel cut into his opportunities ; Malacca he hoped would enrich them. He went there in 1841 ; a couple of years earlier, he had thoughts of long leave coming to him in 1842 ; at returning to Malacca, in 1844, he was sure that it could not be far ahead ; and then he died in 1845, considerable preparations having been made towards the return to London, where only he could consult books and collections, which would ensure nomenclatural accuracy in his Flora. Incidentally, it must be mentioned that Sir William Hooker had moved his large collections to Kew when he was appointed Director of the Royal Botanic Gardens in 1841, and London offered unparalleled resources for what Griffith proposed. That he would have completed it is to me more than doubtful ; he had no ability to measure time and the area of his target had become too large ; it had become the flora of the whole face of Asia towards the Indian Ocean. Hooker's *Flora of British India* with its 14,500 species may be used as a measuring rod. It took the labour of Hooker for a quarter of a century, through which he commanded a great deal of assistance ; and the design was compressed ; but Griffith would have started. He does not seem to have estimated how many species he would be called on to describe, though he made some rough guesses at the sizes of his collections from various parts of India,

1,900 from Tenasserim, 1,700 from Assam, supplemented by a further 1,000 from his own personal collector, 800 from the Mishmi Hills, 1,000 from Bhutan, and over 1,200 from Afghanistan. The intensity of his examinations led him to observing the limits of variation and he declared that Variability had to be used as a character in defining species; some had it more than others. Such a conviction implied extension of his descriptions. He had a way of requiring the course of development and would have been an organographer rather than a morphologist had the distinction come in his time. He was so critical of past work that he wrote to Wight that he held, say, a third of the genera recognized as genera on sufferance, convenient for use but needing testing. He lived to work at generic level and sought to make them stable. Surely a great object!

IX. THE INTERIOR OF NORTHERN INDIA

When the Afghan War was over, the officers who had dried plants for Griffith became scattered in cantonments towards the centre of India and mostly not remote. Ritchie returned to Bombay and then he was sent to Sind where he renewed his collecting; he made a considerable personal herbarium which, increased by many moves, remained in his possession until his death in Scotland in 1866. Hotton was sent to Neemuch in Rajasthan and Duran to Meerut, but probably these two did no more botanical collecting. Meerut, with a little diversified flora, had been the collecting place of several beginners. Finlayson had been there; Royle testifies to his collecting, but whither his plants went is not evident; Royle apparently began his Indian collecting at Meerut. The following also collected there: Falconer, Vicary, Thomas Thomson and Edgeworth. The last named was stationed in Bundelkhand towards the end of his service and explored the district of Banda with considerable thoroughness. Griffith, Macleod and Beddome have already been mentioned as collectors of Jabalpur.

X. EDGEWORTH, THE FIRST ECOLOGIST

Michael Pakenham Edgeworth (1812-51) was sent to Edinburgh as a student of languages when, as it happened, the present Botanic Garden was being laid out; and he found pleasure in watching the progress. There was no formal teaching, but a gathering of knowledge from William McNab who had the business in hand. Then he

went out to India in the administrative service and was sent to the north-western plains. From Ambala, when stationed there, he made short journeys into the Himalaya and collected. At Ambala the daily tasks of administration focused his attention on the relations of crops to soils, and then, extending his interest to the relations of the spontaneous plants to the same soils, he wrote a paper (*J. asiat. Soc. Bengal* 7, p. 751 ; 1838) which may be regarded as the first ecological paper published in India. Edgeworth's other publications were taxonomic or dealing with geographic dispersal.

Among his friends were two who supplied him with specimens from deep in the Himalaya. One was Captain William Hay, Superintendent of the Hill States, with his office in Simla. He became Lord William Hay while still at Simla. He travelled deep into the mountains towards the upper Indus, drying specimens which he gave to Edgeworth. The other friend was Lance who visited Spiti and Lahul and Dras to the north of the snowy barrier across Kashmir ; and again the plants collected were given to Edgeworth. Edgeworth submitted these to Bentham through whose herbarium they passed to Kew. He was stationed for a time at Multan and investigated its flora thoroughly.

The ecological work next done in India after Edgeworth's was that of Hugh Cleghorn, whose first paper after he came to India was on hedges, the plants used for them and the plants that use them as situations (*Ann. Mag. nat. Hist.*, 1, p. 435 ; 1850). Later Cleghorn published an account of the sand-binding plants of the Madras shore.

XI. THREE BOTANICAL EXPLORERS OF KASHMIR WHO WERE ALLOWED ENTRY DURING THE LIFE OF RANJIT SINGH

At the end of my first chapter (p. 40), I gave an outline of Jacquemont's visit to India, one summer of which he devoted to collecting in Kashmir. His success in gaining entry led to permission being given to two others, Godfrey Vigne and Baron Karl von Huegel. The latter has already been mentioned as having botanized in the Nilgiri Hills and in Ceylon. Godfrey Thomas Vigne (1801-63) had left Britain in 1832 without plans for a visit to the north-western Himalaya: this he explains in his book, *Travells in Kashmir* (1842); but the desire came after his arrival in Bombay at the end of a journey through Persia. He spent the summer months of 1834 in Simla, where he made contact with the three Gerards and with Sir George Everest, then the Surveyor-General; and perhaps the plan of his rough surveying came out of this. With Ranjit Singh's permission he entered Kashmir in 1835. Describing his baggage, he names a plant-press as part of his outfit; but there is evidence of its use in only two parts of his wanderings. In the same

year Baron von Huegel obtained a like permission; and it happened that the two met in Srinagar and, having met, travelled together about the Valley and left together for Lahore. Vigne seems not to have collected plants in that summer; von Huegel probably did; if so, his specimens went to the Hofburg Museum in Vienna. He wrote a large book in four volumes *Kashmir und das Reich der Seik* (1844) in which there is no botany. Vigne returned to the mountains in 1836 and remained in them until 1838, during which time he collected in two places; one was on the edge of the Deosai plains near Dras and the other was in the Astor valley. When Vigne reached London he took his bundle of plants to Royle in which he was a bit late for Royle's convenience, as Royle had published almost the whole of his *Illustrations of the Botany of the Himalayan Mountains;* but Royle supplied Vigne with a short account of the flora of Kashmir, which Vigne printed as a supplement to his own book. Royle had found determinations of the species difficult in consequence of imperfect drying and rough handling; but he preserved the specimens which are in his herbarium at Liverpool. Determination today would be easier than it was to Royle in consequence of the flora having now become relatively well-known.

In 1836, Sir Alexander Burnes started on a Trade Mission for Kabul taking with him Hugh Falconer, the successor to Royle at Saharanpur. Circumstances altered the purpose of the Mission which, as far as Falconer was concerned, became one of economic exploration; and Falconer, detached at the Afghan border, tried to find a way up the Indus, but after three marches was held up at Derband, deflected and passed into Kashmir, wintered there and in 1837 travelled *via* Tragbol and the Kishenganga valley to the upper Indus where he found Vigne, across the Indus near Skardo, and to Askoli, collecting all the way. Vigne's collection from Astor and Falconer's on his journey from Tragbol to Skardo were the first plants from the Himalaya towards its right-angle bend of the Indus. Royle, as said, could not do much with Vigne's plants, and it has to be added that Falconer's found their way into the back water of India House. But Falconer had his attention all the time on what he saw and wrote to Royle in London a long letter telling him of the plants that he had collected. The Linnean Society printed it in their *Proceedings* (1839, p. 7). Falconer followed Royle and differed from most of the earlier botanists in India in recording the localities whence his plants came; these were written in Persian or Devanagari script against his specimens; clearly he required his collectors to do this. Again following Royle, he paid special attention to anything economic. The Botanic Garden at Saharanpur, indeed, kept very closely to its first intentions and under William Jameson, who succeeded Falconer in 1842, was little but economic. Falconer's earlier papers, with one exception, were on economic plants and in pairs. The information to give which was purely

economic he put into a paper for the Agri-Horticultural Society in Calcutta, and the information of more narrowly scientific value he sent elsewhither. In this way, he wrote on 'Kut' or 'costus' (*Saussurea lappa* C. B. Cl.=*Aucklandia costus* Falc.), on asafoetida and on the paper plant, *Monotheca buxifolia* Decne, which he called *Edgeworthia buxifolia.* At heart Falconer was a geologist; it is recorded of him that as soon after landing at Calcutta as was possible he was in the Asiatic Society's Museum on a geological quest. His arrival in Saharanpur coincided with the discovery in the Siwalik rocks, through the digging for the Jumna canals, of plentiful bones of extinct animals and he made for himself a great reputation by studying them. A diligent collector of plants, he was more so a collector of these bones, so that when proceeding on leave in 1841, while he had 76 packages of plants, he had 5 tons of the bones; and when he had arrived, the plants were put into India House to be taken care of, and there they lay until after his death in 1865.

Griffith's death led to Falconer being appointed to the post of Superintendent of the Calcutta Botanic Garden. Wight had foreseen this, and wrote that he regretted how much more Falconer was a zoologist than a botanist. Falconer, after taking over, was soon required to go to Tenasserim to report on the forests and there he made considerable collections of plants.

XII. PENETRATION OF THE HIMALAYA BETWEEN THE RIVERS SUTLEJ AND KALI

The reader will recollect that the first botanically minded visitor to this part of the Himalaya was General Thomas Hardwicke who went on a diplomatic Mission to the ruler of Garhwal, whose capital bears the same name, Srinagar, as the capital of Kashmir. Hardwicke entered the Himalaya at Kaldwara and followed a trail which crosses the mountains to the Alakananda valley some thirty miles back in a straight line. The Alakananda river is here at an elevation of about 1,700 ft. and flows westwards to enter the Ganges within the hills. The next penetration was a little further westwards; in it William Spencer Webb reached Jumnotri where the river Jumna takes its origin. His companion Felix Vincent Raper wrote a report on the travel (*As. Res.* 11, p. 449; 1810) which names various plants as observed to occur. This was immediately followed by Moorcroft's dash through the Himalaya and out on the Tibetan side at the Manasarowar Lake where the Sutlej has its origin. The plants which he brought back were sent to Robert Brown in London, Hardwicke's and Moorcroft's introductory contributions to a knowledge of the mountain flora were made before the Nepalese War of 1814-15. The peace made at the end of it enabled Webb to continue his survey and, as already recorded

(chapter 1, p. 30), Wallich promptly placed his collectors Kamrup and Blinkworth under Webb's protection. Thus he reaped a harvest of hill plants. Botanizing in the Himalaya after this moved again westwards following the establishing of the cantonment of Sabathu and the associated sanatorium of Simla. The first permanent house at Simla was built in 1822. In 1817, that is to say, before Simla came into being, the surgeon George Govan, not yet with the Garden at Saharanpur under his charge, travelled for a short distance into the mountains from Sabathu in the company of the surveyor Alexander Gerard. In the next year Alexander Gerard, starting again from Sabathu and joined by his brother Patrick Gerard, penetrated *via* Spiti as far as Shipke. Again a year later, *i.e.,* in 1818, the then Surveyor-General James Dowling Herbert, taking Patrick Gerard with him, went by Kotgarh which is 40 miles east of Simla to Shipke.

An explanation is due for the termination of penetration at Shipke; Shipke is the place where Tibetan authority is met in this part of the Himalaya, a political terminus, but not the boundary of the Himalayan flora. Commonly, in human geography, highlanders flow over the rim of a plateau and this the Tibetans have done conspicuously in three places, the Chumbi valley between Sikkim and Bhutan, the Kyerong valley to the north of Khatmandu, and a wide-angled area on the east of Lahul in which is Shipke. It followed that at Shipke a number of early explorations were unwillingly terminated.

In 1821, Alexander Gerard with his surgeon brother James Gilbert Gerard visited the Shattul and Borendo passes. The next penetration, which was also in 1821, was a further move westwards; Moorcroft travelled *via* Kangra and Kulu into Lahul and forward to Leh in the Upper Indus valley where he remained longer than the Government thought reasonable, wintering there and emerging over the Zoji pass into the Vale of Kashmir. As before, he collected a little. On this occasion, the collection was sent to Wallich.

There were three Gerards. Alexander (1792-1839) had commenced surveying in the Punjab plains in 1812. In 1817, his work was transferred to the hills. James Gilbert (1794-1835) was in the medical service. Patrick (1795-1838) was an army officer, whose service was continuously in the hills. Of the three he made the closest relations with Wallich, and it was against a specimen which had reached Wallich from Patrick that the name *Pinus gerardiana* was written, in consequence of which Lambert stated that the pine was dedicated to him. The three brothers held closely together, and Vigne records spending an evening with the trio. Alexander wrote *An account of a journey through the Himalaya* (*Edinb. phil. J.* 10, p. 295; 1824), *i.e.,* of the journey to Shipke in which Patrick joined him. James wrote *An account of the Spiti valley and the circumjacent country* (*Asiat. Res.* 18, p. 238; 1833). The three between them kept meterological records at Sabathu or Kotgarh in 1817 and continued to do so for a long time.

Spiti proved to be the botanists' way into the remoter Himalaya from the front westwards of the Ganges.

Judged by the circumstance that Govan, when he returned to Scotland in 1823, took with him a collection of plants, it seems likely that in the trip of 1817 he collected, but that is not established. He did not record the trip; but he recorded another made through Nahan, the capital of the State of Sirmur (*Edinb. J. Sci.* 2, p. 277 ; 1828). At Nahan, he had a nursery as a branch of the Saharanpur Garden and therefore he must have had cause to visit it; but the elevation is only about 1,000 ft. above Saharanpur, and the climate can differ in little. Govan communicated plants that he collected to Wallich and they were distributed in the great distribution of 1828-32. His interests seem to have been mainly geological but he could discuss mountain plants with the Countess of Dalhousie when they met in Scotland; and he had in his possession specimens which he could give to her. Royle, succeeding Govan at Saharanpur, found his medical work too heavy in his first years to allow him to leave the station, so he trained collectors to procure hill plants for him, but when he asked them to go as far as Kunawar they ran away. However, a good friend in the regiment stationed there, Lieutenant E. Maxwell, had a collection made for him. Wallich's tour of inspection of the Oudh forests in 1826, brought him as far as Hardwar and Dehra Dun, but not actually into the mountains. Mussoorie (so named from *Coriaria nepalensis,* the *masuri* of the hill men) took its origin from Dehra Dun, by an officer stationed in Dehra Dun building for himself a house. It was there before Wallich's journey. It was called the Potato patch from that valuable plant having been raised first in its garden. Royle soon had in Mussoorie a larger garden for acclimatizing, one of 40 acres, and therefore cause for visiting the station. He recorded no visits, nor any travel at all, save a journey to the summit of the Chur mountain through Sirmur in the direction of Simla. He closed Govan's Nahan nursery; the garden at Mussoorie was obviously much more serviceable. By 1828, he had plant-collectors more reliable than the first that he could send as far as the Vale of Kashmir in the company of home-going shawl pedlars. He used the pedlars also for procuring plants from Kashmir, surely on a large scale, for Jacquemont looked round the Saharanpur garden in 1830 on what he calls hundreds of plants from the Vale of Kashmir, which represented species that he had already seen in the hills, and guessed from their origin the elevation of the Vale before he had actually been there. In 1828, when Wallich was proceeding on leave, the artists of the Calcutta Garden were sent to work under Royle. If Royle had asked for them, it was because he had already planned to write his *Illustrations of the Botany of the Himalaya mountains:* if he had not asked for them, then the use of them suggested the writing. The latter is the more probable because from the time of the arrival of the artists he redoubled his efforts to get material together. He

ransacked the bazaars for trade products perhaps more assiduously than he had been doing, and he certainly intensified his field collecting. He sent collectors to Kashmir in 1829 and 1831 and in the latter year caused Kunawar to be explored again.

It is of interest that two of the friends who supplied dried plants to him, George William Trail and A. D. Lindsay, shared his economic occupations; the first was the author of an account of the rural economy of Kumaon and the second of a similar paper on the uplands of Pithragarh, west of the Kali valley. Another friend who collected for Royle was James Stephen, an army officer who visited the Bamsaru pass, whereby one may get from the Ganges to the Jumna watershed. Another friend of the Army was a Major Cohen.

It has been recorded already (chapter 1, p. 39) that Jacquemont passed through Saharanpur when he first entered the Himalaya and left his collections to date in Royle's care ; he called again to recover them. Another visitor to Saharanpur of the same year was a traveller who remains mysterious. Royle calls him Mr. R. Inglis of Canton and an address-list of members of the Asiatic Society of Bengal records his name with China as his country. He had travelled to Shipke; returning to the plains he called on Royle and showed him plants that he had collected. He did not give his collection to the Royle, but sent it to Robert Brown. Robert Brown later, when Royle had settled himself in London and was working on his *Illustrations,* passed the bundle over to Royle for such use as he could make of it. Inglis's plants are in Royle's herbarium at Liverpool. It is intriguing to find a man from Canton, whom one cannot identify, going to the Tibetan border in the Himalaya.

Royle invited subscriptions to his *Illustrations* in quarterly parts and worked nearly to time in the years 1833-36; but fell out of time after that and did not get the last part out until 1840. Meanwhile, he had become Professor of *Materia Medica* at King's College. When the book had been finished he divided his specimens into three sets; the best he kept for himself and it is now at Liverpool; of the other two, he gave one to the Linnaean Society and he sent the other to Berlin.

Why did Royle from Saharanpur pay attention in particular to the Vale of Kashmir and to Kunawar? Because they were centres of population and his botanical collecting started with an economic bias.

The sanatoria, such as was Simla, brought botanists into the mountains who were less interested in the plant as useful than as something classifiable and satisfying to whatever urge to collect was in them. The first of the Simla botanists was the Countess of Dalhousie who made a collection of about 600 species between April and October, 1829. Royle's friend, G. W. Trail, seems to have visited Simla at that time. Jacquemont paid three short visits in 1830 and Inglis one. The three Gerards were in and out of Sabathu. Then Lord William

Hay had his office in Simla. G. T. Vigne spent the cold weather of 1833-34 there, but he probably did not collect at all. Baron von Huegel was there in 1835 and Vicary was at Sabathu. So far 10. The Countess's plants found a resting place in Edinburgh; Royle's along with what Royle obtained from Trail, Vigne and Inglis, are now at Liverpool; the Gerards' were sent to Wallich and so went into great distribution; Hay's were given to Edgeworth who shared them with Bentham; von Huegel gave his plants to the Museum in Vienna, and Vicary's were sent to the Calcutta Garden, a scattering indeed ! Continuing, Griffith paid his short visit to Simla in 1841 and his friend Captain Sanders, now a Major, was there. In 1844, General and Mrs. Walker made a collection in Simla which they sent to Sir William Hooker. In 1845 the Artillery officer, Edward Madden, was there and while he was there the first Sikh War suddenly broke out. On the eve of this Prince Waldemar of Prussia who has been mentioned (p. 51) as touring in Ceylon with his botanist-physician, Werner Hoffmeister, arrived in Simla. He had visited Khatmandu and then penetrated the north-western Himalaya as far as Shipke, Hoffmeister ventured on to the battlefield of Ferozshah, where a musket ball from the Sikh lines killed him. His collections were sent to Berlin and there entrusted to Johan Friedrich Klotzsch for a report. Klotzsch decided that Hoffmeister had collected 456 species, to 108 of which he gave new names (*Bot. Ergebn. d. Reisen des Prinzen Waldemar von Preussen,* 1862). Scarcely ever has a worse piece of taxonomic work been presented to the botanic public: on the test, when it came in the working up of the *Flora of British India,* barely a dozen of Klotzsch's so-called new species were found good. The work is abundantly and well illustrated and that is its only merit. Hoffmeister had not labelled the individual gatherings and consequently even a geographic value is denied. Berlin and Kiel seem to have shared the specimens. In 1847, R. S. Simpson collected in Simla, and in June and July of that year Thomas Thomson was there awaiting his companions of the Kashmir Boundary Commission and had all the leisure that he could desire for collecting the flowering plants of these two months. These plants, which he collected with his usual thoroughness, went into the collections of Hooker and Thomson and so were distributed from Kew in 1855. Lastly, making 18 individual visitors in all, James William Grant needs mention to bring the Simla list of the year 1850. There was plenty of material for a Simla Flora by then, but no way of bringing it together.

Kunawar, because it is so accessible from Simla, received visits from Jacquemont, Inglis, Hay, Madden, Hoffmeister and Thomas Thomson; and earlier Royle, as recorded, had had it doubly collected over.

The hills west of Simla received less attention. Edgeworth collected in Mandi and Kangra. William Hawtayne Parish visited Mandi and Kulu in 1847, collecting in particular ferns, and added what he

got to the collections of Hooker and Thomson. William Jameson (1815-92) of the Bengal Medical service, early in his Indian service, collected where Parish had been. He succeeded Falconer at Saharanpur in 1842, and held the post until 1875 with considerable effect in promoting the cultivation of economic plants, but with little further work in investigating the wild hill plants.

Beautiful collections were made on the western side of Kashmir by James Edward Winterbottom (1803-54). After taking a medical degree in Oxford, he spent his life in travel. In 1846, he went to Java and then returned westwards to India; proceeding to the north-west, he entered Kashmir through Hazara and travelled through the mountains to Astor, to Sakardo in the Indus valley and Gilgit beyond. This was followed by a short visit to Khatmandu; and then he joined Richard Strachey to make his great journey to the sources of the Sutlej. Winterbottom returned to Britain, but set off wandering again and died away from home in 1854. His joint work with Strachey has its place in the next section; his herbarium remained in the possession of his family until 1900, when it was given to Kew.

A few words need to be said regarding work centred on Mussoorie. Naturally as Royle had founded a garden as a branch of his in Saharanpur, collecting in that direction remained an interest of Saharanpur. Falconer when he had succeeded Royle, sent collectors through the whole countryside up to the Niti Pass; and Jameson knowing that Hooker and Thomson contemplated a '*Flora Indica*' added material. Edgeworth had a period of service there.

XIII. THREE ATTEMPTS TO EXAMINE THE HIMALAYAN FLORA IN DEPTH

Early in the Survey of the north-western Himalaya the Ganges was a boundary between two fields of work; W. S. Webb, who had been the first in the survey of the mountains, was told to continue where he had commenced, and J. D. Herbert to survey west of the Ganges. That is how the latter came to journey to Spiti in 1819. Botanical work followed the pattern of the Trigonometrical Survey, and there were two botanical journeys right through the north-western Himalaya, one on each side of the Ganges. A third was far away in Sikkim, with the whole length of the forbidden land of the Kingdom of Nepal separating it. It was a need of fixing the northward limits of Kashmir that evoked the Commission of Major Alexander Cunningham, Dr. Thomas Thomson, and Captain Henry Strachey on Herbert's side of the Ganges.

Thomas Thomson (1817-78) had been a pupil of Sir William Hooker in Glasgow and a fellow-student of his son Joseph Dalton Hooker. He entered the medical service in Bengal and was sent to

to the northern plains (1839) where he botanized diligently through Rohilkand, whence he made short trips into the Himalaya. In 1847, orders came to him at Ludhiana, where he then was, to proceed to Simla to join the two named with him above for the purpose of examining the most northern mountains at the back of Kashmir. He had to wait until August before the three could start; then they took the road through Kunawar to Spiti, where Henry Strachey left the others that he might proceed to the upper part of the Indus, where he was to survey; Cunningham and Thomson directed their way towards Leh, where they parted. Thomson's work was to explore the routes from a little above Leh down to the right-angled bend below Rondu, and also the valleys of Nubra and Shyok. He was caught by winter and compelled to stay at Skardo until the Zoji Pass was passable. He crossed it to the Vale of Kashmir, only to ask for a second season in the parts where he had been. He returned through Zanskar and going beyond the Indus visited Karakoram. Thomson must have gathered practically all the flowering plants that occur in the parts that he visited, just as Griffith had gathered practically all to be had about Kabul.

Henry Strachey (1816-1912) was the elder brother of Sir Richard Strachey. He did not possess the zeal for collecting of his brother but enough to make him collect, though sparingly. He did a work of most arduous surveying. He had visited the sources of the Sutlej in the year before he was put on the Commission (*J. asiat Soc. Bengal*, 17/2), and in 1847 he went to the sources of the Indus.

Richard Strachey (1817-1908; afterwards Sir Richard) had entered the Bombay Engineers and transferred to the Bengal Engineers. He was sent to the Jumna Canals until, in 1846, the survey of Kumaon was entrusted to him.

In enumerating the Simla botanists I have named Edward Madden. He (1805-56: ultimately a Lieut.-Colonel) had developed a great interest in mountain Passes, perhaps initiated by considerations of mountain warfare; and, immediately after the Sikh War, we find him visiting the Shattul and Burum Passes (1845), and later the Pendras pass (1846), and then the Pindari glacier. He collected plants on these expeditions and described his experiences in the *Journal of the Asiatic Society of Bengal* (15, p. 79: 16, p. 226). Illness caused him to go to Almora, here he met Sir Richard Strachey who was commencing his survey. A common interest resulted in a joint paper. Madden retired and in retirement he became President of the Edinburgh Botanical Society; and he gave his official presidential address to the Society on the distribution, chiefly altitudinal, of trees in the Himalaya. After retirement, he had been sending dried plants to Kew. Strachey in the course of his survey was at the Pindari glacier a year after Madden and again in the next year. In 1848, Winterbottom, having left Kashmir and having made a short visit to Khatmandu, joined Strachey to pro-

ceed from Almora to Milam and over very high passes to the Manasarovar Lake, the source of the Sutlej, at 15,000 ft. As stated Winterbottom made beautiful collections in Kashmir and now, with Strachey, did the same in Kumaon and within the limits of Tibet. Not only were the dried plants well selected, the labelling was excellent. Strachey returned to Britain and spent 1850 determining his species and then distributing sets of them with a printed list. This list was reprinted in Atkinson's *Gazetteer of the North-west provinces of India* (II, 1882) and, after a revision of the names by Duthie and others, republished in 1905. It is said of it in the introduction rightly that it gives a cross-section of the Himalayan flora from the plains of Rohilkhand to the Loess plateau of Tibet.

The third cross-section, that of Sir Joseph Hooker in Sikkim, was all but contemporaneous with the two in the north-western Himalaya. Joseph Dalton Hooker (1817-1911; knighted in 1877) was the second son of Sir William Hooker. Having decided on the outlines of his travel, he arrived in India in January, 1948, at which date Thomas Thomson was in the remoter parts of Kashmir, and Strachey, arranging for but not yet engaged in his great journey to the Manasarovar Lake. He made his way through Chota Nagpur and by Patna and Purnea to the Sikkim Himalaya and established quarters at Darjeeling. Then he commenced an intense effort to acquaint himself thoroughly with the plants obtainable there through the activity of a crowd of up to 18 collectors. In a letter to his sister (*Life and Letters,* 1, p. 260), he described his morning's work, the arrival of the collectors with the spoil of the previous day in baskets on their backs, himself preparing labels, setting aside that to be drawn and that to be dried. When he felt that he had started this well, he made a short trip to the mountain of Tonglu. When the autumn had come, he made the first of his journey through the mountains. With sanction he entered Nepal and travelled up the Tambur valley, that is to say on the further side of Tonglu and Kinchinjunga, to the passes into Tibet. This occupied him from the middle of October to the middle of January, when he regained Darjeeling over the Islumpo Pass and through Pemionchi. Then followed an early spring collecting of the plants of the outer hill faces to secure what had been missed in the previous year. At the commencement of May he started up the Tista valley and spent the summer close to the political boundary of Tibet. The two thrusts, one up the Tambur and the other up the Tista, were not so remote form each other as were Thomson's and Strachey's, and phytogeographically may be counted as one. Hooker went to the frontier in two successive years and so did Thomson.

Hooker would have liked to spend the next summer in Nepal, but that could not be arranged. Instead, Thomson joined him and they moved the collecting to the Khasia Hills where they worked with great intensity from early June to late November. While they were

there, Thomas Lobb passed by with his train of collectors of living plants. I do not know what motley of transport he was using, but it tickled the imagination of Hooker to call it Lobb's circus. From the Khasia Hills, Hooker and Thomson moved to Chittagong, then to the Sundribans and so to Calcutta. Both returned to Britain in 1851. Their collections were pooled, worked up into sets, and distribution began in 1855, distributed just as Wallich's were to secure international agreement in nomenclature; Thomson worked up his diary into his book entitled *Western Himalaya and Tibet* (1852), and Hooker wrote his *Himalayan Journals* (1855) ; the two conjointly issued the first volume of their projected *Flora Indica* (1855). Then lack of financial support compelled abandonment. As the first 280 pages hold a valuable review of the state of knowledge of the flora of India, making it much more important than the rest, it is a pity that we cannot alter the premature title.

Sir Joseph Hooker had been able through his father to arrange from India for the publication of his *Rhododendrons of the Sikkim Himalaya;* and the parts followed one another from 1849 to 1851. It is appropriate here to mention John Ferguson Cathcart. He (1802-51) was of the administrative service in Bengal, where he collected a herbarium; and it was his pleasure to employ an artist to make plant-portraits of the most striking flowers, much of the work being done in Darjeeling. After his death the plant-portraits were given by his sister to Sir Joseph Hooker, who used them for the *Illustrations of Himalayan plants selected from drawings made for the late J. F. Cathcart.*

The combined collections of Hooker and Thomson were computed at 150,000 specimens, representing roughly 3,500 species from Sikkim, 3,000 from Khasia Hills, about 1,000 from the plains of north-eastern India, the same number from the plains of north-western India and lastly 2,000 from the north-western Himalaya.

As soon as it was known that the two would write a Flora, help flowed in. The collecting of Jameson has been mentioned ; James William Grant sent plants from Kunawar; Jenkins and his associates in Assam increased their collecting; Falconer, now in Calcutta, sent so many men to Khasia to collect that Hooker suggested the path-sides were becoming stripped of vegetation; the Government of France responded with a set of Jacquemont's plants, and Andrew Fleming, a geologist then mapping the Salt Range, sent a considerable collection.

While Hooker and Thomson were busy tidying their work by distributing their duplicates, Wight happened to retire, bringing to London his last collections. Wight made these up into sets which were distributed from Kew in continuation of the Hooker and Thomson sets. Hooker contrived to get out of India House Falconer's 76 boxes of dried plants deposited in 1844 and these, somewhat deteriorated by their 20 years of waiting, were distributed also.

Lush, who had taught in one of the London medical Schools before he went to India, was perhaps the first experimental worker on cotton, antedating Wight's work; but Wight's lasted longer. Lush had experiments not only in the Dapuri Garden but in Khandesh and in Dharwar. He published on cotton in 1835 or shortly before Wight had charge of experiments.

Alexander Gibson succeded Lush at the Dapuri Garden in 1838. He had arrived in Bombay three years before John Graham. John Sutherland Law had arrived two years before and Lush one year before. John Graham was in Bombay 11 years before the publication of his *Catalogue of Bombay plants;* Lush 12; Law 13; and Gibson 14. Before any of these were in a position to study the Bombay flora, William Henry Sykes (1790-1872, ultimately a Lieut.-Colonel), an excellent man of business and a zoologist of considerable competence, collected plants in the Deccan, chiefly about Poona. He held the post of Statistical Reporter, Bombay, from 1824 to 1829, but continued to collect to 1831. Wallich indicated on the map that ends his *Plantae Asiaticae Rariores* his travelling. The collections amounted to about 1,000 species. He did not study them; but John Graham had the use of them and Gibson also. They were given to the Linnean Society and the Society asked Royle about 1840 to make determinations. In 1863 when the Society withdrew from curating small collections, Sykes's was sold and found a home in the herbarium of van Heuckx in Antwerp.

Joseph Nimmo seems to have been born in India, his father the captain of a ship trading in and out of Surat or Bombay, but this is a surmise. As a young man he was in Government service at Surat (1819), but lost his appointment ; and it is not known what his employment was later. His means were apparently restricted and, in correspondence with Sir William Hooker, he more than once apologised for not being able to do more collecting. Wight, with whom he corresponded, thought highly of him; he corresponded with Royle also, seeking determinations. Wight indeed calls him 'the acknowledged head of the corps botanique of Bombay—a gentleman whose diligence in collecting is only equalled by his liberality in distributing the proceeds'. I think that Nimmo must have had a greater influence than appears on the surface and perhaps saw Graham through the accumulation of data for his Catalogue as he finally finished it and saw it through the press. John Sutherland Law (1810-1855) was born in India (as were Royle and Hugh F. C. Cleghorn) and resided in India from 1829 to 1854, firstly at Thana, and later at Dharwar or Belgaum. He made a considerable herbarium by which Gibson much benefited and was generous in giving plants to Sir William Hooker and to the Oxford Garden. Alexander Gibson (1800-67) did considerable service for Botany in the Bombay Presidency. The Government employed him as

a vaccinator in the Deccan and in Khandesh; and that wandering employment brought to him a most intimate understanding of village life and the plants of the open country. He seems to have been at the beginning rather a lone figure, as Wight was, and it was Law who helped him out of that. When Graham's *Catalogue* appeared Gibson checked his collections by it. A year before it came out he had written his *General sketch of the Province of Guzarat* (*Trans, Bombay med.-phys. Soc.* 1, p. 1; 1838), and in the same year he was put in charge of the Dapuri Garden at Poona. Two years later he published a report on Teak (*Trans. Bombay agri. hort. Soc.* 1840, *p.* 120) and a year later reports on Senna and Tobacco. Six years after this (1847) he was appointed Conservator of Forests and held the post until retirement in 1860. He was the first of such officers that India had; the attempt, very much earlier, to arrest the over-exploitation of the Teak supplies having been a police measure which proved ineffective. Gibson as a forest officer was after a time to have Dalzell associated with him. Nicol Alexander Dalzell (1817-78) arrived in Bombay in 1841, at which date Gibson was not yet a forester, but a promoter of any kind of crop likely to be useful, *i.e.,* he was in charge of the Dapuri Garden. Dalzell had an Edinburgh degree but not in Medicine, and he took an appointment in the Custom House, botanizing in his leisure. Next he took a subordinate position in the Forest Service and worked his way up. He intercalated descriptions in a copy of Graham's Catalogue; they were sketchy, but Gibson approved of them and financed the printing. In this way, Dalzell's and Gibson's *Bombay Flora* originated (1861). It is Graham's Catalogue expanded. Bombay had a second vaccinator-botanist ; this was John Ellerton Stocks (1822-54), a pupil of Lindley, with a medical degree. He reached Bombay in 1847 and was sent to vaccinate in Sind. A year after commencing work there, he found it possible to reach Shah Bilawal in Baluchistan (see *Lond. Journ. Bot.* 7, p. 550; 1848) and a year later to go as far as Quetta and Nushki (*Hook. J. Bot. and Kew Gard. Misc.* 2, p. 303; 1850). Griffith had been to Quetta a year before Stocks, but there was this difference between them, Griffith came by the Bolan pass, but Stocks from the southward. In 1852, Gibson being on leave, Stocks acted as Conservator of Forests, having charge privately of Gibson's herbarium which he enriched. In 1853, he brought his personal collections to Kew to work on them, but died in 1854.

Dalzell succeeded Gibson as Conservator of Forests in 1860. Gibson's plants were given to the Calcutta Garden. The line of Botanists in charge of the Bombay forests was continued by the appointment of Eyre Champion de Crespigny (1821-96). He had reached India in 1845. The posts of Conservator of Forests and Superintendent of the Dapuri Garden were combined in his case. He made a herbarium which is now at Manchester. So also is a Bombay herbarium of ferns made by another medical man, Andrew H. Leith.

On p. 64, I referred to David Ritchie (1809-66), a surgeon of the Bombay service, as providing Griffith with dried plants from Herat. He during 35 years, 1831 to 1866, collected considerably. In 1838 he was in Afghanistan; later at different dates he was in Sind, the southern Mahratta country, the western Punjab, and Central India; and his collections were in his possession at his death. Then they were given to the Royal Botanic Garden, Edinburgh.

During the period under review, Herbert John Giraud reached India (1842) and became a teacher in the Grant Medical College; and Bernard Kaspar Kamphoven, a Danish botanist, visited Bombay (1845) and made a collection which is at Copenhagen, with duplicates at Kiel.

XV. WIGHT'S IMMEDIATE SUCCESSORS IN MADRAS

Wight was in India to and beyond the last years of this chapter; among those who joined him the most conspicuous was Hugh Francis Clarke Cleghorn (1820-95). He had been born in India, and had received a medical degree in the University of Edinburgh and with it returned to India in 1842. It has been recorded that Wallich was nominated Professor of Botany in the Calcutta Medical College in 1837; Giraud, as recorded in the last section, began teaching in the Grant Medical College and had the title of Professor of Botany in 1845: Cleghorn was made Professor of Botany and Materia Medica in Madras in 1851, where judging by his versatile writing, he was assuredly an inspiring teacher. So, too, Giraud seems to have been. Cleghorn in his first years collected plants in the northern parts of the Madras Presidency which were sent to the Calcutta Garden. In 1856, he left his teaching for the post of Conservator of Forests and was finally Inspector-General (1867). His herbarium is at Edinburgh.

A less purposeful collector of Madras of these years was Gideon Thomson, a younger brother of Thomas Thomson. He made large collections through collectors which passed into his brother's possession and then were distributed through Kew. A resident in Tinnevelly, L. D. Thomas, sent a small bundle of plants to Sir William Hooker in 1844.

XVI. MOSSES STUDIED BUT LOWER CRYPTOGRAMS AWAIT FURTHER DEVELOPMENT OF THE MICROSCOPE

Francis Buchanan collected a few mosses when in Nepal in 1802. Edward Gardner, who was Resident at the Court in Khatmandu in 1820, collected more, and after him Wallich Royle collected some in

north-western India; and Wallich had 113 numbers for distribution when in London. Sir William Hooker had commenced describing Indian mosses in 1820 in his *Musci Exotici,* and with Robert Kaye Greville continued this in the *Edinburgh Journal of Science,* 1-3 (1824-25).

At the other end of India Schmid collected mosses in the Nilgiri Hills and gave them to Zenker at Jena, who, when he died in 1848, had done nothing with them. Karl Mueller of Halle, obtaining possession of these, described them in 1853, twenty years after their collecting. Schmid, on receiving a list of the determinations, just before his death passed it over to the Madras Society for Literature and Science: and it appeared in their journal (19, p. 84; 1858). Perrottet collected in the same part of India and his specimens were worked up by Montagne (*Ann. Sci. Nat.* ser. 2, 17, p. 243; 1842). Wight collected on occasions. Griffith collected mosses vigorously in the Khasia Hills when on the Assam Delegation and worked them up when at Sadiya. He alone in India touched their taxonomy; otherwise the naming of Indian mosses required that they be sent to specialists in Europe. William Mitten made a complete review of these plants as known to him from India in 1859 (*J. Linn. Soc.* Suppl. 1.). He names the following as collectors: Belanger, Booth, Buchanan, Foulkes Edward Gardner, George Gardner, Gough, Griffith, J. D. Hooker, Law, Mack, Maxwell (a Ceylon collector), McIvor, Parish, Perrottet, Royle, Schmid, Richard Strachey, Gidlon and Thomas Thomson, Walker, Wallich, Wight and Winterbottom. It is evident that the date for study of the mosses had come; and it may be commended that students of them had contrived to get them into fair order without much magnification.

So too the date for the study of the Hepatics had come. The collectors of mosses were prepared to collect Hepatics also. Falconer went further and published in 1861 a new genus. Through the years 1844 to 1847, Gottsche's Lindenberg's and Nees von Esenbeck's *Synopsis* was in course of publication. It occupied a place parallel to Mitten's review of the mosses. By the number of Indian species known to these authors, Wallich comes first, and Perrottet second.

Of Algae and Fungi there is little that need be said. Rottler had collected some of the larger seaweeds; Strachey and Winterbottom had collected lichens to which Churchill Babington gave names. Royle did not let Chara pas unnoticed. Bisby has occupied himself in a search into references to fungi (see Butler and Bisby in *Sci. Monogr. Conn. agric. Res, India,* 1, 1931.)

XVII. FELLOWSHIP AS AN AID TO INDIVIDUAL EFFORT

To this point the investigations of botanists in India have been referred to as the occupations of individuals; and their corporate efforts kept in the background. Wight called a friendly working together of the Tranquebar missionaries a botanical Society, but surely there was no scientific society as such bodies are understood. The missionaries were united as missionaries, and the words 'United Brothers', which Wight indicates as the names of the society, was no more than a name for the Moravians to which these missonaries belonged. As United Brothers, they agreed to using this as the name of the Mission to transmit dried plants to Banks. Instead of the United Brothers, the first Society formed in India was the honoured Asiatic Society (of Bengal) which Sir William Jones called into being in 1784 or two years before the founding of the Calcutta Botanic Garden. Its business was to be learned; and Science was within the ambit of its learning. The Society's journal, *Asiatick Researches*, the first volume of which appeared in 1788, contained one botanical paper. The Society asked that communications to it be polished, expected them to be of some length, and hedged their printing with rules that made it very deliberate, so deliberate that the founder's aspiration for an annual volume devolved into a volume at an interval of, on the average, $2\frac{3}{4}$ years. That was not a marching with impatient Calcutta, and, when the Society was about 30 years old, provoked demands for a change, a dropping of some of the dignity for the sake of a quicker return. In what group of members protest was strongest, I do not know; but one botanist, William Jack, isolated in Sumatra, recorded his wish for a journal that would accept and print quickly notes that needed record such as if not recorded tended to delay larger things, and in his words encumbered his work. Though the Society in the third decade of the 19th century debated its course, it at that time somehow could not contrive reform, or rather its attempt at reform led nowhere. Carey's Agri-Horticultural Society had in 1829 started the printing of *Transactions* and took papers with an economic appeal, somewhat relieving the pressure for reform. Further relief came in an interesting way. James Dowland Herbert, who has been mentioned as surveying in the north-western Himalaya, being in Calcutta as the Deputy Surveyor-General, started in 1829 at his own risk a little venture called *Gleanings in Science*. It came out monthly and had a popular appeal. In 1830, he left Calcutta putting the *Gleanings* into the hands of a relatively new man, James Prinsep; and Prinsep in 1830 was elected a Secretary (there were two) of the Asiatic Society. To him it occurred as of advantage to make the *Gleanings*, which punctually recorded the proceedings of the Society, into an organ of the Society. The council consented. The punctual *Gleanings* now became the *Journal of the Asiatic Society* (he added of *Bengal*) and made a

way for prompt printing. The gain was never lost and the *Asiatick Researches* slowly died.

In Madras in 1834, the Society for Literature and Science commenced a journal parallel to the *Journal of the Asiatic Society of Bengal* as an outlet, and an Agri-Horticultural Society was formed in 1836 likewise providing an outlet. Bombay had done similarly slightly earlier. Wight used the *Madras Journal of Literature and Science* during the years when he was in Madras; and Gibson made use of the Bombay Agri-Horticultural Society's *Transactions* for the publication of his paper on Teak.

The Surgeons had societies of their own in all three Presidency cities, and if, as they sometimes did, they printed a botanical paper they were not out to help the botanists. The few occurrences that there were need not be named. Bombay had a Geographical Society which printed a paper on the rural economy of the District of Ellichpur, but not another with the slightest botanical interest.

In 1840 McClelland seems to have thought that the biological sciences might sustain a quarterly and began his *Calcutta Journal of Natural History*. This was premature, and publication ceased in 1847. McClelland after three years secured as co-editors Griffith (1844), Wight (1846), and George Gardner (1846), who were obviously glad to have the outlet; but their competence did not save it. All other publications printing papers on Natural history had the security of an association of members behind them.

XVIII. RETROSPECTIVE

Two men dominate this chapter, Wight and Griffith. The mantle of Roxburgh, left behind when he was transferred to Calcutta, may be said to have been picked up by Wight who extended the influence of Roxburgh's *Coromandel Plants* over the whole Peninsula. Griffith was the follower of no one who had preceded him in India; he came as a fresh impulse out of the school which was in a position to influence Botany in India. He showed no interest in economic botany which was a gate that helped a number of others to official recognition. To him the plants of India needed recognition, and that demanded all the energies which he used up with such prodigality. It was greatly to the credit of the rulers of India that they recognised and used his genius and that after his death they did what was immediately in their power to save as much as possible of this work.

Griffith's intensity of examination led him to turning over in his mind the implications of variability where he was probably halted by Swainson's dictum 'varieties do not perpetuate the peculiarities that they possess'. Swainson's writings had impressed Griffith.

Within the period, actually in 1835, the Company had decided on an educational policy in which taxonomic botany was recognized as needed in the medical schools; it was also recognized contemporaneously as fitting a man for the control of experimental horticulture and preliminary forest conservation. Bombay's interest in supplies of Teak brought the last recognition to the front in Bombay.

The taxonomic outlay had got so far that ecology could appear, and with Sir Joseph Hooker's work phytogeography also. Furthermore, as I have suggested, the taxonomy was spreading from the large and obvious to the less easily studied mosses and hepatics, but the period left the still smaller plant-life virtually unstudied. Publication for the botanists seeking print became a little easier.

CHAPTER III

AT THE MIDDLE OF THE 19TH CENTURY

I. THE EAST INDIA COMPANY AND BOTANY

My reader will readily consent that India made such economic progress at the middle of the 19th century that Botany could not escape its influence. A great unification was effected by a vast network of roads; the electric telegraph came (1851). From 1850 forwards railways were under construction. Parochialism receded. The interests of the majority were widened. As to the botanist, with whom we are concerned, he among them with a little leave to take could use it for enlarging his experience, and was not long in doing so. I will begin the chapter by recalling the name of the botanists who worked in India at the middle of the century.

The East India Company never engaged in Britain any officer expressly for what he knew of Botany; when they wanted a botanist they sought him among their officers already in India. It was otherwise in the manner of appointments for service in Ceylon, as Ceylon had no deep well to dip into, and in consequence only such men as the *ad interim* holders of the post of superintending the Peradeniya

Garden on the death of Moon and the death of Gardner were found locally. Frazer, acting in Ceylon when Gardner died, seems to have collected a little. The Company's procedure, unlike that of Ceylon, left room for the chosen to have had time to grow a little rusty. And in 1854, as if in anticipation of the coming administrative changes and in step with the passing out of British politics of a conviction that *laissez faire* led to progress, the Court of Directors accepted the planning of education as a duty. But the acceptance of the duty did not press on the Directors, for their authority was swept away too soon. Nothing came; but there was an increase in the number who botanized which must be attributed to diffusion of interest in botany in Britain in the stratum of the population whence came those who served in India.

Our science had been, as it were, an unexplored country into which a route is first made and names are given to landmarks; successive explorers perpetuate them. The route is marked on the maps along with the places on it suitable for rest and refreshment. Branch routes take off at these; their rate of establishment, like elongation of the main road itself, depending on the terrain penetrated. Into the kingdom of scientific Botany the main route is that of taxonomy; the landmarks are genera and species; the places of rest and refreshment are Botanic Gardens, Museums, Learned Societies, and the like; the branch roads are the several divisions into which the science has fallen, and the development of some may have been hindered for tools such as the microscope to be improved, adjuncts such as laboratories to be built, and data to be accumulated.

The resemblances are so close to reality that the facts recorded in the next three sections are arranged on the analogy.

II. THE BOTANISTS WHOSE ACTIVITIES CONNECT THE SECOND CHAPTER WITH THIS CHAPTER

Wight left India in 1855. For the last few years he had been occupied in winding up his affairs. The Coimbatore Experimental Farm had to be left so shaped that his successor could use it. He seems to have ceased to collect and dry plants ; at any rate he left no collections form the Anaimalai Hills (*teste C. E. C.* Fischer in *Rec. bot. Sur. India.* 9 : 5) from which Coimbatore is only 26 miles distant. Apparently his collections were already in packing cases when the call came to close down ; they had filled 10 bullock carts at the last move and would be larger than in 1850. Of his serial publications he closed these two : *Illustrations of Indian Botany* in 1850 and *Spicilegium Neelgherrense* in 1851. He did not close down his *Icones Plantarum Indiae Orientalis;*

and a part was added after he had reached London, where also a report on cotton was finished and published.

Wight, who had learned the art of lithography in the house of Sir William Hooker when on leave in Britain, was now back in Britain and in contact with Sir William Hooker who had been removed to Kew, and whose resources for naming plants he could use ; and Kew was ready to distribute his duplicate botanical specimens. Wight had dominated botanical work in India so greatly that his departure was a major event by which the period changed. In some measure, the leadership on his going passed to H. F. C. Cleghorn. Wight finished his life farming near Reading.

Hugh Francis Clarke Cleghorn (1820-1895) was a grandson of Hugh Francis Cleghorn who, as recorded in the second chapter (p. 49), engaged Rottler to accompany him as interpreter on an inspection tour in Ceylon. He had been born in Madras and had taken a doctorate in medicine in Edinburgh. Having returned to India he was sent to Shimoga in Mysore as Civil Surgeon (1842). The teak forests of the district interested him ; and in 1847 he called attention to the waste of timber caused by the way in which the land was exploited. In 1850, being on leave, he laid his case before the British Association which was meeting in Edinburgh and the Association appointed a Committee of which he was secretary, to report back in 1851. In 1852, having returned to India, he found himself no longer a district surgeon, but a professor of Botany and Materia Medica in the College at Madras. There from a position, which entitled him to a hearing, he addressed the Government (1856) and in 1857 he was taken from his teaching to occupy a new post, the post of Conservator of Forests. The reader notes the implication of caring for more than teak in the title of his post ; there was in view wood-fuel, of all sorts ; but teak-timber was most in view. From 1857 to his retirement in 1870 Cleghorn was occupied in Forest Service, and even afterwards as an adviser of the India Office. More about Cleghorn will be found later.

The reader doubtless appreciates the fact that Cleghorn came to his forest service as a botanist. He had previously collected dried plants which were given to the Calcutta Garden and he had written ecological papers. Contemporaries there were who were connected with conserving teak, but they were not botanists; they were practical men; and the association of these with botanists was merely provisional. One of these practical men was H. A. Conolly, Collector of the district of Malabar, where the teak forests had received the most damaging exploitation. He had asked to be allowed to buy up and replant ruined teak forest, and had great success in restocking; particularly in the Nilambur forest which is ideal for teak. Nilambur is half-way between Calicut and Ootacamund. Of course restocking, with cropping about 100 years ahead, does not allow Conolly's financial questions a place here; but Conolly showed himself a pioneer.

While he was doing what he had undertaken, Captain Frederic Cotton, an engineer, was making a road along the border of the State of Cochin ; and he called attention to the teak that he saw in the Anaimalai Hills—teak which Wight might have seen by going into the Hills from Coimbatore. Cotton's teak was put (1850) into the charge of another army officer, James Michael, then a lieutenant, ultimately a general. He held his charge until 1856, and did a little collecting of plants; but very little. In 1856 he was succeeded by one who was already a botanist, R. H. Beddome. It is to be noted that the year of Beddome's appointment is the year of the appointment of Cleghorn as Conservator of Forests; and that 1857 seems to have been a year of thinking ahead—a Forest Service was coming in Madras. In its foreshadowing is the third of the marks of our new period.

Michael in due time took leave and did not re-enter the Forest Administration, though he kept his interest in forestry through life. In the Anaimalai Hills he had tried to minimize the injury that fire did to his seedlings of teak by causing the coating of dying leaves that fell on them to be swept aside.

Richard Henry Beddome (1830-1911) had reached Jabalpur in 1848; and had commenced collecting there. The Government of Madras, when in 1856 it took him into the initial Forest Service, employed him in the Palni Hills, where he picked up Wight's mantle in one respect, namely the illustrating of the plants of southern India by the use of lithography. He threw himself with great energy into collecting and made a considerable herbarium. He learned his forestry by experience, but was all through his life predominantly a botanist.

I have classified Cleghorn as an ecologist, calling him the second ecologist that India had, the first having been Edgeworth. Both were Edinburgh students, but it is not clear that their interest had a common origin, though it is apparent that ecology was, so to speak, in the air at Edinburgh. John Hutton Balfour (1808-1884) introduced a little of it into his professorial teaching; and, though he had not become professor until 1845, he had given extra-mural lectures in Edinburgh some ten years earlier. I suggest that this vigorous teacher, whose classes were described as 'thronged' and as 'the largest ever brought together', forced the contemplation of the life of the plant into the teaching of his time; whereas Robert Graham, his predecessor, by making his students carry pocket lenses on their expeditions with him into the country, forced observation of the details of the flower into the teaching.

Wight, Michael, Cleghorn, and Beddome are not the only botanical names of the Madras collections of about the fifties : these also served : Heber Drury (1819-1872), a colonel in the Madras Army was in Travancore; Sir Yalter Elliot (1813-1887), an administrator of wide interests, was at Vizagapatam; Thomas Caverhill Jerdon (1811-1872), who made his reputation as a zoologist but also collected plants, was in the

southern part of the Presidency until 1868; Gideon Thomson (see Chapter, 2, p. 88) was collecting there until 1855; a missionary, E. Johnston, was a rather discriminating collector of the South-western coasts; where also was another, Samuel Mateer (1835-1893), who paid attention in particular to the vernacular plant-names that he encountered. There were two horticulturists in the Presidency who did excellent work in their own line, Andrew T. Jaffray and William Graham McIvor, the first at Madras, the second in the Nilgiri Hills at Ootacamund. The zoologist Jerdon made excursions into Botany and the botanist Beddome made excursions into Zoology.

As Ceylon at this date hung on to Madras by accepting the guidance that Wight gave, it is convenient at this point to look southward to it. General Warren Walker had protested that the Peradeniya Garden was in the charge of 'an ignoramus who could not read the language of Botany'. This was James George Watson (for whom see page 50 of the second chapter), and the General's protest had borne fruit at Watson's death, when Sir William Hooker had been able to get his former pupil, the surgeon George Gardner, accepted. Sir James Emerson Tennent was the Colonial Secretary; and between him and Gardner a friendship arose which led to companionship; one may say that the Botany in Tennent's account of Ceylon had been talked over with Gardner in joint rambles. It was during the years of this friendship that the German surgeon Warner Hoffmeister reached Ceylon (see the second chapter, p. 51). Neither he nor Prince Waldemar of Prussia, with whom he was travelling, saw Gardner who was away from Peradeniya at the time, Hoffmeister wrote that Gardner was the only botanist in Ceylon; but this overlooks amateurs who were there; and the meaning of Hoffmeister's words must have been that Gardner was officially the only botanist. Another officer of the General's name, Colonel James Thomas Walker, collected plants in Ceylon between 1830 and 1840.

William Ferguson (1820-1887), by profession a surveyor, was in Colombo. It is not quite sure when his interest in ferns developed; but he assuredly was already interested in economic plants from his arrival in 1839. He was a man of great ability and activity.

Harmanis De Alwis, the splendid artist of the Peradeniya Garden, has a large claim for attention. He came on to Moon's staff as a clerk and Moon, discovering his talent, paid for his training as a flower-painter. He served from 1823 to 1861 and a son succeeded him.

Gardner on assuming charge, commenced work exactly as General Walker would have wished, *i.e.* by collecting vigorously. He had his artist to draw for him, and it is to be noted that perishable fungi received his attention but to be regretted that from want of direction these drawings, in Petch's opinion, are impressions rather than portraits.

Unfortunately Gardner's death came suddenly in 1849, when the Colonial Office appointed an equally efficient man G. H. K. Thwaites

to succeed him and we find this new man in the last days of that year climbing the road from Colombo to Kandy to assume charge.

George Henry Kendrick Thwaites (1811-1882) was probably the most liberal-mined botanist then in the East. As a young man, earning his living by accountancy, he employed his leisure to very good effect in studying the lowest plants; then he became a teacher himself in the School of Pharmacy at Bristol and in succession to this in the Medical School. From Bristol he applied for a teaching post in Ireland; but he did not get it, though his sponsors were among the most prominent botanists in Britain and France. The reader, noting this, is made sure of the competence to which Thwaites had brought himself. Instead of the post in Ireland he was appointed to succeed Gardner in Ceylon. Thwaites in detail did so; as he climbed the road to Kandy he moved exactly into the work of Gardner, the work that General Walker had wanted; he became a student of the Flowering Plants of the island. The study of the Lower Plants was for those whom he could induce to work on what he would collect. William Mitten worked up his mosses, W. A. Leighton his lichens, and Miles Berkeley his fungi. Berkeley took Christopher Edmund Broome for a fellow worker and between them they carried the knowledge of the fungus flora of Ceylon a vast way beyond that of India. Thwaites could not have done better.

Let it be stressed here that Gardner had set the example of collecting the fungi.

Gardner seems to have brought a large personal herbarium to Ceylon and to have amalgamated it with the collection started by Moon. The amalgamation had to be undone so that Gardner's property could be sold for the benefit of his family. With that done the growth of the herbarium became the work of Thwaites. Neither Berkeley nor Broome visited Ceylon, and the species which they named were those collected by Thwaites. A biographer credits Thwaites with being 'a naturalist, pure and simple, a keen and accurate observer of great industry, quitely enthusiastic and with great reasoning capabilities'. Broome had known him when resident in Bristol. Berkeley and Broome co-operated with equally great and equally quiet enthusiasm; in fact they isolated themselves.

William Ferguson (1820-1887), by training as surveyor, in Ceylon from 1839 until his death, developed, as already said, an interest in economic plants and in ferns; and he took an interest also in the seaweeds.

Thwaites used Wallich's way of getting help from Europe, the way of liberality, of distributing specimens in the hope of obtaining determinations; he made up sets of dried plants which were given where a return was expected, and were on sale also. His greatest help came from Kew, where Sir Joseph Hooker would compare the Ceylon with

India Plants. Thwaites's *Enumeratio Plantarum Zeylaniae* (1858) was made on the materials that went into his sets.

The Colonial Government had been caused to transfer their botanical work from the coast to the hills by the rush into the coffee districts of would-be planters, many of them agriculturally ignorant and all in need of guidance, which they came to expect but did not particularly go to seek. Thwaites seems to have been left in his first years to find his feet. In 1854 came what Sir Emerson Tennent, the Colonial Secretary, described in his *Ceylon* (2 : 211) as 'a murmur of ill-informed utilitarianism against the expenditure bestowed on the Botanic Garden and a proposal that the Garden be abandoned'. Tennent shows that official opinion supported Thwaites; and Ferguson took a leading part in upholding him; but Thwaites as a consequence had more economic work thrown on him, while the preparation of the *Enumeratio* was still in progress for yet another few years.

The following also botanized in Ceylon at this time : a chaplain, John Gibson MacVicar, just before 1850, and apparently the judge, Sir William Norris, in the period before he was transferred to Penang (1836). That these two were actual collectors of Ceylon plants is not certain; both may have developed collecting as a pastime after leaving Ceylon. Edward Frederick Kelaart (1818-1850) was born in Ceylon, but most of his botanical work was done elsewhere; and he was more interested in zoology than botany.

Neitner, a German biologist, made a stay in the island (1854-1855) and took a collection to Berlin.

It is time to turn northwards to the Bombay Presidency. John Graham had died in 1839. Charles Lush and Joseph Nimmo had died in 1854. A fourth botanist of Bombay of those years was lost to Bombay—Captain Henry Geburne, an Artillery officer, who left by retirement (1846). John Sutherland Law remained as the doyen, but not for long. He knew the plants of the districts in which he had served; but he published little. Four years after the year in which this chapter begins he also retired, taking with him a herbarium of about 1500 species, part of which went to Oxford and the rest to Kew.

When Law left India, the leadership in Bombay passed to Alexander Gibson who had been in charge of the Dapuri Garden in Poona from 1836 to 1847 and had published thence several not unimportant papers on economic plants including one on the Teak tree (1840). In 1847 he was appointed Conservator of Forests for the Presidency, a post he was still holding when Cleghorn came forward in Madras. N. A. Dalzell was under Gibson. It was not until 1861 that their joint *Bombay Flora* appeared : two years later Gibson published his *Handbook to the Forests of the Bombay Presidency* and inserted into it an enumeration of the valuable forest trees of India as a whole. In the year after this he retired, giving to the Calcutta Garden, as he left, his collection of dried plants. Dalzell did not immediately

succeed Gibson; but by way of economy the Bombay Government united the posts of Conservator of Forests with the charge of the Dapuri Garden in the person of Eyre Champion de Crespigny whose collection of dried plants is now the property of the University of Manchester. de Crespigny retired in 1862; Dalzell remained in India for a few more years in charge of the forests.

The forties had brought the first opportunity of making acquaintance with the interesting flora of Sind. Military operations led to it; they caused Nathaniel Vicary to be sent thither with his regiment. Vicary had been in India from before 1832, but it was not until more than ten years later that he found himself in Sind. He was a diligent collector who, perhaps because of his repeated transfers of station, let his collections suffer damage. It was probably the inconvenient size of his possessions which in 1832 or 1833 led to the gift of them to the Calcutta Garden. After that he began a new collection and when he left India for Australia there was a second gift. He published on the plants of Sind in 1854 and 1857.

The next to study the plants of Sind was J. E. Stocks.

John Ellerton Stocks (1822-1854) had been one of Lindley's pupils in London; and having qualified in Medicine he went to India in 1847 where he was sent out to vaccinate. At the end of a period of service of normal length he took his collections to Kew for determination; but he died prematurely. Hyderabad (Sind) was within his area and from Hyderabad he made his two expenditions into Baluchistan.

A contemporary surgeon of Bombay with an interest in ferns was Andrew H. Leith. His time of activity also spanned the year 1850. His collection is now the property of the University of Manchester. Another contemporary surgeon was H. J. Giraud. The Bombay Government brought him out from Britain to teach in the Grant Medical College and he was not of the Service which in general provided the Company's botanists. Herbert John Giraud (1817-1888) arrived in 1841 or 1842 with the title of Professor of Chemistry. Not at first, but after 1845 his teaching extended to Botany, and during his years he held various civic positions in addition to his teaching and is said to have been a popular lecturer. He returned to Britain in 1867.

John Forbes Watson (1827-1892) arrived in India in 1850 and taught Physiology in the Grant Medical College, then returned to Britain in 1858 to take the place that Royle had in the service of India House as Reporter on Economic Products and Keeper of the Museum at India House. This post he held until 1879. The brothers George Christopher Molesworth Birdwood (1832-1917, knighted in 1877) and Herbert Mills Birdwood (1837-1907) arrived in India respectively in the years 1854 and 1858. The elder did much for Bombay. He had been born in the Presidency. He qualified in medicine at Edinburgh with Hutton Balfour as his teacher in Botany and was one of the keen men who helped in getting class-material together. After reaching

Bombay he taught various subjects in the Grant Medical College; and a great interest in Materia Medica induced him to pay a collector on the coasts near Aden to seek for the trees yielding myrrh and frankincense. It led also, though less directly, to a catalogue of the economic products of Bombay. He served the city in many ways; among them he was Secretary of the Agri-Horticultural Society; and he took the leading part in raising money for a museum in the Victoria Park. When in 1868 ill-health drove him out of India, he carried his interests to Britain and gave his service to India through the India Office. The younger became a judge who wrote in his leisure a *Flora of Matheran and Mahableshwar* and an account of Indian timbers.

It may be mentioned here that the French botanist, Charles Gaudichaud-Beaupre, serving under Freycinet paid brief visit to Pondicherry and Calcutta in 1837; and that in 1845 the Danish exploring ship *Galathea* touched at Tranquebar, Pondicherry, Madras, and Calcutta on her way to the Andaman and Nicobar Islands, Dietrich Ferdinand Didrichsen collecting.

In 1850 Sir Joseph Hooker and Thomas Thomson were collecting plants with great thoroughness in the Khasia Hills. They had collected separately in the Sikkim Himalayas and the remotest parts of Kashmir; and were working for a joint account of the flowering plants of India. They would have called their publication *'Flora Indica'* taking into it as much as they could, making it an account of the largest area that their knowledge could justify, just as Roxburgh had done with his *Flora Indica* and as Griffith would have done had he got so far as writing. *'Flora Indica'* did not mean 'the Flora' but 'a Flora'. From the Khasia Hills, they moved southwards as signs of autumn came over the uplands and, collecting through Sylhet, Chittagong, and the Sunderbans, reached Calcutta to leave for Britain early in February 1851.

Falconer was now in his second spell of work in India (1847-1855). He had been to Moulmein to report on the teak forests and was occupied, when Hooker left, in replanting the Calcutta Garden in the wake of McClelland's destructiveness. As for McClelland, after a short time in Birbhum he had been sent to Pegu to collect through the teak forests. Falconer had been of great service to Hooker by receiving his collections and preparing them for sending forward to London. He sent collectors of his own to the Khasia Hills to supplement Hooker's collections. Francis Jenkins was still the Governor General's Agent in Assam and stimulating collecting from Gauhati. His subordinate J. W. Masters collected up the Brahmaputra to Sadiya. Vicary was making his last collections in India; he had collected in several parts of the lower Ganges valley and Hazaribagh. The strength of the army in the upper parts of the Ganges valley was so great that there was nearly continuous study of its flora. Lady (Elizabeth) Gomme, wife of the Commander-in-Chief, collected a little (1856). William Jameson (1815-1882) was in charge of the Garden at Saharanpur. He had been sent

to Saharanpur in 1842 and when he understood that Hooker and Thomas Thomson would write a flora, he supplied them with plants in the hope of helping them .... M. P. Edgeworth, now in Banda, was helpful from thence; and in the year 1850 he was transferred to Multan where he made a list of the flora. Lieutenant William Hawtayne Parish sent Himalayan plants from Kulu and Mandi. Brigadier J. B. Hearsey was sending to Kew plants from the Punjab. Thomas Lobb was at the time collecting plants worth culture for the firm of Veitch of Exeter; but of course a bird of passage as to India. The following three botanists reached India during the fifties—John Lindsay Stewart (1853), Charles Murchison (1853), and James Edward Tierney Aitchison (1858). The work of the first and the last will be indicated later; that of Murchison was little; during his two years in the Bengal Medical Service he made small collections of dried plants which he gave to Kew.

A missionary, Francis Mason (1799-1874), as avid of acquiring knowledge as William Carey, had arrived at Tavoy in Tenasserim and had moved to Moulmein in 1850 where he embarked on a book, small in its first edition, on Burmese plants etc., entitled *Natural Productions of Burmah or Notes on the Fauna, Flora, etc. of the Tenasserim Provinces and the Burmese Empire.* There was a second edition from the author in 1860 and remotely (1882) a greatly enlarged edition by another hand (W. Theobald's edition).

At the beginning of our period (1852) Charles Samuel Pollock Parish (1822-1897) went to Moulmein as Chaplain and threw himself with energy into a search for interesting plants. One expedition took him to the Andaman Island.

III. BOTANIC GARDENS—THE BOTANIST'S FIRST CARAVANSERAIS

After the men, their memorials! And as an opening question, by what is a botanic garden to be distinguished?

A garden becomes a botanic garden when its purpose is the bringing of plants into some kind of philosophic study. It must be a garden first: that was undisputed; but a very little botanical learning superposed brought the addition of the adjective. Such was the consequence of the newness of scientific botany in India. The missionaries of Tranquebar doubtless were provided with a garden of vegetables as a supplement to which, from 1768 when Johann Gerhard Koenig came among them, they accepted what interested him in his quest for knowledge and associated it with the vegetables, as that was convenient. Then their garden became a Botanic Garden, as they indeed called it. But the Calcutta Botanic Garden did not get the adjective 'botanic' into its name in the same way. Kyd in the letter that carried his pro-

posals to the Government of Bengal expressly excluded from its operations the study of plants, *i.e.*, the addition to the garden of the operation that entitled Koenig's and M. R. Smith's to be called botanic.

I have reached the conclusion that when Colonel Kyd set out to address the Government of Bengal on his proposal for the establishment of a Calcutta Botanic Garden, he had no clear mind as to the name to give it. He described what he was asking for in terms indicating a horticultural nursery. We have such nurseries today and there were such in Britain in Kyd's time: for instance, the first nursery held by the Veitch family was for raising trees for planting in Devon. Kyd would have the like close to Calcutta. He wanted something that was more than just a garden; as something better than a garden he called it a botanic garden. He proposed no pure botany for it and in fact explicitly wrote that there would be none.

He pointed to 310 acres along the river just below Calcutta and he estimated 200 Rupees a month as the cost of maintaining. The Government approved, and began operations without waiting for sanction to come from the Directors in London. They used Kyd's name—Botanic Garden, and Botanic Garden it was to the man in the street. His expectation determined that it should develop in that direction, and so it did. Kyd lived on adjoining land and accepted charge. When the approval of the Directors came there was a comment with it that they would not have objected to a higher estimate of cost; Kyd lived for a further 9 years and, when he died, the Government called Roxburgh from Samalcottah to take his place. We see from the time of Roxburgh's arrival pure botany in place in the Garden mixed into the increasing stock of the nursery. The conduct of affairs new under Roxburgh diverged so much from the proposals of Kyd's first letter as to suggest that the adjective 'botanical' in Kyd's name had driven botany into the administration, actually during Kyd's years of control, so that at the date of Kyd's death it was a natural thing to call in a botanist.

Who was the founder of the Garden? Kyd for horticulture, Roxburgh in great measure for Botany.

To Banks and those in London who were taking part in the advancement of Botany through Kew, Roxburgh's greatest contribution to the Science was through his descriptions and drawings and it was customary for Banks to see the drawings.

Calcutta was in a great wave of prosperity and with consequent liberal impulses the Government was prepared to retain all the 310 acres as garden, but later took some away. Little is the information preserved on the Garden's early appearance. Its area was from a ditch bordering the property towards Howrah, on which Kyd lived, to the Great Banyan tree at the west end. This tree was young enough not to have completely suffocated the Indian date-palm tree on which its seed had germinated as an epiphyte. In depth the Garden extended

from the river bank to an untidy undefined area to which Hooker thought the noisy picnickers from the city, amusing themselves by folk-dancing, might profitably be confined; and it is doubtful if at Hooker's visit the scenic possibilities of the river-front were attractively developed. But when Maria Graham visited the Garden as Roxburgh had it in 1810, she commented on its orderliness. Orderliness need not imply finish, and the scattered tanks and nurseries, remarked on by Griffith, indicate irregular and improvised extending of cultivation. Landscape gardening was not aimed at; and most certainly the Garden passed through a period when its greatest beauty was not in it but in the youth of its trees—natural, therefore, and not by art.

The founding of a garden in Calcutta led to a wish for other gardens, the promoters seeing possibilities much as Kyd saw them, but not as Roxburgh did.

Maria Graham, later Lady Callcott, used the words 'botanic garden' in describing the garden where Dr. James Anderson had experimented a few years earlier in raising cochineal. James Anderson had written on various economic plants and doubtless had grown them. Lady Callcott used the same word for the Calcutta garden. The garden of the magistrate, M. R. Smith, which was a transit garden between Sylhet and Calcutta, was similarly named.

Tipu Sultan of Mysore had converted a fruit-garden that his father had made in Bangalore into a garden of ease. On his downfall in 1800 the fate of this garden had to be decided and, pending a decision, it was put into the charge of Benjamin Heyne, he being the Madras botanist at the time, and a proposal having been made that it should become 'a botanic garden'. After Heyne it was entrusted to an agri-horticultural society; then relinquished but remaining an open space. Cleghorn contrived to get the status of garden restored. He made his recommendation in 1856 ; and it was to apply to 50 acres. A horticulturist named New, to whom there is a *Strobilanthes* dedicated, was put in charge; then followed Allan Black, sent out from Kew in 1863, but he lived for two years only. Black (1832-1865) had had a horticultural training at Kew and had held the post of Curator of the Herbarium. After him the Bangalore Garden had for its Superintendent from 1873 to 1907 John Cameron, to whose planting it has owed much of its beauty.

Another Cameron—William Cameron— had left Kew about 16 years earlier for the similar service of horticulturist at Peradeniya. It is said that when in 1857 he went to Ceylon he was entrusted with the conveying of a consignment of cinchona plants. He left Government service in 1860 for coffee planting, was hit by the coffee-leaf disease, and piloted his estate back using cinchona.

One year before the death of Tipu, Ceylon had obtained a small acclimatization garden in Colombo entrusted to a gardener named Jonville, brought from Europe by a new Governor. This garden, to

give it a better position, was removed for a short distance in 1810; then to increase the field of interest Banks caused William Kerr, a Kew Gardener, to be sent out in 1812. Kerr had travelled to collect desirable plants and could be relied on to bring together such as he could get and grow. The Colombo site however was still condemned, as it was liable to be flooded; but there was available an abandoned sugar plantation at Kalutara, which though 26 miles from Colombo, was accepted; and the garden was moved. Kerr died in 1814, and another who had had the same training in travelling and collecting, Alexander Moon, was sent to Ceylon to replace him (1817). In that year the Government completed its military road from Colombo to Kandy. It was decided on this that Kandy should be the hot weather station of the Government with a residence for the Governor, and, following that, to use Nuwara Eliya as a sanatorium, for which purpose the road was continued right to the very middle of the hills. It opened a wide area for planting, and there was a rush into it of would-be planters, many of them very ignorant of planting possibilities. To meet the situation and teach them, the Government set aside about 150 acres at four miles from Kandy for a garden that could illustrate possibilities as well as acclimatise and become a Botanic Garden. They closed Kalutara and sent Moon uphill after the planters.

The Dutch when they held the coasts of Ceylon had tried to introduce coffee-growing as an industry. They got no further than to familiarise the bush in the coastal villages. The excellence of the hill climate for growing it did not remain unknown; but the cultivation in the hills came only with the entry of planters from 1817 forward. One of Moon's first acts when in possession of Peradeniya was to lay out with coffee an area conspicuously where the new high road passed the Garden and to lay out another with the traditional crop, cinnamon. These, the reader realises, were demonstrations. Moon added as he could, in order to attract the interest of the passers-by, a few acres near the gate of miscellaneous cultivation; the balance behind remained in natural forest.

This founding was in many ways unlike that of the Calcutta Garden; it was a lone job for Moon, whereas the founders of the Calcutta Garden had abundant well-wishers and potential supporters. The two were alike in the liberal provision of land. Moon had the London idea of what a Botanic Garden should be; he backed it up by determining his plants, catalogued them and found an artist who pictured them. What he got into the cultivated acres can be gathered from his *Catalogue of Ceylon Plants,* published in 1824. He died in the next year, a great loss. Moon was not the first to make a herbarium under the British crown in Ceylon, for there is evidence that Jonville collected and dried plants.

Two years passed before Moon's successor arrived. This was James Macrae whose training for his work had equally been by travell-

ing as a collector of useful and ornamental plants. Macrae died in 1830 and again it took two years to secure a successor. He was James George Watson, accepted on Wallich's recommendation, but not a success in the post. General Warren Walker's scathing condemnation of him has been quoted. At the time of Watson's death in 1838, the Government was allowing the produce of the Garden to be sold in Kandy; and it found locally successive caretakers, (i) in J. G. Lear, a professional horticultural collector who had been sent to Ceylon and (ii) and (iii) in two of the island's surgeons, H. T. Normansell and W. C. Ondaatje. They were naturalists and no doubt did faithful curating. Normansell died. A little later we discover Ondaatje on a visit to London where he joined the Linnaean Society. Exhibits which he brought to meetings indicate that he had an interest in medicinal plants. But in 1844, at last the post of superintendent was filled, as General Walker urged, by one able to study the botany of the island. This was George Gardner, with a qualification in Medicine, a pupil of Sir William Hooker and with a reputation as a botanist got from extensive plant-collecting in Brazil. At Peradeniya a close friendship sprang up between Gardner and Sir Emerson Tennent, who was at the time Colonial Secretary, so close that the botany in Tennent's *Ceylon* must have been talked over by the two in their rambles together. Tennent praises the Garden for horticultural efficiency. There were flower borders but not yet any of the art of landscape gardening.

Gardner died in 1849, and the custom established, of employing a botanist, led to the appointment of Thwaites. When Gardner was put in charge, 40 acres out of its 140 were in cultivation and, taking into consideration the way in which the Garden had been officered, it is hard to see how the planting community had had a real lead.

In 1821 the Governor-General of India, Lord Hastings, visited the North West Province[1]. The reconstructed canal carrying water to Delhi was one of his interests and he visited Saharanpur near to its head. In that pleasant station, his attention was drawn to a neglected fruit-garden supported originally by the revenue of seven villages on the foundation of a public-spirited administrator and dedicated to the improvement of local horticulture. In its neglected state, self-sown inferior mango trees standing in coarse grass filled it. Lord Hastings decided that it should be preserved and replanted under the care of the Civil Surgeon, who at the time was the fully competent George Govan. Under him its small area of only a few acres was extended; canal water was brought in; roading was done; lawns made and it was dedicated anew to its original purposes. Govan, to extend its work, opened a nursery at Nahan on one of the routes of trade from the plains into the Himalayas. Retiring in 1823, he was succeeded by the energetic J. F. Royle, who intensified the work and investigated

[1]Later the United Provinces of Agra and Oudh, and now Uttar Pradesh

the flora on the near-by hills by sending collectors for plants and seeds, creating a herbarium, employing agents to bring fruit trees from Kashmir and, when Wallich went on leave, obtaining the services of the Calcutta artists. He closed the Nahan nursery, when he was able to open a larger and more elevated one at Mussoorie. Saharanpur with Mussoorie in support had resembled Kalutara with Peradeniya in support, if Kalutara had been retained; the years were the same.

Royle gave to Saharanpur all required to make it a Botanic Garden, of the Kew type, the display, the botanical nomenclature, the study of plants, and a recording in print and by illustration. Assuredly he knew Kew. The distance of Saharanpur from Calcutta and the entirely dissimilar climates kept the two Gardens from any competition. But in the eyes of the Adiministrators, the elder was always the elder brother, staffed therefore by the experienced, for instance Hugh Falconer, Thomas Thomson, and Sir George King each in his time was entrusted with the care of Saharanpur before promotion to the care of the Calcutta Garden.

The north of India under Persian influence obtained a number of gardens of ease. Tipu's at Bangalore was the Persian influence carried to the south of India. All that Tipu's garden did towards the promotion of Botany was to provide land used botanically after a long interval. The Saharanpur Garden was not of the same kind of origin; but again what it did was to provide land after a break just as Tipu's Garden did.

Three of the north-western gardens of ease may be mentioned in passing : (i) that at Fatehpur Sikri because it is so instructive in construction; (ii) that at Shalimar, a little to the west of Lahore, because though never serving in pure Botany it played a part in fruit selection, and (iii) the better known Shalimar Garden in Kashmir for we have descriptions of it as it was. This garden, set on a superb site, exposed too much art.

I have need to revert to the Calcutta Garden. In the year 1830, Wallich being on leave in Britain, a Retrenchment Committee cut the financial support for the Garden so severely as to arrest progress. Wallich on his return to Calcutta in 1832 found he had to retrench, he could not withdraw from raising large quantities of stock for giving away and also for supplying to small experimental patches up and down Bengal which were in his charge. He did not send out collecting parties and, as I have said elsewhere, showed an unwillingness to maintain a collection of dried plants. His accumulation of drawings suggests economy, for a record exists to the effect that during his second period of service his artists gave him 552 drawings against the 2350 done for Roxburgh. I take it fair to say that this retrenchment fell on the development towards a mature Botanic Garden; and that the ideas of the Government retrogressed towards Kyd's nursery establishment.

Griffith, who criticised Wallich for abandoning Botany, took a very curious and unjust position when, along with the attribution to Wallich of what he saw amiss, he promised the Government in asking sanction for undoing so much of Wallich's work that he would do it on his budget allowance; for this he implied that the allotment was adequate. Of course the Government wished it to be so, and went on wishing until the Crown displaced the Company.

IV. GARDENS ADDED FROM 1830 USING BOTANICAL TAXONOMY TO SERVE THEIR PURPOSE

The first of these gardens was that of Bombay; it was originated by an agri-horticultural Society in 1830. Two years earlier John Graham had reached Bombay; and he was involved in the Society's welfare from its foundation. He had reached Bombay without employment, but must have had reasons to expect it. It seems that he was known in advance to the Governor, Sir John Malcolm, and the Governor took him into his own household on arrival. The Society formed an acclimatization garden at the suburb of Sewree and Graham could examine Bombay plants cultivated in it.

When Graham had ready for the press his *Catalogue of the Plants Growing in Bombay and its Vicinity,* the Society undertook to see it printed. As we discover two grants of money from the Government to the Society, one just before printing and one after, the inference that the Government was helping to finance its publication seems correct, although the Society had another cause for needing money, namely their expenditure on the laying out of their grounds by an expert named MacCulloch. Graham died when the type-setting had reach its 200th page.

The Society had willing support from some of the best of the citizens of Bombay. These may be named : George Buisk, the Editor of *The Bombay Times,* H. J. Giraud who was called to Bombay to teach in the Grant Medical College and served the city in various capacities, and Dr. George Birdwood who also taught.

George Christopher Molesworth Birdwood (1832-1917, knighted in 1877) was born in India, then graduated in Medicine in Edinburgh and returned to India in 1854. In Edinburgh he had been a pupil of John Hutton Balfour a great teacher. When he had returned to Bombay, it fell to him to teach Materia Medica in the College. Out of his great energy, the Victoria Museum came into existence in the Agri-Horticultural Society's park. In 1862 he catalogued the economic products of Bombay ; and he returned to Britain in 1868 on account of illness, but to continue economic work at the India Office.

The city of Madras obtained a botanic garden in the same way as the city of Bombay, namely through an agri-horticultural Society, the date being 1838. The reader notes that it was within eight years of the Bombay garden, and it is to be added that the Society grew on the willing service of the citizens in a like measure. It has been recorded that Wight in 1838 was taken from military service and instructed to look into the state of Agriculture in southern India. The year was that of the foundation of the Society's garden and Wight who had been called to Madras city looked after it. The records call him Superintendent. H. C. F. Cleghorn similarly looked after the garden when he was a professor in the Medical College (1852 forward). An Army officer, Francis Alexander Reid was Superintendent for a while. The Society for a considerable period had the services of the horticulturist, Andrew T. Jaffray. Another horticulturist, Robert N. Browne, trained in Edinburgh, succeeded from 1857 to 1863, and wrote a guide book which went to a second edition, edited by the surgeon, John Joseph Wood (1828-1867). He at the time was on the staff of the Medical College. When Wood left India the Garden was again superintended by one of the fighting forces, an officer of the Army, Robson Benson (1822-1884, ultimately a General) who had done the same service for the Agri-Horticultural Society in Rangoon at the time (1865-1869) when he was with his regiment in Lower Burma.

Sir Joseph Hooker spent a day ashore in Madras at the very beginning of 1848 and passed his time in the Garden. Catalogues of other dates than those named above were issued. Certainly the Garden was very active.

A catalogue of the plants grown, prepared by James Matthew Gleeson, Superintendent of the garden, who left Kew for India in 1870, in the first instance to superintend experimental cotton cultivation, then in Madras to 1899, runs to 95 pages. It was issued in 1884.

The Nilgiri Hills, as we have seen, were coming forward and Ootacamund becoming a sanatorium in the days of Schmid, Metz, von Huegel, and Baikie. This development led to the establishment of a Garden of ease. A resourceful gardener from Kew laid it out in 1848. This was William Graham MacIvor. He had more land than he could immediately use, but it was not long before it was required for the experimental raising of Cinchona, whereby the garden may be said to have become a Botanic Garden. MacIvor died at his post in 1876.

To accommodate cinchona in Ceylon on its arrival the high level plantation of Hakgala was laid out as a branch from Peradeniva. The second horticulturist to be in charge of it, William Nock, whose service in Ceylon lasted from 1881 to 1904, was sent to Hakgala in 1882, and he embellished the area by extending the range of the plants cultivated. What he found the garden would grow may be read in a contribution which he made to Lemesurier's *Manual of the Nuwara*

Eliya District. For the sanatordia of the Himalayas to get gardens may be regarded as natural; for a garden is a part of the road to health. The Garden at Naini Tal and the Lloyed Botanic Garden in Darjeeling were created on land donated for the purpose.

After the fighting in Lucknow in 1857, those who sought to remove the disfigurements set aside an area for a garden. At first it was but a garden of ease, indistinguishable in purpose from a half-dozen other gardens in the northern plains of India, but the second officer to be in charge of it, the surgeon Emmanuel Bonavia, added experimental studies of fruit trees (1876) and from that time it has had a claim to the name of Botanic Garden.

Emmanuel Bonavia (1826-1908) had entered the Bengal Medical Service in 1857 and was in charge of the Garden at Lucknow in 1876. It was then that he began to write about citrus fruits, their classification, and their history in cultivation, and about the date palms and other botanical subjects.

V. HORTICULTURE IN ALLIANCE

Horticulture is one of Botany's technologies. At any rate the two are mutually helpful; and botanists have been not a little indebted to the horticulturists for bringing the plant world under their eyes. The whole of the credit of conveying tropical plants alive and keeping them alive in temperate lands belongs to the horticulturists, for they worked out ways of transporting over the sea between India and the lands where Botany had a stronghold and they devised plant-houses with an artificial climate for their reception. There had been a century of experimentation from the time when the first plant-house was built for Clusius to the time when Europe had stoves hot enough to encourage a flow of plants from India to the curious in horticulture in western Europe. This section of my paper is devoted to the gains of Botany by reason of the aspirations of horticulturists, and the Calcutta Garden was called in to aid, if not already in Kyd's time, at least as soon as Roxburgh had been called to Calcutta. In the year after that (*i.e.*, in 1794) the Company appointed Christopher Smith their 'Botanist at Calcutta'. His business was the stocking of the Company's possessions in the East with economic plants and he caused thousands of plants to be transported by sea within the tropics. The transport to Europe, which of course was round the Cape, was a somewhat more exacting task.

At that time a very generous friend of the Calcutta Garden was M. R. Smith; the magistrate stationed at Sylhet. His position enabled him to tap the riches of the Khasia Hills; and I would attribute to him the beginning of horticultural exploitation. At the same time

Francis Pierard was sending to the Garden plants from the direction of Chittagong. Francis Buchanan had been to Ava with the Symes Mission and later was able to visit Chittagong where a flora of Burmese type is met with ; and he too enriched the Garden. Roxburgh is known to have contrived to get orchids in good state to London where they were established in stove cultivation and to flowering (1813). Wallich, with the way shown to him, posted a collector at Pundua to work from a boat where M. R. Smith had gardened up to his death in 1819. Duty had sent Wallich to Lower Burma and to Northern Tenasserim, where he personally touched a flora rich in beautiful plants and after his return he had a collector there. He sent plants into cultivation freely.

Let the reader suggest, if he can, why so many beautiful flowers seem to have had their evolution there.

In 1818 the Royal Horticultural Society of Britian, being 14 years old and having created for itself a garden with greenhouses, set to work to furnish these by sending gardeners to various destinations to seek and bring back desirable, chiefly ornamental, plants. One of the gardeners was John Potts, who went by ship of the East India Company to Calcutta and to Canton. From Calcutta in spite of being based on the Botanic Garden his success seems to have been small--Wallich would be in Nepal at the time. But it was otherwise from Canton where John Reeves was living ; and Reeves put him into the way of getting the showy plants of the Chinese flower market. Doubtless Potts travelled back along with what he had obtained in Canton and cared for it (1821), but was compelled to entrust to others his earlier consignment from Bengal. The lesser success from Bengal may not have been by his fault ; but most certainly the Chinese had gone further than Bengal in flower selecting.

Many botanists must have asked exactly where Pundua is : it was 16 miles north-west of Sylhet, and owed its importance to shallowing water arresting trade and making it a terminus on the river ; and it would be an excellent base for collecting. As Wallich's collecting trips would be somewhat expensive, the cessation of such after the Retrenchment Committee's sittings in 1830 is understandable ; but a trip such as de Sylva's would have brought much living material into the Garden.

When Wallich went on leave in 1828, he took living plants with him as well as his accumulation of dried plants. Five years after Wallich's return the then Duke of Devonshire, who had adopted orchid-growing with enthusiasm, sent a gardener by name John Gibson to collect in the Khasia Hills. Gibson, aided by Wallich's direction and support, brought back large and possibly rather indiscriminate supplies but a number of novelties to cultivation (1837). Only a little more than a year earlier Wallich and Griffith had crossed the Hills seeking the tea bush ; and Griffith was at the time of Gibson's visit at the head of the Brahmaputra valley. He had not seen *Vanda caerulea,* the gem

of the Hills on that, his first crossing (1835), but did so when he varied his route in 1837. But Griffith did not take it alive ; he dried specimens of it.

John Gibson (1815-1875), after some years at Chatsworth, moved to London, and in a busy life laid out or controlled nearly all of the large parks in London.

It is very evident, and indeed natural, that greenhouse plants sold in Britain more readily than stove plants ; and therefore China was the country to search but, if stoves were to be favoured, then the Khasia Hills were to be visited. The firm of Loddiges and Sons employed a collector in India ; but it is not recorded who he was nor whither he went. It was to the Khasia Hills that the Duke of Devonshire sent his collector John Gibson.

Gibson's cases of living plants would need to be carried round the Cape and therefore be long at sea, and though the Wardian Case had been invented (1836) it is not certain that he was able to use it.

In 1843 the firm of James Veitch and Sons of Exeter sent their employee Thomas Lobb to Singapore as a collector. At Singapore he was to determine if the disturbed state of China would allow him to work there ; if it would not, he was to go to Java : he went to Java and some other parts of Malaysia. In 1848 he signed on for another expedition and sailed for Calcutta. Among the many places he now visited were the Khasia Hills. Later he went to Tenasserim and he continued his travelling life over many years. He was away in 1853 when his employers moved that part of their business which was with stove plants to London, splitting the firm ; and Lobb's services were thenceforward concentrated on the London half which became the predominant half. Hooker's record of Lobb's 'circus' passing him in the Khasia Hills has been recalled.

Contemporaneously Simons, the Government's apothecary at Gauhati, was sending local plants into cultivation and so also was a collector named Freeman, and a Captain Williamson who sent orchids to his uncle John Day (1821-1888), whose enthusiasm as a cultivator led him to make a trip to India, both to the north-east and the south, to inform himself on their cultural requirements.

In the fifties the lure of the orchid began to move south-eastwards. Charles Samuel Pollock Parish had become chaplain at Moulmein (1852) and he probably brought more eastern orchids into cultivation than anyone else, keeping the stream up at least until 1871. While Parish was active from Moulmein, so equally was an officer of the army, Robson Benson, ultimately a General (1822-1894), in Rangoon where he looked after the Garden of the local agri-horticultural Society. His most generous area was a transect of the country from the Arakan Yoma at the Toungup pass through Prome and through Toungu to the Shan plateau ; the transect connects the best teak forests of Burma with orchids, but he obtained plants from other parts of Burma.

Following General Benson came Major-General Emeric S. Berkeley who sent orchids into cultivation from various parts of India but chiefly from Burma. Of the professional plant collectors, Thomas Lobb's activities were along the trail made by M. R. Smith, Wallich, Gibson, and Simons and secondly in Tenasserim followed one of Wallich's trails which Parish had reopened. After these came William Boxall, first penetrating the area of the Lower Burma teak forests whence Robson Benson had drawn many orchids, then going into the Shan States because the exploring of Sir Henry Collett had exposed some of its riches.

There is a great interest but little explored in delimiting the area of the evolution of the magnificent orchids. The evolution has required long ages of continual tropical humidity fixing the plant and fixing its pollinating agents. Both are involved, Henry James Murton (1855-1881), the first horticulturist to be put in charge of the Singapore Botanic Garden, was seeking in the year after he had left Singapore to start in business as an orchid collector ; his area Siam. Another collector of the same time was J. C. Prazer, who took employment under Sir George King when it would seem he was in Manipur. Thence he moved to the lower valley of the Chindwin.

VI. THE LARGER MUSEUMS IN INDIA AND THEIR GROWTH IN EDUCATIONAL VALUE

Long ago, about the year 280 B.C., a Greek in power in ancient Egypt set apart a building, called the Museion, for the promotion of learning—whence the word museum. This building seems to have had attached to it land for the cultivation of plants and for the exhibition of captive animals. It is nice to recollect how long the word museum' has indicated a building where one stores to study and displays to instruct ; and then the historian enquires into the line of culture intended by the dedication.

I propose to bring into one view the dates when India dedicated in its turn buildings as museums and the different sciences which benefited. The dates are somewhat clustered in the fifties of the last century.

1817 : the Asiatic Society in Calcutta, at that date 30 years old and the possessor of a house holding their library and objects, mainly archaeological, which had been donated to the Society, planned to display these objects, and make the building function as an Archaeological Museum (let us call this collection No. 1), and further they would have it extended to Zoology (2), Geology (3), and Botany (4). But Botany soon fell out of the planning.

1819 : it seems that Madras put by a little museum material (see Markham & Hargreaves, *The Museums of India :* 176 ; 1936).

1840 : the Government, directly interested and very desirous of increasing the public interest in India's mineral wealth, planned a 'Museum of Economic Geology' within 3, and

1841 : brought into India from Britain a large collection of minerals (5) which was placed beside item 3.

1841 : the Government at the same time agreed to give sufficient financial aid to pay a salaried whole-time Curator, and Edward Blyth was brought from Britain. Under him the zoological material (2) grew into a large collection.

1846 : we read of a collection being formed in Madras (7) perhaps based on that of 1819 ; and we read later of a collection which would seem to have been the same or a part of it, being in the entrance hall of the Madras Medical School.

1850 : the Government of India created the Geological Survey ; and the Survey began to make a collection (8) in its own possession. In 1856 it was able to withdraw 5 from its position alongside 3 to its own premises.

1853 : the Government of Madras planned an Exhibition and started energetic collecting for it (9), and absorbed 7. The London 1851 Exhibition doubtless suggested the Madras exhibition of 1855 to its promoters. When the Madras Exhibition came to closing, the Government desired to retain a part and having a building available converted that building into the Madras Museum (1857).

1855 : the founding of a museum in Bombay had been under discussion for a few years ; in 1855 a museum (10) of Economic Products of Bombay and processes of their manufacture took orgin and was opened in 1857, then disordered by a hasty removal. Sir George Birdwood's *Catalogue of the Economic Products of Bombay* (1862) suggests what material was in it—at least in its earlier years. It became a mixed local museum, after reorganization.

1856 : though the removal of the economic minerals (5) from the Asiatic Society's building gave a little relief, the museum remained overcrowded and the zoological collections (6) in particular were in need of much more room, moreover the geographic range covered had widened. Then the Asiatic Society memorialized the Government of India for the establishment in Calcutta of an Imperial Museum, and expressed their readiness to transfer all their extensive collections, except their library.

1866 : the Indian Museum Act was passed, whereon collections 1 and 6 became possessions of Trustees created under the Act, while 3 was transferred to the Geological Survey.

1872 : the Lieutenant-Governor of Bengal, Sir George Campbell, moved to get the economic products of his Presidency collected. A committee was set up in every district which collected samples of the grains, seeds, oils, fibres, timbers, and minerals. This collection (11) doubtless was very comprehensive by 1879 and had a considerable value; but the cart was before the horse, as the essential building—the Museum

proper—to hold the collection was wanting. Disorganization then set in with vagabondage.

1875 : the new Imperial Indian Museum building was ready for occupation by 1 and 6.

1882 : an enquiry was raised if the Museum building could be made to hold an economic line ; to this the reply was 'not without enlargement'. This was followed by a request for the temporary use of a part of the building to assist the holding of an exhibition; and an agreement was made that in return for temporary use an economic wing should be added.

1883-1884 : the Calcutta Exhibition. By most energetic collecting exhibits (12) were brought together into which 11 had been absorbed.

1891 : the wing of the Indian Museum for the display of Bengal economic products having been completed, stocking it began ; but a considerable amount of replacement had become necessary, and this collecting (12) was set about. It required time. That which was good in the material was used for the Exhibition, and the new collections were gradually brought together, and the gallery receiving them was opened to the public at the commencement of 1901.

Until then Botany had had no place in the Museum ; and, as my reader understands, it was only economic botany that now obtained a place.

Museums are of many kinds ; the best have grown with declared purposes ; some have been or have become no more than depositories.

After the founding of the Madras Museum several small museums were set up by decree in the Presidency. One is said not to have functioned ; the others did in a way, but it is evident that they were too small to maintain interest, though even the smallest may have done good by intercepting historic stones and the like which were exposed to loss ; in this doing as the beginnings of the Asiatic Society's collection did.

There is a particular interest to be found in the earliest years of that collection.

To the year 1817 the Society's house would have been a depository, though the establishment of a museum must have been adumbrated. The first official suggestion came in that year from Wallich, who had been 7 years in the East, had practised medicine in Serampur, and now was residing in Calcutta seeking a new medical practice and had not yet so succeeded as to be without leisure. He offered his services. The Council took up the idea, discussed the scope, and accepting Wallich's offer drew up a list of classes of gifts that they would receive, at the same time naming Wallich 'Superintendent of their Oriental Museum'. Difficulties for him were only just round the corner. He was almost immediately accepted as an Assistant Surgeon in the Medical Service, and ordered to join the column marching on Kathmandu. Where now was his availablity ? Though he did not join the forces, he did not

become fully available for the museum, as he was sent to the Calcutta Botanic Garden to take Roxburgh's place and the Garden needed the whole of his time. Wallich, however, kept the title of Superintendent.

The archaeological exhibits as they came in went into the care of the Librarian ; it would be a simple matter for Wallich to separate the geological and zoological and to take the botanical to the Botanical Garden ; but one does not know if there were many of the last. The Society on second thoughts had decided that botanical objects belonged to the Garden. After a few years so much travelling fell to Wallich that he could have had nothing to do with this receiving and putting away and a clerk looked after it ; visitors were asked to help if they could.

The list of desiderata prepared by the Council when asking for specimens shows that the Society thought to educate their own members, not the public. The next move was an attempt to educate whoever it could reach in geological products, by the side of the most praiseworthy steadfastness of the Society in taxonomic zoology. Botany was kept apart, one may say, by the difference due to the way of handling its specimens.

Before Wallich's day, Roxburgh from the Calcutta Botanic Garden had collected and dried plants. He valued them less as evidence than he did his artists' drawings ; he had no museum building and he dispersed the specimens to those who had the means of storing them. Wallich at 1828 likewise dispersed all that he had at that date. He too had no museum building, but kept part of the specimens in the basement of his own house and another part in a seedhouse for the convenience of his more advanced horticultural staff.

The missionaries in Madras made an effort at continuous use of dried plants for identification, and Rottler showed himself so convinced that the Calcutta Botanic Garden should do as they did that he forced on Wallich the recommencement of maintaining a collection. Seeing him as he was on his way back to Calcutta in 1832, he gave him a bundle of dried plants.

Wallich took the lesson and proceeded to rebuild the set for the garden shed. Vicary seems to have followed by unloading his baggage on to Wallich ; and Wallich in this way seems to have found himself not exactly with a herbarium but with a collection of collections. I do not know which of his successors did most of the work of unification; perhaps it was Thomas Thomson. Under King the material increased very rapidly, and King was successful in persuading the Government of Bengal to supply a fire-proof building for it (1883).

Common usage, because it associates display with museums, tends to dissociate herbaria and museums.

Exhibitions are temporary museums ; but that statement does not carry a complete parting line. Exhibitions do not provide for research, which is what museums do. However exhibitions display very generally

material suitable for museums and become part parent in consequence. My reader is reminded that at the commencement of this chapter a reference is made to the East India Company having recognized their duty towards education. By what measures could they remove the vast rural ignorance that had grown up? They followed the line of using the museum, and India was furnished with exhibitions.

The first exhibition staged in India, that of Madras, gave hope to those concerned with education that the illiterate, to whom a label conveyed nothing, gathered knowledge by the sight of classified objects. Certainly they do.

The organizing of the exhibition was put into the hands of Surgeon Edward Green Balfour (1813-1889), who had been in India from 1838 and was to be Surgeon-General of Madras before he retired. His organizing work in this connection led to the publication of two books: his *Cyclopaedia of India,* 1857, and his *Timber Trees of India,* 1858. The Exhibition led to two other publications: Sir Walter Elliot's so-called *Flora Andrica,* 1859, and Colonel Heber Drury's *Useful Plants of India,* 1858.

Walter Elliot (1803-1887, knighted in 1866) had had rather long service in the southern Maratha country, where he had studied the local fauna rather closely; in 1837 he became Private Secretary to Lord Elphinstone, the Governor of Madras. Next he was transferred to the Telugu-speaking part of the Presidency and was there at the date of the exhibition. His so-called *Flora Andrica* is a compilation of plant names, got together by his contact with the people and through pundits; and shows that he must have known the flora. He was a man of many interests and a well-proved administrator.

Heber Drury (1810-1878) was a Colonel in the Madras army who studied with not a little care the flora of the southern parts.

The following officers were connected with the exhibition in different ways: General William Cullen, Resident in Travancore with the same interest as Colonel Drury, and the horticulturist Andrew T. Jaffray, then serving the Madras Agri-Horticultural Society. He did great service in assembling the exhibits. Later the name will be found in these pages in connection with the introduction of Cinchona.

Surgeon Balfour controlled the Madras Museum which, as said, was the outcome of the exhibition; and the study that he caused to be made of visitors is interesting. He kept statistics of their ability to read, and of course found a very large amount of illiteracy which frustrated in their case all values in the labels. Nevertheless it seemed that the illiterate did profit. The Government proceeded to arrange small museums for their larger towns. These must be called on the whole failures.

Few know that Colonial Botanic Gardens throughout the Empire had received at one time instructions to keep small collections of plant

products in the round and in a small number of cases the experiment succeeded.

The collection of miscellanea in Bombay did not come into their Museum in a manner quite like those of Madras : they were brought out of a store room in the Custom House as soon as there was a Museum building in the Victoria Park into which to put them (1857). The erection of this building has been mentioned earlier ; the year was 1871.

Why Calcutta got its museum buildings later was mainly because it was a very much larger proposition to build the Indian Museum than it had been to build the Museum in Bombay. The year was 1875, twenty years after the institution of the Geological Survey of India, and 15 after the Asiatic Society in memorial to the Government of India had asked for the building, not of a Presidency Museum, but of an Imperial Museum, whereinto what they had stored could be taken. The reader notes that the date of this coincides with the creation of the Madras Museum and not unrelated to the planning of the Bombay Museum.

All three museums of the presidency cities had attained functioning when in 1882 the Government of Bengal sought to get the range of the display extended on the economic side and received the reply that this could only be by adding to the building. Then followed an enquiry if the Museum could be made the focus of an exhibition and the discussion ended in an agreement that in return for this temporary accommodation the Government of Bengal would add a wing and so it did in due time : the Economic Section. Meanwhile the Calcutta Exhibition of 1883-1884 ran its course. The Government of Bengal naturally passed over to it what there was in its 'Economic Museum' though the specimens were in a sorry state. These—grains, fibres, oil-seeds, drugs, timbers, and minerals that had been commandeered from all parts of Bengal—had very soon after the institution of the collection outgrown the space allotted to them and more than one move had thrown them into disorder, into some neglect and disrepute. The collection was advantageously broken up with the retention of no more than was worth keeping and this now made part of a new collection gathered from all parts of India. Now the native of other parts of India who visited the exhibition could see what came from beyond his own knowledge, and surely this was a gain on the showing to the native of Bengal what might be familiar to him. The new wing which the Government of Bengal had promised was ready in 1891 and the Exhibition's collection, screened afresh and added to, was arranged in it over the years 1891 to 1901. The reader can if he desires get all the details for which he is likely to wish in the volume issued by the Trustees in 1914 for the Museum's Centenary.

The Imperial Museum in Calcutta and the Presidency Museums in Madras and Bombay have been immensely popular and undoubtedly have passed forward a great deal of elemental knowledge. The Superintendent of the Madras Museum, Dr. E. G. Balfour, kept a register

of the proportions of literate and illiterate among the visitors and the percentage of the latter was high enough to suggest that the least promising gained something.

It is interesting to note that the earlier geologists of the Geological Survey lent themselves to promoting the collecting of plants almost as if they thought it incumbent in them. Thomas Oldham, Valentine Ball, William Blanford, and Ferdinand Stoliczka were of the Survey and remitted dried plants to the Calcutta Garden. Still more the zoologists did this—the surgeon John Scully, the ornithologists T. C. Jerdon, Allan O. Hume, and Eugene W. Oates ; the entomologist W. S. Atkinson ; the malacologist Lt. Col. Henry H. Godwin-Austen, and others who will be named later.

CHAPTER IV

THE ROYAL GARDENS AT KEW BEGIN TO GUIDE THE DIRECTION OF BOTANY IN INDIA

I. RETROSPECTIVE

My first chapter covered the service that Wallich gave prior to his long leave (1828-32). His predecessor, William Roxburgh, had come near to instituting a 'botanic survey' when he sent his sons, William and John, field-collecting. Wallich moved further in that direction, for he sent out a series of collecting parties whose activities, when added to the collecting in the field that he did himself, most obviously made up a 'botanic survey' of limited extent. Its limits were towards the north-east of India, towards the north, east, south-east, and south of Bengal, excluding other directions. He himself collected through the tarai of Oudh, into the Himalaya to Kathmandu, through the Ganges plains, the Brahmaputra Valley, Sylhet and the Khasia Hills, and up the Irrawaddy to Ava and the edge of the Maymyo Hills, as well as in the Straits Settlements. His collecting parties worked in Kumaon, Nepal, Chittagong, Sylhet, and Tenasserim (the Moulmein and Tavoy districts). We cannot withhold the term 'survey' from so wide an

effort. Wallich distributed almost the whole of the spoil to date during his leave, and at the same time there was deliberating in Calcutta a Retrenchment Committee, which cut the provision for the Calcutta Botanic Garden so severely as to prevent any reconstruction of the survey. So it was that Wallich returned in 1832 to a difficult position, and, unfortunate man, in addition to his troubles his health broke down. The delegation to Assam in search of tea which followed was only carried out by a great effort. He had professorial duties at the Medical College and he had his obligation to provide from the Garden whatever growing stock was reasonably demanded ; and for more administration than this he seems not to have had the energy.

My reader will recall that Wight, immediately on appointment to the post of Madras Government Botanist at Samalcottah (1825), made a long collecting trip—a trip of duration equal to some of Wallich's, and indeed proper for inclusion in the 'survey' He will recall also that Wight proposed a longer trip in the next year and was promptly called to heel and sent back to military duty. This checking of Wight was part of the retrenchment from which Wallich suffered.

The Retrenchment Committee had been called by Governor-General Lord William Bentinck and rightly, for the finances of the Company had been tremendously disordered by war with Burma and there was not the money to spare for promoting undertakings in which the Company saw little to gain. It is a reasonable comment that immediately Wight and Griffith declared their faith. Wight by beginning publication and Griffith by the zeal of his collection and intention to use the same for the preparation of a *Flora*. Wight may be said to have been already in the breach. Official planning put the Calcutta Garden out of action in one respect ; volunteer surveying took its place.

Of course progress was hindered ; but it would be wrong to say seriously. Chapter 3 has given the reader the names of almost a hundred who promoted botany in India during the years of the middle of the 19th century. Picking out from them those whose botany was of a level high enough to reach print, I put the following sequence of arrival before my reader.

Wight, who arrived in Madras in 1819, begins the list. J. S. Law reached Bombay in 1826 ; John Graham reached Bombay in 1828 ; General Warren Walker to Ceylon in 1830 ; John McClelland to Bengal in the same year ; David Ritchie to Bombay in 1831 ; William Griffith to Madras and Hugh Falconer to Upper India in 1832 ; Joseph Nimmo appeared in Bombay in 1834 ; Alexander Gibson reached Bombay in 1835 ; Thomas Thomson to Upper India in 1839 ; N. A. Dalzell to Bombay in 1841 ; General William Munro to southern India in 1843 ; George Gardner to Ceylon in 1844 ; Sir Joseph Hooker and John Ellerton Stocks to northern India (Stocks initially to Bombay) in 1847; R. H. Beddome to the central parts of India in 1848.

Sir Joseph Hooker was the only one of these who owed his

coming to botanical knowledge; and he was not in the service of the East India Company.

It would be easy to gather together a second group of contemporaries whose botany was that of collectors; the group would tell the same story, namely that these came one after another, as the first group did. But what I have given suffices for the recognition of arrival after arrival of men botanically minded. I desire that my reader shall understand that the coming of Botany was a consequence of a knowledge of Botany being spread through Britain so widely as to come as it were by accident. It was not exactly invited; its arrival was somewhat welcomed; its possession sometimes brought rewards. The country was not ready to assimilate it; the results of the studies done in India had to be carried outside in order to be assimilated internationally.

II. THE GROWTH OF KEW THAT MADE IT THE PLACE FOR THE INTERNATIONAL ASSIMILATION OF INDIAN STUDIES

The little village of Kew had held a royal residence long before the year 1791, when the widowed mother of a king found pleasure in embellishing her garden in various ways and carried the embellishment from design to a great discrimination in the choice of plants grown in it. This discrimination was continued by her son George III after her death and, better to succeed, the advice of Sir Joseph Banks was sought and in a measure followed. Banks, who had travelled much, who had visited Newfoundland, Iceland, and Australia, and had sailed with Captain Cook round the world, who had created for himself a considerable herbarium and scientific library, who was so eminent as to be President of the Royal Society, quite naturally saw the means of advancing Botany and used what persuasion he had to that purpose. It is said that he sought sanction for the maintaining of a herbarium by the side of the plants in growth; but this did not come about. At his death in 1820 his own herbarium and scientific books were willed to his librarian Robert Brown, from whom they were to go to the British Museum. That parted the living and the dead—the exotics in the houses and parterres at Kew, from the references dried and preserved.

In the years of Banks, the flow of interesting plants into cultivation at Kew was maintained by sending collectors abroad who remitted them, and by the services of acclimatization offices in the possessions overseas. We have already seen that William Kerr and Alexander Moon went to Ceylon at the choice of Banks. Of dried plants from India Banks received bundles from Francis Buchanan and Gerhard Koenig, and then by will the whole of the latter's herbarium. Banks used his influence to recommend Roxburgh's work to the East India Company.

Apart from India, in the year of his death he promoted another appointment of great interest, namely the appointment of William Jackson Hooker, who was quietly studying plants at Molesworth in Suffolk, to the professorship of Botany in the University of Glasgow. Buchanan, now retired and whose surname had been changed to Hamilton in 1820, wrote expressing expectation that Hooker would be distinguished, and then in 1822 followed this by 'Dr. Hooker at Glasgow I see frequently He is more active than Graham (the professor who preceded Hooker).. Hooker's influence on Wight's publication has already been referred to (see p. 48).

The University of Glasgow was quick to give its new professor a doctorate; and the Crown kinghted him in 1838. The two honours equally reached his son Joseph Dalton Hooker, who was but four years old when the move to Glasgow came. The son obtained a doctorate in medicine in 1839, and was knighted in 1877. It is convenient, ignoring the dates, here to write of them as Sir William and Sir Joseph.

One of Sir William's activities in Glasgow was the fathering of a new botanic garden, which held about 9,000 species in the year after Sir William's arrival, and about 20,000 in the year before he resigned his professorship. By the side of the growing collection went the great growth of his personal herbarium until it was the largest in Britain in private hands. When Sir William removed to Kew, and of course took his private collection with him, the living and dead records, which I remarked were parted by Bank's will, came into juxtaposition and so they were when Sir Joseph returned to his father's Kew house bringing what he had from India with him (1851). Sir William's private collections were purchased from him in 1861, but through the years to 1861 had been freely open to students.

III. THE GREAT COLLECTIONS OF SIR JOSEPH HOOKER AND DR. THOMAS THOMSON LINK KEW AND INDIA TOGETHER : THAT WHICH KEW REGARDS AS SPECIFIC LIMITATION PASSESS TO INDIA, TO INDIA'S GREAT ADVANTAGE

A species is a concept; there is no possible definition, save by consent. The wider the consent the better the international understanding of the concept. Divergent understandings have led to the subdividing with a recognition, say of micro-species or Jordanian species; and other subdivisions will appear. For the advance of knowledge in line, there must be a ruling standard. In brief Kew worked out by consent an idea of permissible variation and on the leadership of Kew the taxonomy of Indian spermatophytes rests.

The following concisely states what happened to the applied work of the two botanists. They had attended the botanical classes given to the medical students by Sir William Hooker, had sat in 1839 for the

same examinations and qualified. The one then joined Sir James Ross's ship *Erebus* as Assistant Surgeon and sailed with Ross to the Antarctic to fix the position of the South Magnetic Pole; the second went into the service of the East India Company and was sent to the Upper Gangetic Plain. They were not to meet for ten years. The meeting took place at Christmas 1849, in Darjeeling. Thomson, his delegation to the remoter parts of the north-western Himalayas over, went to the Sikkim Himalaya, where he waited for his old college mate, who meanwhile had the uncomfortable adventure of being held prisoner by an intriguing Sikkim official.

Hooker was bringing back to his base his last specimens. I need to quote what Hooker wrote of the finish of this part of his expedition: 'Thus terminated my last Himalayan exploring journey, which in a botanical and geographical point of view had answered my purposes beyond my most sanguine expectations, though my collections had been in a great measure destroyed by so many untoward events. It had enabled me to survey the whole country and to execute a map of it, and Campbell (Dr. Archibald Campbell, the Superintendent) had further gained knowledge of its resources which the British Government should all along have possessed as the protector of the Rajah and his territories'.

My reader notes the reference to mapping. The Government of India subsidised Sir Joseph's travel to a little under half the cost of it. Why? Because they needed the geographical information and it was this that they were buying, not the botany. We learn from the same statement that Sir Joseph had lost bundles of his dried plants from time to time; for instance, from other sources we know that a large part of what he had collected to illustrate the genus *Impatiens* fell into a river at a certain fording place. The Company had had at other times and from other botanists similar service.

The meeting of the two botanists was followed by discussion of ways of joining work on the collections. It is evident that this was anticipated by both with considerable enthusiasm.

Hooker wished for another year in the Himalaya, and that he could spend it in Nepal. But the Maharajah was unwilling, as he was to be away and did not care that strangers should be in the country in his absence. This being so, Hooker and Thomson consented to a season in the Khasia Hills, and after a business visit to Calcutta, where the collections were then lodged, they put in 7½ months of energetic collecting in the hills, seldom having fewer than 16-18 men daily searching the country for plants. Here they collected not only species for drying, but exhibits in the round for an economic museum at Kew, which Sir William had commenced in 1847—timbers, bamboos, dry fruits, gums, resins, etc. This went on until signs of autumn with a cessation of flowers made the flower hunt unprofitable. Then with about 200 men's loads of spoil they descended to the low country of

Sylhet to get water carriage for it to Calcutta. They themselves went southwards to Chittagong, and thence made Calcutta through the Sundarbans.

Does not this collecting again remind us of the thoroughness of Hooker's work? What he lost of his collections, such as most of his specimens of the Sikkim species of *Impatiens* in crossing a swollen river, does not detract from this judgement.

Calcutta was reached on 28 January 1851, and England on 5 March of that year. Naturally Kew and his father's roof was Sir Joseph's destination, and naturally Kew was likewise Thomson's. There they lodged the collections and together began to work on the taxonomy of the higher plants.

IV. HOOKER MAKES THE BEST POSSIBLE USE OF THE HOLD-UP OF HIS FLORA INDICA

Thomas Thomson would have buried himself in species-describing, if undisturbed. Sir Joseph Hooker had a mind that took in a much greater breadth of botany. Seemingly both of them had started the *Flora* expecting that the East India Company would promote it just as the Admiralty was promoting the publication of the results of Hooker's work in the Antarctic on Ross's expedition. The Company did not respond. Other possible bodies which might support the publication were tried in vain. The disappointment fell much more heavily on Thomson than on Hooker, for Hooker had a crowd of other interests and the work of Assistant Director to attend to; which was increasing as Sir William Hooker was beginning to lean on his advice. Hooker then did the great service of directing his collections to the advantage of Kew. The distribution of the duplicates as exchanges of material could be done; there were such assistants as Allan Black (1832-1865) to take the burden of such service.

Hooker had described Wallich's distribution of his collections of 1832 as 'the most valuable contribution of its kind to Science'; and Hooker put precept into practice by his own distributing.

Kew, it is recorded, sent out at this time no fewer than 300,000 specimens to institutions and individuals, jointly advancing the internationality of Botany, ticketed with locality of origin and named as far as possible. Moreover by doing this on so large a scale Kew made a great contribution towards fixing on the indefinite unit 'species' an approximate value. This, declared each packet of exchanges, *is the Kew standard;* these specimens are material for critically enquiring if the standard holds.

The Hooker-Thomson sets were being distributed when Wight finally returned to Britain with the balance of his collections for the

same treatment. Hooker succeeded in getting India House to release Falconer's 76 cases deposited in 1841 and they also were distributed.

From these distributions the Calcutta Botanic Garden came into possession of so much material which carried the Kew imprint as to get a great lift forward; and by the gifts by well-wishers of Wallichian specimens that were duplicates to them, it had the disadvantage of Wallich having kept nothing for Calcutta in 1832 very largely wiped out.

Justly to be remembered for his services at Kew at this time was Allan A. Black (1832-1865). He had had a horticultural training at Kew from which he had been taken into the Herbarium where he proved himself most valuable. In 1863 he was appointed Superintendent of the Bangalore Garden, but died at sea invalided from his post in 1866.

V. GENERAL WILLIAM MUNRO (1818-1880)

I introduced General William Munro to the reader in Chapter II (p. 55) as a Lieutenant who botanized in the State of Coorg in the year 1834. He was in India until 1848 and collected wherever he went, specializing in grasses until he was the leading authority on them. His last collecting places were in the Himalayas. He had supplied grasses from Agra to Wight; but the two never met. He was resolving the perplexities of the bamboos and was engaged on a monograph on the Gramineae when he died. His collections were bequeathed to Kew. In the year 1837 he prepared a catalogue of the plants in the nursery of the old garden at Bangalore. In 1847 he published a book *The Timber Trees of Bengal.* He was a great advocate of "soldiers' gardens", and belonging to a British Regiment he was no doubt the originator of an interest in gardening in many of his men when they were in India.

VI. HUGH FALCONER, SUPERINTENDENT OF THE SAHARANPUR GARDEN, 1832 TO 1841, AND SUPERINTENDENT OF THE CALCUTTA GARDEN, 1848 TO 1855

Hugh Falconer (1808-1865) arrived in India with Griffith; Griffith's voyage ended at Madras; Falconer proceeded to Calcutta, whence he was sent to the Upper Gangetic Plain ; and when Royle departed from India in 1832 on long leave, he took Royle's place after so little as two years in India. Though charge of the Saharanpur Garden in general fell to a young man, to be appointed so young as Falconer would seem remarkable. His scientific equipment was more geological than botanical; but then at that time a young scientific man was expected to have wide unspecialized knowledge. No sooner had he

landed in Calcutta than we see him seeking geological information which he desired from the museum of the Asiatic Society. Hooker called Falconer 'a mountain of admirable and accurate information' and 'a scientist of inflexible and uncompromising integrity'

By a coincidence, at the time of Falconer's arrival in the Upper Gangetic Plain fossil bones were discovered to exist in quantity in the Siwalik sandstones by the constructors of the Jumna Canal-head works at that river's exit from the Himalayas. Govan seems to have known that they existed. Falconer, his geological interests alive, started to collect them, and so did the engineer Sir Proby Cautley. To work out what the animals were could not be done in India; the bones had to be brought to Britain and were brought when that was convenient.

Falconer conducted the affairs of the Saharanpur Garden on the economic lines that Royle had adopted. The reader will recollect that Royle had looked to Kashmir for plants of value to bring into the Garden. Falconer was required in 1836 to join Sir Alexander Burnes in an economic mission over the north-western frontier and he left Saharanpur late in that year. Politics called away Burnes, causing him and Falconer to part at the Indus, Falconer seeking a way up the river; but at his third march, when at Darband close to the Black Mountain, his progress was interrupted, force threatened, and he was diverted through Hazara to Kashmir where he wintered. In the next spring he took that route northwards which keeps closest to the Indus though really far from its impassable gorges, until he reached the river again at Sukaram Murbal. Thence he was able, crossing it, to go to Askole, and also up the river through Baltistan and Ladakh. In what way he had contrived to have names for the plants which he collected is not recorded; but he certainly had them, as we know from a letter written to Royle in London and published by Royle. He must have carried books of reference. Falconer's collectors were required to record the localities of the collecting on the coarse packing paper. He was more methodic in this than others of his time. What he published later shows an economic interest. Falconer was back in Saharanpur at the end of the summer of 1838. Then he turned his collectors into the mountains of Kumaon up to the Niti pass; no doubt they also helped him in bringing to him the fossil mammalian bones of the nearer hills.

In 1841 illness drove him to take leave and he took these collections with him, 76 cases of dried plants and 5 tons of the bones. The dried plants were placed in India House and Falconer got to work on his major interest, the bones. So brilliant was his work that his time in Britain was extended that he might get on with it. Furthermore, it led to his election as a Vice-President of the Royal Society.

On his return to India in 1847 he was appointed Superintendent of the Calcutta Garden, from which, as already recorded, he did all that he could to facilitate the work of Hooker and Thomson. From Calcutta he was required to go to Moulmein that he might advise on the

teak forests. What he did in Tenasserim is given in the next chapter. The reconstruction of the disordered Calcutta Garden has been referred to in the second chapter.

VII. THOMAS THOMSON (1817-1878)

Thomas Thomson, son of a Glasgow professor and, as already recorded, a fellow student of Joseph Hooker, had entered the service of the East India Company in 1839, when he was sent to the Upper Gangetic Plain. In 1841 he was with the troops sent into Afghanistan and lost his all, including whatever collections he had made to date. He was at Ghazni in the next year. Three years later he served through the Sutlej campaign. Between these disturbances he studied the flora of the northern Indian plains and appears to have collected about 1,000 species. As a reward for his zeal he was called in 1847 from the medical charge of troops to serve as one of three Commissioners who were to report on the geography and general conditions of the Kashmir-Tibet border. Because Thomson's travels were continuous with Hooker's whom he joined at Darjeeling in 1850 for a further year of collecting, it has been convenient to me to describe them at page 125 above. Thomson took leave and was in Britain from 1851 to 1854, working at Kew, part of the time on earned leave and part of the time on leave without pay; then he returned to India having been appointed Superintendent of the Calcutta Garden, where the new plantings of Falconer were now 4 to 5 years old. Immediately, Thomson counted his means of organizing a general herbarium in the Garden out of the collection of bundles of dried plants which came into his charge. He had of course brought to Calcutta as much as he could of his own collecting, and through the generosity of friends he had received a very fair representation of the Wallichian dispersal. He reported on the materials that he had, and sent the report to the Asiatic Society of Bengal for publication (*Jour. As. Soc. Beng.* 25: 405, 1856). Thomson's interest was in the dried plant. With facilities given he might have put in order a very fair working basis for determining Indian plants. Perhaps the living plants in the open garden were too young to interest one whose bias was a way from them; and he would not be able to open out under the imposed financial stringency: and again the disaster of the Oudh Mutiny came during his years. Was it by a mis-judgment of his that his horticulturist, Robert Scott, was allowed to slip away to Burma on a collection trip which was prolonged for a whole year, as Thomson's successor says, to the damage of the cultivation which was his proper charge ? Finally, Thomson became ill and was invalided out of India in 1861. Mention has been made of the *Praecursores ad Floram Indicam,* published for Hooker and Thomson after they had been compelled to

drop their *Flora Indica*. The last of the *Praecursores* appeared in 1861, and with that year Thomson's activity in defining Indian plants ended.

Circumstances had been against him at either end of his service, but with a (to him) golden period of three years of uninterrupted Botany in the middle.

Captain R. S. Simpson, who was in Simla when Thomson was starting for the remote parts of the Indus watershed, now reappears as a collector in the Khasia Hills. What he collected reached the Fielding Herbarium and was sent forward to Sir Joseph Hooker at Kew.

VIII. THOMAS ANDERSON, THE LAST OF THE SUPERINTENDENTS OF THE SECOND CALCUTTA BOTANIC GARDEN

Thomas Anderson (1832-1870) succeeded Thomas Thomson in 1861. Five years later his brother John Anderson (1833-1900) followed him to Calcutta having been selected by the Secretary of State for India in 1865 to be the Curator (shortly afterwards called Superintendent) of the zoological and geological collections which the Asiatic Society were ready to pass over to the new Indian Museum (see pp. 179-181). There are two conditions here for the reader to understand: the one that at the date there were two geological collections in Calcutta, the newer in the possession of the Geological Survey which had been formed in 1851, and the older still in the hands of the Asiatic Society because of agreements not yet completed; and the other condition how it happened that John reached India as much as 10 years after Thomas though only one year younger. This is how it happened. Thomas, having qualified in Edinburgh in Medicine in 1853, went out to India without delay; John went into business, but left it again and qualified in Medicine in 1862, at which time the admission of candidates into the medical service in India had been temporarily suspended. He then taught the Natural Sciences in the Free Church College of Edinburgh until the appointment to the Indian Museum became his. As both brothers collected plants the reader is warned against confusing them. However they were only together in Calcutta from September 1866, when John arrived, until 1868, when Thomas was invalided out of India. During that short time they demonstrably aided each other. John was sent as naturalist on the Yunnan expedition of 1867-1868 and collected between Bhamo in Burma and Momein in Yunnan, *i.e.* in country never approached by Thomas. The leader of the expedition was Major E. B. Sladen and the plants collected went to the Calcutta Garden where they were in time named by Kurz. Thomas had no connection with them, as illness had overtaken him before they could have reached Calcutta.

Thomas's overseas collecting was done in Aden (1860), and Singapore and Java (1861).

When appointing Thomas Anderson to be superintendent the Government had told him that he would be required to introduce Chinchona cultivation into the Sikkim Himalayas. Its experimental cultivation had already showed promise in southern India and Ceylon.

I propose at once to show how the proposals for extension were entangled with Anderson's charge in Calcutta and the reader will find the history of the experiment later.

It was in the nature of governmental policy that such a requirement should be made to the Superintendent of the Garden. My reader recalls that Kyd described the garden which he proposed as one would describe a horticultural nursery. He will recollect that it was laid out on blocks for supplying others. He may be reminded that Wallich met large demands from the Medical Storekeeper for making syrups, lotions, etc., and he may be reminded also that Wallich was in charge of little patches of trees up and down Bengal. There appeared now a demand enormously exceeding anything the Medical Storekeeper might make, a demand in comparison with which Wallich's scattered acres or half acres were insignificant; and moreover to meet which a mountain site was needed. I stress this for it forcefully pulled forward the horticultural nursery and therefore the botanic garden backward.

Anderson took over charge, pulled the Garden's horticultural staff together, making the reluctant Robert Scott to return from his holidaying in Burma—it had lasted a whole year and Anderson said it had been to the damage of the Garden—and then went to Darjeeling to look into his prospects.

The Government's control of the Darjeeling hills had commenced out of the desirability of keeping the Lepchas from subjugation by Nepal. In 1840 a local quarrel caused the Government to send into the hills as arbiter James William Grant, then of Malda. He was the Grant to whom Griffith dedicated his genus *Grantia*, and he was once for a short time in charge of the Calcutta Garden. Grant, when he returned from arbitrating, suggested that the establishment of a sanatorium in the hills might repay the cost of establishing it. With this in their mind the Government sent to Darjeeling Archibald Campbell who was then their Residency Surgeon at Kathmandu, choosing him for his two qualifications—a knowledge of what a sanatorium could be and a knowledge of at least some of the hill folk.

Campbell's bridle-paths had by 1861 made the interior accessible enough for tea planters to seek land, and then came Anderson looking for land for Cinchona. He was clearly at a disadvantage; he could not yet know exactly where to find a situation for his purpose where considerable expansion would remain possible if the crop became a success. The tea planters had obtained some of the most accessible positions. Anderson it seems was able to put Cinchona plants out

experimentally at various elevations and aspects; then he returned to Calcutta and sailed for Java because an exchange of planting material had been arranged with the Dutch, and he had to give and get what was promised on either side. It was on this trip to Java that he collected in Singapore. He returned via Madras, leaving some of the Cinchona Plants that he had got with McIvor at Ootacamund and taking thence other plants with which he went back to Darjeeling, the horticulturist Andrew T. Jaffray accompanying him. It is not surprising that the difficult first start involved seeking a new place. The use of abandoned army huts at the greatest convenient elevation was a makeshift, and the foggy rim where the clouds bank up an unsuitable position. Anderson would seem to have broken his health in the toil of going down hill by day and up hill in the evening. The Government was sympathetic and recognised that they asked much of him.

As a first contribution towards his success, they engaged in Britain a most excellent horticulturist, John Scott (? 1838-1880). He had been trained in Edinburgh and also employed by the Duke of Devonshire in his orchid houses at Chatsworth. John Scott's name is met with in Darwin's account of *Various contrivances by which Orchids are fertilised by insects* (1862) as making observations at Chatsworth.

A second horticulturist followed John Scott; this was James Alexander Gammie. The change of position of the plantation came just before the latter's arrival.

Anderson had had the use of abandoned buildings at the forefront of the mountains, constructed as part of the unsuccessful military sanatorium, not accepted by him for his use as suitable, but because they had to be put to use. The position of the new plantation was down hill.

James Alexander Gammie arrived in 1866, at which time Robert Scott had just resigned his post in Calcutta. Gammie became Manager of the Mungpu plantations and John Scott was given the post of Curator of the Calcutta Garden in the place of Robert Scott.

The reader needs here to be told that the 'Robert Anderson', to whom is credited a *Catalogue of Calcutta Plants,* did not exist. While Robert Scott was still in Calcutta, Thomas Anderson had prepared a catalogue of the Garden's plants and it would seem that the name Robert Anderson was due to confusion between Robert Scott and Thomas Anderson. John Scott served in Calcutta until 1880.

Anderson's administrative ability is seen in his seed lists for exchange and his several catalogues. When he returned from Java with the Dutch collections he reported to the Government on that Herbarium, which would have been Thomas Thomson's joy but was Anderson's burden. He explained that he was the only officer at the Garden competent to work it up and that he could not do it for want of time. He went on to tell the Government that he had found

two botanists willing to accept the post of Curator of the Herbarium at quite a small salary provided quarters could be given them. One in fact was already working without pay in the Herbarium. This was Jean-Baptiste Louis Pierre (1835-1905), of French origin, a native of the island of Reunion and an *emigré* thence because a tornado had destroyed his coffee plantation. The other was Wilhelm Sulpiz Kurz (1833-1878), a German, who had been a pupil of the eminent botanist von Martius. He had found it advisable to flee from his native land and enlist under an assumed name in Java. His ability discovered, he was made useful to Teijsmann, who held the post of Hortulanus at the Buitenzorg Garden. Anderson, having gone thither to get his Cinchona plants, heard of Kurz who, like Pierre, was in trouble and that is why they were prepared to take service in India. The Government sanctioned the employment of both; but Pierre almost immediately had an invitation to Pondicherry; and then another to Saigon where he was to build up a Botanic Garden and where he did most excellent work on the forest trees of Indo-China. Kurz became the Curator of the Herbarium in the Calcutta Garden where, be it noted, his appointment created a staff of two botanists, himself and Anderson, which was the first botanical reorganization of the Crown when the Company was displaced.

Kurz had commenced to publish on the Malaysian flora before he left the Dutch service; then after taking service in Calcutta he began to publish through the Asiatic Society on Indian plants, chiefly on those of Bengal. He wished to publish a Flora of Bengal and some pages were actually in print when his attention was redirected.

The shadow of Sir Dietrich Brandis falls across the page in this. Brandis was in Simla as Inspector-General of Forests; and he influenced the Government of India not unreasonably to send Kurz about Forest business. Kurz received instructions early in 1866 to proceed to the Andaman Islands to study the timber trees, to determine them to get seedlings and seeds to grow in the Calcutta Garden, and to report. Accordingly he went to Port Blair in April and was away until July. The first part of his stay was disappointing as nothing was in flower, and there was almost a disaster when the Burmese convicts told off to serve him set on him and left him bound in the forest. Kurz returned to Calcutta in the early part of the rains and got together as much information regarding the Andaman flora as the Calcutta Garden had. Various officers had been there, Kyd was one; two surgeons, named Liebig and Playfair, had collected; and there were others. Kurz visited Arakan in the next year. Surely then it was to help the Forest Service for Schlich was there. He was in the Andaman Islands again when he emended his first report, and for the whole of the rest of his service he worked entirely on trees of the Burmese flora, travelling considerably. The culmination was his *Forest Flora of Bri-*

tish Burma, 1877, in two volumes. When, shortly, I come to the work of Sir Dietrich Brandis, the cause of the switch-over from Bengal to Burma will be more evident. Kurz, his Burma flora written, took leave and would have visited his earliest collecting grounds in the Dutch Indies, but he died in Penang (1878) on his way there.

While the stay of Robert Scott in Burma in 1860-1861 was to Brandis's advantage, it is not certain that it was at his suggestion. But a remark made by Thomas Anderson in a letter suggests that the Calcutta Superintendent was not certain that he would be allowed to keep John Scott now on his way to India.

When Anderson had had but three years at the Calcutta Garden, a tremendous disaster fell—waves estimated as 16½ feet above normal for a high spring tide broke into the Garden. It could not have been foreseen. The saline water did great damage. And three years later, after heavy rains had softened the soil, a tornado toppled the trees over like ninepins. This is the record that was made: 'almost the only trees dating from before 1800 that were spared were the Great Banyan tree and a second and smaller tree of the same sort, some Pipals (*Ficus religiosa*), country almonds (*Terminalia, catappa*) about 20 Mahoganies, and some palms'. Someone, seeing that timber specimens would be acceptable in the Bengal Economic Museum, made hand-samples that a little might come from the calamity. Perhaps a few of them still exist in the Industrial Section of the Indian Museum. Anderson's health broke down, and he could not repair the damage and the distress of it must have fallen severely on John Scott. Therein was virtually the end of the second Calcutta Garden.

In some other ways Anderson's years had been years of great achievement, an aftermath of the considerable unification of India.

The head of the Bay of Bengal has a record of destructive but, fortunately, spaced tornados travelling into it: In 1842 the Garden suffered damage by one; in 1897 another hit Chittagong and destroyed 600 acres of planted teak.

The hollow land, that was taken in 1787 for the Botanic Garden, may well have owed freedom from trees to earlier cyclones with flooding from the river.

Reference has been made to the way in which Lord Bentinck's Retrenchment Committee cut Wallich's funds for the Botanic Garden; it was after this that 2½ acres of the Garden were put at the service of Carey's Agri-Horticultural Society. The area was raised later to 25. After the flooding the Society could no longer use it, as it was saline.

IX. CHRONOLOGY OF THE INTRODUCTION OF CINCHONA INTO INDIA

I propose to give the history of the bringing of Cinchona into India in a series of statements :

(i) The Physicians had decided after an abundance of experience that sulphate of quinine was their sovereign remedy against malaria ; but the supply of the bark, whence it was prepared, was subject to manipulation for the sake of financial profit in the Andean states where the wild supplies grew.

(ii) The supplies of bark reaching the ports of shipment showed that the species drawn on were several, and not of equal value. The question of exact specific origin therefore came up.

(iii) The British, chiefly for the benefit of India, and the Dutch, for the benefit of their eastern islands, decided to possess themselves of the desirable species. This required expeditions in search of them ; and the probability that the quest would meet with opposition had to be faced.

(iv) Before the agents of either country started, the French explorer, Hugh Algernon Weddell, had returned to Europe from the Andes with a little seed from which a small number of seedlings were raised, some in France and some in Edinburgh. The French gave a seedling to the Dutch who sent it out to Java ; and one successful cutting was taken from it before it died. It died at Bogor (Buitenzorg); the cutting survived by transfer to the hill graden of Tjibodas. The seedlings raised in Edinburgh were sent to India, conveyed to Sikkim, and there all died. Thus Weddell's exploration left a single plant in Java for a commencement of the work.

(v) The Dutch chose for their mission to the Andes, Justus Karl Hasskarl, a former employee in Java whom they recalled from retirement, and sent to Bolivia where, overcoming considerable difficulties, he collected a quantity of seeds and seedlings and they were got down to the coast and conveyed to Java (1854).

(vi) In Britain Clements Robert Markham (1830-1916, knighted in 1896), already knowing the parts of the Andes which had to be visited and able to converse in at least two of the languages that were talked, was given authority to organize a more extensive search. He planned a 3-pronged attack, taking for himself the most equatorial latitude for penetration, engaging for penetration a little further north Q. T. Pritchett and engaging also the well-known traveller Richard Spruce to penetrate further south over the lower slopes of Chimborazo ; but Spruce fell ill, whereafter Robert Mackenzie Cross took up Spruce's work. Between the three lines of attack very

nearly the whole was covered of the latitude at which the best kinds were expected to occur. A little latitude was added in the north when the German botanist and explorer, George Hermann Karsten, fell in with valuable seed a little further north than Pritchett's line. Instructions had been given to Markham that he should send his spoil to Britain ; some have said unwisely, as the risks in transport were increased ; there was shipment up the South American coast and shipment from the Isthmus of Panama to Britain before the risk of transmitting via Suez to India. The Dutch had avoided such increases in the sea risk. Markham had considerable losses, cancelled out by the largeness of the collecting. Considerable use of Kew was made as a half-way depot.

(vii) An unexpected windfall fell when a merchant, Charles Ledger, offered a packet of seed for sale which had reached him as a gift, the excellence of which he did not know.

(viii) The Government of India had been very well advised, largely by Markham, on the conditions required for plantation ; and preparation had been made both in Ceylon and southern India chiefly at Ootacamund in the Nilgiri Hills where the horticulturist W. G. McIvor was now in charge of an experimental garden. Cleghorn had been associated in the choice of land in the Nilgiris. In Ceylon Thwaites laid out a high level plantation at Hakgala to receive the plants and raise the seedlings : it was under his horticulturist William McNicholl, who however did not remain long ; then it passed into the horticultural charge of William Nock who added attractive planting.

(ix) The climate of Hakgala proved to suit some of the Cinchonas so perfectly that they grew as weeds ; and some showed ready vigour at Ootacamund, so that there was little risk after the journey to India was over. Markham visited the East and approved of what he saw.

(x) The acclimatisation had thoroughly started as the reader sees, in the most equatorial part of Asia where the rainfall is spread fairly well and there is an evenness in the day lengths. Is not this of interest because the genus *Cinchona* is in the Andes at its best equatorially? Furthermore the equatorial preference draws attention to the existence of a latitudinal geography in southern India.

(xi) When an exchange of plants had been arranged between India and Java, as recorded on p. 131, Anderson went to get what the Dutch had to give and took to Darjeeling his material for experiment there, almost assuredly quite ignorant of possible effects of a two-season climate high in rain and day-lengths. The sequel was observation that what suited

the south did not do so well in the north. We find Anderson at first with the assistance of the horticulturist Jaffray, then with John Scott, and then with James Gammie.

(xii) Free growth could not be assumed to produce the best bark in the market ; chemists were required and the Government engaged John Broughton in London to proceed to India. A laboratory was built for him at Ootacamund where he did the essential analysis.

(xiii) At the same time he sought to cheapen the costs of extracting the alkaloid ; but he had no success.

(xiv) This did not prevent the planters of Ceylon from adopting Cinchona as a crop selling the bark on the market. The quantity offered depressed market prices and so discouraged them. Most of the tea planters in Darjeeling toyed with little experiments but did not accept Cinchona as a crop. The Ceylon planters, who had accepted Cinchona, soon abandoned it for Tea. Two Nilgiri Hills estates were offered for sale, but the Government could not get their price, though these estates were stocked with *Cinchona calisaya* which had been shown in India, as elsewhere, to yield the most sulphate of quinine. The work done had demonstrated an ability to increase the supplies of sulphate of quinine but not an ability to cheapen it. And as there had been a most generous distribution of seeds to many parts of the world, the condition was evidently world-wide.

(xv) The work done in India had now made it obvious that two species, *Cinchona calisaya* and *Cinchona succirubra,* promised better returns than others in this way—the first gave the most sulphate of quinine, the second the more total alkaloids ; the first grew more freely in the south, the second in the north.

(xvi) McIvor experimented with increasing the thickness of the bark by injury, but, though he believed in his method, there seems to have been nothing of advantage in it.

(xvii) The Government's promoting of Cinchona was an entirely different adventure from that in Tea. In the case of Tea the Company did the work of proving that the tea plant was present and its cultivation possible. Then the industry took the natural trading profit. But in the case of Cinchona the philanthropic intentions of building a barrier against malaria knocked the natural profit out ; for any in sight needed to be sunk in the price.

(xviii) The physicians' opinion that sulphate of quinine was the substance to use kept *Cinchona calisaya* as the more desired therapeutic, and therefore the southern source of supply seemed that to be in particular exploited. After Anderson's departure from India (1868) C. B. Clarke, given the acting post,

went to the Nilgiri plantation on inspection and Sir George King, later in Anderson's post, did the same. *Cinchona calisaya* var. *ledgeriana* had meanwhile won the first place.

(xix) To C. D. Wood a chemist in the service of the Government, employed in Calcutta, was given the work of trying to cheapen the cost of extracting the alkaloids from the bark, but he failed as Broughton had failed. The Government of India then threw the responsibility for this on the Superintendent of the Calcutta Garden, *i.e.* on King as their Quinologist ; and King happened, though not immediately, to learn when visiting the Netherlands a fact which he took to Wood, now retired from India and in business in London. Wood elaborated it of his own free will. King took Wood's process to the Sikkim Plantation where Gammie directed it into commercial lines.

(xx) There was one thing yet for King to do. At the Sikkim Plantations he could have the total alkaloids extracted at an advantageous cost from *Cinchona succirubra ;* he had yet to get the surgeons in India to accept it. Several tried it and reported well.

(xxi) The business passed, next, to a group of able administrators who set to work to canalize the course of the febrifuge between factory and the malaria-stricken in the villages in need of it, defeating at the same time speculation by traders who tried to cut in.

The above is the epic of Cinchona establishment. Anderson during its enactment had died from the consequences of malaria, which was almost certainly contracted during his search for land in the Sikkim Himalaya for the raising of the remedy.

The alkaloids, like tannin and some other substances which Man extracts from plants, are seasonally increased. This Broughton learned. No doubt there was little call at 1868 for further enquiry into this physiological matter.

X. ON THE BOTANICAL SIDE OF PHARMACOLOGY

Two appointments were made for the control of the Cinchona work in southern India, respectively in 1882 and 1884. The first was the appointment of Malmaduke Alexander Lawson (1840-1896) as Director of a Botanical Department covering the Cinchona undertaking, with headquarters at Ootacamund ; the other was the appointment of Dr. David Hooper as Chemist under Lawson. Lawson's transfer to India from Oxford, where he was holding the combined Sherardian

and Sibthorpian professorships, was not what would have been expected, but I believe it was at his own suggestion. He had been teaching Botany in Oxford for 14 years and had had a part in the great advances in teaching methods instituted by Huxley, but administratively he had not pushed his department forward; nor did he get far in India; he had no personal acquintance with the flora before he went to India except that he had elaborated three small families for Hooker's *Flora of British India*. One may say that he was still getting to know the Indian flora when in 1896 he died. Dried plants that he collected in the course of his learning went into the Calcutta Herbarium. Hooper had a long and useful service in India, though more away from Madras than in the Presidency.

David Hooper (1858-1947) studied Pharmacy in the Pharmaceutical Society's London school and then in various manufacturing laboratories in London and in the Netherlands. In 1884, he accepted the post of Government Chemist, Madras. When the chemical work in the Nilgiri plantations lessened, he was transferred to the Industrial Section of the Indian Museum in Calcutta with the title of Curator. A laboratory was his and a very wide range of material coming in on which he was able to work. The zoologists and the geologists of the Museum had their strong research side; Hooper's laboratory brought the economic annexe into line by providing the research for the annexe. Without it, there had been some want of matching.

Of Hooper at work a biographer has said he was meticulously accurate, careful, industrious in collecting facts, in arranging them, and in publishing them, and in the course of this became an authority on the drugs of Asia.

Much of Hooper's work got its first publicity through Dymock, Warden, & Hooper's *Pharmacographia Indica*.

William Dymock (1832-1892) had entered the Indian Medical Service in 1857 and was posted to Bombay. Chance sent him out to sea on a mission westwards and in the ports then visited he seems to have obtained his first interest in the drugs of their markets. Gifted in languages he turned to what he could get out of Flukiger's *Pharmacographia* and began to make his own study on the material referred to in that book. His first book is based on it. He held the post of professor of Materia Medica in the Grant Medical College (1874-1881) and was the Government's Medical Storekeeper. He could not have been better placed, for the doors of the trade of the Parsee community had been opened to him. His much larger work, *Pharmacographia Indica,* came when he joined with Lieut.-Col. C. H. J. Warden and Dr. David Hooper; and the three volumes which make it up appeared in parts. Colonel Warden was Chemical Examiner, Bengal, and Professor of Chemistry in the Calcutta Medical col-

lege; and from 1899 to his death in 1900 the official Examiner of Medical Stores. The *Pharmacographia* deals with Indian drugs in turn, thoroughly and with authority.

The work of the Indigenous Drugs Committee must be passed by as it was without sufficiently deep roots.

John Shortt, who went to Madras in 1846 and was there until 1878, wrote much; some useful. Edward John Waring's *Bazaar Medicine* of 1860 is a book not to overlook. Henry John Carter, who was in Bombay from 1842 to 1862, a man of many sides, studied the sources of frankincense. Professor Kanoba Ranchhodas Kirtikar (1850-1917) of the Grant Medical College made himself an authority on poisonous plants and in his subject was followed by Jean Ferdinand Caius.

In Calcutta Udoy Chand Dutt wrote an informative *Materia Medica of the Hindus* (1877) with a glossary by Sir George King.

XI. C. A. BARBER (1861-1933)

When Lawson died, the post of Madras Botanist went to Charles Alfred Barber. Barber had been successively a demonstrator in the Botany School at Cambridge; the Superintendent of Botanical and Agricultural Department, Leeward Islands, where he met with his first sugarcane cultivation; Professor of Botany at Cooper's Hill 1895-1898; then Government Botanist, Madras, and again in contact with sugarcane among a variety of other crops. The importance historically of Barber's transfer to India lies in the circumstance that he may be called a pioneer specialist in agricultural botany of a new school, and the work that he did in the great efforts commenced chiefly in the early years after 1900 to increase the return got from Indian crops. His work with sugarcane was of great excellence.

XII. THE MUNGPU COMMUNITY

It is obvious that the congregation of trained horticulturists growing Cinchona at Mungpu would promote the study of the flora of the Sikkim Himalaya. They were considerably isolated and had to discover uses for their leisure. Exploration of the flora was an obvious outlet.

James Alexander Gammie (1839-1924) reached Mungpu in 1865. Before his arrival the land which Anderson had chosen at first had been abandoned as unsuitable and a new start had been made. He took over charge as 'Manager' with almost entirely new cultivation in hand. He found diversion for his own leisure in the animal life

about him, saying that by so doing he sought the means of removing his thoughts as far as possible from the consideration of the problems which Cinchona produced. But King was very soon highly praising his handling of these problems. His interest in the animal kingdom was well spread. He collected information on birds, mammals, and reptiles, and then moved on to insects. But he admitted plants into the attentions of his leisure by making a pleasure garden and bringing into it local plants. The zoologists welcomed his animal records. Some of Gammie's subordinates deserve mention. A. Biermann joined Gammie in 1867 and then was sent from Mungpu to try how the Cinchona would grow in the Khasia Hills whence, after securing information that it would grow, he was recalled to Mungpu, where the growth was such as to suggest that extension in the direction of the Khasia Hills would not be needed. Biermann later became Curator at the Calcutta Garden. A third recruit was Robert Pantling (1857-1910). He was not long in Mungpu in the first part of his service for, Biermann dying, he was required to take his place in Calcutta ; but he returned to Mungpu in 1879 as Senior Assistant in the place of J. L. Lister who, after a short service in Mungpu, had resigned to become a tea planter. Pantling completed his service in Mungpu, succeeding James Gammie on the latter's retirement in 1897. Pantling devoted his leisure and opportunities in a way suggested by Gammie's gardening, and brought from the hillsides all the orchids that he could get and, being a good draughtsman, he drew and supplied the plates for a volume, conjointly with Sir George King, of the *Annals of the Royal Botanic Garden, Calcutta.*

Joseph Parkes went to India a year after Pantling, and it fell to him to experiment with Cinchona at Kalimpong. The next assistant due here for naming was Amos C. Hartless whose first destination was Calcutta (1889). In 1900 or thereabouts he was transferred from the Calcutta Garden to Mungpu and while at Mungpu he wrote upon the Agriculture of the Darjeeling district. After that he was successively at Bombay, Poona, Mahableshwar, and finally Superintendent of the Saharanpur Garden. He obtained a wide knowledge of Indian horticulture from this extensive experience. He left India in 1923 and died in 1941.

Close on the turn of the century, other assistants arrived whose names a taxonomic student of the Indian flora will find on the labels of herbarium specimens. One who took a considerable part in advancing botanical exploration from Mungpu was George H. Cave. He reached India in 1897. Oliver Teetgen Hemsley followed in 1898.

Mungpu was naturally a centre which the Calcutta Garden could use as a base for native collectors. Sir George King so used it. Hooker's appreciation of the Lepchas' familiarity with the hill forests

was echoed by King, who tried also to use Tibetan familiarity with the way to live in high valleys for getting what he could from the back of the mountains. One of King's men was the Tibetan Dungboo. We hear later of the Lepchas Ribu and Kari making annual trips for seed, which passed into the exchanges with gardens outside India, and for other material for the Calcutta Garden. Cave at one time directed this collecting of seed. Later, but after the period of this chapter, he made in the company of Sir William Wright Smith an arduous collecting trip in north-eastern Sikkim (1909).

O. T. Hemsley, son of W. B. Hemsley, was at Mungpu for 4 years on either side of the turn of the century.

The reader doubtless recognizes that, thanks to the attractiveness of the Sikkim hills, thanks to the succession of botanically-minded forest officers who have served in the Darjeeling District, and thanks also to the steady exploitation directed from Calcutta through Mungpu, our knowledge of the flora has grown a long way towards the possibility of a complete list. It has grown at the same time in a fair measure in regard to local dispersal and altitudinal extension—so much in regard to altitude that there seemed to be profit already in 1925 in putting on record altitudes for comparison with altitudes in the Abor Hills (*Rec. bot. Surv. India* 10) ; but there is need for a great deal of further collecting before a complete Flora (Flowering plants and Ferns only) can be produced. No other part of the Eastern Himalayas is known appreciably.

XIII. FURTHER COLLECTIONS OF THE END OF THE CENTURY

It is time now to mention George Alexander Gammie (1864-1935), son of James Gammie. I have separated him from the succession of Mungpu collectors, because most of his collecting was done elsewhere and his training was not that of Kew. But his name was on the service register of Mungpu in 1892 in which year he made a collecting tour in Sikkim. In 1894 he collected up the Brahmaputra Valley ; and in Chamba and Kangra. He was in charge of the Saharanpur Garden and the Lloyd Botanic Garden in Darjeeling at different times and had acted as Curator of the Calcutta Garden, when he was transferred to Poona, first in a Botanic Survey, then with the title of Economic Botanist.

It is time also to introduce the names of various collectors of the north-western borderland, some of them collecting just because they desired to help forward the publication of Hooker's *Flora of British India*. This is evident in the records of plants inwards to the Kew Herbarium. One collector, Colonel Meade, was particularly interested in the grasses of the dry north-west, and would seem to have been

very through in his collecting (1872) for he sent no fewer than 140 in number. In the next year Colonel Johnstone, when on duty in Kandahar, made a collection; and these following officers collected during these years near India's frontiers: J. S. Gibb, Sawkins, Spratt, and G. W. H. Talbert. The well-known traveller and scientist, Henry John Elwes, made the first of his expeditions in Sikkim in 1877 and his collection reached Kew. Another collector of Sikkim was the Chaplain Mountford. In 1877 Sind collections came from W. S. C. Pinwill, who from Sind went to the Malay Peninsula and then returned to create a beautiful garden in Cornwall. The ornithologist Thomas Caverhill Jerdon gave plants from peninsular India. A horticulturist trained at Kew who had become a tea planter; Richard L. Keenan, sent to Kew an extensive collection from Cachar.

This welcome assistance was to continue through the next decade and beyond. Another student of grasses, Collins, a veterinary officer sent grasses of the Punjab (1881).

Intense collecting in the Gilgit Valley, extending into Wakhan and other near parts of the hills, was carried out by Dr. (Surgeon-Major) G. M. J. Giles from which Kew greatly benefited.

Surgeon-Captain Henry Alfred Cummins collected in Sikkim and on the borders of Bhutan in 1888; Elwes again collected in Sikkim. The District Commissioner Stephen Lushington Aplin collected in the Shan Hills. A. K. Nairne author at a later date of *The Flowering Plants of Western India* (1894) was sending plants in 1888 from Bombay.

Sir William Wright Smith wrote in his account of his collecting trip in 1909 after referring to the work done in the Sikkim Himalaya by Sir George King, C. B. Clarke, Sir David Prain, Robert Pantling, George Gammie, and officers of the Forest Service: 'probably no corresponding area in India has been more fully ransacked for its flora and none so well as the Sikkim Himalaya'. His estimate may be approximately right; at any rate it is the opinion of one entitled to express an opinion.'

The mountain of Tonglu, which Hooker visited from the eastern side in May 1848 in pouring rain, was made approachable from the south by a new bridle path and C. B. Clarke took an apportunity of visiting it in September 1875. The same rain! Many have used that path since. A number of the flowers along it have the interest of facing downwards so that their pollen is not damaged by the rain.

CHAPTER V

THE UNDERTAKING OF TWO GREAT ENTERPRISES, THE FLORA OF THE HIGHER PLANTS AND THE FOREST SERVICE

I. A TEXT-BOOK FOR THE TAXONOMY OF INDIAN FLOWERING PLANTS

In 1861 Daniel Oliver was appointed Professor of Botany in the University of London in succession to John Lindley. In 1864, he published a small book entitled *Lessons in Elementary Botany* which was intended to supplement the teaching of his British students in taxonomic botany on British types. Substituting Indian types he sought to adjust the book for use in India, and as the floras of Britain and India are so diverse the whole had to be rewritten and the illustrations replaced. With the title *First Book of Indian Botany* it appeared in 1869 and long held its place. Who they were who bought and referred to it is hard to say; but it was fitted to be a refresher to surgeons serving in India and a vade-mecum to those beginning service.

II. THE INDIA OFFICE REALISES THE PRIOR NEED OF A FLORA

It has been mentioned in the last chapter how it was that the *Flora Indica* of Hooker & Thomson came to an end from Hooker's failure to obtain financial aid towards its printing. As he was at the time receiving help from the Admiralty towards the publication of his Antarctic results, the unwillingness of the East India Company to see his work through was a great blow. They had given a grant which covered rather less than one half of his travel-expenses and with that their subvention ended ; it is not incorrect to say that the Directors' subvention was a buying of geographic information which they needed ; the Botany did not interest them. Hooker had sought support in other places without success.

About 1870 the India Office had decisions to take touching Botany in India ; and someone reminded the Office that Hooker had proposed a Flora seeking financial support from the East India Company.

So far had this proposal gone out of sight that all the Office's papers could not be found and some had to be replaced by copies from files at Kew. Thomson was still alive but in poor health; Hooker was available and moreover had all the resources of Kew behind him. Hooker was asked if he could undertake to produce a Flora and consented. By way of economy there was to be compression ; and the whole was to be in English. Thus originated Hooker's *Flora of British India* in seven volumes; and, because the *Flora Indica* that Hooker and Thomson had commenced could be used as far as it went, the first volume of the new work was out of the press in 1872. The admission of the Directors that it was a duty to plan Education bound their successors in the India office to see to the publication of a Flora.

III. CHARLES BARON CLARKE (1832-1908)

This brilliant mathematician—the third Wrangler of his year at Cambridge—spent the next 10 years of his life quietly teaching mathematics and using his leisure to botanize in Britain, Switzerland, and Madeira. In 1866 he left Cambridge to teach in the Presidency College, Calcutta. As if to call attention to his change he published a list of the plants of his native town, Andover, a very small town on the edge of the Salisbury Plain. It was the only publication made by him to that date. He returned to his interest in the Madeira flora later. He had been in India but two years when Thomas Anderson was invalided and he was appointed to act for him. The following statement corrects several confusions that have appeared in print.

Thomas Anderson had taken up his post in 1861 and had received instructions to establish Cinchona in the Sikkim Himalaya ; he pro-

ceeded at the end of that year to Java with plants for the Dutch in exchange for others that he brought back. He discovered in Java that Kurz would accept a post in the Calcutta Botanic Garden, and on his return arranged it. Anderson had the assistance of A. T. Jaffray in getting the Java Cinchona and Cinchonas from the Nilgiri Hills to Darjeeling. Jaffray belonged to Madras and went back. To Anderson John Scott was sent out (1864) and was followed by James A. Gammie (1865). When Robert Scott, the then Horticultural Curator in the Botanical Garden, resigned (1865), John Scott was called to Calcutta to take his place. Kurz had settled down to write a *Flora of Bengal;* but a report on the forest wealth of the Convict Settlement in the Andamans was wanted and Kurz was delegated (1872). After the Andamans flora Kurz was directed to that of Burma, on which he began to publish in 1872 and on which were all the further publications of his life.

C. B. Clarke had arrived in Calcutta in 1866. He made use of his first long vacation to visit and collect in the Khasia Hills. Then Anderson's health gave way entirely and Clarke was appointed to act. He took over charge in Calcutta and then of the Cinchona plantation at Mungpu where James Gammie was extending his planted area. He seems to have contrived in Sikkim to do a little collecting. In the next year he visited the Nilgiri plantations and also collected. In 1871 he was again in Sikkim to enable King to take over from him. In each of the following years he made one long collecting journey: the Khasia Hills for the second time (1872), Kangra and Chamba (1874), Sikkim (1875) again, and lastly, before taking leave, Kashmir had through to Karakoram (1876). Through Clarke's two years it seems that the Cinchona undertaking moved on the lines that Anderson had given it and John Scott was doing what he could to restore the damaged Calcutta Garden; Kurz was on a profitable line of work and all that he wanted were facilities for it. By the way in which Clarke threw himself into collecting when back to the Education Service, he probably chafed when tied to Calcutta until Surgeon Captain George King, who had now had 6 years in India, was appointed Superintendent of the Garden in 1872 and relieved him.

Between inspections of schools up and down the Bengal plain he went on with his collecting. There the weeds of cultivation may be said to have intruded on his interest, for most of his travelling was through the cultivated fields, where the glare of the sun combined with his shortness of sight made him in general look down. Nevertheless his near vision was excellent. These circumstances seem to have heightened his interest in the Cyperaceae, Commelinaceae, and little Scrophulariaceae—three families in which field-weeds abound.

He obtained further away in the school vacations, sometimes going far, and did it with the methodic ways of a mathematician: the specimens were always ticketed and annotated before there was any chance of information going astray. When long leave became due to him,

which was in 1877, he took to Britain very considerable collections from the north of India, including the Khasia Hills, Sikkim, the north-west Himalaya, both the forward parts and back to the Upper Indus and beyond to Askole. Along with these of the north of India, he had plants from the Nilgiri Hills. He took all to Kew for elaboration, and he offered his services there to Sir Joseph Hooker, who had now commenced the printing of the second volume of the Flora. The reader will find information below regarding his substantial aid. When the termination of his leave approached, an arrangement was made by which he continued to work at the Flora at Kew until 1883. Returning to India after that he had a further four years in the East, half of it in Bengal and half of it in Assam.

Every botanist familiar with the Herbarium at Kew, knows the geographic arrangement of the species-covers : the planning of it was largely Clarke's. He interested himself in geographic botany and wrote on it.

As recorded in the last chapter, Hooker and Thomson elaborated in the first half of the only published volume of the *Flora Indica* a way of dividing India into what they called provinces. It is impossible to deal with plant-geography without putting forward such divisions; Clarke came to it and treated the flora differently, though there is evidence that there had been discussion between him and Hooker. Clarke's use of the word 'area' for a geographic expanse is thoroughly commendable and so is his use of sub-area and sub-sub-area for divisions of the area. Hooker started from a different position. He, and Thomson working with him, had a political unit and this they divided into three parts that they called regions. Their regions are geographic not phyto-geographic. Clarke starts with geographic south-eastern Asia—his adjective is Indo-Chinese—and he takes out of it a sub-area which is India. He is still geographic here ; but at the next stage—his sub-sub-area stage —he endeavours to be phyto-geopraphic, *i.e.* to have got down to an area small enough to have distinguishing characters in its vegetation. To the problems raised by this approach to phyto-geography I shall need to return later. What I desire here is to attribute to Clarke his due. The chief paper in which he laid out his facts is the presidential address that he gave in 1898 to the Linnean Society.

Clarke's interest extended over the ferns and he published a monograph of those of northern India. He reprinted at his own cost Roxburgh's *Flora Indica,* not because he had a liking for the Linnean system of classification, but because he felt that the medical students had a need of a classification and that such a work in the Natural System as Griffith suggested was not a thing for which he had time.

IV. HOOKER'S HELPERS PROGRESS WITH FLORA OF BRITISH INDIA

It has been mentioned that the preparation of Hooker's *Flora of British India* began with a revision of families that had had a place in Hooker & Thomson's *Flora Indica*. Hooker, tied by his official duties, enlisted the co-operation of several eminent botanists : Thomas Anderson, Alfred William Bennett, Michael Pakenham Edgeworth, William Turner Thiselton-Dyer, Maxwell Tylden Masters, William Philip Hiern, and Malmaduke Alexander Lawson; between them they relieved him of two-thirds of a volume of 700 pages, published in 1872. There were larger and more exacting families just ahead. Of these John Gilbert Baker took the Leguminosae; Hooker reserved the Rosaceae for himself, and entrusted the Myrtaceae to John Firminger Duthie. Meanwhile Charles Baron Clarke appeared at Kew on leave from India and began to take part, writing all but a very little of the remaining part of volume 2 which was out in three parts, 1876, 1878, and 1879. Clarke's work began to appear in the last of these three parts. He had brought his own most extensive collections to aid. A fourth botanist, George Henslow, had a small part in this volume. Clarke continued to aid ; of volume 3 he wrote almost 200 pages and 520 out of the 734 pages of volume 4, Hooker writing the rest. It was Clarke's permission to stay in Britain that enabled him to give this great help; but the time came when a return had to be faced and consequently to the last three volumes his only contribution was the Cyperaceae. All the difficult families of these three volumes were elaborated by Hooker but the sub-order 'Bambuseeae' which was the work of General William Munro. Hooker's work on the Gramineae was wonderful. The self-effacing work of Clarke is to all botanist a matter of extensive gratitude. The last volume of the Flora was published in 1887.

V. SIR GEORGE CAMPBELL ENDEAVOURS TO PROMOTE THE TEACHING OF BOTANY WITH AN UNFORESEEN RESULT

Sir George Campbell, Lieut.-Governor of Bengal, whose interest in the rural economy of his Presidency led to the building up of the collections of the Bengal Economic Museum, suggested that Botany and Chemistry should be taught in the Presidency College, Calcutta. The proposal became exceedingly controversial; and it is difficult to see how it could have been otherwise. But he carried his advocacy so far as to get from Britain a teacher (professor) for each subject. The teacher chosen for the botanical professorship was George Watt.

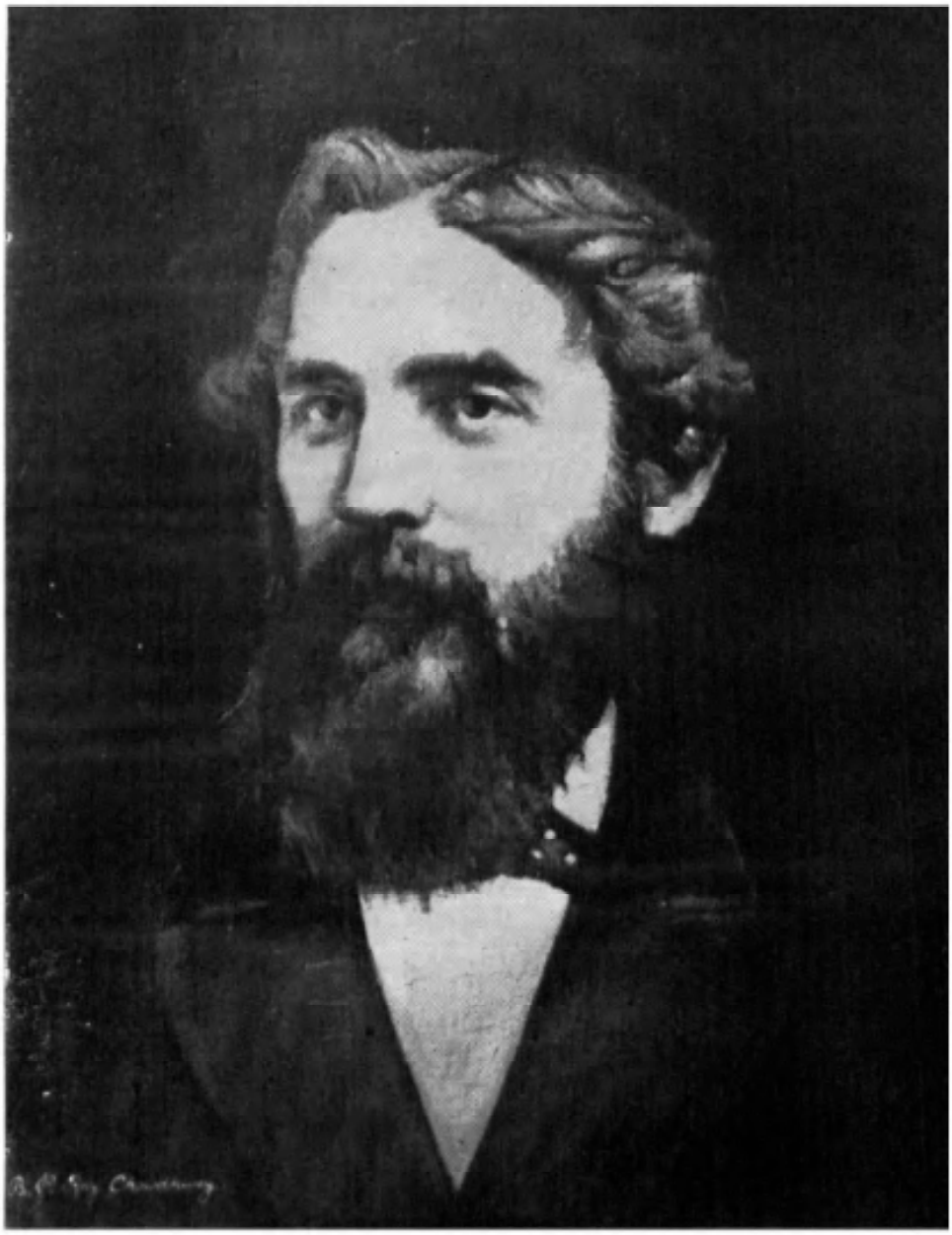
George Watt (1851-1930) had newly qualified in Medicine at the University of Glassgow. He asked for a little delay in sailing and when he reported his arrival in Calcutta (November 1873), Sir George Camp-

bell had taken leave prior to retirement and the opponents of bringing Botany into the teaching of the Presidency College held the field. It happened that Clarke had to receive Watt for the head of his Department and tell him, which he did with a measure of hesitation, that he would not teach in the College, but that a post at Hoogli was open to him, and that certain compensation would be given if he would accept it. Watt did, and went to Hoogli. (See Pl. III).

A fitting reward had been offered for a text-book, and it was to get it that Watt wrote his *First Steps in Botany*. This the Government caused to be translated and published in Bengali (1876). It had no sale as there were no students. Watt followed it up by a smaller book written (1877) at the suggestion of a mission, but it is not known to have been used for teaching. It would have been exacting on one so new to India to hit on the perfectly apt plants for illustration, but the writing was to him invaluable in that during writing he himself was learning. In vacations he made collecting trips—one (1879) to Kulu in the north-west Himalaya, and one (1881) to Jongri in Sikkim. He began to think there was in travel a way out of his frustration and made attempts to induce the Government to give him opportunities. They gave him one : he was attached as a Surgeon to a commission demarcating the Burma-Manipur boundary. He made good use of his time in the field, but did not work out his collections as he saw another opening, for which immediately after the months in Manipur, he asked. It was employment on the staff of the Calcutta Exhibition of 1883-1884; and he got it. Now at last, with 10 years of Indian experience behind him, he was where his genius came to the front. He threw his immense energy into amassing exhibits. He brought his ability for organizing into action and by a great effort compiled in a few months a statement of over 1700 pages enumerating the economic products of India, a statement which served firstly as an indent on the Provinces and secondly as a catalogue for the exhibits, and thirdly as a scheme for their arranging. A man who could do this was clearly capable of more; for instance he could put his knowledge into a cyclopaedia; and he was given the work of compiling his *Dictionary of the Economic Products of India*. Furthermore he was told that he would be required for the forthcoming Indian and Colonial Exhibition in London.

Watt commenced the compiling of his *Dictionary* while waiting for the time of departure for London and had the first volume in print before he sailed. Called to teach in the Presidency College, he never did so ; but was from this time devoted to the service of a much larger audience to whom it was his to expose the 'wealth of India'.

When the Indian Court of the Indian and Colonial Exhibition had been closed and he had returned to Calcutta, his first duty was to complete the writing of his Dictionary. Then followed the creating of a permanent exhibition for Calcutta; one may call it the Dictionary illustrated for the illiterate as well as the literate. And lastly came the



G. Watt

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exhibition of Indian Art at the Delhi Durbar of 1902. On the occasion of this last he was knighted—a very great man on the instruction side of applied Botany in India.

His last work was a revision of the major articles in the *Dictionary* being those on products which command a place in trade.

VI. THE SAHARANPUR GARDEN DURING THE TIME OF THE SECOND CALCUTTA GARDEN, AND AFTER

For the resuscitation of the Saharanpur Garden with George Govan in charge, the reader is referred to Chapter I, (p. 33). The charge was given because Govan was the Civil Surgeon and quite competent to take it as an addition to his medical work. Govan soon retired; and Royle succeeded him as Civil Surgeon and in charge of the Garden. He was active in stocking it with pretty plants and economic plants; and by reason of climate and distance from Calcutta he did this without overlapping. When he took long leave—leave from which he did not return—the post went to Hugh Falconer, who had been for such a short time in India that the promotion is astonishing: but Falconer was of outstanding ability. In this appointment he had 9 years, but through two of them he was away exploring. His arrival in Upper India coincided with the discovery of fossilized mammal bones where the Canal Engineers were constructing the intake of the Jumna Canals and being at heart a geologist he entered into a study of them with zeal and with immense credit to himself. In 1841 his health gave way, and he was forced to leave. The post now went to William Jameson, who held it for 33 years. He had been in India only 4 years when appointed to it. The reader may be reminded that this was the third time that the appointment had gone to a comparative novice, whereas that of Calcutta was reserved for older men; and it may be called to his attention that two of the Saharanpur superintendents became, when older, superintendents of Calcutta. The Calcutta post was intended to be a larger responsibility.

William Jameson (1815-1882) had qualified in medicine in Edinburgh. He reached India in 1838 and for a short time was in Calcutta where he aided the Asiatic Society in their Museum. During his long tenure of the Saharanpur post he did much towards pushing crops into the neighbouring hills, but comparatively little that was botanical. He would collect if a demand reached him, but not determine what he had collected. In this way he made collections for Hooker when he expected Hooker and Thomson to elaborate their *Flora Indica* at once. He had an unpleasant adventure in the very beginning of his service, when having gone to the Indus below Attock to enquire what the cause

had been of disastrous floods there, the Chief of Kohat set on his company and imprisoned him.

In his economic work there was a lack of incisiveness which let him labour too long at causes which were destined to disappoint. The Kangra tea planting was one. Royle and Falconer had so stoutly recommended trials, that he was bound to try the crop. And he did, and succeeded in demonstrating that within the species *Thea sinensis* races exist suited for the north-west Himalaya. But to raise a crop does not insure a market if quality be lacking; that was patent. Yet Jameson went on and he actually became a planter himself on retirement. A second quest on which he spent much time was directed towards getting the flax plant raised for fibre. It could be raised for linseed, why not for fibre? Again the inhibition was economic. A third quest was in potato raising. The raising was all right : Simla, for instance got its potatoes from close at hand; but when the crop was harvested, the rain carried away the now bared soil and sterilized the hillside. Much hill-soil went down the Sutlej and Jumna.

Of course during Jameson's 33 years in the Saharanpur post there were several periods of leave. In one of them J. L. Stewart acted; in another George King.

When Jameson's retirement came, J. F. Duthie was appointed his successor (1876), the post going outside the Medical Service, for Duthie was not a Surgeon, he had been holding a professorship in the Agricultural College at Cirencester. It looks as if those who selected Jameson's successor were seeking a man of economic interests such as Jameson was; instead they obtained a man of strong taxonomic interests, but all the same he gave to the Government much in point relating to economic plants. The following is, in a very curtailed form, Duthie's outline.

John Firminger Duthie (1845-1929) with a degree taken at Cambridge in the Natural Sciences (1867) and, after travelling in the Mediterranean collecting plants, became the Professor of Natural History at the Cirencester Agricultural College, followed in the next year (1876) by appointment to the care of the Saharanpur Garden, where he started by taking stock of the flora, wild and cultivated. Of the wild he compiled an enumeration. The great need of fodder in the dry north-west drove him to pay attention particularly to the grasses, on which he wrote and which he illustrated. Jointly with Joseph Bampfylde Fuller (afterwards knighted) he illustrated in a like way the crops, starting in 1882. Year by year he made a long exploring expedition, bringing into the Saharanpur herbarium considerable material. These expeditions were more often in the Himalaya than in the low country and were spread from Gilgit to the western edge of Nepal. By degrees the information on the plants of the plains grew adequate for the compiling of a Flora, and he published his first part in 1903, by which time he had been collecting material for it for a quarter

of a century. He was extremely particular in matters of detail; and this so delayed him that he did not finish it. Moreover the area which he accepted was large, being as the title has it a *Flora of the Upper Gangetic Plain and of the Adjacent Siwalik and Sub-Himalayan Tracts*. The lay-out deserves great praise. On the other hand for the north-western Himalaya there never was, nor could have been the material for a Flora : Duthie's labours caused materials to accumulate. He returned to Britain in 1903 and was for a short time Assistant for India at Kew ; the position enabling further work, notably a full report on the plants of Sir Richard Strachey's traverse of the Kumaon Himalaya from the Gangetic Plains to the upper or gritty Tibetan Plateau.

Duthie trained a notable collector, Inayat Khan, who came to know the vegetation of the District of Hazara with remarkable thoroughness; and Duthie also exercised considerable influence over Upendranath Kanji Lal, whose *Flora of the School Circle, Dehra Dun,* has the lay-out of Duthie's *Flora.* He caused the Saharanpur Garden to be a collecting centre to which Army officers sent gathering from remote places, so saving them from being lost. His teaching in the Forest School at Dehra Dun by excursions with the pupils was of immense value to the Forest Service.

It is convenient to mention here in passing a botanist of the Punjab of almost the same years as Duthie, but not closely associated with him. This was James Ramsay Drummond (1851-1921), nephew of two men who made their mark as collectors in different parts of the world—James Drummond (1784-1863) in Australia and Thomas Drummond (-1835) in North America. James Ramsay Drummond collected in India as if collecting were in the blood, employing trained men. His considerable collections were given to Kew.

VII. PRAIRIE FIRES

Prairie fires and forest fires intrude into our history. Their effects are so obvious as to compel a botanist's attention; they reshape the medium in which he works, their economic consequences keep them in the highest lights. Prairie fires are fed by grasses and spread under the open sky; forest fires spread under and among trees. They grade into each other, the first the less destructive. The cumulative effects of forest fires at close intervals prepare the surface for prairie fires; and the cumulative effect of prairie fires is degenerated prairie.

On a hot cloudless afternoon in the hottest part of the year it happened once that my work took me to the border of the Toung-Yin teak forest in Tenasserim. I had crossed the level land from Moulmein and had just reached the first rise of the Dawna Hills within which this forest begins, when a line of fire arrived through the virgin forest

of the plain. The flames were gentle; they scarce exceeded 12 inches in height. My road happened to part the level from the first rise of the hills. A spark leapt across it, and there followed a rush of flame up the hill through shrubs, small bamboos, and the lanky grasses that straggled into these. The bamboos exploded as the grass about them burned. Timid animals appeared from hiding places and fled. The contrast between the fire on the level and the fire on the slope was great. Nature was helping the latter in two ways : one was by the rising of the ground; the other in the deteriorated scrubby state of the vegetation as the result of the passing of previous fires. Nature greatly helps. In this case the aid was remotely through the drainage of the slope of the hillside ; secondly by the advantage to the fire of a slope to ascend; and thirdly by the use of an established fire-path. The big trees had gone from it; fires attack them by killing their seedlings as well as by exposing to drying the damp soil which suits them. The light let in had favoured grasses and bamboos; and the fire was the fiercer consequently. As I saw at the foot of the Dawna Hills, so everywhere the effect of firing varies with its relation to the contribution that Nature makes.

An extreme case of contribution is when a big river sterilizes areas by depositing sand as sandbanks.

After accepting that areas are naturally exposed in varying degree to the effects of fire, the next step is to note the consequences of recurrent firing, and that the longer lived by nature the trees that are removed the more remote becomes recovery.

My readers, if they have access to Sir Dietrich Brandis's book, *Indian Trees* (1906), will find interesting facts in it to which I would now refer. At various pages he directs attention to relatively lowly woody plants which grow in places frequently fired and survive by possessing the power of making good after a fire has passed, from underground stems; and it is the covering of soil which secures survival. They have evolved the provision of protected buds where buds are relatively unusual in their allies. One of these plants is *Indigofera hamiltonii*. Its specificity was not admitted in the *Flora of British India*, where the above name will be found as a synonym under *I. atropurpurea* Ham. Others are *Flemingia nana* Roxb. and *F. sericans* Kurz, and *Erythrina resupinata* Roxb., equally belonging to the family Leguminosae ; *Ochna pusilla* Ham. of the Ochnaceae ; *Olax nana* Wall. of the Olacaceae ; *Careya herbacea* Roxb. of the Myrtaceae ; *Combretum nanum* Ham. of the Combretaceae ; *Mussaenda uniflora* Wall. and *M. incana* Wall. of the Rubiaceae ; *Premna nana* Collett & Hemsl. of the Verbenaceae ; and *Jasminum smalesianum* Brandis of the Oleaceae. To these may be added *Grewia scabrophylla* Roxb. of the Tiliaceae in which the character is rather variable, for it grows into a tall shrub if not annually burned down.

Further, attention may be drawn to such herbs as the orchid, *Pachystoma senile* Reichenb. f., whose annual cycle keeps it underground through the months when grass-fires are liable to spread. More could be cited; but those named suffice. I ask my reader to keep in mind the presence of such plants in India; and I have further to ask him to note that they are Indian apparently by origin and for that reason evidence of grass fires in India over their time of evolution.

My reader, having consented that the existence of such plants is evidence of exposure to fires for as long a time as their evolution has required, asks where did the exposure take place. And the answer, taken from their present distribution, is—in the part of Asia which is now India and most probably in India itself. The answer implies firing in India.

Grass can be fired by agencies which Man does not control—by lightning for instance ; by sparks that a landslide produces when its stones collide; by long continued friction in a steady breeze of one dry bamboo over another. But such occurrences would seem to be far too rare for a plant to develop characters to counteract. On the other hand pastoral Man's deliberate incendiarism suffices. Over how many centuries can its operation be claimed? The cultivator in south-western Asia can be shown to have started his selection of cereals 7 or 8 millenia ago and probably earlier See *Proc. Linn. Soc. Lond.* 164, p. 42, 1953). The pastoralist came before him, and it were not unreasonable to think of 10,000 years as serving the pastoralists. In as much as the cultivation of annual crops has extracted from them cultigens, the pastoralists would have had time enough for their annual fires to have led to the evolution of new species in the grass-lands, so long as Nature co-operated with them. I am prepared to think that as remotely as the passing away of the Glacial Period such firing could have commenced to be fairly regular in the Near East with extension to northern India. I am also prepared to think that in the course of time this incendiarism spread down the peninsula of India on the eastern side of the Western Ghats. And I recommend the problems raised to those who can study the northern plains, the southern grassy hills, and the patanas of Ceylon.

The pastoralist who begins to use fire would continue until it became a religious observance carried out even without needing to fire in order to get herbage for animals.

It is impossible to travel about the wide plains of the Indus and the Ganges without recognizing that at one time they carried trees that have gone.

Forest destruction colours the imagery of the Mahabharata, and the suggestion has been made that Alexander the Great was favoured in his crossing of the Indus to attack Poros by trees then existing in concealing density (326 B.C.). It is impossible to look at many southern hillsides without thinking of their lost trees. The removal of forest

brings interference with the springs by drying of the ambit of their sources. This was effectively brought to the notice of those who built the first permanent houses in the Nilgiri Hills; they found their supply of water uncertain. The villagers, too, found that they had further to go for water as for fuel. A realization of this, unreasonably late in time, led to ideas of the importance of forests and contemporaneously ecological ideas touched the more thoughtful in India. It is with this that my next sections deal.

VIII. SAFEGUARDING THE GROWTH OF TEAK IN BURMA

In the year 1826 by a treaty between the East India Company and the King of Burma, the province of Tenasserim was put into the charge of the Company; and Wallich was immediately sent to report on the teak forests. He returned saying that there was plenty of standing teak and that a crop should be taken, but that the teak forests should be declared 'preserved' at once, otherwise they would be ruined in a scramble for that timber. The Company acted on his advice for no longer than two years and then took the short cut of substituting a system of leasing out rights to exploit. It is not necessary here to discuss this; it suffices to note the rapidity with which Moulmein grew rich when the Administration had thus put itself into blinkers. One hundred and nine ships were built in the 20 years between 1830 and 1850 with a great wastage of timber, not in the dockyard but in the forests where the logs were felled in preparation for marketing and then not removed.

In 1837 an Austrian explorer, Johann Wilhelm Helfer, arrived in Tenasserim, having an idea that he would like to settle there, and the Company, thinking to get good independent advice, sought it from him. He said, as others were saying, that the forests were being destroyed. Two years later the Company sent Hugh Falconer to visit the two forests that were exploited from Moulmein, that of Toung-Vin and that of the upper Attaran River. Falconer reported on the latter; his time ran out before he could visit the former; but the opinion he gave applies to both. It was that distant control, attempted from Moulmein by officers who had other affairs to attend to, was ineffectual.

Falconer pointed out that the teak tree is there invariably in a minority among the associated trees and that competition is a normal factor in its life. He listed the competitors; but the end of the fine weather coming, he could not get far.

As a result of what Falconer said, the Company sent McClelland to the Pegu forests that he might collect the competing species there, which he did thoroughly enough. His report (1855), not however by its matter but by the circumstance that the receipt of it drew the attention of the Governor-General Lord Dalhousie to teak, led to the writ-

ing of a most important memorandum on the policy which he thought should be pursued. Then began a search for an administrator with the required preliminary knowledge of botanical methods and the choice fell on Dr. Dietrich Brandis, son of a Professor of the German University of Bonn and himself a teacher of Botany there.

Falconer's suggestion that the teak tree normally lives in competition did not give rise to the thought that there might be compensations. Ecology was too primitive for the idea that the mixed forest by the resultant isolation of the individual could get a measure of protection against the spread of diseases. Meanwhile the coffee planters in Ceylon were leading up to a position that made obvious the possibility. Teak very rarely grows in small pure stands.

Here we part with McClelland. He remained in India until 1865 having reached it in 1830. He has been described as having mediocre ability, but 'born to be a hodman'. He arrived in India with a reputation for geology and was employed studying soils in the hills of Kumaon and was there when required to report on the soils where tea could be found, and so went to Assam with Wallich and Griffith (1835). His report was held to be good. After this he was in and out of Calcutta and for a time worked on the collections of the Asiatic Society, writing a report on the species of carp in India. His central position in Calcutta led to the founding (1841) of his *Calcutta Journal of Natural History* which lasted to 1847. His comradeship with Griffith ended in worship; and it was to Griffith that he became hodman. When he had reported on his work in Pegu, the successor to whom the forests were handed was Sir Dietrich Brandis.

IX. TEAK IN THE PENINSULA OF INDIA

Ring the bark of the ripe teak trees; and let the trunks die standing: they will grow light enough to float and then, felled, use all possible water-porterage to get them to where they are wanted. That treatment has made them peculiarly serviceable down the Bombay coast. We know that teak beams were carried to the Euphrates at least as early as 800 B.C. If teak was carried, teak ships conveyed it. Where were they built ? The merchant Cosmas Indikopleustes, writing much later however of 'sesame logs exported from Calliana', apparently referred to teak that was sent westwards from the Bombay coast. The trade would be slow but continuous. Teak could reach the sea down rivers on the Malabar coast from the Narbada southwards, and on the side of the Bay of Bengal from the Godavari southwards. We read later of *navies* in the Bay.

The East India Company's activity in their Bombay Dockyard produced a demand which strained the supply from time to time and pro-

voked demands for control. I have mentioned in Chapter I (p. 35) an attempt about 1800 A.D. at controlling felling in the southern part of Malabar to safeguard the dockyard's supply. The control was not allowed to last long; but there was another demand in 1822 and with it a claim that the control was workable as it had succeeded in the limited area of Travancore. There was nothing botanical in these spasmodic controls, nor requiring our attention until 1842 when the Government of the Presidency of Madras 'to safeguard the future' permitted the Collector of the District of Malabar, H. V. Conolly, to buy up worked-out teak forest and to spend money on planting teak in it. Within what was his District are the Nilambur forests with conditions ideal for teak; and he is said to have planted over 50,000 seedlings. Conolly has been mentioned in Chapter 3 (p. 95) and along with him Lieutenant Michael who made an attempt at fire-protection by sweeping dead leaves from the seedling plants. Michael's operations were done in the Anaimalai Hills and so a little to the south of Conolly's. Cleghorn, who had earlier recommended fire-protection, obtained his first knowledge of teak further to the north in the Shimoga District. Michael's protective sweepings begin the real history of care for the teak tree in peninsular India. The Swiss horticulturist, Georges Samuel Perrottet, employed in Pondicherry, passing by, was asked what he thought of Michael's sweepings and with an illuminating insight suggested the need of directions from a 'vegetable physiologist'. Conolly's wish for a 'properly qualified conservator' suggests that he too was aware of his and his associates' inadequacy. Michael gained a commendation from the Company's Directors in London for a report made in 1849, and the expression of a hope that the forests under him would escape 'the serious injury that other forests had incurred'. So we see that the Company was awake : indeed they had before this appointed Conservators of Forests, Cleghorn and Gibson, for Madras and Bombay respectively. Appreciating Michael's activity they sent him to Moulmein in 1861 to learn the Tenasserim way of transporting logs, which seems to have been good. The Moulmein fault was waste in the forests by felling and neglecting to take away.

Cleghorn took the position that the fault in Mysore was letting forest fires run through the forests; and he had a temporary administrative success in getting shifting cultivation prohibited; but the Mysore Government went back. Later he experienced the same vacillation from the Presidency Government whose land records were in a confusion which took years to unravel. This briefly was why the Madras Forest Act came to be the last of its series; it came only in 1882.

Passing to Bombay, attention falls on Alexander Gibson (1800-1867). He, like Cleghorn, was an Edinburgh student, but took his qualification in Medicine twenty years earlier. He went to Bombay in 1825, and in the first part of his service was connected with the Company's shipping. In 1836 he was employed through the Deccan and Khandesh in vaccinating, and this rural occupation was the introduction

to charge of the Dapuri Experimental Garden at Poona (1838) in succession to Lush. Among the many reports that he wrote from Dapuri was one on teak (1840). It led, but not immediately, to the post of Conservator of Forests falling to him (1847). It seems that the practice of shifting cultivation was on the increase; and he had a difficult position to maintain. Presumably he had been collecting and drying plants from the days when the work of vaccinating came to him (1836). He seems to have continued to collect to 1867 when his herbarium, which contained contributions from Stocks and Dalzell, was given to the Calcutta Garden.

A custom, very extensive on the Malabar side of India, is that called *rab*. The rice plot is prepared by lighting fires about its surface, and the forest in its neighbourhood is raided to add fuel to the fires. There is no doubt in regard to the benefit of the firing and therefore resistance was to be expected from interference with the cultivators. Gibson had to save the teak which they would lop; and to do it against resistance which came to actual violence; but in the end he succeeded in getting the use of teak forbidden and later the use also of the branches of *Dalbergia latifolia*, the Black Wood.

Four years before his death Gibson published *A Descriptive List of the forest trees of India*, a book which covers rather more than the title indicates, for it contains a discussion of conservancy *i.e., it* touches on the life of the tree that has been described.

X. TWO ILLUSTRATIONS OF SILVICULTURE AS APPLIED ECOLOGY

The deodar (*Cedrus libani* var. *deodara*) is a very valuable timber tree which occurs gregariously in the Himalaya; a companion which grows with it is the woody climber, *Clematis montana*, a lover of the sun, which when it has the opportunity will gain the sun and rob the deodar by climbing on it even to surmounting it. Its seedlings take advantage of the humidity of the shade marginal to the deodar; the grown plant gets the sun in its turn as soon as it can. The perennial stems leaf each year to the detriment of the host and the pretty flowers follow. Lady Amherst, who has been mentioned as one of the first botanists of Simla, saw it there and sent it into cultivation in Europe. An Indian forester knows that by cutting the *Clematis* down he has an easy way of giving back the advantages to the deodar. Should he do so, he is applying an elementary ecological observation to a simple silvicultural operation.

The second illustration is taken from the teak tree, *Tectona grandis*. The ecologist uproots a seedling and observes the size of its taproot; he sees it to be large and by the simplest of reasoning deduces that there is a value to the plant in its capacity; and clearly one of the materials it holds is water to secure growth. Then he sees that

there is an advantage to the seedling in the cover of the accompanying vegetation, for it keeps the moisture from evaporation in the direct sunlight; but the seedling is seen to be light-hungry and disadvantaged if the associated vegetation takes the light. A silvicultural problem appears with the question how can the seedling get the best of its position. The seedling is of rapid growth if favourably placed. Moreover it is desired to encourage the single stem which under the best circumstances will result in a straight and well-grown trunk. The silviculturist has problems of competition to consider and the responsibility on him of a harvest distant may be a hundred years and more, with moreover reproduction thrown in. Advanced silviculture discovers that it can be possible to welcome a little firing if it frees the teak from competitors. However, this is not the place in which to show that the advanced silviculturist needs exceedingly high qualifications, which were not at all in view when Michael swept fallen leaves away and Falconer listed competing trees.

Everything recommendable is then qualified by its expense. The end is reached in this way not by, but through, Botany.

XI. THE INDIAN FOREST SERVICE HAD THREE STAGES

The Indian Forest Service developed from nothing, not evenly, but in three stages. The first covered operations directed at safeguarding the supplies of the timber of one particular tree, the teak tree. These operations were extended to other trees, notably trees useful for fuel, and by provisions for soil-conservancy and water-conservancy, for which the wardens, all, even the lowest, required an elementary knowledge of these trees. The third stage came when the forests were treated as a whole and there was importance in a knowledge of the grasses and herbs of the carpet under the trees, among at least a leaven of the more responsible.

One may say that the Forest Service lived experimenting not only with their material but with their personnel. As to personnel it suffered from the disadvantage that, while able to obtain from Europe experts trained in the methods of the Forester, they had been trained in their application to trees that the Forester was not to encounter in India. These Foresters had inevitably to learn the Indian trees after their arrival in India, in other words to go on learning even under difficulties. The Forest Officer who proved at the same time a conspicuous botanist was manifestly an enthusiast in Botany.

XII. SIR DIETRICH BRANDIS AND THOSE UNDER HIM IN THE FOREST SERVICE WHO WERE BOTANICALLY-MINDED

Dr. Dietrich Brandis (1824-1907, knighted in 1887) was son of a

Professor of Philosophy in the German University of Bonn. After a prolonged education there and elsewhere he became a teacher of Botany in the University. He married a daughter of the Calcutta scholar and missionary, John Clark Marshman, whereas another daughter married the soldier Sir Henry Havelock whose conspicuous service to India is so well known. Thus Brandis had obtained an indirect connection with India a little before his name was brought to the Governor-General when the appointment of an officer to save the teak in Burma was under consideration. It was natural to think of the possibility of the right man being found in Germany as the care of the forests in that country was a matter of some pride to the landowners. In the end Brandis was appointed to the charge of the Pegu forests, Cleghorn and Gibson being at the time respectively Conservators of such Madras and Bombay forests as had not been alienated. All three gained their position as botanists, the two already in India, also as tried administrators. Brandis had his administrative reputation to gain.

Brandis passed through Calcutta at the end of the year 1855, seeing the Governor-General to whom he outlined his plans and from whom he got not only approval but the remark that the plans would prove of great value. Brandis went forward to Rangoon and took over what had been McClelland's last charge.

Few records connected with Brandis are so enlightening as his first report; but I will quote first in Brandis's own words what he regarded as his duty : 'The object of my being appointed in January 1856 by Lord Dalhousie to the charge of the Pegu forests was purely practical. My duty in Burma was to place the management of the teak forests upon a safe footing so as to ensure the maintenance and gradual improvement of the valuable growing stock while utilizing timber not exceeding the amount annually produced in the forests'. It would have been strange if Brandis had not visited the Botanic Garden in Calcutta when passing through. That he did, seeing some of the trees planted in Kyd's time which were still growing, and making a personal estimate of the years to maturity on which his average fellings would have to be calculated.

Brandis sent in his first report as annual from the time of his arrival, *i.e.* January to December. Later the reports were based on the Government's year that ended with March.

I revert to his first report; in it with a kind of austerity Brandis keeps the teak tree as his only subject; there is no mention of any other. The austerity was characteristic; Brandis allowed himself to be a botanist when Forestry was not in view; when it was, he was wholly a Forester; and in dealing with his staff he expected the same of them. I have referred earlier (p. 152) to his book *Indian Trees*. It was written in retirement, when he could allow himself to see plants botanically. Of course in his first years he was learning what names belonged to the associates of the teak; but until they came within a

Forester's interest they were to him outside the day's work. He mapped the areas whence teak could be drawn at mercantile costs without compromising the future and planned extraction. And the report was so well received that in the next year the Tenasserim forests were added to his charge.

In the years from 1856 to 1862, during which Brandis did service entirely in Burma, he made his reputation. Powerful interests sought to frustrate him, as he himself records. Those competent to judge call his appraisal of the position correct and praise him for prevailing.

There was not much ordered knowledge of the Burma flora when he arrived ; but there was a missionary at Moulmein engaged in getting it together. This was Francis Mason (1799-1874). He had resided at Tavoy for a time and then moved to Moulmein. He was a man after the mould of William Carey, of great industry; and he was intent on collecting all the knowledge that he could about things Burmese. In 1850 he published as a small book the first edition of his *Natural Productions of Burmah, or Notes on the Fauna, Flora and Minerals of the Burmese Empire,* a second edition following in 1860. Later (1882-1883) came Theobald's edition, a completely changed book.

Brandis would find Mason's equating of Burmese and botanical plant names useful. Kurz joined in that work, but not until 1866 when he tried to extract plant names from Burmese convicts in the Andaman Islands. Kurz renewed his efforts when shortly he began to travel in Burma.

Cleghorn and Alexander Gibson alike published on Forestry in 1861; then Gibson retired. Meanwhile the Government began to consider the possibility of a Forest Service for the whole of India. Two circumstances hindered them; one was inability to get at Cleghorn because he was on leave and the other the anticipation that they would need to give Brandis leave.

When Cleghorn returned to India in November 1861, he was not allowed to go back to the Madras Presidency, but was sent to the Punjab to study the timber and wood-fuel supplies. By then trains were being hauled in the Punjab plains by engines using wood for fuel and this in a part of India where fuel counted for much. Fuel was also in short supply elsewhere, even in the very south where fuel was wanted for smelting. It is easy to understand why the north-west of India was marked out for fuel study. Moreover there were wise men in Simla with a demonstration at their doors of waste of hill land by the washing away of soil bared of forest in the raising of potato crops (p. 150).

In 1862 Brandis, now back from his leave, was called to Simla and brought into a prolonged contact with Cleghorn to debate the possible service. Their joint report was in print in January, 1964. The Government retained the contact between Brandis and Cleghorn mak-

ing them jointly Inspectors-General. Meanwhile a little engaging of staff had been done; but the number required was so enormous that great courage was needed to face it. There were in India capable men who fancied life at a distance from the cities; men for instance like General Michael who became a great game-hunter. A few of such men came forward; but made barely a handful. There were no means of learning Forestry in Britain such as might serve in supplementing the influx : but there were Forestry Schools in continental Europe; and they were drawn on. The French had a most efficient school at Nancy where young men learned how to take care of growing oaks, pines, and other trees of their countrysides and look after the water supplies. German landowners had combined to create institutions in which their young men qualified for managing the production of timber. By agreement provision for training at the French school at Nancy was arranged. Brandis in 1866 asked that he might be allowed to recruit two trained men from Germany and personally selected Wilhelm Schlich and Berthold Ribbentrop. Cleghorn retired from India in 1867 and became an adviser at the India Office on the selection of entrants whether students from Nancy or with other qualifications. Ribbentrop tells us in his *Forestry in India* (p. 227) that between 1871 and 1880, *i.e.* within the period with which we are concerned, 95 men were accepted who had received teaching at Nancy. They had had the opportunity of learning Botany, up to what was considered qualifying and of course illustrated by trees of a temperate climate, very generally artificilly consociated. The Nancy students were by no means exclusive; but just some among many.

Brandis on Cleghorn's retirement became the sole Inspector-General with a great deal of legislation to help forward. He may be said to have inherited the services of two botanists, N. A. Dalzell and R. H. Beddome, the first in Bombay and the second in Madras. There was at the time in the Punjab Medical Service John Lindsay Stewart (1832-1873) who reached India in 1856 from Edinburgh and was so botanically-minded that he set to work at once accumulating notes with the intention of writing a Flora. He continued to do so for the rest of his life and he could say in 1873 that he had tramped over all the districts of the Punjab. Brandis secured him as Conservator of Forests, Punjab, in 1864, and later we find the two touring together. Brandis secured Gustav Mann in the next year in quite a different way.

Gustav Mann (1838-1916) was born in Germany and trained in horticulture, proceeding to Kew in 1859 for further experience. When at Kew he was offered the post of botanist on the Niger Expedition in the place of William Balfour Baikie who had died; and he accepted it. After returning from the Guinea Coast he was offered service in India and sent to Assam and Sikkim (1863—1881). The India-rubber plantation at Charduar on the Brahmaputra was of his establishing.

I call these four men—Dalzell, Beddome, Stewart, and Mann—

Brandis's botanical scouts. That was exactly their place; behind them as Brandis's front line were other men, engaged in India or brought out from Britain.

I have in previous pages made it clear to the reader that the East India Company brought out 'surgeons' and picked them over when they happened to need a botanist. After the four scouts, recruiting of botanists into the Forest Service was not unlike the East India Company's way; they imported botanists as it were by accident. Those among the Foresters sufficiently botanically-minded showed their flair after reaching India; they had perhaps some knowledge of the names and ways of European trees; setting foot in India they were learners still, the trees different, the conditions different, and of a certainty presenting difficulties. With those entrants who did not turn to Indian Botany we are not concerned; but among the few who did we find some in the front line. It is convenient to name them at once and give the dates of their arrival in India : Schlich and Ribbentrop had, as said, been recruited in 1866; William Rogers Fisher, 1866; George King 1869, serving only to 1871; James Sykes Gamble 1871; Alexander Talbot, 1875; James William Oliver, 1874; John Nisbet, 1875; John Henry Lace, 1881, and George Michael Ryan, 1883, but of the Bombay Presidency Service.

Brandis had been himself in 1856 in the same position as the newcomers into the service from 1866 forward, namely in need to learn his material, but fortunate in the instructions centred on the teak tree. Transfer to Simla brought the need of learning the ways of a very unlike lot of trees. Certain it is that he looked with great hope on the assistance of Stewart. After appointments as Conservator, Stewart had leave and took his collections to Kew for authoritative naming; then he returned for further work, Brandis expecting a *Flora* from him, but Stewart died (1873) with it unwritten, whereon Brandis, being on leave, hastened to Kew and, getting Stewart's memoranda, within a rather astonishingly short time wrote his own version of the *Flora*, namely the story of the woody plants. By Brandis's energy the volume was out of the press in 1874, under the title: Stewart & Brandis, *Forest Flora of North-West and Central India;* and Brandis added to it a volume of plates by the botanical artist, John Nugent Fitch. It is a pity that he devised the name 'Forest Flora' for botanists had long accepted the word 'Flora' as something of geographic import and here was a new and undefined class of guide-book. Perhaps one should say it is a pity that the Forest Service in India adopted the term, for successive compilers were never sure what to omit.

One reason why Brandis was so prompt with his book was that by omitting all the herbaceous families he avoided that which would have delayed him, namely in general the Gamopetalae and Monocotyledons, which Hooker had not yet reached in his *Flora of British*

India. He owed extensively to Hooker for that which Hooker had already done.

The make-up of the book indicates how much more Brandis was casting a line for a Forester than for a Botanist. It is difficult to see how it could have been otherwise, as Brandis was working against time.

Just before Brandis went on the leave in which he took Stewart's place, he had seen through a major event in the history of his Service; it was the setting up of the Forest Survey Office at Dehra Dun. I call it 'major' chiefly because it clinched the connection between the Service and Dehra Dun. The great surveyor, George Everest, had made the connection between surveying and Dehra Dun.

I have called Stewart one of Brandis's scouts. Brandis by taking up the writing of the *Forest Flora* put himself into that exploratory position. It is time to turn to what I have called his front line. I would remark in doing so, that the front line had more need of ecology than the scouts; and of course there could be no preparatory teaching of it in the undeveloped state of that branch of Botany.

Brandis was in the Indian service for 27 years. Schlich and Ribbentrop were under him for 17 years, Gamble 14, Talbot 12, Oliver 9, Nisbet 8, and Lace only 2.

Schlich by his close association with Brandis influenced the service more than any other after Brandis. He proved the apostle of forest education. It has been suggested that Brandis contemplated a teaching staff; but whatever he thought was not presented to Government so as to quicken matters; action there was but it is Schlich's name that is particularly connected with the course forest education took.

Wilhelm Schlich (1840-1925), his school years over, entered the University of Giessen; he associated with his studies the Forestry training available in Germany; and had completed that when Brandis, seeking for two trained men whom he was authorized to engage, found him and persuaded him to adopt India for his profession. His University in 1867 awarded to him a doctor's degree. After arriving in India he had service successively in Pegu, Arakan, Sind, and Bengal; and the service in Bengal extended over the years 1872 to 1881. His task in Arakan was a rather special one, it was to extend a measure of control over the extraction of the timber of *Xylia dolabriformis,* the *pyinkadu* of the Burmese, which had come into demand for railway sleepers. The *Report on the Pyinkadoh Forests of Arakan* published after he had been in India for 4 years holds the names, both botanical and Burmese, of many associated trees and thus is definitely, as could be expected, a study of the forest and in making it Kurz seems to have joined. After this Schlich was transferred to parts of India where Burmese names were not the help that they had been where his native staff was Burmese; and it must have been brought home to him then that Forest Rangers needed a common nomencla-

ture; and he would recognize that the only naming that could possibly suffice is that of Botany.

For seeing what could be done in this direction at small cost Brandis had the experiment tried of sending Forest Rangers in training to the engineering schools where they were to get appropriate teaching. The apprentices, their year's course done, returned to forest work under the Conservators and those of Bengal came from Roorkee to serve under Schlich who had become Conservator. Schlich reported in 1873 that they returned, may be, with a good deal of useful engineering knowledge but with little or nothing gained in forestry. However, only in 1878 did the logical action follow; it was agreed then to set up a school, and Dehra Dun was chosen for the situation. The teaching commenced in 1881, in which year Schlich succeeded Brandis as Inspector-General, and that being so, we may ascribe the early guiding of the school to Schlich. The teaching of the lower classes was in the vernacular and so the School could not serve the south of the Peninsula nor Burma. Schools in these parts came later and did not function within the period under our consideration. This northern School was firmly established before Schlich, in 1885, left India to found and organize forest education in Britain at Cooper's Hill and to guide its subsequent removal to Oxford (1905). From Oxford Schlich, though he wrote nothing purely botanical, wrote much of value in applied botany and encouraged others most extensively to do the same. Gamble, as a very junior member of the service, came under Schlich in 1872 and owed to Schlich's broad-minded outlook the facilities he had for doing excellent botanical work during his years in northern Bengal.

Schlich just before he left India had done another thing for the Dehra Dun organization—one of importance as great as the original founding; he had assigned the preparation of working plans to Dehra Dun and that assured a double portion of the botanical ability of the Service being concentrated there.

In 1869, *i.e.* three years after Schlich joined the Service, William Rogers Fisher (1846-1910) was recruited. He was an Australian by birth; then took a degree in Cambridge and a training in Forestry at Nancy where his course was interrupted by the Franco-Prussian War. During his years in India he took to translating works on Forestry and that led to a transfer to a teaching post at Cooper's Hill and later to the Professorship of Forestry at Oxford in succession to Sir William Schlich. In this way his mark on Indian Forestry fell only indirectly. Gamble's was very different.

James Sykes Gamble (1846-1925) had taken mathematical honours at Oxford, before deciding on Forestry as his life-work and so proceeded late to the Ecole Nationale des Eaux et des Forests at Nancy in France. Then his course was interrupted by the Franco-German War, but escaping to Britain he went under the tuition of Cleghorn

in Edinburgh for a while, until he could return to Nancy to finish his course. He reached India in 1871. During service in northern Bengal (1872 forward) he compiled *A List of the Trees and Shrubs Found in the Darjeeling District* (1878, revised 1896). He followed this up by a paper, the like of which no one in India had thought of: it was an account of the distribution of species of trees on the Darjeeling hills—a most interesting ecological study. Gamble was now a marked man, and was appointed Personal Assistant to the Inspector-General (1877-1879). During these years he prepared the first edition of his *Manual of Indian Timbers*. A second edition came out in 1902 and had been entirely rewritten. After 1879 he was Conservator of Forests, Bengal, then later of Madras, then of Uttar Pradesh, with the Directorship of the Imperial Forest College as part of his duties. We may call him an administrator sent to large charges to bring them to pattern. When retirement set him free he gave himself over to taxonomic research aiding Sir George King by taking over the unfinished *Materials for a Flora of the Malay Peninsula;* and he commenced a *Flora of Madras*. Ten years passed from the arrival of Gamble to the arrival of J. H. Lace.

John Henry Lace (1857-1912) reached India in 1881. For him there were two charges in succession of north-western areas, the first the forests of the State of Chamba which had been put under the direction of the Forest Service by the ruler of the State, the second the forests of the Quetta uplands in Baluchistan. Of each he compiled lists of the flora. In 1900 he was appointed Assistant Inspector-General of Forests and collected then about Simla. After this administrative exigencies sent him to Bengal (1901) and after that to Burma (1904) and kept him there until retirement in 1913. Lace throughout his time was a diligent and critical collector, a pioneer both as to the floras of Chamba and Baluchistan; and he would have issued a *Flora of Maymyo* in the Shan Hills had he lived a little longer. Generous with his material he supplied much to Kew, Calcutta, Dehra Dun, and what he had at the time of his death was given to the Botanic Garden, Edinburgh.

William Alexander Talbot (1847-1917) went to India in 1875 and spent his whole time in the Bombay Presidency. He compiled *A Systematic List of the Trees, Shrubs, and Woody Climbers of the Bombay Presidency* (1894), and followed it by a *Forest Flora of the Bombay Presidency and Sind* (in two richly illustrated volumes, 1909 and 1911). The reader will note that he, Gamble, and Lace were all students from Nancy. In the years when Brandis was a teacher of Botany at Bonn he would instruct taxonomically by a German system; wisely, he conformed to the taxonomic usages of Britain so as not to disturb the knowledge which candidates for enrolment brought to their work; and when these men came to know enough of their forests to list the species, they inevitably arranged them by Hooker's *Flora*. Brandis did

his best to build on the work that the taxonomic botanists were doing and to the furtherance of this came the accident—accident it was as far as he was concerned—of Hooker's sequence leaving the herbaceous Monocotyledons to the last. By the date of Brandis's retirement Hooker had published on the majority of the families that are woody.

I would have the reader note that the botany of those who came to their service under Brandis was taxonomic. This was natural. The Forest Service had not reached an ecological level; and did not before 1880, so that Professor Troup needs to point out that of instructions for forest treatment none before that date were deserving of the name of Working Plans.

In 1881 when the function of preparing these was assigned to the College at Dehra Dun the first period of the Forest Service was over.

Brandis as soon as he had seen through the press his *Forest Flora* left taxonomy alone for a time and become again the forester ; and though he published during his years up to retirement a variety of papers they were strictly practical. Collections of dried plants such as came to him, he passed over to taxonomists. A Conservator of the very early years, Richard Haratio Ely Thompson, had the forests of Oudh which were under him, collected over : he sent the collection to Brandis (1870) and Brandis sent it, as received, to Kew. The collections of a Moravian missionary seeking to get determination for use in a Tibetan dictionary were treated in the same way. About the same time a collection went to Berlin from another missionary named Herzog.

To make it easy to get the early Forest Service into perspective I propose to list the dates in series :

1855 : Lord Dalhousie, the Governor-General lays down a policy for safe-guarding the supplies of Burmese Teak, and Dr. Dietrich Brandis, a teacher at the University of Bonn, is engaged and appointed Conservator of the Pegu forests, a large part of which had been having some protection under Burmese rule.

1856 : Brandis takes over, and in 1857, the forests further south are added to his charge.

1862 : H. F. C. Cleghorn having experience as Conservator of Forests Madras, is brought to the Punjab to widen his experience ; and Brandis is brought into contact with him that the two may advise on a Forest Service for the whole of India where a scarcity of woods other than teak was also causing concern.

1864 : The joint report printed.

1865 : The first Indian Forest Act passed.

1866 : Recruitment of staff in progress. The first recruits from Nancy and two trained in German methods arrived ; local engagement on general ability.

1867 : Cleghorn retired. Brandis left the sole adviser.

1872 : Surveying of the forests in charge of a special branch provided with offices at Dehra Dun where the Headquarters of the Great Trigonometrical Survey had long been.

1872 : Plans for the teaching of Forest Rangers. Brandis realized that tuition would be needed ; he experimented by sending Rangers in training to the Engineering schools for a year.

1873 : Schlich, if not also others, condemned the result and advocated teaching within the Service.

1874 : Brandis devised the *Forest Flora* which shows a kind of tuition he thought needed by the executive staff.

1877 : J. S. Gamble initiated the working lists by an enumeration of the woody plants of the Darjeeling District.

1878 : Effect given to the recommendation that there should be teaching for locally recruited staff, by planning a School at Dehra Dun.

1881 : Teaching begins in the School ; J. F. Duthie called in to help.

1881 : Schlich succeeded Brandis as Inspector-General.

1881 : The first edition of Gamble's *Manual of Indian Timbers.*

1882 : The Madras Forest Act, completing the series. Schlich assigned the work of preparing working plans to Dehra Dun.

1885 : Schlich left India to organize the teaching of Forestry in Britain, B. Ribbentrop succeeding him as Inspector-General.

Dehra Dun was pre-eminently suitable for the central place, for there was place available through which Duthie, called in to help, would lead students in parties among the trees teaching them to know their botanical names. In time the College became self-contained. Stewart had already written on the flora of the Siwalik Hills. The College produced in time an ideal teacher among its own men, Upendranath Kanji Lal. It was not altogether without irregularities that the Forest Service spread ; Kerala for a time remained outside the area of the Imperial Forest Service. During these years Lieutenant-Colonel Alfred Augustus Davidson collected in the State and gave his collections to Kew in 1883. When Kerala obtained a Forest Officer, he was Thomas Fulton Bourdillon who had been coffee planting. Ceylon in like manner provided itself with a Forest Officer, who had formerly planted coffee. This was Frederick Lewis (1857-1930). After a service of 15 years he was transferred to Land-settlement. He was connected with the introduction of Para rubber, planting out the first for the Government.

XIII. THE THIRD CALCUTTA GARDEN : THE GARDEN OF SIR GEORGE KING AND SIR DAVID PRAIN

Sir George King (1840-1909) lost his parents at a very early age

and had a business training under an uncle who was his guardian, but as soon as he was at liberty to shape his own course, an inherent love of Nature led him to decide to enter the Medical profession, which then was the only avenue holding promise to a Naturalist. He wished also for travel and that particularly in the East. He qualified in Medicine in the University of Aberdeen (1865). The avenue to employment in India had been closed in 1860; there was no recruitment of surgeons; but to his delight it was reopened just in time for him, and to Bengal he went. He was stationed in Calcutta, but illness supervened; on that account in the hope that a drier climate might cure it, he was sent to the Upper Gangetic plains and had service successively at Agra, Mathura, Goona, Deola, Mount Abu, and Jodhpur. Such leisure as he had in these places was employed in collecting data on famine foods. Then came a short spell as acting Superintendent of the Garden at Saharanpur (1868), followed by a spell (1869-1870) at Dehra Dun as an Assistant Forest Conservator, during which he was called on to put an end to a deep network of extensive frauds and did so with conspicuous effect, which led to the offer of permanent employment in the Forest Service; but the Secretary of State for India had to find a successor for Thomas Anderson who had been invalided, and he appointed King to the post in the Calcutta Garden. Thus he returned to Calcutta, not now a surgeon in its hospitals, but with the triple duties of (i) Superintendent of the Garden, (ii) Professor of Botany in the Medical College, and (iii) the responsibility for the Cinchona experiment in the Darjeeling Himalaya. Something, I do not know what, thought it may have been the change from rule by the Company to rule by the Crown, caused him to hope that there would be made an Imperial Botanic Service, and he was disappointed; but his friends and counsellors pointed out that the Bengal Government had a deeper pocket than the Government of India and an intenser urge to restore the Garden. King settled to his arduous responsibilities and, with the hope of an Imperial Service gone, he proposed that the botanists under the various presidential and lesser Governments be united into a loose federation with the advantage of a common journal for publication. The command of the journal would be in itself the promoting of research on connected lines. King from this became charged with direct access to the Government of India as Director of the Botanical Survey with the *Records of the Botanical Survey of India* as its Journal (1891). (see pl. IV).

King's awareness that India provided for no survey of the lowest plants, caused him to ask for the addition of a Cryptogamic Botanist to his staff; but he met with a refusal.

By agreement a regional interest was recommended to the different centres of botanical work by which Calcutta had priority in the Eastern Himalaya, Bengal, Assam, Burma, and eastward in general.

When King was appointed Superintendent, Kurz and John Scott

G. King

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plants. The zoologist, Dr. John Scully, stationed in Kathmandu sent dried Nepalese plants, in part collected by Mrs. Scott, wife of one of the Residency staff. The reader sees here a weakening of the botanical momentum of the Garden; the Superintendent tied by his duties to his desk; contact with living vegetation left to others. Prain so long as he was Curator of the Herbarium was able to travel. His longest travel was by the Government's Survey ship to the Andaman Islands and the quiescent volcano, Barren Island. He travelled next through upper India in connection with field weeds, seeking with Lieutenant-Colonel D. D. Cunningham an alternating host for rust of wheat. Another collecting trip was a brief one to Khambajong in Tibet where the Mission of 1903 was halted. Other journeys in India there were but they were not collecting trips.

A visit to the Laccadive Islands had been intended for 1897, but could not be arranged; and collecting from the *'Investigator'* which went thither for coastal survey, was done instead by Colonel William Alcock, the Surgeon-Naturalist and by the ship's apothecary, John Fleming.

When in 1897 Prain stepped from the post of Curator of the Herbarium to that of Superintendent of the Garden, the post of Curator was given to Surgeon-Captain Andres Thomas Gage and he like those before him travelled collecting until the larger responsibilities fell on him. He collected along the southern margin of the Lushai Hills in 1899 and later he collected through the Burmese District of Minbu from east to west. There had been also a short trip in the hills of Ganjam. The reader will note the considerable but not absolute measure in which eyes were directed east in Calcutta agreeable to the understanding that Calcutta's interests were on that side. King's paid collectors were employed almost entirely to the east of the Bay of Bengal.

Under King the Hebarium grew greatly and a new fire-proof building was provided for it. The precaution was underlined as wise when later Gamble's small collection of the Forest Service at Darjeeling and the whole herbarium at Poona were destroyed by fire.

King had had the idea that centres of Forest work would be more efficient if the officers had a small collection for reference and was prepared to make up sets; but seems to have been discouraged by Brandis who saw in them an invitation to scatter energy away from the few economic trees of the very young service.

One of King's constant thoughts was how to forward Hooker's progress with the *Flora of British India*. It was done not only by the flow of herbarium material, but by the preference he gave to work on families of complexity. The Government of Bengal sanctioned the publication of King's illustrated taxonomic monographs as the sumptuous *Annals of the Royal Botanic Garden, Calcutta*, as fulfilling this

purpose. The Asiatic Society agreed to publish the descriptions of the Malayan plants.

King's solicitude extended to the use that he made of funds that he had for sending out collectors. They were sent eastward under the agreement that Calcutta's special interests were towards the east. By their work, the Shan Hills were explored and also the Ruby Mine District of Burma and some mountainous parts of Assam which were penetrable to these men. Under King and after King these served—Abdul Huq, Abdul Khalil, Badam Khan, and Shaik Moqim. The last named went with Pottinger in 1896 into the wild country north of Myitkyina.

Immediately east of Sikkim is the Chumbi Valley, politically Tibetan, but a valley of wild roses, smiling and in features mid-Himalayan. Into this valley an expedition went in 1888 and serving on it was Surgeon-Captain Henry Alfred Cummins of the Royal Army Medical Corps, and finally Professor of Botany at Cork, an enthusiast who collected wherever he went, as well as in the Chumbi Valley. Another who collected in the valley at this same time was E. H. Walsh, the political officer. Some years later a member of the Chinese Customs Service, H. E. Hobson, was stationed at Yatung within the valley and made collections too which were given to Kew. Later, but after 1900 an engineer making a road, Searight, added his quota. The consequence is that an interesting list of the plants is possible.

Contemporaneously, collecting was done on the northern frontier of Sikkim; it was commenced by Sir Francis Younghusband when he arrived at the frontier on a mission to Tibet. Sir David Prain was enabled to make a short visit to the same centre and collect. The collecting was then taken by the surgeon, Walton, who continued it all the way to Lhasa. Another surgeon also collected; this was Lieut.-Col. Lawrence Austine Waddell. Prain had intended to study these collections but pressue of work prevented him.

King's handling of the reconstruction of the Garden was masterly. The reader recalls that the double disaster was due to overmuch water in two forms, saline tidal at the first flooding, saturation of the soil at the second. King saw that the filling of hollows behind the banks was the remedy needed. He took the measure of the earth required to fill these hollows completely ; he calculated the increase of area of the tanks in the Garden that would be necessary to supply it. He plotted its dispersal in a way that would enable visits to be made in favourable positions ; he calculated the cost of the labour that would be adequate; he proposed the spreading of the work over a series of years—nine was agreed on—and in nine it was done. The tanks making one-ninth of the whole surface, were connected by underground pipes and provision made for pumping water into or out of the system. It is probable that no other superintendent in the succession had such clear artistic appreciation as King; at any rate they had

not shown it. Roxburgh may have been a victim of circumstances; he had to build slowly and therefore patchily. Wallich seems to have been unappreciative. Griffith was an iconoclast and the remark that Falconer had to close little winding paths shows McClelland to have lacked taste. Falconer apparently did not have time for planning; Thomson probably lacked the energy and Anderson the opportunity. King's designing was bold and his business-like way, along with that, got him such great credit that he was asked to plan the new Zoological Garden and the gardens of official residences in Calcutta and in Darjeeling. Trust in King brought him sanction for large improvements in the Garden, new lattice plant-houses, propagating pits and their adjuncts, new quarters for staff and, most important of all, the fire-proof building for the Herbarium.

In 1870 a resident in Darjeeling, William Lloyd, generously gave land for a garden in the station; and this land became an annexe to the Calcutta Botanic Garden, serving it as the Mussoorie Garden served Saharanpur, for experiments with plants impatient of the climate of the plains. If when King was appointed Superintendent, the state of the Garden was depressing, the state of the Cinchona experiment almost one of despair. The East India Company had found the establishment of tea expensive, but it had been worth while, as the preliminary expenditure could be called buying knowledge; likewise a large preliminary expenditure was incurred over Cinchona which was justified, but after that the two enterprises were not parallel because a new item had been brought into the estimates for Cinchona, the need of splitting profit between a natural gain and a philanthropic attack on malaria. They were optimists who, envisaging that the claim for the latter could be satisfied, asked of King the apparently unattainable. However, King's horticulturists were succeeding in the part that was theirs.

King in 1884 had cause to visit the Netherlands on a quest not connected with Cinchona; but when there an accident brought to him a little light on the manufacture of quinine which he passed to the chemist, C. D. Wood, who after his work on Cinchona at Mungpu (p. 137 above) was now in London. Wood of his own free will resumed chemical investigations and produced a laboratory process, which King took to Gammie and Gammie converted into a manufacturing process. There was now the possibility that if the medical faculty would accept the total alkaloids of *Cinchona succirubra* for use in India, a cheap malaria remedy could be made available. King put that to the faculty and on the observations of a number of physicians in India it was accepted. King's factory at Mungpu made the febrifuge; the prisons made it up in doses; the post-offices throughout India sold it and the middle man who had tried to intervene was kept outside a country-wide undertaking.

Truly King deserved well of the country of his service.

Prain, working under King from 1887 to 1897, was as King in all the Garden's undertakings, save that a slight preference for economic botany began to show itself in his publications, a preference that was to develop. It fell to Prain to prepare plans against contingencies ahead. King's plans were largely scenic. Prain prepared for gradually sorting the trees on a geographic base; for instance, trees A and B, both natives of Australia, which had now by chance come to be displayed at opposite ends of the Garden by Prain were destined to come together, when one or the other should need to be replaced.

Prain, except that he contrived to make a short collecting visit to Khambajong in Tibet in 1903, was as King had been a prisoner of his administrative work.

When Gage was brought on to the Botanic Garden's staff, on the retirement of King and the promotion of Prain, he was able to travel and went (i) *via* Chittagong to the Southern Lushai Hills, (ii) to Ganjam in Madras in the company of C. E. C. Fischer, and (iii) across the Burmese district of Minbu with L. A. Aubert. When he succeeded Prain as Superintendent, like Prain he was chained to his administration. But late in his service he had cause to botanize in the field seeking land in the Himalaya and Tenasserim for Cinchona cultivation.

Facts show how deeply the Cinchona experiment acted on the Calcutta Garden. Teak and Tea had broken into the Superintendent's routine at different periods and for short times ; but Cinchona entered into the routine and there was no travel for the sake of collecting for the Superintendent as for the Curator. The voluntary collector, the botanist whose pleasure it was to collect lost none of his importance, now Prain realized that and tried to work up the Botanic Survey.

CHAPTER VI

THE PUBLICATION OF HOOKER'S *FLORA OF BRITISH INDIA* AND WHAT ITS PUBLICATION RELEASED

I. THE PUBLICATION OF HOOKER'S *Flora of British India* RELEASES FLORAS OF DIVISIONAL OR SUB-AREAS

Sir Joseph Hooker described his *Flora of British India* as 'an attempt to sweep together and systematise a century of hitherto undigested materials scattered through a library of botanical books and monographs, in vast public and private herbaria and a "pioneer work". It was a large undertaking; its seven volumes together weigh so much that a botanist cannot conveniently take them into the field; the work is for the study. In a valedictory preface to the last volume he expressed a wish that 'it would facilitate the preparation of local floras'. That it did. By the time that others were in a position to guess the date of its conclusion some of them were engaged on writing their own local Flora. So much the better. Hooker himself set the example by taking up at once the completion of Trimen's *Handbook to the Flora of Ceylon*; and he had vol. 4 out in 1898 and vol. 5 in 1900. But the reader is entitled to comment—5 is not a great reduction

on 7. The next author in time was Theodore Cooke with the first part of his *Flora of the Bombay Presidency* who reduced the number of volumes to 2, albeit bulky. Theodore Cooke (1836-1910) had gone to India in 1860 to build railways; Botany became a hobby, ability brought him to the position of Principal of the Poona Civil Engineering College and it was from it that he organized both teaching and a field study of Botany. When the Forest Service wanted to start training Forest Rangers (see chapter V, section XI) he came forward with proposals to have Botany taught at Poona. The proposal was not accepted. But when King advised the formation of the Botanical Survey (see chapter V, section XIII) Cooke organized (1891) a Bombay section complete with a Presidency Director and collectors and within the College buildings a herbarium which remained under his direction until he retired (1893).

From 1866 George Marshall Woodrow (1846-1911) had been in charge of the Ganeshkhind Experimental Garden—in 1872 his charge was extended over all the official gardens in Poona; in 1879 he became lecturer in the College; and in 1893, when Cooke retired, the directorship of the local Botanical Survey passed to him. He held it until 1899, when his retirement came and it was passed to George Gammie. The Survey originated a method of collecting by caravan. This team was well calculated to advance available knowledge of the Bombay flora. Cooke determined to write a Flora for which purpose he moved to Kew on retirement. He had divided a personal herbarium into two parts, one to retain, the other for the Herbarium in the College. Cooke contrived to get a volume of his *Flora* completed by 1901. Later, when an unfortunate fire destroyed the Herbarium, that he had so enriched, he gave in replacement the half that he had kept. He continued his work, completing it by a second volume (1908).

It will conduce to clarity if I assemble the dates here : Ceylon, recognizing that the first essential rested in a Flora, began the preparation of that for the island with Trimen's appointment to the post of Director of the Peradeniya Garden (1879) ; Bengal held itself ready at the publication of Hooker's *Flora of British India* (1897) and was prompt (1903) with one; Upper India held itself entitled to begin one (1903) ; Bombay and Madras were left behind ; Bombay took the help that Kew was able to offer and Cooke did his work there; the means of Bombay had not been developed adequately. Later Madras needed similar help. As the Government of India had turned a nearly deaf ear to King's suggestions for linking the botanical work of the different parts of India together, the efforts were independent, save that the Saharanpur and Calcutta gardens kept in rather close touch.

When Cooke commenced making his collections he was so domiciled as to be able to explore rather more freely that part of the Presidency where Bombay City and Poona are than the southern parts of the Presidency; these were then getting the attention of Alexander

Talbot and A. P. Young. The considerable collections of the latter were sent to the British Museum (Natural History) in 1884.

The next flora to reach printing was Kanji Lal's *Forest Flora* of the School Circle, *i.e.* of Dehra Dun. It was out as a whole in 1901, the year of Cooke's first volume and much before Cooke's second. It was followed in the next year by two other Floras, Sir David Prain's *Bengal Plants* and Sir Henry Collett's *Flora Simlensis;* and these were followed one year later by the first part of Duthie's *Flora of the Upper Gangetic Plain and the Adjacent Siwalik and Sub-Himalayan Tracts.* With this sequence of dates before him reader sees how real was the release.

Beyond all doubt, each of the five authors felt the need of keeping down the size of his volume or volumes; but they reacted in very different ways. Prain took the most original line. Writing actually for the students that he taught in the Medical College and well aware that the common garden plants of Bengal were on the whole better known to them than the country's wild plants, he inserted these, getting room to do so by excluding descriptions in favour of keys. Brandis, who had retired to his native town in Germany at some date in the early nineties, returned to taxonomic work ; and, restricting himself as he had done before to woody plants, started to write his *Indian Trees.* In 1899 he moved to Kew that the work might be checked there. The book has great value, but is of course not a geographic section cut out of the *Flora of British India.* It was not published until 1906. Another forest Flora which must have been well in preparation before 1900, but not published until 1909 (with a second volume in 1911) was Talbot's *Forest Flora of the Bombay Presidency and Sind.*

Duthie's *Flora* is deserving of great praise, but progressed so slowly that he himself did not complete it.

Prain, while engaged on writing his *Bengal Plants* prepared a working list for the use of the dweller in Calcutta— a list of the plants of the three districts that surround the city—Howrah, Hughli, and the Twenty-four Parganas. It was printed in the third volume of the *Records of the Botanical Survey.* The nearer these publications were to the date of the *Flora of British India* the more faithfully do they follow its taxonomy. Does my reader at times give thought to the 'species' as a conception that has grown up very much without challenge but with universal consent ? That consent is basic in the biological sciences, and the species concept is unavoidable. But the individual taxonomist, except, it seems, a Russian school, forms his own concept of the range of variation which he should allow. That being so, it was vastly to the advantage of India that one man, namely Sir Joseph Hooker, should be allowed to impress his estimate of specific range on the whole phanerogamic flora of the sub-continent.

To a small extent Dalgado's *Flora of Goa* escapes Hooker's influence in that Celasio Dalgado, the author, though a correspondent, was not more closely associated with Kew. He had been born in Goa, had qualified in Medicine, and became the Civil Surgeon of the little State of Sawantwadi. Goa and Sawantwadi are outside the area of Malabar whence Rheede drew his information; but it was the *Hortus Malabaricus* that drew Dalgado to his study of the simples. The *Flora* was published in 1898; and later its author lived in Lisbon.

While Prain was at work on his Flora, the surgeon John Justus Wood of the Madras Medical Service retiring, moved to Chota Nagpur and collected compiling a list of the *Plants of Chutia Nagpur* published in the *Records of the Botanical Survey* in 1902, and two missionaries Father Cardon and the Rev. Campbell of Pokhuria collected. Further the Hieronymite missionary, Father Rastier, collected at Bettiah in the unworked district of Champaran.

The following information may be inserted here. A list of Simla plants was printed privately by Mr. H. B. Smith and Lady E. Smith; and some years after 1900 Miss Emilia Frances Noel published an enumeration of plants that she had found in various parts of Kashmir.

Right in the extreme south of India Emile Deschamps and Francis Wilms collected. The first mostly in the French Settlements of either coast and in Ceylon; the second in Kerala. Wilms's specimens were given to Kew.

II. COOPER'S HILL AND A MORE FAVOURABLE OUTLOOK IN INDIA TOWARDS BOTANY

Towards the end of section XI of chapter V the reader was made aware how it came about that teaching was provided at Dehra Dun for Forest Rangers and told that, though Brandis was still in India when events led up to it, the moving spirit was Schlich's.

Schlich was Inspector-General of Forests for less than five years, as in 1885 he left for Britain to organize another teaching centre—the Forestry College as part of the Imperial Engineering College at Cooper's Hill (some 20 miles west of London) where Foresters for India were to have the advantage of learning their technology through the medium of their own tongue and under a specially appointed staff.

I have called the Botanists who entered the Forest Service under Brandis, Brandis's front line. Those who followed them, and had had a different training make the second line. They had for a teacher Marshall Ward, who was appointed to the Professorship of Botany (1886).

Harry Marshall Ward (1854-1906) was contemplating a career as a teacher of the Natural Sciences when at the age of 20 he attended evening classes taught by the most inspiring teachers in London, and then

went to Cambridge where he passed botanically under Vines. With a degree gained, he was chosen to go to Ceylon with an appointment of two years in which he was to find if possible a way of suppressing the coffee-leaf disease. That experience over, he taught Botany in the University of Manchester until chosen for Cooper's Hill.

His suitability for the post was undoubted, his experience of tropical vegetation a recommendation, and he taught for 10 years. I put before my readers the names of a few of his pupils who made their mark on the Botany of India with the dates of entering India: H. H. Haines (1888), C. G Rogers (1888), R. L. Heining (1895); C. E. C. Fischer (1895), and R. S. Hole (1896). Marshall Ward left Cooper's Hill in that year before the following two new pupils could finish their courses : B.B. B. Osmaston (1896) and R. S. Troup (1897).

Cooper's Hill is near enough to Kew, for Ward to bring over his students week by week in summer to see live plants falling within their interest.

The reader perhaps comments that the botanical maturity of these officers came one or two decades after 1900 at which my chapter is expected to end. That is so. I break bounds as without looking forward the shaping of the end of my period will become uninformative and ragged as regards Troup's most valuable work.

Henry Haselfoot Haines (1867-1943) reached India at the very end of the year 1888. He had passed out of Cooper's Hill at the head of the list and it was to be his to serve in northern Bengal forests which Schlich himself had organized excellently; he was in these forests until 1899 when he was moved to Singbhum, south of the Ganges, where working plans for forest management were in hand. Haines collected, but had not at first the idea of writing on that flora. The idea came in a further spell of service in the same part of India which enlarged his opportunities. It may be said that he was fortunate in regard to them. He escaped the very great transfers which have broken into the experiences of so many of the botanists of the Forest Service—interruptions through wide experiences are pleasant if time is given for digesting them. He became Divisional Forest Officer for Chota Nagpur and, when he could obtain leave, tramped through four of the districts of Chota Nagpur to extend his knowledge. Being appointed to the new post of Imperial Forest Botanist at Dehra Dun (1905) he had the time and the means of working out his collections. The working out was finished next at Kew. On his return to India his results to date were embodied in his *Forest Flora of Chota Nagpur including Gangpur and the Sontal Pergunnahs* (1910).

Chota Nagpur had of course come within the area that Prain covered in his *Bengal Plants,* but that in no way lessened the value of Haines's *Flora,* for Haines wrote for an entirely different assembly of readers, and moreover his descriptions were original. We do not need to follow Haines's successive appointments; it suffices to record that in

1914 he became Conservator of Forests, Bihar and Orissa, and that the gradual extension of the interest of the Forest Service over forests in which grazing was encouraged had meanwhile increased the responsibilities and directed attention to the carpet of herbs on the soil. Now at last complete flora had the right which Haines gave to it. Haines had collected as he could; then again he used his own time to work the plants out in the Calcutta Garden and at Kew.

How far Haines's opportunities were officially designed to lead to a complete Flora can only be ascertained from official records. One would like to think that they were; whether it was so or was not, the curating and naming cost Haines most of his leisure. He gave the collections to Kew when his book had appeared.

The next name on the list is that of Charles Gilbert Rogers (1864-1937). Like Haines he had his early service in northern Bengal; thereafter he was posted to widely scattered parts—the Andaman Islands, Berar, and Pegu, so scattered that the learning of each flora involved a step back at each transfer. This and a catholicity in interests made him a collector for others; but he did much to promote their work.

The third name on the list is that of Robert Lawrence Heinig. He had service in the Andaman Islands, Chittagong, and the Sundarbans. He compiled a *Forest Manual of the Andamans* which was published in 1900; and he collected a large part of the information required for working plans for the forests of the Sundarbans whence Calcutta so extensively gets its fire-wood. He compiled *A List of Plants of the Chittagong Collectorate and Hill Tracts* (1925) and supplied to Prain much information for his *Flora of the Sundribans* (*Rec. Bot. Surv. India*, 1903).

The fourth name on the list is that of Cecil Ernest Claude Fischer (1874-1950). He had had part of his technical training at Nancy and part at Cooper's Hill. Arriving in India in 1895, he was sent to Madras and did the whole of his service in that Presidency except a short spell of teaching at Dehra Dun. He sent collections to the Calcutta Garden and, when stationed at Coimbatore from 1911 forward, was able to give time to the flora of the Anamalai Hills and with the help of collections in the possession of the Agricultural College to produce his 'Survey of the Flora of the Annamalai Hills' (*Rec. Bot. Surv. India* 9, No. 1; 1921). After retirement he became Assistant for India in the Kew Herbarium (1925-1937) and did most valuable work including the completion of Gamble's unfinished *Flora of Madras*.

Robert Selby Hole (1874-1938) arrived in India in 1896. He had passed out of Cooper's Hill at the head of the list. His first service in India was in the Central Provinces; then he was sent to Dehra Dun as Instructor in the College; following this he was promoted Imperial Forest Botanist in succession to Haines (1906), teaching and investigating forest composition and chiefly the make-up of the ground covering, seeking the relation between it and the canopy. Hole was indeed a

pioneer. In 1909 he was instructed to prepare a text book for the student. This, his *Manual of Botany for Indian Forest Students,* has for us the great interest of exposing what was taught.

Bertram Beresford Osmaston was an earlier Instructor in the College then did service in various parts of northern India, and was again on the College staff, sending collections to the Calcutta Garden.

The last name on this list is that of Robert Scott Troup (1874-1939). He reached India in 1897, already a marked man; and was sent to the Tharrawadi teak forests of Burma, whence 9 years later he was called to the establishment at Dehra Dun; and at Dehra Dun he completed his service in India in 1920, returning to Britain to succeed Schlich at Oxford as Professor of Forestry.

Troup comments in one place that the Service in India had not the ability—one may say had not the experience—for drawing up working plans until after the days of Brandis. Genuine plans came later and were gradually improved as experience was gathered. Then came the concentration of the minds who did the actual planning at Dehra Dun, and after that the establishment of a Research unit—the Research Institute with five divisions, one of them for working plans. Troup being at Dehra Dun, when the Institute actually came into being, was at first given the Division of Utilisation, but was soon turned over to the Division of Working Plans. The transfer gave him charge of a vast store of data on tree behaviour which he digested into his masterly *Silviculture of Indian Trees.*

In the year after Troup, Sir Ralph Pearson went out to India in the Forest Service. It suffices to add his name as being that of one of the men who put Botany forward. He was not of Marshall Ward's teaching.

I have sought in this section to convey to the reader how greatly Schlich's educational Policy was calculated to increase the efficiency of the botanically minded who reached India, and that the needs of the Service were segregating specialists and, again, what the delegation of work to Dehra Dun has meant.

At the same time a voice whispers—Dehra Dun is far from central.

III. VASCULAR CRYPTOGAMS OVER THE HALF CENTURY

No one can complain that ferns do not get the attention of botanists. Because they are of a size similar to herbaceous flowering plants, they get the same attention. They even get rather more, for there are many of those who specialize. The mosses get the attention of collectors of mosses.

This section is a continuation of the record brought to 1850 in the second chapter. Soon after that year two botanists whose interests were

wide, cleared a way for the fern specialist; they were R. H. Beddome and C. B. Clarke. Beddome published in 1863-1864 his *Ferns of Southern India: being Descriptions and Plates of the Ferns of the Madras Presidency,* following it in 1865-1870 by his *Ferns of British India : being Figures and Descriptions of Ferns from all Parts of British India.* Later (1883) came his *Handbook of the Ferns of British India, Ceylon and the Malaya Peninsula.*

C. B. Clarke had slightly anticipated the last by publishing in 1880 his paper—'A Review of the Ferns of Northern India' (1880). Henry Francis Blandford followed in 1888 with his *Ferns of Simla.*

Very striking indeed is the relative abundance of ferns in different parts of India, so striking as to set the mind wondering on what limiting factor Nature failed to evolve ferns more freely for generally unsuitable areas. The local poverty is illustrated by what Prain records in his Bengal Plants. His area is divided by him into 10 sub-areas: Tirhut, Bihar, Chota Nagpur, North Bengal, Central Bengal, West Bengal, Orissa, East Bengal, Tippera, and Chittagong. He names 112 species, of which 88 are found in Chittagong, 53 being only in Chittagong. Chittagong therefore for a collector of ferns is a paradise. After Chittagong Chota Nagpur is favourable, for it has 12 that are unrecorded for other sub-areas of Bengal and 5 more in common with Chittagong, but not beyond these two sub-areas. The rest of Bengal is strikingly poor, so poor as to handicap the Botanical teaching in Calcutta by making material for illustration difficult to get, save from the Botanic Garden; and of the Garden it may be recalled Griffith discovered his fern material deficient (see p. 69 of the second chapter).

It is evident that the fern specialist who is not free to travel may be area-limited.

Of fern-lovers connected with India Sir William Norris may have been among the first; if not, it would be because he was not collecting during his earlier years in Ceylon: he collected vigorously after his transfer to Penang as Recorder for the Straits Settlements. Lady Dalhousie was at the time in Penang and an enthusiastic companion in the field. Sir William Norris went back to Ceylon as Chief Justice (1847), and on retirement took his collections to Britain and they were given to Kew. He has already been mentioned in chapter II as climbing Mount Ophir with Griffith.

Ceylon is a paradise for the botanist seeking ferns. William Ferguson (1820-1887), a Surveyor who reached the island in 1839 and was there until his death, collected ferns during part of his long career, and in 1880 published an account of them. There were three other collectors in the island about that time—George Wall, a merchant of Colombo, W. Thomas Naylor Beckett, a coffee-planter, and Frederick J. Hutchinson, an army officer. They rivalled each other in collecting and helped each other. Hutchinson collected also in the Nilgiri Hills. After his service in the East he was stationed in Plymouth and, when he died,

he left a beautifully mounted and cared-for collection. A contemporary, collecting in northern India, was Charles William Webley Hope (1832-1904), a Civil Engineer who had reached India in 1859 and had adopted fern collecting as a pastime. His *Ferns of North-Western India* was published by the Bombay Natural History Society in 1899-1903. One of Hope's interests was to connect the epiphytic ferns with the most favourable support, a line of study which belongs to ecology. Harry Corbyn Levinge (1831-1896), of the Bengal Public Works Department, collected ferns in the Sikkim and Kashmir Himalaya and in the Nilgiri Hills; and J. Munro, a tea-planter, collected in Sikkim. It happened that Britain was leading Europe in attention to ferns; and, by British workers of the time in India, the knowledge of the ferns was brought to a very dependable level.

Not so the Mosses; specialists interested in them were few, and their study more difficult.

The study of the Mosses of India may be said to have commenced when the road to Nepal was opened; but it was not long before the southern parts of the Peninsula also received attention. Francis Buchanan, the first (1802) to collect in Nepal these small but most attractive plants, had collected mosses to good effect in Scotland before he went to India (see Prain, *Life of Francis Buchanan*, p. vi, footnote). The first close attention to the southern mosses came from some of the earliest to settle in the Nilgiri Hills and also when collecting in Ceylon followed. Sir Joseph Hooker, when he searched for geographic data for his *Sketch of the Flora of British India*, was compelled to admit that in 1900 data which would serve him did not exist. Nor did they for yet another 30 years—that is until the publication of a list compiled by Professor J. P. Briihl (*Rec. Bot. Surv. India* 13, pp. 15-120; 1931). The list suggests a great abundance among them in all the wettest parts of India proper, not only of species of mosses but also of endemics. This great endemism is doubtless exaggerated and will be reduced by further study as exploration is continued. Many of the Ceylon species not recorded as occurring in the mountains of southern India will be found to have been overlooked; and a considerable number now known from the Nilgiri or Palni Hills will be found in the Western Ghats or elsewhere outside their known range. As for the species of Burma the knowledge that we have is very meagre.

Among the collectors of mosses in India, the only taxonomist so advanced as to make determinations had been Griffith.

In my second chapter I referred to Mitten's *Conspectus* of the mosses that he knew to occur and I got together the names of the collectors to his year of publishing (1869). At that date Thwaites was collecting as opportunities came to him, and Mitten (1873) reported on Thwaites's specimens including what W. T. Naylor Beckett obtained for Thwaites. In 1872 Odoardo Beccari left Italy on his great travels in Malaysia, and halted in Ceylon for a short time. His mosses, then

collected, were determined later by Hampe (1872). Activity increased towards the end of the century. J. F. Duthie collected vigorously when touring in the north-western Himalaya, and Brotherus reported on the results. He reported also on mosses collected in Coorg by Dr. T. A. Walker, Mrs. May Bradford collected in the Sikkim Himalaya; J. H. Darrell and C.E.C. Fischer in southern India, H. N. Dixon reporting on these. A. W. Fraser, an officer in the Royal Engineers, collected in northern Burma.

The Hepaticae drew very little attention until 1893, in which year Victor Felix Schiffner, at the time a lecturer in Prague, was commissioned to write up this group for Engler's *Pflanzenfamilien,* and to get material travelled in Bombay, Ceylon, and forward to Malaysia, collecting in large quantities.

IV. THE MICROSCOPE IS GREATLY IMPROVED AND BOTANY PROFITS IN UNDERSTANDING THE LOWER PLANTS: EFFECTIVE COLLECTING OF THEM BEGINS IN CEYLON

The great improvements referred to in this section were made in Europe, where every branch of Botany profited, perhaps most of all the understanding of sex in the higher plants, which, as it involved understanding sex in the plants at large, intensified the interest in the Algae and Fungi. The first Botanist to make any systematic attempt at collecting these in our area was George Gardner who in 1844 reached Ceylon as Superintendent of the Peradeniya Botanic Garden. During the short time before his death in 1848 he sent herbarium specimens to his former teacher, Sir William Hooker, and by the services of the artist Harmanis De Alwis preserved records of fleshy Agarics in coloured drawings. But Gardner's time was short; and it was not much that he could do.

William Henry Harvey (1811-1860) as a school boy made all the use that he could of holidays at the sea-side to satisfy a tremendous inquisitiveness into the life that was there, and again as a young man in business used the opportunities of holidays. Among diverse interests he found his greatest in collecting the sea-weeds of the British Isles. Then came to him some years of employment at the Cape of Good Hope where he made acquaintance with a different algal flora. A return to Ireland was followed by appointment as Keeper of the Herbarium of the Dublin University. He had made a friendship with Sir William Hooker as far back as 1829; now University vacations allowed Harvey personal contact with him in work at Kew. Publication on British sea-weeds commenced. Harvey was next enabled to visit the east coast of North America. In 1853 he executed the largest collecting trip of his life. He sailed for Egypt, proceeded via Aden to Ceylon,

then went to Singapore, Australia, the Central Pacific, the west coast of South America, and returned to Dublin carrying back very extensive material; and in Dublin was elected a Professor (1848). His collection had numbered 5000 specimens before Australia was reached.

The reader realises how advantageous it was that so great an authority should name up the Ceylon sea-weeds.

Next as to Fungi :

Thwaites, as the reader will have realized, was at Peradeniya at the time of Harvey's visit. He had been in Ceylon for 2½ years, finding his feet, enquiring what the obscure as well as the obvious plants were. Like Harvey he had been in business and his knowledge was that which a naturalist gets by contact with living things.

He was soon sending specimens which he could not name to Sir William Hooker at Kew and leaving to his discretion the manner of handling them. Hooker from 1828 had had the friendship and co-operation in work of the mycologist, M. J. Berkeley, and all the fungi received from Thwaites were sent to Berkeley.

Miles Joseph Berkeley (1803-1889) was already a naturalist before he went as a student to Cambridge. There he came into the company of J. S. Henslow, not as yet the Professor of Botany but sufficient of a leader to have been elected Secretary of the Cambridge Philosophical Society.

Berkeley left Cambridge for a curacy at Margate on the Kent coast, where he was able to give his leisure to studying the life of the sea-shore, just as Harvey was doing on an Irish coast of very different aspect. Berkeley's first publications were on animals; the next (1833) were on Algae. Fungi later usurped the first place, partly because Berkeley by moving inland lost touch with the sea-weeds and partly bacause he found his energy satisfied when Hooker persuaded him to undertake the elaboration of the Fungi for his edition of Smith & Sowerby's *British Flora*. Later the interest became world wide and a very fruitful association commenced between Berkeley and Christopher Edmund Broome (1812-1886) which carried the study of Ceylon fungi so far that before Broome's death they had described more than 1200 species. Broome was by profession a lawyer, but leisured and had had the friendship of Thwaites in Bristol.

The coffee-leaf disease, *Hemileia vastatrix,* got its condemnatory name from them in 1871; but it had not deserved the epithet *vastatrix* had not intense cultivation, by offering unbroken stretches of planted coffee, invited its riotous spread.

Wallich's son George Charles Wallich, born in the Calcutta Garden in 1818, after taking the degree of doctor of medicine in Edinburgh had entered the service of the East India Company. In Calcutta he became a specialist in the Diatoms of Lower Bengal and of the Bay of Bengal and listed them. Later when the great undertaking came of connecting the coasts of Britain and North America by a submarine cable (1860)

he was drawn from India to study the life on the floor of the Atlantic.

The algae of the Indian fresh waters, swamps, rice fields, and rivers got little attention; and it was their smallness that led to this.

In 1888 an ingenious botanist, Professor G. von Lagerheim, observing in the Copenhagen Museum much debris attached to the roots of a specimen of a *Myriophyllum* collected by Hooker in the Bengal plains, soaked off the adherent material, and identified 52 species of algae in it. Then he treated specimens of *Utricularia* similarly.

Professor George Dickie (1813-1882), at one time of Aberdeen and then of Belfast, in the last paper that he wrote describes Algae that he had received from the Himalaya (1881).

William Joshua (1828-1898) described (1886) Desmidiaceae of a considerable collection that Dr. Robert Romanis had sent to him from Rangoon. William Barwell Turner's *Fresh Water Algae,* principally Desmids of India, appeared in Stockholm in 1892. Professor Antonin Hansgirg collected in the Bombay Ghats; and his collection was worked through by Wilhelm Schmilde (1900). In 1896-1897 William G. Freeman took rather extensive samples from various places in western Ceylon and from under various conditions. Freeman's sampling, probably the best sampling made before the century ended, was reported on fully by the two Wests, William West (1848-1914) of Bristol and his son Professor George Stephen West of the Mason College, Birmingham. The Wests' report on the Ceylon Algae was followed by reports on Algae from various parts of India both by the Wests and by Dr. Nellie Carter. But right up to the early years of the 20th Century the Indian freshwater Algae were very inadequately collected.

Some collecting of fungi in Ceylon was done by Odoardo Beccari. He (1843-1920), as soon as he had finished his University studies (1864), began to plan jointly with Marquis Giacomo Doria the first of his collecting expeditions to the Malay Archipelago. Together they set out in the next year and there was a halt in Ceylon when a small collection of fungi was made.

The reader will find more details regarding fungi than are given here in a paper by Sir Edwin Butler and Dr. Bisby in the first of the Science Monographs of the Imperial Council of Agricultural Research, 1931.

V. A GREAT STEP FORWARD IN THE BOTANIC LABORATORY : THOUGH VERY HESITATINGLY TAKEN

Laboratories are of many kinds ; but our interest is in none until dedicated temporarily or otherwise to botanic work.

The word 'laboratory' had obtained recognition as meaning a workroom for chemical investigations and other work requiring apparatus.

What was new in the use of it in India was not the holding of apparatus, but the idea of needing a building to hold apparatus for the purposes of Botany. The medical schools, powder factories, museum of the Asiatic Society, etc. had had need of a room set apart; Jacquemont describes a chemical lecture given in Calcutta in 1829 which implied a chemical laboratory. Without Mycology the appearing of the botanical laboratory in India would have been even later than it was.

David Douglas Cunningham (1832-1914) entered the Indian Medical Service in 1868. He and another entrant, T. G. Lewis, were not forthwith sent out to India in the usual way, but were marked off for a little further learning; they were sent to Berkeley to see him at work and then sent to Germany to see Professor Anton De Bary at work. We have seen Berkeley at his life-work—the taxonomy of the Fungi. Why were these two entrants to the Indian Medical Service sent to Berkeley?

De Bary had published two years earlier one of his books—his *Morphology and Physiology of the Fungi, Lichens and Myxomycetes,* a book which he himself said had been well received and had paved the way for further advances. De Bary was a master of method of laboratory study of the Fungi and other Lower Plants; Cunningham would be able to see life-histories under investigation in the most fertile conditions.

The two entrants into the Medical Service were sent to other centres of research also. They went to India in 1869; doubtless the better for what they had seen; though their delegation might be taken for an intention to promote a study of the fungi, their careers were not directed towards that. Cunningham's first laboratory in India was pathological and only mycological in an incidental way. In 1885 there was a redistribution of work which affected both. Lewis called to the India Office in London and Cunningham nominated Professor of Physiology in the Medical College, Calcutta. He controlled a laboratory of course; and in that laboratoy carried out some very interesting mycological investigations. Sir David Prain, who saw Cunningham's work in progress, classes his mycological writings as recreations of an active mind, 'either questions which attracted his attention as a teacher of Physiology or subjects in which his interest was the outcome of his early friendship with Berkeley and De Bary'. The reader doubtless appreciates that whatever were the thoughts of the Government that sent him to see these two, there was no official dedication of him to Mycology; but he kept this laboratory in part mycological. King had asked that a Mycologist be added to his staff; but had not received one. Cunningham was a good friend who could and would do work for him at times, but his health broke down in 1897 and he was invalided out of India. In 1880 he had acted as Superintendent of the Calcutta Garden.

Four years after Cunningham had been attached to the Calcutta Medical College Arthur Barclay (1852-1891) entered the same service and was appointed Professor of Pathology in the College. He, too commanded a laboratory which though dedicated to a different purpose, provided him with room for mycological work.

Barclay specialized on the Rusts of Wheat. He died in India in 1891, having been the Professor of Physiology in the Calcutta Medical College from 1874.

Two years after Cunningham's arrival in India, and the same before Barclay's, a parasitic fungus had appeared on the coffee bushes in Ceylon ; and this, *Hemileia vastatrix,* was destined to bring another mycologist eastwards. The mycologist was Harry Marshall Ward whose career as a teacher of Botany brought mention of him into section 2 (see p. 177). The rapid spreading of *Hemileia* had been alarming ; it girdled the World in 25 years—whence its sudden vigour is not clear. At length (1880) the Ceylon Government determined to find funds for an investigation in Ceylon. Now (1880) for the first time a laboratory was set aside in the East completely but temporarily dedicated to Botony. In it Marshall Ward did superb work on three or four different fungi and a lichen ; but the coffee-disease had gone beyond control, as every villager's garden was full of it.

He returned to Britain and held among various professorial posts that of Professor of Botany at Cooper's Hill. Marshall Ward's work drove into the minds of the least philosophical of administrators and planters this—that there may be circumstances when a botanical laboratory has an overruling value. In 1897 the planters of Cacao in Ceylon, troubled as to their crops, engaged the mycologist John Bennett Carruthers, which meant providing the service of a laboratory, and in the same year the tea-planters in Assam engaged Dr. Harold H. Mann for their crops for work, at first conjointly with Sir George Watt, on pests and then with a laboratory for whatever he saw needed attention. In 1900 Dr. John Christopher Willis (1868-1957), who had succeeded Trimen in 1896 as Director of Peradeniya, sought to make mycological work at Peradeniya permanent by the appointment of J. B. Carruthers as Assistant Director and Mycologist.

The Botanical Laboratory with this began to be a mark of advance at large characterizing colleges as well as research institutions.

The indigo-planters later, but too late, engaged experts of their own.

VI. BY WHOSE BOTANIZING CAME THE RECOGNITION OF AN UNLIKE FLORA TOWARDS THE PERSIAN GULF

An observant traveller from Gujarat to Sind is readily aware of passing into an altered vegetation. This altered vegetation is Persian. Botanizing in Sind was impossible before 1838 ; but in that year Vicary was sent thither with his regiment ; and Griffith, deputed from Calcutta, entered the northern edge, later to be the Upper Sind Frontier. Griffith was not again in Sind ; but Vicary was, and he wrote three papers on the vegetation. Next Ritchie visited Sind ; then Stocks.

John Ellerton Stocks (1822-1854) had been a pupil of Lindley in London and went to Bombay in 1847, where he was employed as a vaccinator in Sind. In 1848 starting from Hyderabad (Sind), where he verified the Assyrian method of pollinating dates, he ventured into the Las-Bela District of Baluchistan. Two years later, ascending the Indus to the Upper Sind Frontier District, he passed through Nushki and Kalat to Quetta (Shawalkot). He wrote to Sir William Hooker that he had collected 300 plants new to him. He explains further that in traversing the Zawa pass and returning through Zehri he saw change in the vegetation. Both places are to be south of Kalat. What this implies is that Stocks had detected the passing over of the flora of Persian type which occupies southern Baluchistan and Sind into that of Afghanistan.

Stocks took his collections to Kew in 1855 where Bentham was prepared to work them out with him ; but he died in the next year. Sir Joseph Hooker has said of Stocks that he was a collector so observant that he scarcely missed anything.

During the seventies two other men collected to good effect in Sind ; and the collections that they made were given to Kew in the year 1877. One was Captain William Stackhouse Church Pinwill (1835-1920) whose regiment was stationed there. At the time he was an indefatigable collector, not only of plants but of animals of various groups. He collected also in Malacca. He left the army, inheriting property in the extreme south-west of Britain and the enthusiastic collecting was redirected into an equally enthusiastic accumulation of growing plants ; he indeed became a great horticulturist.

The second was his brother-in-law, Archdeacon Stead of Bombay.

Two very highly placed administrators, both Commissioners in their time, were among the next collectors of plants of the Sind flora—Sir Bartle Frere and Sir Henry Evan Murchison James.

Many of the plants that occur retain their positions by means of water which rivers bring to them, and their drought-resistance is very interesting. So too is the fight of the field weeds to keep a place. I would call my reader's attention to the collecting along the rivers by

Father E. Blatter and T. S. Sabnis in order that more may be done in this ecological line.

After the year 1900 this intrusive flora of Persian type was studied as it occurs in southern Baluchistan.

VII. BEHIND THE PERSIAN FLORA IS THE AFGHAN FLORA

The Afgan flora has attracted considerable attention. The first to collect in Afghanistan was John Martin Honigberger, a man to whom adventure seemed irresistible. He was born in Kronstadt, Transylvania ; and in 1815 left his home to practice medicine and surgery for various periods in Constantinople, Cairo, and elsewhere and continued, until in 1833, he found himself on the Indus at Dera Ghazi Khan where he joined a caravan starting for Kabul. The caravan took him to north to the Kurram and thence to Ghazni and Kabul. He collected a little, but the weather was at its hottest and conditions unfavourable. His few specimens he took at a later date to Vienna and Endlicher described them in his *Sertum Cabulicum*.

A second period in India followed, during which he studied the Indian Materia Medica extensively, and employing an artist, figured the plants in his *Thirty-five Years in the East* ; but it was no longer Afghanistan in which he worked, but chiefly Kashmir.

The next botanist was Griffith, who reached Quetta by the Bolan pass in the spring of 1840. He was at Kandahar on the first of May and then passed by Ghazni to northern Afghanistan to spend the rest of that year and the next year collecting diligently, getting aid from friends and employing local men. There was a trip to Bamean and a trip to Saighan and a trip up the Kuner Valley. In fact Griffith would have allowed little to escape him in the latitude of Kabul. As to the south he had friends there, too, who collected for him and added to what he himself had obtained of the spring flowers. But the botanist of that part of the Afghan flora was J. E. T. Aitchison.

James Edward Tierney Aitchison (1838-1898), with a degree in medicine, had entered the service of the East India Company in 1858 and was sent to the Punjab where he started studying the plants at once. In 1865 he published a list of what he had observed in the Jhelum District, Thomas Thomson helping him to name them. Six years later he published a list of what he had found in the Hoshiarpur District, followed by a list of the plants of the Punjab and Sind. He returned to the Jhelum District and to Rawalpindi, but was soon sent to Leh in the Upper Indus Valley on an economic mission which resulted in his *Handbook of the Trade Products of Leh* (1874) ; then he had a short time in Hazara. These many charges with their considerable experience ended now in a permanent dedication to the

eastern and south-eastern margins of Afghanistan. The collections that he made then were worked up at Kew, conjointly with Dr. W. B. Hemsley, into a valuable report.

In the year 1876 Quetta became the centre of civil administration. There was a collecting of plants also by two medical officers, Oliver T. Duke and H. Hamilton who sent what they collected to the Calcutta Garden. Duke collected as far south as Kalat. In 1877 Colonel J. W. Johnstone collected a little at Kandahar and Kalat-i-Gilzai. By 1884 it had become possible to put the fuel and timber supplies under control ; and John Henry Lace was appointed Deputy Conservator. He made considerable collections in the area under him until 1888, and an account of them was published for him by the Linnean Society. In 1888 Sir Robert Sandeman had straightened out the affairs of the area of the Zhob river, east and north-east of Quetta, and Duthie, who had paid a visit to Quetta, was able to send his collector Harsukh into that part of Baluchistan. In 1896 there was another Boundary Delimitation Commission on which Surgeon-Captain Frederick P. Maynard collected along the border west of Quetta. He in conjunction with David Prain reported on the collection. Maynard's work had extended towards Persia. After 1900 Baluchistan in general was collected over by Mr. R. Hughes-Buller and Rai Bahadur Diwan Jamiat Rai, and their results were incorporated by the writer into an enumeration of the Baluchistan flora published as a supplement to the Baluchistan Gazetteer. The southern Afghan flora appeared now to be fairly well-known ; to the names of collectors of it are to be added those of two more army officers, Henry Appleton and Edwin Pierce.

VIII. ASCERTAINING WHAT THE HIMALAYA SHUTS OUT FROM INDIA

The abruptness of the Himalaya brings the flora of the upper or gritty Tibetan plateau to a position against the real Himalayan flora ; but in Kashmir the long range of snowy peaks on the north of the Vale has been interjected and is like a parting fence. It is interesting historically that botanical investigation should have found so much favour behind the fence.

The reader will recall that in 1812 the Government's veterinary officer, William Moorcroft, made a dash through the Himalaya of Kumaon to procure shawl-wool goats (see p. 30). In 1819 he endeavoured to reach Turkestan that he might procure horses. On this occasion he was not an expedition with a directing official but, on his own responsibility and for rather obscure reasons, he began by proceeding through Kulu to the Upper Indus, where he lingered. A little bundle of dried plants sent to the Calcutta Garden was the

result of the lingering—plants which would seem to have been to Moorcroft curios. Among them was *Gentiana moorcroftiana* from Dras, which village he would pass through when in 1822 he left the Upper Indus to reappear in the Vale of Kashmir. The date was 10 years before Jacquemont botanized in the Vale ; it was the year of the building of the first permanent house at Simla and two years before the Garden at Saharanpur was reconstructed. Only when those 10 years were over was further botanising to be done. Jacquemont did not penetrate as deeply ; he entered the Vale via Punch and Baramula, collected through the summer, and left by Jammu when the winter came. Godfrey Vigne obtained entry into Kashmir in 1834. He was a leisured traveller who claimed to carry a plant press on his journeys, but probably used it only on a few occasions. He had entered the Vale by Jammu and thence crossed the Snowy range to the Upper Indus ; he was in Srinagar again in 1835 where he met von Huegel who likewise had reached the Vale by Jammu. The two left together by Baramula and Hazara, after a little exploration near Srinagar undertaken while von Huegel was packing and sending to Bombay collections which would seem to have held little botanical. Vigne went back to Kashmir and again into the rift of the Upper Indus, and there he met Falconer who had entered the Vale from Hazara (1836), had wintered there, and had taken the road northwards through Tragbol. Falconer, as one knows, collected in that year diligently ; and Vigne, then or afterwards collected in Astor. Falconer's plants would represent the first serious botanizing in the Rift of the Upper Indus ; they were fated to be kept for working out until Falconer could take them to London and after that to lie in the store of the India House until 1865 when Sir Joseph Hooker succeeded in getting them out, somewhat the worse for the passing of time. Vigne's plants were taken to Royle in England, the worse for not having been well collected or from rough handling.

Simla was becoming an attractive base from which to go into the Himalaya to its north. Edgeworth did so, collecting in Kulu and Chamba ; his friends Lance went to Ladak and Lord William Hay went to Lahoul.

James Edward Winterbottom visited Kashmir at the time when Thomas Thomson was there. It was a short visit and not quite along the Rift ; but to Astor where the upper Indus wriggles out of its confinement.

A few words may be said here regarding the juxtaposition of the exit of the Indus to the peaks of Nanga Purbat. It has been pointed out that such juxtaposition is to be expected for the supply of snow which the peaks secure, and therefore the supply of water to be run off, intensifies the grinding power of the streams it feeds. It is therefore not to be thought that the appearance which the Indus has of cutting the corner comes from some remote period of greater volume

in the river above the corner, but can be explained without supposing that. There are three kinds of plants among these peaks : the melt water species whose vegetative season climbs the hill-side behind the thaw of the winter snow, the short-lived annuals which are followers of man, and the xerophytes. The earlier collectors scarcely appreciated this ; but Thomson did point out what melt-water meant in the maintenance of flowering plants on stream sides.

Thomson went north from Leh to the Shyok Valley and the Nubra Valley, reaching the passes of the Karakoram. He was followed (1854) into these desolate regions by the brothers Schlagintweit. These three brothers, Hermann, Adolph, and Robert, were financed by the King of Prussia and their occupation was chiefly physical geography ; but they collected plants also, though their collections not being in the first line only very tardily received attention in Europe. Adolph was seized and killed by a rascal in rebellion at Kashgar. The other two worked on until 1858, their area of work the upper parts of the rivers of the Punjab, the Tibetan plateau to Gartok, and the Karakoram. The next interest in the area came after an interval of 10 years. The Chinese had lost their overlordship of Kashgaria and their traders had been driven away. This produced a great shortage of such things as tea which had been coming to these parts from China. But it could also come from the new industry of the lower Himalaya by caravans trading from Kashgar to the Punjab in increasing numbers. For their convenience a market had been established at Palanpur, north of Amritsar. Contact with these traders caused a Kangra tea planter, R. B. Shaw, to adventure back with some of them to Yarkhand. A request for official contact followed. Two embassies were sent, the first in 1870, the second in 1874, both under Sir Douglas Forsyth. Each embassy had a surgeon—naturalist and the second had other scientific officers. The embassies went through the Vale of Kashmir, over the Zozi pass, up the Indus to Leh, and then over the Karakoram, varying the way a little after reaching the Tibetan plateau. As surgeon-naturalist on the first was George Henderson (1836-1929) ; we hear of him later as acting Superintendent of the Calcutta Garden. As surgeon-naturalist on the second was Henry Walter Bellow (- 1892) who had seen service on several political missions around the eastern frontiers of India. Ferdinand Stoliczka, the geologist, who reached India in 1862 and died in 1874, was on the second ; he was taken ill in Tibet, and he died two marches short of Leh, to the great loss of Geology, for he had made himself an authority on the structure of the Himalaya. While attached to the mission he had made several side trips as, for instance, to Wakhan. The missions were so timed that, by crossing Kashmir when the passes were free, they left Tibet soon after the entry of spring—too early for a part of the flowers. The reader understands that the stationing of Aitchison

at Leh, summer and winter, in 1874 was connected with the consent to send these missions. After all, the tea which Kangra produced was not liked in Kashgar and the trade in Chinese tea slowly came back. Bellew was observant enough to comment on the change in the vegetation at the Zozi pass; already he knew the flora of the Vale from previous residence in it. The Vale had become a popular hot weather resort and now and then among the visitors would be someone who found an interest in the plants. Such was W. S. Atkinson, the entomologist, who collected at various places round the Vale shortly before his death in 1878 or 1879.

C. B. Clarke's longest collecting trip was through Kashmir in 1876. He had entered the mountains in 1874 from Kangra, 2 years earlier, going forward to Dalhousie; but the journey of 1876 was much longer. Entering Kashmir at its eastern end he travelled through the Vale, then took the Tragbol route by Astor to the Upper Indus, across the Indus he visited Askole and then the Karakoram. From these journeys he took to Britain in the next years vast collections.

Forsyth's two Yarkand Missions were preludes to collecting in Tibet with Leh a centre from which explorers set out or to which they came on returning. In June 1890 Captain N. H. P. Deasy and Arnold Pike crossing the Lanak pass went over the gravel plateau as far eastwards as the Choral Cho, which lake is roughly north of the Manasarovar lakes, and returned. In 1891 Captain (later Major-General Sir) Hamilton Bower and Surgeon Captain W. G. Thorold crossed Tibet from the Lanak pass eastwards well to the north of Lhasa and so into China, descending into the lower plateau at the position where the Brahmaputra leaves Tibet. In 1895 Sir Martin Conway explored the Karakoram defiles north of the Lanak pass. In October of the same year Mr. and Mrs. St. George Littledale, who had crossed the Thian Shan in February of that year, completed the arduous part of their journey at Leh. In 1896 Captain M. S. Welby and Lieutenant Neill Malcolm left Leh on a route parallel to that of Deasy and Pike, crossed the whole upper plateau, and descended on to the lower plateau, where there was a carpet 'everywhere of good grass, flowers and wild onions, rhubard and game', in the month of August. These expeditions and the plants that were collected on them are very fully discussed by Hemsley in a paper published by the Linnean Society in 1902 (*Journal* 35, pp. 120) to which the reader is referred. What I wish to do here is to take these statements from Dr. Hemsley's paper: Above 16,000 feet 282 flowering plants and one fern are reported to grow, of which 53 belong to the Compositae, 30 to the Gramineae, 23 to the Cruciferae, 19 to the Ranunculaceae, 18 to the Leguminosae, 11 to the Caryphyllaceae, and 10 to each of these—the Crassulaceae, Gentianaceae, and Labiatae, also 9 to Polygonaceae, and 8 to the Cyperaceae. Bulbous species are

few in number but as there is a part of eastern Tibet where *Allium* is so common that the country is called 'the onion country', there seems nothing against the bulb as a way of survival.

Hemsley, having called attention to the Compositae being present in more species than any other family, showed that this is so for the floras of the Karakoram, of Gilgit, and of the Yatung in the back of the eastern Himalaya.

While the adventurous explorers, who have been named, were exploring Tibet, certain botanists were paying attention to the flora where the Indus bends southwards. Collections made in Baltistan by Captain Hunter Weston and by Dr. A. Neve (1895) reached Kew in 1890 and 1898 respectively ; and the first named was in touch with Duthie in Saharanpur. Gilgit to this time had attracted other collectors ; C. B. Clarke visited the Gilgit Valley in the very long tour that he made in 1876. Colonel H. C. B. Tanner did so in 1880 ; Dr. G. M. J. Giles went there for a long stay in 1886 ; J. F. Duthie paid a visit in 1892, and so did Professor Paulus Johannes Briihl of the Shibpur Civil Engineering College. Colonel Tanner's and Dr. Giles's collections were large, and the later who was able to make excursions beyond the Gilgit Valley had reached Wakhan. In 1895 there was an expedition to meet the Russians in the Pamirs, on which Captain Alfred William Alcock went as surgeon-naturalist.

Though the phyto-geography of the western end of the Himalaya needs much study yet, it is convenient to recognize as the Trans-Indus Himalaya an approximately rectangular block with the Indus on the east, the Kabul river on the south, and Russian Turkestan completing the other two sides. Chitral is towards the back of this rectangle. In the last years of my period the rectangle had needed military occupation along with parts of the mountains of Afghanistan, and it is interesting to record to what a large measure officers whose duty kept them in these wild mountains found the collecting of plants a relief from the tedium of their watch and ward. The names of the following can be found on herbarium sheets of these years :

Field Marshals Lord Roberts and Sir Arthur A. Barrett, Sir Francis Younghusband, Sir Henry Collett, and Sir William Gatacre ; Colonels Henry Halcro Johnston, Davidson, Mainwaring, H. H. Rich, and Wingate ; Captains Hare, Harriss, Marsh, Milne, Pirie, Skey, and Wright ; and Lieutenant Sidney Miles Toppin.

Six of these, Sir William Gatacre, Colonels Rich and H. Johnston, Captain Harriss and Wright, and Lieutenant Toppin, collected also on other occasions, and Colonel Johnston (1856-1930) possessed a herbarium of his own which, after his death, was given to the Garden in Edinburgh.

The Afgan flora laps round the end of the inner north-west Himalayan flora and then appears to have its own end tucked into it. But there is a great deal of disentangling to do towards sorting out

the components of the vegetation. Duthie's collector Inayat by visits to the district of Hazara made extensive collections there. James Ramsay Drummond (1851-1921) collected largely in the submontane districts and gave his collections to Kew.

The following comment may be made here. The geologists have shown that there have been descents in the mountains of glaciers to 4000 feet below present altitudes and therefore periods of increased cold ; and G. S. Puri has discovered plant impressions in Kashmir of living species which at one time grew at greater elevations than they now do. Thus we have in considering distribution evidence of changes of the climate in both directions. Perhaps a few northern species were enabled to reach the Deccan by the lowering across the plains.

IX. THE FLORAS OF FURTHER INDIA AND THE WAY IN WHICH A KNOWLEDGE OF THEM GREW

In the last three sections we have seen the way in which knowledge grew of a Persian flora that extended into India, a flora characterizing Afghanistan, and of the flora of the upper or gritty plateau of Tibet. It is time to do the same for the opposite or Assam corner.

India proper is rather symmetrical in the way it spreads as an isosceles triangle with the long angle pointing south, almost reaching the equator, and with the Himalaya from west to east in the north. Warm seas make the southern complete boundary ; frosty and very high mountains make the less incisive but yet incisive northern boundary ; and there can be a great range in climate on the score of temperature, which is mixed with room for a like range in humidity. Under the Himalaya at either corner the isolation of India is modified by continuous land, a consociation of lowland and mountain which has allowed plant migration through it to a degree which must interest a phyto-geographer. The passage way towards the west is half as wide again as the passage way towards the east the addition of width being towards the north. Favoured by the width, passage towards the west would seem to have been more penetrable during climatic change than the passage towards the east, but climate rules.

Of the two floras which today plug the passage towards the west, the Afghan flora is montane and the Persian lowland ; but in the passage towards the east there is less difference due to the elevation. Exactly what this amounts to is a matter for future work ; and therefore let us assess the incompleteness of our knowledge of the botany from the eastern Himalayas to the isthmus of Kra.

The first botanical specimens which reached any scientific destination were sent from Siriam in the delta of the Irrawaddy by Ed-

ward Bulkley to the East India Company in London. Siriam faces the site on which Rangoon was to be built some 50 years later. And after that a century passed before there was a fresh and better opening. Then (1793) Francis Buchanan, newly arrived in India, was attached to Captain Michael Symes's mission to the Burmese court at Ava. He collected in the Irrawaddy delta in the hot weather and ascended the river in the rains, returning in the cold weather.

After that he was stationed on medical service at Noakhali and gradually worked out his collections in correspondence with Roxburgh. From Noakhali he had a brief deputation to Chittagong and then a move to Baruipur, which to his satisfaction brought him within a day's journey of the books of the Calcutta Garden. In 1809 the missionary Felix Carey sent to the Garden dried plants from the neighbourhood of Rangoon. In 1826 Wallich made the journey that Buchanan had made 22 years earlier ; he did yet more, for after descending the Irrawaddy he went to Moulmein and up the Salween as far as the East India Company's authority ran, and up the Ataran river to its teak forests. A very few years later the missionary Francis Mason arrived and was at first at Tavoy, then at Moulmein. There was in him that thirst for knowledge that characterized and drove forward the Serampore missionary Carey. Next Griffith arrived ; stationed at Mergui, Moulmein was within reach and he actually was there, for according to Griffith his collections ran to 400 species. A year after Griffith had been called away to join the Assam Delegation, Helfer and his wife arrived—energetic and diligent collectors. Helfer went to the Andaman Islands and lost his life in an attack on his party by a band of Andamanese (1840). His wife apparently returned to Bohemia (see Kerr in *J. Thail Res. Soc. Nat. Hist. Suppl.*, 12 p. 9). In 1849 Falconer was sent to Moulmein to report on the teak forests. In 1857 McClelland was sent to Pegu to take charge of the forests ; and these in 1856 passed into the charge of Sir Dietrich Brandis, who in 1857 was also given charge of the Moulmein forests. About four years earlier Charles Samuel Pollock Parish had been appointed chaplain at Moulmein and he remained there until 1878, collecting and sending dried plants to Kew.

Before this activity, Griffith had made (1838) his journey down the Irrawaddy. The colony at Rangoon had been growing, looking after its own affairs and reached the state of maintaining a horticultural establishment.

Chittagong as to its flora is Burmese. Mention has been made of Buchanan's visit of a month's duration in 1798. Roxburgh had arranged also the visits of his sons William and John as he well knew the interest of the plants there. Later Wallich sent his collector, Henry Bruce, to Chittagong. But none of these contrived to explore in the interior. However a door was found further north and in this again water-carriage had a great influence—the way by water from the mart

of Bengal into Sylhet was so convenient and useful. Along it the first botanical exploitation was made; and we find in Roxburgh's day the magistrate M. R. Smith residing at Pundua (16 miles from Sylhet village) to which the hillmen would come to barter. It is evident that his dealings with the hillmen extended to getting plants for his own garden, some of which he would send as gifts to Roxburgh. He died in 1819. To Pundua Wallich sent a collector, Francis de Sylva, who living on a boat could carry on collecting in a most convenient way. In 1826, the missionary teacher of Serampore, Professor John Mack (see Chapter II, p. 45) visited the stations of the mission to the Khasis, presumably *via* Pundua, and he and his wife prepared a collection of dried plants which was beginning. Sir Alexander Mackenzie records that 1826 was the year of the first political approach to the Khasis. David Scott, who has been mentioned as sending a scrap of a Camellia to Wallich in 1826 enquiring if he had in it the tea plant was at the time the Governor-General's Agent on the north-eastern frontier, and in 1829 he suggested to the hillmen the convenience of a bridle-path down from the neighbourhood of Cherrapunji and at the further end down to Gauhati. Scott constructed for himself a house at Cherrapunji and the path was made with the trouble that followed its completion we are not concerned, save to mention that the police officer Captain Lister, who had the business of restoring order, later did a little plant collecting. Scott died in 1832 and after a short break Francis Jenkins succeeded him (1834) operating from Gauhati. He was there when at the end of that year Wallich received through him a twig and admitted it to be the tea plant, and admission that caused the Assam Delegation to be planned, Jenkins taking a leading part. Of the alternative ways of reaching Gauhati, the river for the whole way or the river to Sylhet and David Scott's path through the Khasia Hills, the former wasted an opportunity of seeking the tea bush in accessible parts, and so Jenkins would have the Delegation cross the Hills; from Gauhati there was no alternative but the river. Perhaps Wallich would have preferred to use the river all the way; Griffith certainly did not. And so the plateau received its first visit from a professional botanist. Griffith was destined to cross the plateau again and able slightly to vary his route. Masters must have used the road, for he travelled not a little when in charge of half the Company's patches of tea and he certainly collected as far away as Sadiya and in a journey into the country of the Angami Nagas. Griffith kept a paid collector in the Khasia Hills.

In 1851 Hooker and Thomas Thomson spent the months from May to November collecting in the Khasia Hills with great vigour and, when they left, Falconer had collectors there; the Kew Collector Richard Oldham made a short visit in 1861, the geologist Thomas Oldham, the zoologist H. H. Godwin-Austen, and the physician Sir

Joseph Fayrer as occasion offered would collect. C. B. Clarke was appointed Inspector of Schools, Assam, in 1883 and that connected him with Shillong until his retirement in 1887. Sir George Watt visited the Hills at the beginning of Clarke's years in Assam. The hills then and continously afterwards served as a base for botany deeper in the Province. The tea industry brought fresh workers into it. Wild tea had been found in Cachar in 1855 and planting followed. Among the early planters was Richard L. Keenan who left Kew, where he had been training, in 1867, to become a tea-planter, and carrying with him his interest in Botany sent a consignment of dried plants to Kew in 1874. There is a reported abundance of wild tea on the Manipur-Burma boundary, where Watt later collected, but the difficulty of communications beyond Cacher arrested planting towards it. Few tea planters collected in the Brahmaputra Valley. One who did was S. E. Peal of Sibsagar. Further collecting was a little here and a little there, but nothing consecutive. Early in the time when any collecting was possible Griffith had gone some 80 miles into Bhutan on Pemberton's mission—the season : late rains to the return of the rains—when he collected nearly 1600 numbers. On his short journey among the Mishmis in mid-October he collected nearly 1200 numbers. Smaller collections resulted from Booth's journey for rhododendron plants into the mountains just beyond Bhutan, ascending to 7000 ft. Colonel Lister's gathering from the edge of the mountains when occupied in a bloodless blockade of the Daphlas of the Dukrung Valley ; a little material from the zoologist Godwin-Austen, Griffith's collections from the more eastern Naga country ; Collett's visit to Kohima in 1891 ; Prain's collections a year in the hills of the Angami Nagas ; J. Rollo's collecting of Bamboos, and the Calcutta Garden's collecting from the trace of the railway through the hills ; Griffith's rains and cold weather collecting about Sadiya and George Gammie's collecting there in 1894.

The collectors of plants for growing ; Thomas Lobb was hunting for them on the Khasia Hills when Hooker was collecting. Booth soon afterwards came to hunt for handsome rhododendrons on the other side of the Brahmaputra Valley. Others followed.

X. SIR JOSEPH HOOKER EXPOSES IN A NEW WAY SOME OF THE PHYTO-GEOGRAPHIC PAST OF INDIA

When the *Flora of British India* was done, Sir Joseph Hooker was asked if he would prepare a review for the *Imperial Gazetteer* then in preparation, and he consented. No one living could have done it better than he. He recognized and admitted that what he had written in 1855, conjointly with Thomson, was now quite out-of-date. The two of them

had then suggested 64 areas each characterized floristically, and these they had called 'provinces'; Hooker makes it quite clear in the new *Sketch* that he put them aside though suggestive. He now made a different approach; he reduced the number of 'provinces' to 9, as parts of three divisions of political India which calls regions.

At the time when Hooker was commencing to write his *Sketch*, C. B. Clarke had prepared a paper on the geographic dispersal of the Cyperaceae in British India, and had read it to the Linnean Society as his presidential address (1898). His approach was through an Indo-Chinese area cut out of Asia, of which British India became a sub-area ; and the sub-area he divided into 11 sub-sub-areas. They had a close resemblance to Hooker's 9 provinces as the adjoining table shows :

Hooker's Provinces		Clarke's Sub-Sub-Areas	
Himalayan Region	Eastern Himalaya Western Himalaya	Eastern Himalaya Western Himalaya	
Western Region of India	Indus plains Gangetic plains Malabar Deccan Ceylon	India deserta Gangetic plains Malabar Coromandal Ceylon	British India
Eastern Region of India	Burma	Assam Ava Pegu	Sub-area of Indo Chinese Area of Asia
	Malaya	Malay Peninsula	

Differences not obvious on the Table need not be detailed here : Hooker and Clarke had discussed them. Clarke excluded from his paper any botanic defining of areas and sub-areas, as being to his purpose no more than links with Geography.

The agreement between Hooker and Clarke is important as far as it means that both of them regarded sub-sub-areas as having dimensions appropriate for discussion, Hooker judging by the whole vegetation, Clarke by the family Cyperaceae which he had recently worked up for Hooker's *Flora*. They may assuredly be accepted. Clarke's nomenclature is better than Hooker's in avoiding the word 'province', which word from its very origin has belonged to political geography. But the term 'region' is as elastic as 'area' and is without political implications; there is no objection to recognizing 'regions', 'sub-regions', and 'sub-sub-regions' as in the following pages, should 'region' suit the context better than 'area'. The two authors diverge widely in dividing or not dividing Hooker's Eastern Region and in the ways of dividing the Peninsula of India.

Hooker put an enormous amount of work into the collection of the data that he used. He would have liked a large number of plant-lists and had to compile many for his purpose. Having provided himself with lists, he scored them by the ten families with most species proved present.

A few pages back I have had cause to quote Hemsley on the flora of the upper Tibetan plateau in which Compositae come first, and the

families follow it in this order: Gramineae, Cruciferae, Ranunculaceae, Leguminosae, Caryophyllaceae, Crassulaceae, Gentianaceae, Labiatae, and Polygonaceae. Hooker's first 10 in all cases differ from the sequence of high altitudes in Tibet. I do not wish to quote all; but I wish to indicate what a striking result can be reached, and in the following table quote eight lists:

	Ceylon, as a whole	Western Peninsula	Gangetic Plains	Indus Plains	W. Himalaya	E. Himalaya	Burma	Malaya of Hooker
Acanthaceae	7	3	7	..	..	..	6	..
Annonaceae	..	..	..	..	..	..	..	5
Asclepiadaceae	..	10	..	..	..	..	..	..
Boraginaceae	..	..	..	7	..	..	..	..
Compositae	8	8	4	5	2	4	9	..
Convolvulaceae	..	..	9	10	..	..	..	..
Cruciferae	..	..	..	..	8	..	..	..
Cyperaceae	4	5	3	4	4	5	7	9
Euphorbiaceae	6	6	8	9	..	10	5	3
Gaamineae	1	1	1	1	1	2	3	6
Labiatae	..	9	..	6	5	..	..	..
Leguminosae	2	2	2	2	3	3	2	2
Malvaceae	..	..	6	6	..	..	..	..
Melastomaceae	10	..	..	..	..	..	..	8
Orchidaceae	3	4	..	..	7	1	1	1
Ranunculaceae	..	..	..	..	6	..	..	..
Rosaceae	..	..	..	..	9	8	..	..
Rubiaceae	5	7	..	..	..	9	4	4
Scitamineae	..	..	..	..	..	..	10	7
Scrophulariaceae	..	..	5	5	10	7	..	..
Urticaceae	9	..	10	..	..	6	8	10

The 8 columns carry the name of 21 families of flowering plants: of them 3, being Gramineae, Cyperaceae, and Leguminosae, occur in all the columns; Compositae and Euphorbiaceae in 9; Orchidaceae and Rubiaceae in 8. I have arranged the columns to show that the families in which turf-making herbs abound are on the left and those in which epiphytes abound are on the right. In brief the table exposes the fact that the turf-herbs belong to the west side of India and the epiphytes to the ease side. Why? Climatic. Hooker was endeavouring to read back from present dispersal into geological time. Furthermore he had called attention to the existence of a Cupuliferous boundary line which runs along the base of the western Himalaya and at Bhutan turns south to the Bay of Bengal; and now his new figures suggest another line, say from southern Gujarat to the Nepal Himalaya sagging southward in the centre line that under increasing dryness might sag right to the south of India, restricting without driving out the flora which Hooker calls 'Malayan', or putting an end to the evolution of the seasonal Podostemaceae of the Western Ghats.

If that line at one time sagged enough on the map for this — and the patanas of Ceylon suggest that it did — it has retreated as well as

advanced. The line anyhow is something that must be considered in discussions on that drying of India which certain other features demonstrate.

Hooker published further decads which do not illustrate climatic change at all, usually because the collections had not been spread over the whole year. If two lists be prepared and compared, one from Griffith's intense collecting when he spent 24 months in the Afghan area and the other from list of Aitchison's Kurram Valley collection, the first has the Acanthaceae in the sixth place and the second has Scrophulariaceae in the fifth place, neither getting into the decade of the other. And in regard to this the reader needs to be told that military exigences kept Aitchison out of his area in the spring, causing the periods to disagree. If Hooker's method is to be used, the periods and area must agree. The use of Hooker's device is most certainly recommendable but with considerable caution.

There is another confusion possible. It is obvious that genera such as *Impatiens, Pedicularis,* and showplant *Rhododendron* must greatly disturb the sequences in some areas. In their case evolution seems recently explosive so that their species have not the specific value safe to associate with evolution.

Clarke postulated a land-bridge from the Malay islands to Ceylon to account for the presence in both area of certain sedges ; he did not bring to notice the alternative of a route round the Bay of Bengal.

I would that the reader should realize the tremendous but complicated interest of Hooker's line of investigation.

The *Sketch* was put into print in 1903 for the convenience of obtaining criticism; then in 1907 it was published in the appropriate volume of the *Imperial Gazetteer.*

In 1903 Sir David Prain's *Bengal Plants* appeared. He applied a terminology of his own to geographic areas in relation to Bengal. He accepted *India deserta* for the dry north-west, *India diluvia* for the Gangetic plains, *India aquosa* for the western coastal strip which the south-west monsoon soaks, *India vera* for the plateau east of it, *India subaquosa* for Coromandel which the dying monsoon saturates, and *India littorea* for the great Ganges delta and the lesser deltas of India's outline. Prain's terminology is climatic saving the last name. Professor Troup later gave another set of names which, though their date is 1921, I mention here lest they be overlooked.

Robert Scott Troup (1874-1939) entered the Indian Forest Service in 1897 and had had 9 years experience in the best teak forests of Burma when (1905) he was transferred to the forest central station at Dehra Dun.

The Forest Service as far back as 1872 had taken to Dehra Dun their survey work. Already three years earlier Brandis had pointed out that the Service would need to teach at least its Forest Rangers and, when teaching began, the experiment was tried of giving it to

apprentices sent to the Engineering College Schlich, who had suggested this, was soon to come into contact with the result and found himself constrained to report that the new Forest Rangers back from the Roorkee College had acquired there much useful knowledge, but not in Botany. The upshot was that teaching was established by the side of the Forest Survey work and a large area of forest attached to the School, where, as recorded, J. F. Duthie would teach the young men to know their trees.

The Forest Service was irregular, experimenting with its working plan until 1880; then by way of improving work their preparation began to be regularized; and the process led to specialization ending in transfer of the final and decisive stages to Dehra Dun. The next step was the setting up of a department for Research, and Troup, though he was not at first in charge of working plans, soon found his day to day work in them. The Forest Service had collected large quantities of data. Troup with these wrote his excellent *Silviculture of Indian Trees*. He had commenced it in 1916; he was called to Oxford in 1920 to the post of Professor of Forestry; and the three volumes were published in the next year. The date of course is far beyond the end of my period, but to proceed without a reference would suggest that the work of Hooker, C. B. Clarke, and Prain had a sort of finality.

Troup's phyto-geography founded only on the growth of forest trees— there are a little over 700 referred to or dealt with in great detail, led to suggesting these 'regions' :

(i) Western Himalaya; (ii) Eastern Himalaya; (iii) The Trans-Indus ; (iv) the North-Eastern Dry Region; (v) the Gangetic Plain; (vi) the West Coast Region; (vii) the Central Indian Region; (viii) the Deccan along with the Carnatic; (ix) Assam; (x) Burma; and (xi) the Andaman Islands. Like the sub-regions or sub-sub-areas there is as much definition in them from geography as from botany, or perhaps even more.

It is desirable that the nomenclature should come under criticism, and that botanists now in India should shape it, and that they co-operate with the climatologists for they have put forward classifications of India's surface that, differing in detail, should not be neglected. They suggest improvements : for instance, they take note of the equatorial air-regime by which there is rain twice in the year as the sun is twice at its remotest from the equator. Of this the phyto-geographers up to 1900 have taken no notice, although Ceylon and Kerala show its effects; phyto-geographers, furthermore, before 1900 had not thought it proper to divide Ceylon into its dry and humid parts. Other improvements originating with them are recognition of a sub-Himalayan belt on the north-west of India, and a closer union between the Santal Hills and the Gangetic deltaic plains than had been conceded.

XI. PLANNING IN CEYLON

John Christopher Willis (1869-1958) succeeded Trimen as Director of the Peradeniya Garden in 1896. Trimen, who had become a very sick man, was endeavouring in spite of his difficulties to complete his *Hand book of the Flowering Plants of Ceylon ;* and Hooker, his own *Flora of British India* completed, had promised to see Trimen's *Handbook* out. The situation suggested the end of a chapter to any involved in it, and of course particularly to the new Director with whom lay planning for the future. The Government of the island accepted his views.

The taxonomic work of the Garden was to be intensified as to the lower plants, and particularly towards the fungi for economic reason : the disaster of the coffee-leaf disease impressed that. Further, for the security of existing crops provision for the entertainment of an entomologist was made ; and for miscellaneous enquiries needing the attention of a biologist the entertainment of one who acted as an assistant to the Director and, as the occasions for requiring his research could not be predicted, was to be as it were on post-graduate research within a period of three years.

The three, a mycologist who was to be at the same time Assistant Director, the entomologist, and the post-graduate engaged on research were laboratory workers whose results depended on development of buildings in the Peradeniya Garden.

I have called my reader's attention to the creation of a high level plantation in 1860 when the introduction of Cinchona was contemplated. This, the Hakgala Garden, preserved also a sample of the vegetation characteristic of its zone on the mountains. In 1876 another plantation was required, a hot humid one for the accommodation of the rubber tree, *Hevea brasiliensis,* from the Amazon; this, the Heneratgoda Plantation, also held a sample of the local jungle. Naturally these were used for lesser experiments — the way plants unsuited for Peradeniya would behave in the climates of these plantations. They are called gardens officially, and botanical work was theirs in this geographic way. About 1880 the whole of Peradeniya was landscape-gardened. In 1886 another plantation was established, that of Badulla, hot and relatively dry, with a dry season between July and September instead of that between January and March of the Colombo side of the island. Yet another plantation was made, that in the dry north at Anahadrapura.

This useful dispersal of trial grounds was to be somewhat increased. There was a small school of Agriculture in Colombo and proposals came forward to close it in favour of something more ambitious on the Gangaruwa estate alongside Peradeniya. The estate had been owned by the Governor Barnes who, having opened the way for the coffee-planters into the hills by making the Colombo-Kandy road;

had grown coffee, indigo, and sugar-cane on his estate. It was now to hold demonstration plots, and agricultural practice regarding them was to be taught by the officers of the Garden staff. The illiterate peasant, it was hoped, would learn new ways through those who had learned them at Gangaruwa. Meanwhile he was to learn through school gardens and then a teacher using a vernacular language of the island was chosen as a demostrator for the schools.

There was a planters' magazine in the island; this, taken over and entrusted to Willis as editor, sufficed along with Circulars to keep the literate in touch with the progress of the Gardens. As an outlet for the Gardens for scientific research, Willis arranged for the publication of a journal in pure science — the *Annals of the Royal Botanic Gardens, Peradeniya;* and the first part appeared in June, 1901. In it he gave an account of his planning to that date. When later the duty of education was entrusted to him, he began to call his charge a department of Agriculture. Then someone else planned, seeking to place Agriculture over Botany; this came after Willis's department had been growing for a decade and so was outside my period but I have to refer to the way in which it broke up Willis's planning, leading him to retire.

The speed of a convoy is that of the slowest unit in it; the slowest speed of Willis's convoy was that of the unit of the peasant's education.

Ceylon is on one of the busiest of ships' highways and for some time before Willis's appointment botanists of various nations had, as it were, looked in if they had the opportunity. Some of them were on their way to the Netherlands Indies to undertake research, and the Dutch provided facilities for their work. Willis, taking a lead from this, planned to do the same at Peradeniya. He wrote : 'it would be difficult to exaggerate the value of travel in other countries to the working botanist, especially if his work lie in the departments of systematic botany, geographical distribution, ecology, morphology or economic botany, whilst to the physiological or anatomical worker there are also innumerable problems which can only be solved by research in tropical countries.' He sought to make it easy for students new from British centres of teaching, and their teachers too, to visit Ceylon as others were visiting Java, to learn how the plant lives in the tropics — a knowledge which really is essential — and got sanction for an extension of his laboratory facilities to make work easy. It had been necessary to create working room for Marshall Ward when the coffee-leaf disease needed investigation; Willis would have the working room ready in advance. But visitors from Britain had come without waiting, some with grants for travel.

Willis assembled his staff. But on the horticultural side the two chief men were already there — (i) William Nock who had been acting Director from the date of Trimen's retirement and who on

Willis's arrival went back to his substantive post at Hakgala, and (ii) Hugh Fraser Macmillan who had been sent out from Kew in 1895. H. F. Macmillan (1869-1948) took charge of the horticulture of Peradeniya when Nock went back to Hakgala. From that year until 1912 he held this position; but in 1912 with the passing of Peradeniya under a Director of Agriculture he was given charge of all the Department's horticulture and had the title of Superintendent of Gardens. His 30 years in Ceylon enabled him to write his *Tropical Gardening* (1912). John Parkin had arrived in Ceylon by an understanding with Trimen; and to him was given the new three-year post of Assistant to Director. A disease of Cacao had alarmed the planters of that crop and they had invited John Bennett Carruthers (1869-1910) in 1891 to Ceylon to seek for remedies. The Government accepted his as their Mycologist, coupling with that post the post of Assistant Director of the Garden. Ernest E. Green was in the island investigating insects, chiefly pests, and was attached to the staff. The research work of these three was such as would be done in a laboratory, and so was also the work that the Director expected to do apart from administrative duties; and so Willis planned to facilitate the research of visitors by providing laboratory accommodation for them too. Willis went on to get chemists attached to the Garden. The plans for the education in agriculture took time to shape and, except that the Garden's officers were to teach, could have been separate.

Parkin joined the Director for work on the bleeding of rubber trees and joined Pearson in research on the plants of the patanas. At the end of his period he gave place in 1900 to Herbert Wright (1874-1940, knighted in 1930) whose future economic interests were shaped in Ceylon, partly as the Assistant to Willis and then as Controller of the Peradeniya Experimental Station (1904-1907).

Carruthers left Ceylon for Malaya in 1905, T. Petch succeeding him as Mycologist and remaining until 1906. So far the intensification of the taxonomic work of the Garden towards the fungi has had a favourable development.

Willis entertained no doubt as to the nature of the department entrusted to him; it was to be brought into line with such departments as that of the Dutch in Java and reflect the thought of lively European universities as far as possible. The island could teach many lessons in the way that tropical life moves.

Here is a list of eminent botanists whose visits proved this awareness :

Karl I. E. Goebel, Assistant Professor at Strasburg, visited Ceylon in 1886; Michael C. Potter, when teaching in Cambridge, in 1888; Wilhelm O. A. Tschirch, a professor of Berlin, in 1888; John Bretland Farmer from London in 1891 ; Frederick W. Keeble, a post-graduate student of Cambridge in 1893; Carl Holtermann from Berlin in 1895; Hans Molisch, a professor from Prague, in 1897; Henry H. W. Pearson,

a post-graduate student of Cambridge, in 1899; J. Stanley Gardener also from Cambridge in 1899; Andreas F. W. Schimper from Basel in 1899; K. Giesenhagen from Marburg in 1899; Aurthur George Tansley and Felix E. Fritsch together, from London, in 1902. The list might be made longer; but from it the reader understands that botanists of the new school were very well aware that to visit the tropics was expedient. I have excluded from it others who came to collect as Otto Warburg (1881), Wenzel Svoboda (1886), and Gustav F. Radde (1890). The first visited many parts of India collecting economic plants. Willis embarked on a morphological and taxonomic study of the Podostemaceae, for which he had excellent material in the river Mahaweliganga close at hand and for the furtherance of which he made two journeys in India, one to the Bombay Ghats and the other to the Khasia Hills. The value of his work was great; as to the geographic dispersal in the East which the work detailed, there was a connection with that of Hooker which I have pointed out in section 10 and which did not emerge at the time.

The conditions under which Podostemaceae can grow are limited by their seasonal need of torrents; therefore their dispersal proves a past climate of contrasted season dry and wet in alternation for ages long enough for their establishment. Applying what this shows to the knowledge that climates within the peninsula of India have oscillated, we have it clear before us that the margin of the Peninsula has never failed, since Gondwanaland went to pieces, to retain its wet seasons while the inner parts went dry.

Willis did not succeed in finding Podostemaceae in Sikkim, but they are now known to occur in at least one part.

What was the dying condition of Gondwanaland when the condition of India, bordered by deluge-monsoon-needing Podostemaceae, took its origin ?

In 1907 a serious accident terminated Willis's field work. His administrative planning, than which there was nothing more advanced in India, had made its mark and it is for another to assess the effect of the counter planning to which I have alluded.

When Willis was appointed to Ceylon, the Forests were in charge of A. F. Brown, who had written an account of the forests as an appendix to Trimen's *Handbook*. He was followed by Frederick Lewis, who, like Bourdillon in Travancore, had been a planter at one time. A planter with a botanical interest, who was in Ceylon at the time, was John Foot Jowett. Passing mention is due to J. Miguel Silva, plant collector at Peradeniya under Trimen and for twenty years after Trimen's death his name becomes familiar to any botanist interested in Ceylon collections.

XII. A GREAT STRIDE FORWARD COMES THROUGH THE UNIVERSITIES

At the end of section 5 attention was called to the setting up in India of laboratories to aid or guide certain large industries. It had seemed, when Dr. D. D. Cunningham was sent to see Miles Berkeley at work and to visit various teaching institutions in Germany, where the study of fungi was active, as he was to link his work with the greatest industry in the country, namely the raising of food crops; but that was not to be; Sir David Prain, a most intimate friend, states that Cunningham's work with fungi, when it came, originated without attachment to economy. In 1878 he was publishing on the way in which a living organism, whether animal or plant, meets starvation. This was followed by other work as purely scientific, which gave to Cunningham the place of a pioneer. The next pioneer after him was Marshall Ward, who went to Ceylon in 1882 on a two years' agreement originating in a definitely economic enquiry, but which gave him the opportunity of making investigations of great general import in pure science. Marshall Ward left Ceylon in 1885 when his mission was finished; Cunningham left India in 1897, broken in health.

It was shortly after this that Professor Jagadis Chunder Bose (knighted later) turned his attention to the perceptions of plants. He had been led into making observations by physical work which at first he had in hand in London; and then he took the prosecution of it to his University laboratory in Calcutta.

The reader sees that the entry of the botanical research laboratory into India, which ensued through the three old Universities, was at the very end of my period. That being so, I shall not follow its course more than to refer the reader to a publication by Professor P. Maheshwari and R. N. Kapil [*J. Univ. Gauhati* 9 (2), 1958] in which are named the Universities and University Colleges where at courses in the Science of Botany are given. My chapters are not for the scholars of these teaching establishments but for the botanists engaged in taxonomic research; and the proper place for them is not the class-room but the herbarium work-tables, as four-fifths of the names in them are the names of men who collected plants and by their collecting not only established the make-up of the flora of India but got together also a fair amount of information on plant-geography. I began a card-index when engaged on herbarium work in India and it ultimately became a foundation for these chapters. As to completeness I think very few names can have been omitted. The chapters could have been headed 'A record of the growth of systematized knowledge of the plants of India.'

I had not in my mind, when determining that my narrative should end at 1900, the fact that Reynold Green's *History of Botany in the United Kingdom* ends at the same date. But so much the better, for my chapters become a chronicle that can be read along with that excellent book.

CHAPTER VII

AN EPILOGUE

I. GENERAL REVIEW

The earliest cultivation of plants was in the Near East, adoption being in the manner now to be described.

My narrative of the history of Botany as it fell in India over the four centuries beginning at 1500 A. D. has now been completed. The reason for the adoption of that date is that Europe was for the first time able to instruct India in a refinement of the science that had commenced in north-central Europe. The refinement, though it had very little effect at first, was very real, though weak and imperfect, and had the virtue of permanence. The reader will find an account of the beginnings in Chapter I. Chapter VII takes the History of Botany as a setting into which the reader will readily fit the 400 years as an inset.

When the year 1900 was reached, India had so far adopted the science of Botany, as it had become in the educated world, and now had its own schools, with laboratories and provision for dealing with its own botanical problems. My reader understands why the begin-

nings of the sixteenth and twentieth centuries fixed the ends of my period.

I propose to review the evolution of the genus *Homo* on the earth. But before I do that, it is convenient to consider man only from a date well forward in the Pleistocene, and as he existed in that limited part of the earth's surface where he made his greatest development.

Man made more than one attempt to obtain control of the plant kingdom. Some of these attempts may be classed as agricultural; all should be studied from the view point of the plants with which he was specially concerned. In the case of Europe, he took the cereals, and was singularly successful in the temperate Old World; so that with justification we are able to say that man's first cultivation embraced such plants as Barley and Rice, the first being a plant such as owes its favourable place in the sun to natural conditions limiting tree-growth, the second to soil conditions, namely swamps, which do not suit trees. Man and trees were enemies of each other. He developed away from them, for instance in the most treeless parts of the great continent of the temperate Old World where trees are held back from dominance.

II. MAN AND THE PLEISTOCENE ICE AGE

I draw my reader's attention now to a phyto-geographical matter ripe for work — it is full of interest and full of openings for work. Hooker's last writing on India led to it, namely his essay in the Imperial Gazetteer on plant distribution, but Hooker had not the material that he wanted, and the account is imperfect, though he gave a useful lead by analysing certain provincial floras of India. In my Chapter VI, by re-arranging part of his data, I have drawn attention, as far as seemed desirable in that place, to the contrasted sward and forest sides of India.

Accompanying the contrasts in India's natural vegetation are the contrasts of India's cropping. The history of the crops and the history of the climates should be brought to a common footing. Man's part in evolution had thereby received light. The belt between sward and forest has been pushed eastwards since it became recognizable as the Glacial Ages ended.

Let us see what is believable of it at its earliest. The Glacial Period had great alternations of cold and fertile temperatures—for clarity disregard this and think only of the end. Geographically the last great and extensive glaciation followed the other Quaternary glaciations (some greater) and all inflicted their damage on the evolution of the northern vegetation of the globe. That is a fact which

makes it convenient to draw attention to the passing away of the last Pleistocene destruction by the spread of a condition which must have killed much and spread herbs rather than trees, so that the afflicted areas recovered through herbs. In the place of snow, expanses of tundra were formed; and what interests us in them is that in time they became the feeding grounds of herds of mammals — we may picture cattle and deer of various species, asses and their relatives and mammoths. This abundance caused such forms of mankind as were in a position to associate themselves, to live by hunting and they became intensely carnivorous. As the tundra moved backwards, so did the herds and the hunting men. There came times, more particularly in some parts than in others, when the complex was squeezed out. It was then that pastoralism entered and with the increasing squeeze came the entry of more and more herbs into the diet.

III. DOMESTICATION OF THE DOG

Within the enclosed area, undoubtedly before 10,000 B. C., Man domesticated the Dog to be his companion in the hunt. It had not been a particularly difficult thing to do. The Dog was accustomed to hunt in a pack, and when in the pack an urge to common action determined his behaviour. It was necessary to teach him as a puppy to consort with Man. He wolfed his food when food was present lest another should get it, but at all other times he would be co-operative. He shared Man's shelter and guarded it as his own, while the man was doing what the dog could not, planning the morrow and provisioning against it.

IV. DOMESTICATION OF THE SHEEP

In a way the Sheep took possession of Man, who had to learn to devote the time which had been taken by the hunt to restraining, pasturing and guarding his sheep. It is possible to understand the slowness of the growth of culture without allocating a very long time to that phase. Time and time again Man relapsed individually, and was driven back to hunting, then would renew the shepherding until at last a whole-time shepherd resulted. The advantages of shepherding must, for the area, have been very great, to recall Man to the occupation with millenial persistence.

I propose to proceed now to unravel as far as I can the way in which the first cultivation of plants was undertaken in Asia.

V. MAN'S FIRST APPEARANCE

I am going to the very beginning of man's appearance on the globe and shall reach in time his first cultivation. Man became separated from his kin the monkeys millions of years ago, becoming upright in his walk, flat in his broad feet with his fore-limbs, developed in the service of his head, and of considerably increased intelligence. The animals had evolved hairy coats to keep them warm. He kept himself warm by the borrowed hide of one of them. Animals hardened parts of their body such as horns for defence, he took into his hand a hard body to use as a weapon, namely a stone. So it was that he grew in ability by detachable possessions. In fact, the great difference between man and allied animals is in the additions or furniture that he carries at pleasure.

So for millions of years, up to, say, 10,000 B. C. man made no attempt to bring the plant kingdom under his orders. However, he was active in dispersing useful plants because he carried their seeds to new situations by taking the seeds to his resting places for use as food or in other ways, wholly by accident. I come now to show in what part of the world man first commenced to put plants where he wanted them to be. The first use of this ability by man was in the near-east, and the time was as the Pleistocene Ice Ages disappeared. The end of these, it is agreed to date at 18,000 B. C.

It is not possible to bring into consideration anything earlier. We are therefore in need of limiting ourselves by the Ice which surrounded the North Pole like a cap and destroyed all vegetation which could not resist it. Moreover it lasted so long as to destroy the continued life of seeds. In fact, it must be assumed that large areas were completely sterilised. Southwards, the destruction gradually decreased.

The rest of the land of the World presumably carried on as before with summer and winter, saving for its future the existing floras. I carry the mental picture of the life on this afflicted globe of the Eocene Period as in agitation like boiling water, the agitated particles as genera. I think that the period saw a particularly great proportion of what are regarded as genera, which the agitation threw up. The Miocene period allowed the results to settle (among them was the lineage of apes by which man was to come) by rounding themselves off into species. From this time for several million years we know nothing of the life of man except that he is shown to have existed by fragments of bones and teeth in the soil, of man but not as he now exists, the last being neanderthal man. He was not a success and he died out and in dying gave room to *Homo sapiens* or Modern Man (see Zeuner's "Dating the Past"). Nothing said after relates to any other form of man.

Man emerged in evolution relatively late. He came out of the

tree-living mammals of the lineage of the monkeys by specialising down the length of his body; the hind limbs set apart for locomotion, he walked upright on broad feet while the fore limbs waited on the greatly enlarged head.

At this time, he must have been a herbivore as are the Lemur Monkeys. Also he must have lived in a climate supplying his food throughout the year. It is quite possible, for even larger mammals than man must have been at his origin, provided the herbage was always to be had. He wandered into most parts of the world, but did not reach America for a long time. He varied into tribal divisions, some better than others, and the worst went down. The better would enlarge the range of their food towards a carnivorous state as they obtained ability to hold their own against animals. He was ready to eat everything, whether flesh or vegetable, and whether his diet at any part of the world was mostly carnivorous, or considerably herbivorous, depended on his opportunities. I am going to suggest that after Ice Ages, there was an occasion when he became more herbivorous, and deal with it. Ice-ages may be called unusual occurrences.

Collectively repeated glaciations occurred over wide spaces of time and with wide intervals so that man carried on with repeated changes of environment where one condition would obliterate the state left by the predecessor. This limits our power of penetrating into man's history, but we can draw a sharp line at the last glaciation. We can think of man through the millennia before that, as knowing everything that he could eat wherever he was and eating it. But beyond that arriving only at being able to name it.

The Pleistocene Ice Ages drew down on the North Pole a cold cap which, as far as it extended south, greatly affected the living things, animal and vegetable, which had been natural to those parts. This, as regards man, divided the globe into two parts ; that in which he could live, and that in which he could not. This meant that the extreme north was out of bounds. I am calling my reader's attention to what followed and to explain how it led up to developments in which man was compelled to get food by adopting a habit locally which was quite new, namely, planting for future enjoyment. Note that this carried the obligation to await growth, for the plant needed time to grow and waiting was a tremendous hindrance to foodgathering man. From the very first when man was locally carnivorous until the end of the glacial period was approached, we know nothing whatever, with certainty, about the food of man. We pick up the thread therefore where we can—namely after this tremendous interval, of our ignorance.

It is natural to think that man was always thinly dispersed wherever he existed in the tropics. His density of population depended on a food supply for which he had no means whereby to increase it. The

result of this, there and everywhere, would be a controlling factor. In parts of the globe glaciation introduced another factor. The unusualness of glaciation meant a new factor in evolution of the pattern of the world. The Ice Age would sterilise more than a small area towards the Pole and keep it sterile. As the severity of the glaciation passed away, the return of the herbs outdistanced the return of the trees, and together with an established unsuitability this maintained absence of trees and furtherence for herbs, which maintained wide grazing lands for mammals such as would endure the cold.

It is now possible to write that the first tillage in the world that we detect, was brought into existance by increase of population in the Far East. This increase was brought about by larger supplies of food for herbs and mammals, and that was the result of the Ice Ages which led up to the perfection of herbs over trees. The increase of plants for tillage began with the easiest to handle, namely annuals of short growth.

The tillage was caused by need, and then promoted by state-craft, in which the communal granary became a state institution through the Near-east and then a tax collecting institution and war machine. The states were able to maintain a department which was very necessary to many of them who were very exposed to attack from the north.

The reader will find a very interesting account of man as appearing on the earth in the miocene period in *Biological Reviews,* 1940 by W. E. Le Gros Clark.

What did the hunters seek — flesh, skins for clothing and some kind of tent, horns for cups and antlers for digging. Between these hunters and the land falling to Mesopotamia another kind of man lived.

Now let us refer to what must have been Assyrian folk-lore, that was committed to the Hebrews. It is the story of Cain and Abel which occurs in the Bible. Cain the hunter fell upon and killed the mentally superior cultivator Abel.

Returning to this remark that Abel was mentally superior, it is easy to justify it. It was by civic arrangements that it was shown.

It is of course impossible to know if these two kinds of man had any features to distinguish them, but of Abel's ability there is no doubt; Abel was sedentary, belonging to an organised state and the ability was in the state craft of his lineages; he was not altogether without some animal food, for he would obtain fish from the large rivers.

We turn now to the area in which these men lived, and add thereto the Mediterranean with its similar population.

Asia is the largest land block on the face of the Globe, and is increased in size by having Europe, so to speak, soldered to its western side. The remoteness of the source of humid winds affects its climate. The glaciations of the Pleistocene Ice Age must have done the

same. The result was a very wide area of grassland in the centre between the Atlantic and the Pacific which area towards the Equator passed through temperate latitudes. The glaciations, I believe, by their killing of seeds as well as of the standing plant would make it much more difficult for trees to return than herbs. All in all the ground cover became a sward of herbs or else tundra. These wide grassy plains promoted the increase of vast herds of mammals. The herds drew hunters. The population become itensely carnivorous. When the climate sufficiently ameliorated, man had so multiplied that he had considerably depleted the source of food and, moreover, the herds might have moved; from either cause the hunters were driven to add vegetables to their food. I believe it right to see this change characteristic of the northern part of the land in view.

This is the land of Cain. Southward, where the rivers drain into Mesopotamia, the land of Abel, the climate is better and the rivers flood from the thawing of winter snow. The Nile floods later and longer and so is not exactly similar. However, the food seeker who ranged the lands in search of food in the years from say 7,000 B. C. was able to collect similar materials from them.

VI. 7,000 TO 3,000 B. C.

If we compare 4,000 years from date 7,000 B. C. with the last 400 years of our era should we be making an unreasonable comparison ? I mean has history run at a very different rate at the two times ? I think I am not unreasonable, when for my purposes, I ask my reader to go with me to the eastern Mediterranean to look at the condition of man at that distant date. As far as we know, man in Egypt was living by food hunting and was probably of the type that we have called Abel. He was multiplying fast, as the history of Egypt suggests. He knew that it was easier to find food in some parts of Egypt that in others, notably in the Delta of the Nile. This meant spare food in the Delta, then bartering. In fact, it meant trade. To my mind this trade, before the end of the period I have named, must have attained considerable dimensions and, unless we admit this, the history of Egypt cannot be understood. The trade would be State-directed under royal guidance, and the traders largely pedlars. It would be necessary for royal interference. Imitation by states N. E. of Egypt would follow. The pedlars finding markets on the Mesopotamian and other rivers.

Now, if my reader is prepared to admit the double claim that there was trade, and that trade large, we can proceed to point out certain consequences. I hope that my readers are prepared to recognise this trade.

While this trade was developing, the hunting population, away in the north where the climate was severe, was occupied in chasing its food. As to Egypt we may envisage the food-seeker carrying to his sleeping place a day's supply of water lily roots, or just ripe barley, or wild figs or other edible plants. It might be, for instance, a Cress which did not require cooking. With a small stone he would pound it to a paste and add such flavouring plants as he desired equally uncooked. He might be carrying flex with the object of using it shredded, to cushion some protuberance of the floor of his cave. This suggests weaving at some future time, but not necessarily then. The food hunter was quite likely to have interest enough in the places where he got his supplies, to direct flood water to any plant which would benefit by it. It is to be noted that there was no real cultivation, but there would be storage of grain. Towards the end of the period the food gatherer was probably interested in the training of the ass to carry loads and when in need he crossed water on a bundle of dried reeds.

VII. THE POTTER DISCOVERS COPPER

Clay had been at man's service from very early times. He could block the entrance to the cave in which he lived as a protection against intruding animals. His hands were sufficient to do this. After he had discovered how to make fire and had got the use of it, he went on to bake cups. No doubt he had been doing this for a long time — actually, when the profession of potter had become widely extended, an inquisitive artisan took a material which had no use in his hands and baked it to excess. As the material was copper-ore and the temperature high enough to make copper malleable he got a new kind a pot which was not breakable, but could be beaten to shape while hot to make spades and other implements. The exact date of this is not known but it would have been not earlier than 5,500 B. C. or in the next 100 years. Nor is the exact place known, but it is right to associate it with the race of man that occupied the country south of the hunting area. The discovery is one of the characters that I have pointed to as proclaiming a superior mind of the lineage of Abel. We may reasonably ascribe to the same lineage the organisation of the trade to which we have referred. Those who brought copper into use found a means of strengthening it by alloying it as bronze and then later it was found out how to smelt iron.

The use of these metals for agricultural implements does not provide a date for fixing the beginning of tillage, but it does indicate the firmer establishment of it. In fact it would seem that there was no exact date but a slow and unrecorded entry.

The possession of copper quickly led to making bronze. Iron became recognised, but defeated smelting at first. However, that state known to history as that of the Hittites, contrived to find a way of doing so. The Hittites are thought to have been a confederacy. They occupied land on the border of Cappadocia and knowledge that they had discovered how to manipulate the smelting reached the Pharoah in Egypt, who endeavoured to purchase iron. He received a promise of some when supplies were available and also a dagger as a sample. The dagger indicates the nature of the use for which the iron was wanted, but of course it was equally good for agricultural implements.

Now the Hittites would seem to have been much more of the line of Cain than of the line of Abel. Soon after the discovery of how to smelt iron Baghdad was attacked from the north and taken by the Kassites (2100 B. C.) and the Aryans followed.

The reader, having noted how the population had increased may be told of the evidence that the quality of mind was good. How this had come about cannot be suggested. The genus *Homo* broke up at various times into new forms, and it is simple to see in the type of man now occupying the near-east such a new form. My reasons for ascribing to him a measure of excellence may be pointed out. He had not a little success in organising a civil system. He originated writing. The potters' jars made useful grain stores among other uses. There would be a big trade in them, with breakages and renewals. Some intelligent potters experimented in baking a new substance which happened to be copper-ore, and attempting unduly high temperatures actually got copper. This must have been among the people of whom we are writing, and to be counted evidence in favour of their ability. Woolley, in his account of explorations in Chaldaea, obtained a clay tablet recording the bringing by ship, up the Persian Gulf, of copper-ore. The exact source might have been from as far away as India. If it were, it is evidence of traffic not recorded, at any rate it is evidence in favour of the progressiveness of these people. State-craft, among them, put the temple next after the king which obviously entertained a civil service. It collected grain and other stores, where-of naturally food was one.

VIII. LETTERS

The Alphabet came to the same people of the lineage of Abel out of their trading. The potter devised a king of signature stamped on a lump of wet clay as a distinguishing mark.

The official in charge of state stores of grain kept his records of grain both inwards and outwards in accepted hieroglyphics. The latter extended into an alphabet.

The cleverest thing about this was the manufacture of something that could be made to indicate abstract ideas. It was easy to make the drawing of a crocodile indicate the whole sound of the name of the animal. But when it was desired to indicate also the colour of the crocodile, this was more difficult and required a common understanding between readers and writers. More than one alphabet was proposed, discussed and agreed on.

IX. PUBLIC GRANARIES

Archaeologists are accustomed to find buildings that have been used as granaries, recognising them by finding grains of cereals used as food. The most common is Barley. I do not find the reason for this being the commonest to be fully understood. In the records of Mesopotamian States we find that the indented soldier was paid in grain of Barley and required to plant Barley. As I understand it the Barley got its place by civic authority. That is to say, that the same authority fixed the amount and the nature of the grain. In this way one is given to wrongly assume that Barley as food had a much greater importance that it would have had were it not for its yield of beer and its use as currency. It was one of the first cereals to be cultivated and at that the statement should terminate. I see the genius of the lineage of Abel on legislating Barley into the first place. The circumstance is to be grouped along with the Alphabet and Pottery.

X. THE THIRTIETH CENTURY B. C.

It is common with authors to suggest that writing began about this century and so also the age of metal. I should myself feel inclined to put the beginnings of these two somewhat before that century; but I am not prepared to argue it. Whatever is right, the first tillage was much earlier but regular tillage was not earlier.

It is an important and disappointing thing that we have so little information regarding the Wheats. It would be impossible for the food-gatherer collecting Barley to pass over the Wheats when he met with them, possibly he would not distinguish them. If he took them to eat he would be likely to scatter their seed. In brief, Barley and Wheat are two things that could be produced together. The Millets would not share in this. They did not get cultivation because they were not worth it at that stage. My reader may expect cultivation of

Millet to come in when it was worth while to grow it, as for instance when agricultural tools made it so, or increased demand.

The distribution of Millet cultivation, in Europe and Asia, is so definite as to be interesting. The smallness of the grain matters less than the slight inconvenience in harvesting.

At what do we arrive? Man while still entirely a seed-gatherer discovered how convenient for gathering by hand were Barley or any of the Wheats and so gave them the preference, first in harvest, then in multiplication, and these grasses made a nucleus for his store round which other cereals were added. At the same time he was a critic of his own fondlings, taking note of the differences between one and another of the cereal grains, recognising what Barley and any of the Wheats were to him. From the very first assigning beer-making to Barley and then bread-making to Emmer.

It was about 2,000 B.C. when bread-raising passed into favour that, as Barley did not respond, it went into second place after Emmer, which was the standard Wheat at that time.

When I am asked to give a date for the first tillage and to name the plant I am not prepared to be more precise than to suggest that the date for systematic cultivation might be in any century near the thirtieth and the plant might be Barley or Wheat.

XI. THE SHEPHERD

The Shepherd has not been mentioned yet. His occupation was essentially food gatherings, either directly for himself or directly for his sheep. It was a very different thing to the hunt, and of origin late in time. As a wholetime occupation it looks likely to have originated in such a mountain district as Syria. It is much more the question for zoologists than for botanists.

Professor Childe names as centres of progress jutting out as it were from the level of culture in Mesopotamia, namely the Nile, the Euphrates and the Indus, calling them "those tiny patches of the earth's surface" and commenting that each of the three had the character of working on metals, then rare, that were fetched from a distance. The comment is most interesting in the suggestion of exploration, but it does not lead up to an annexation of business in the Indus valley to the west parts of Mesopotamia. When the year 3,000 B.C. had passed, repeated misfortune fell on the eastern states of Mesopotamia by outbreaks of the food hunters to the north. Over the next 2,000 years, these probably kept their overflowing numbers as Millet—eaters extending into northern China. They were not likely to improve the agriculture of the Mesopotamian lands that they invaded but there was improvement which appears as if there was

improvement towards China. There rich light soils offered opening much as the loess soils of the Danube were doing in Europe.

The reader will find in Prof. Childe's *What Happened in History* (page 94) estimates of the populations of the cities of Sumeria together with information on administration matters of this period—the period of urban revolution. Historians suggest two millennia for the urban revolution. It is very interesting to read in Professor Childe's book (page 110) "The first socially approved was apparently Barley, the staff of life that everyone needed and to obtain which they must work and produce goods".

Here we may remind ourselves that raised bread was made from Emmer for the new fashion in Egypt from about 2,000 B.C.

XII. EXPANSION

When the habit of tilling had been established, there were two lines of expansions open, one was purely geographic, namely the taking up of the habit of tilling in a wider area and the other the application of the habit to plants which had not been tilled before. Both may well have been very quickly adopted in time for progress by 3,000 B.C. and there is a record of a King who saved the garden herbs, which obviously means he brought water to them by a new canal.

From the wording of the record it is implied that little patches of vegetables were customary. Prof. Gordon Childe in Chapter VIII of his book *What Happened in History*, describes the falling into decay of this period (after 3,000 B.C.), as lasting nearly 1,000 years. Then came a recovery with Babylon as its centre. Iron had become the dominant metal and agriculture had benefited.

The position towards 3,000 B.C. in eastern Mesopotamia clearly was greatly advanced. The cities were large and prosperous ; the rivers reached the Persian Gulf through a network of water courses with boats coming to them from the sea with merchandise, their banks carrying groves of date palms. Their temples and dwelling houses were set in garden plots served by irrigation. It would seem that there was plentiful cultivation, so long as water could be got. The river mouth provided abundant fertility as silt and abundance of fish. What plants were in the gardens is nowhere recorded, but they must have been in variety.

This prosperity was interrupted soon after 3,000 B.C. and for the next twenty centuries, life for the Sumerians and Akkadians was a succession of vicissitudes. The inheritance of Cain was preying on Abel.

It was during these twenty centuries that the Aryans came from the north into the country, now Western Persia, as nomads, and with the sea in front of them turned eastward into India. They were illiterate and at first barbaric, but the people, among whom they came, reacted and apparently raised the average preserving not a little of the civic organisation that had been their predecessor.

The possession of letters could not be destroyed at 1,300 B.C. and influenced the course of development in spite of warring. The temples with their staff of scribes must have increased, and soon after the end of those twenty centuries were doing new work using clay tablets, those of the King of Assyria, Assur Bani Pal, were writing for the King a dictionary of medicine.

What a tremendous amount of lost endeavour must have passed during which the effort was being made to develop the land. We close the empty record and reopen some ten centuries B.C. The Herbs that had joined Barley in cultivation must have been many but cannot be discussed here. It is interesting to find how greatly the Greeks were advancing.

There is an important observation to make here. It is that the invasions from the north had begun to be less injurious; they replaced rulers more than customs. These replacements left country customs to advance civilisation. It even happens that there was peaceful penetration from the east of Mesopotamia with no other purpose than getting to know the country.

The three great inventions of the lineage of Abel that I have put together, the device of taxation by grain, pottery and an alphabet, were not the total of their credit. Following up agreement on the meaning of the symbols of the alphabet, they started collections of written records which grew into libraries. The scribes were certainly proud of their ability to make records and influential through the priesthood. The medical work written by the scribes for Assur Bani Pal was written on clay tablets and by that way was preserved; the bits have been rescued from the ruins in soils. The King was certainly of opinion that he was doing a good thing, and assuredly he was. It became apparently usual for contemporary kings to do similarly. There would be pride in efficiency.

XIII. A POSSIBLE COURSE OF EVENTS

(1) That Barley had the place to which Pliny assigns it, namely as the first cultivated plant, is not probable, but that it had a very early place, is.

(2) When Man was completely a food-gatherer it would be collected according to abundance.

(3) This collecting was favourable to the most abundant of the food-plants collected, because it obtained the advantage of the most transport by man who took it to his resting-place at the end of the day.

(4) This would give an advantage to Barley if it were the most abundant; and I think that it may well have been, during the first centuries accepted for examination.

(5) We do not possess any data, but can refer to what we know of the present distribution of plants.

(6) The climate of central Asia has been referred to as affording conditions encouraging cereals. There is a great deal of study not yet done.

(7) At about 7,000 B.C. this encouragement may well have been considerable in Egypt, by conducting water to positions remunerative to dwellers by the Nile at flood-time.

(8) The encouragement might even have been greater by disturbing the soil.

(9) After this there would be an extension of encouragement along the rivers.

(10) The collected food-plants were subject to a sorting in the course of preparation for eating, and to a storing of the surplus. This meant a greater scattering of seeds of the cereals. It led to a measure of selection. This would be progressive at 1500 B.C. and the encouraging conditions would be similar in Mesopotamia.

(11) Whether they reached India or did not, cannot be stated.

(12) With 1300 B.C. came the great development which put an unknown variety into cultivation. Population had greatly increased.

(13) The storing of seed domestically had doubtless a general usage and therefore there must have been a very fair knowledge of a variety of plants.

(14) The population was divided between hunters and agriculturists. The wars they made on each other asked for so much civic organization that stores of food became munitions of war. The fighting men were paid from the domestic stores. The chiefs compelled cultivation and the position was created to which Pliny referred.

(15) The centuries between the beginnings of food-hunting and this conversion of Barley into currency had been very many.

(16) Towards the end of this time, as I understand, the success of cereal cultivation in Europe and Asia had drawn the Millets into cultivation.

Eastern Asia is regarded as the original home, and meets the demand made by the Rice for a tropical home. If planted outside the Tropics, its short life permits growth over part of the year, and there are several rivers in S. E. Asia which discharge through considerable deltas, one of which may be taken by the plant geographer as a probable home. I favour those of the Brahmaputra and Irra-

wady. If the former should be given preference, there is a montane species in the eastern Himalaya which can be quoted as a likely derivative. Deltas in general have a zone at the back.

If the river estuary were for instance that of the Irrawady, the road into India was no long one; moreover the lesson of how to make for the rice the right conditions was obvious. Rice got into India; its spreading, after getting in, was a matter of implements for its cultivation and therein we see an argument for the lateness of its coming. On the other side, that is to say away from India, somehow it got a slight modification, for the rice of China and Japan is slightly unlike that of India. In the foot-hills of the Himalaya, it got a selection towards longer life. These characters, I would say, came to rice at the hand of man, though by accident.

Rice was so satisfying that food-hunting man was prepared to make great efforts to spread it from the restricted limits of the delta where he found it, and in this way when cultivation began he produced what is called Dryland Rice, and then he carried his new crop south into the Malay region.

Rice in the Gangetic Delta today finds its most natural home towards the back of the delta where the proportion of river water is a long way higher than in the more saline front. It would seem, for instance, that dwellers of the better end of the wide flats of the river, running sluggishly, nourished a population whose food was got by hunting, but it was the flesh of fish on which they depended instead of the flesh of mammals. It is rather important to note the dependence to be on flesh whether the man was chasing wild mammals in the hunting grounds of early year or snaring fish in a Burmese estuary. The fishermen would seek wild rice of the season of its seeding, but what of the rest of the year? I suggest such things as aroids were resorted to, and that he might even be induced to move to the muddy puddles near his shelter, living plants for use as needed. Rice would naturally become associated and there was the beginning of his cultivation.

It is well to point out with some emphasis that the agricultural system commencing with Rice had learned nothing from the system commencing with Barley. The two met end to end in India. The full light of the sky came to the first from a climatic inhibition of trees, but to the rice by the active removal by man of trees. There was of course a third distinct system, that of America. It began with hunting and continued with hunting until man had reached his limits, when he was driven into association with trees. Where the fresh water enters from the rivers, this favours the growth of Rice by reason of diminished interference by trees with the light which Rice demands and is of little salinity.

It is believed that Rice, originating on the very borders of India, passed into cultivation east and west, entering India and entering China.

It happens that the races of Rice in China and Japan show a very slight difference in shape to those of India, which is as if the plant had once and for all time started in either direction. Starting its spreading into India, it there and then immediately, so to speak, sailed against the wind. Man found himself obliged to impound water in order to give it enough, thus being obliged to invent the artificial lakes in which he grows it throughout India. It may be noticed what an advantage an efficient spade could be when he came to throw up the embankment holding up the water. Quite commonly he prepares the surface under the water by use of a kind of plough which stirs but does not lift; however throwing the embankment round the field means lifting, so that there is very good reason to remark what an intimate connection there is between the spread of Rice growing through India and man's acquisition of metal. The metal is recorded as coming into use in agriculture in India.

The following statements refer to this crossing of India. Campbell Thompson wrote in his *Dictionary of Assyrian Botany* (1949, p. 106) that there is no difficulty in accepting as a certainty that Rice was at least known in Mesopotamia, if not cultivated, in the 7th Century B.C. Shipping was alone sufficient to have made the grain known, though carriage by ships cannot prove cultivation.

What view are we to take of this crossing of India? It would be a matter of clearing land of forest at every new advance, and though fire might be used, much more than fire would be required to bring the advance about. Wheat and Barley were certainly met in the journey and of a certainty they fought back. Rice found it difficult to penetrate the Wheat area, but I will not discuss this.

The Pallavas are said to have migrated across India, which would be by the Godavari Valley. The statement, however, lacks substance. In Java and some other parts the nature of the soil gave such encouragement that swamp rice was resorted to. My reader must realise that much written about dry land Rice coming before swamp Rice is wrong save in regard to unusually favourable localities.

That Rice held the first place in crops in Burma and Indo-China is beyond challenge and it spread beyond these countries. In spite of the plants light-hunger there was in Malaysia a slight margin of advantage which led to the cereal being grown without impounding it.

By the closing of the gap in India between Wheat and Rice, there was a tremendous step forward, and it is certain that a large part of the success of the Maurya Rulers and probably much of the brilliancy of the Gupta Period came out of the prosperity to which it led.

I am very anxious that my reader should understand that Rice came into cultivation without any contact with the cereals of Mesopotamia. I have suggested that its original home might have been the Brahmaputra Delta. Now what is there to support this? In the

first place its spreading expressed itself, and its representation north is by a possibility derived species; so that geographically the situation is correct. It is also correct in regard to the possibilities of achieving the distribution historically. Southwards, it would seem to have had a forest to overcome and with man's aid did it. He brought that about by producing what is called "dry land Rice" When Rice reached the intensely fertile, volcanic soils of Java, the return was so rewarding that field was joined to field until large areas become swamp rice. It is very disappointing that we have no hard information of this spreading but as theory it is reasonable.

Rice will grow along with certain aroids. The cultivator of the Delta might be interested in planting *Colocasia* and *Alocasia* and other aroids. As Rice crossed India, three Millets of the genus *Panicum* appear to have become associated in cultivation.

Rice cultivation is quite likely to have been a factor in drawing westward the sugar-cane also.

XIV. NORTH TEMPERATE EAST ASIA

The whole of this is a region of Millet. From the great abundance of Foxtail Millet in China, it has been assumed that its cultivation originated in China, but it appears as likely to be at home in any part of temperate Asia also. A transitional way of life is seen in the south of its mountainous area, where hunters go out at mid-winter, carry the flesh that they take over the period when it will keep to lowland markets, and after that, and the delay due to it, set about Millet-growing in a short season.

XV. TROPICAL SOUTH-EAST ASIA

This part of the world, which includes Malaysia, is characterised by a humidity which so prevails that phytogeographers have some difficulty in dividing it. However, associated in its north parts, to which I have attributed the origin of Rice, is the origin also of the Greater Yam, which found its way down the course of dry-land Rice into eastern Malaysia, the most serviceable species of *Musa* taking a course of the cultivated rice across India and forwards into Africa.

Reverting to the origin of Rice, it is necessary to recognise that it is an imperfect food when there is no addition of animal food, therefore the need of the fish. Deep in the delta the fisherman had his shelter and he gathered such vegetable food as he wanted to eat

along with the fish. I suggest that a beginning was made with perennial aroids, which the fisherman stuck into the bare mud banks of a creek conveniently near his shelter and that into this perennial source of food in the course of time wild *Oryza sativa* was taken. The position suggested embanking; and with that conditions were present for starting artificial lakes outside the delta and the inflow into the delta ceased to be a limiting factor.

The parental Wheats had spikes that shattered ; so would the first Rice be expected to have the shattering habits of *O. sativa* var. *fatua*. The attraction of Rice which sent its cultivation eastward, sent its cultivation southward into increasingly rainy country, where Man, to give it the needed sunlight, had to fell, and it was dry land rice which was then raised. Inasmuch as the labour of felling was more exacting than the labour of embanking, the date of the spread of dry-land rice towards Malaya would be later than the commencement of the march of irrigated rice across India.

Dry land rice makes a return so much lower than irrigated rice that enterprise, where the labour of entrenching and terracing brought reward led, for instance, to such glorious stretches of rice as may be seen in Java. They were developed late in time by redirection. Such rice-growing for success requires co-operative labour, and has been a great political factor. Irrigated rice in Java presumably had no direct connection with the aroids that led irrigated rice to its popularity.

When did the cultivation of Rice reach north-western India? Hymns of the Rigveda contain no mention of the grain. The Atharvaveda which came as the last of the Vedas and other Brahmanas literature is dated by scholars as likely to have got into writing after 600 B.C. If it can be connected with the provision of spades, Rice perhaps started the journey from the head of the Bay of Bengal about 3,000 B.C. The pace at first would be very slow. It would be slow again at the dry end of its journey by which time shipping leaving India and rice harvest would familiarise the grain in new ports without familiarising cultivation. Campbell Thompson wrote in his *Dictionary of Assyrian Botany* (p. 106 : 1949) 'there is no difficulty in accepting the certainty that rice was at least known, even if not cultivated in Mesopotamia, in the 7th century B.C.' Laufer points out in his *Sino-iranica* (p. 372 ; 1919) that rice was unacceptable—we may say, it is still unacceptable—in Persia at the date of Alexander the Great (327 to 325 B.C.). This would be natural, as the novelty of the cultivation would hold the cultivators up and the novelty of the domestic preparation would influence the markets. It was not until the 8th century A.D. that Rice took a first place in Persia. But it seems to have advanced rather more freely into Turkestan.

What of its passage across peninsular India? It had most certainly other cultivated plants in company, and it is possible to name some, but to arrange their adoption chronologically is not possible. There was the Barley and Wheat system to the west of India and influencing the Indus plains at 3,000 B.C. and this date has been suggested for the start of the movement of Rice from the Bay of Bengal. A subsequent leap of wheat into the hills of the centre of India would be certain, and take place early, and be followed rapidly by acceptance for parallel cultivation of the three panics, *Panicum crus-galli, P. miliaceus* and *P. miliare* and in addition *Pespalum scrobiculatum,* all four likely to have had their first cultivation in India. Probably the Leguminous *Phaseolus rediatus* and two derivatives *P. aureus* and *P. mungo* were added and *Amorphophallus campanulatus* as a root crop. Not one of these needed more water than the climate supplied within the Peninsula. If the acceptance of these was in India, they were most certainly associated with other cultivated plants before a date at which Rice took the local lead.

Moving with Rice from East to West were cultivated races of *Musa,* of *Dioscorea alata,* perhaps *Colocasia esculentum.* The conclusion is that Dravidian India collected to itself an agriculture between 3,000 B.C. and the holding up of the Aryans' coming, that was not despicable. Further than that the closing of the gap between Rice and Wheat which brought all India everywhere a supply of the best available cereals was a tremendous event. The abundance favoured the release for agriculture labour that the buddhist fraternity claimed, and got, and it can be thought that the brilliance of the Gupta Period was not without stimulus from the resulting proportion between productivity and population.

The swamp dweller grew sundry plants which he took for eating with his fish. The river banks were muddy and because it was convenient he brought certain aroids, *Colocasia* and *Alocasia,* to the mud nearest home and thrust them into it. He would bring home rice panicles to eat the grain when he found them and some of the rice grains would be dropped into the mud, until he made an elementary garden plot. Meanwhile, his neighbour who lived beyond the swamp, seeing profit to be got from the rice, tried it above swamp-level. The fisherman's efforts led to embanking; the forest dweller's to dry land rice. The fisherman's anxiety to conserve the stock on his mud led to embanking and the forest dweller's to forest clearing. The impounding of water made it possible for the swamp cultivation to spread away from the rain; the forest dweller's efforts met with some reward if he worked into the wind that brought the rains; so his way of life was directed towards Malaysia.

We may say that Rice cultivation had three streams; one across China availing itself of the course of the Yangtse; the second down

southwards to Malaya ; and the third across India chiefly in the latitude of the Circars and Godavari. The last advantage needing embanking. And yet another spreading has to be recognised, namely into the eastern Himalaya. It is unlikely to have been contemporaneus and likely to have depended on evolution in the mountains.

Kittel has suggested that the word *Vrihi* is dravidian and as such it would have become attached to Rice as Rice made its way across India. The crossing was completed when the Aryans had lost that name among the population of N. W. India. It is demonstrable that Rice had leapt the north-western barriers of India and a competition for preference between it and wheat was on. The reader is referred to Laufer's *Sino-iranica,* p. 374 for additional data. But while there is light available on the time when Rice ended its passage across India, there is none on the beginning of its passage, unless the availability of digging tools is found to afford evidence ; and I do not see value in it yet. There is a claim in Anderssen's *Childern of the Yellow Earth* (pp. 186 and 335; 1934) that a potsherd found in the Chinese province of Ho-nan carried the impressions of rice-husts and belonged to 3,000 B. C., thereby proving Rice in Ho-nan at that time ; but too many uncertainties arise — the date is challenged. Were the husks from cultivation ? And swamp cultivation is not essential. I regard the adoption of millets in Inner Asia as secondary results of success with Wheat, *i.e.* their cultivation did not lead in the cultivation of Barley and Wheat ; but they were led in.

There is today a way of life on the Tibetan borders of Yunnan which illustrates a way, perhaps the chief way, in which the cultivation of millets would begin. The shortness of the season during which a millet is on the ground is not much more impressive in length to have that of the better cereals, and that needs explaining. The way of life referred to is this. Hunters go out in the severest of weather and hunt in the mountains, whence they bring back venison or other like meat, conveniently frozen, and sell it in low level markets. When their hunting season ends they do a little millet-raising and the operations for it had to be added to the actual cultivation and by this make a full millet season. I do not claim that the original adoption of millet for cultivation was in the localities where this is the way of life, but I do claim that it would happen in the interior of Asia. Various writers claim the adoption of Foxtail millet in China and suggest northern China, but I wish to point out that adoption in the centre of Asia is more likely. Northern China has a most trying climate in spring, which could have been against cultivation.

The closing of the gap between Rice advancing from the East, and Wheat from the West would have consequences of historic moment, even becoming part of the conditions on which prosperity, and with prosperity, letters spread under the Mauriya Rulers.

From among the small Millets, Asia north of the phytogeographic

line along the Caucasus and through the deserts just south of the Oxus reacted to a demand for quicker returns than Wheat gives, and *Eleusine* would seem to have travelled to India along with *Sesamum* from Africa and through Arabia — a sumerian element.

XVI. WHY IT WAS THAT THE GREEKS WERE THOSE TO WHOM THE ORIGIN OF BOTANY IS ATTRIBUTED

I have written in my Chapter I "that a system emerged out of the Technology off Healing in a particular part of Europe" This was Greek territory and the Greeks exploited it with great success. They have among them one to whom they attributed pre-eminence, this was Hippocrates, born in the Island of Cos, about 460 B. C. and died in 375 B. C. The scientific acumen of Aristotle, who followed him (born 384 B. C. and died 322 B. C.) not as a physician but as a natural philosopher, may be referred to in evidence of penetration among the Greeks. Aristotle had been tutor to Alexander the Great and so imbued was he with the scientific spirit as to stimulate the attachment of scientific observers to the army of Alexander the Great.

The Greeks, that is to say, those of Greece and her colonies, added to which must be Macedonia, outside the west end of eastern Asia were in sharp opposition to the kingdom of the Persians at its eastern end — Alexander started his war over-running Egypt where he founded (321 B. C.) his new port of Alexandria. Then he turned east, overthrew the Persians and invaded India. He did not survive his return, dying in 323 B. C. His new city was so successful that it drew the Greek physicians as a body to it. They remained Greeks on Egyptian soil and filled all the places open to them.

The vast activity meant extensive enquiries and gain of knowledge that was essentially taxonomic botany. The reader will remind me that medicine consists of many parts and that Materia Medica is not the largest part of it; but it was in early days of larger importance than later. It was important that the practitioner should prescribe the approved medicine.

Greek medicine established in the 4th century B. C. filled the libraries of Alexandria during fourteen centuries, not always with really wise judgement, but was certainly useful and learned in such work as that of Galen which extended to sixteen volumes (papyri). Out of the energy of this Greek Medical School, and when the School got so far as to question the identification from one place to another of the materials prescribed, the importance to the sick of identifying the drugs became evident; this was the first step in Botany. In my first chapter I have indicated how when that first step transferred

enquiries to Europe by good fortune it reached the centre of the new art of printing and had the use of Latin as a common language. The physicians of Europe had in their favour fewer propositions in front of them than practitioners in the Tropics. They were naturally keenly critical very serious and anxious to be right. I need not say more than point to the considerable library of what we call Herbals.

I have given in the map in Chapter I, the names of the towns at which the Herbals were printed, and my reader should be clear in his mind, whence spread the foundations of real scientific Botany.

I must refer to the discovery of America. Those wonderful voyages of Colombus and others were thrilling in the novelties that reached Europe. It is not to be wondered at that the novelties that lated description. Maize was established in Europe at once and other useful plants followed. It was at the height of this interest that Garcia da Orta went to India. He put into print the first accounts of Indian plants. Cristobal Acosta figured them. Very slowly, as my narrative shows, new comers took up their study. My narrative indicates this.

XVII. BOTANY IN EUROPE DURING THE RENAISSANCE AND LATER

It is time to return to the botanists themselves to let the circumstance be explained of Europe possessing a system of Botany when the rest of the World had scarcely more than Botany's technologies. Firstly, the system had not at A. D. 1500 had time for spreading. To account for its origination by date and place is a more involved matter, involved because it had needed a very favourable working together of conditions to bring it about. The date had depended on the Renaissance of Learning which followed Europe's Dark Ages. Dr. Arber conveniently cuts out of the general renaissance a late part as the Botanical renaissance.

It is right to call it a movement — a movement among the physicians for accuracy in the healing herbs that they used ; and for communicating their determinations to each other calling their books herbals. They profited immensely by the development of printing among them ; it gave them cohesion. Though they were of several nations the use of Latin secured a common understanding. When the North Italian physician Matthioli visited Vienna to verify if possible what Dioscorides used from the precious manuscript *Codex Aniciae Julianae*, his decision must have had rapid diffusion. The unification of the gathered knowledge was a great asset throughout the movement. It is interesting how woodcuts of plants reappeared in the works of others than the writer for whom they had been cut ; but the publishers were instrumental there. A greater factor in

the movement than the geographical unity was that the physicians were students of a limited flora, a flora which was in contrast to the exuberance of the tropical regions. I think that it is right to suggest that the system could not have developed without the joint co-operation of the three factors — the fraternity, the printing, and the restricted flora of a temperate climate. The like conjunction was improbable on two occasions in the World's history, and the initiated inevitably contacted new conditions wherever they spread. All of us in our education learn on simpler problems how to deal with the more complex ; and the initiated out of their experience were the more ready to read the problems of the Tropics when faced with them.

Let us straighten out the time-scale by a few dates.

In May 1498 a Portuguese ship, at the end of a voyage of 11 months, dropped anchor at Calicut. The voyagers stayed for nearly 6 months and then the first contact was over, with an exchange of merchandise and the departure of the Portuguese with such information as had happened to reach them. Other Portuguese followed. As I mentioned in my first chapter, among them came Garcia da Orta, an excellent pharmacologist who spent the last half of his life in India and wrote a very worthy book on drugs. It held some botanical observations as well. Just in time to print it a printing press was set up in Goa and Garcia took advantage of it. The book, however, was for his fellow countrymen in Europe ; it was intended to be read there. While as yet Garcia was alive, the missionary Christobal Acosta arrived in Goa where he met Garcia ; his visit over he took to Burgos in Spain the materials for another book that holds illustrations of the plants that had interested him. He, better than Garcia, illustrates what I wish the reader to note, namely that the Portuguese had commenced sending botanical information to Europe. I am dividing the centuries from 1500 to 1900 into two parts by the fact that through the first part all the information gathered in India by Portuguese and also by those who followed the Portuguese was sent to Europe — each individual was looking back to the sources of his knowledge.

The Dutch were quick in the wake of the Portuguese and far more effective in carrying information to Europe, for their return voyage took them to the very hub of an interest in Indian botany which had arisen. The Dutch were better schoolmen, more receptive and openminded, more organized ; and one of them, Charles de l' Escluse (Carolus Clusius), as the result of visiting Spain, brought to his countrymen the knowledge that Spain and Portugal had of the flora of the East. The Dutch interest grew ; it may be said to have reached a peak in the time when Rheede was their governor of Malabar. London was also interested, and England produced the great patient naturalist, John Ray, whose *Historia Plantarum* was an attempt at ordering the knowledge that had by then (1704) been

collected. The size of Ray's great volumes testifies to it having outgrown classification.

Release came through Linnaeus, who was born two years after Ray's death. Linnaeus has been called the last botanist of the period of Herbals (Sachs), but as regards Indian Botany he was the first of a new period — an expansionist period, for which Linnaeus was fount and origin.

The collectors of plants went into the accessible parts of the World. It was the time when Captain Cook voyaged and when his and other's ships carried naturalists mainly for the purpose of collecting. India was accessible and not disregarded. India's pace of gathering knowledge was immediately increased by the work of men who collected for themselves more than for despatch to someone who had asked for specimens.

Linnaeus went through his probationary period with the limited flora of Scandinavia about him. With consummate skill he marshalled in his mind all that had then been written, without the blurring of the riot of the Tropics, and when he was ready he went to what I have called the hub, namely the Netherlands. From Holland he issued one after another what may be called a guide to the Botany of the time in five separate publications, which took the rank of textbooks — his *Classes Plantarum, Genera Plantarum, Bibliotheca Botanica, Systema Botanicum* and *Fundamenta Botanica.* Later he put forward an artificial system of classification for the purpose of methodically keeping in order records and herbaria. Though the sweeping away of the system began at once Linnaeus is, nevertheless, to be thanked for it as a setting of the house in order. There was no Darwinian theory then ascribing natural relationships, but only rather uneasy feelings that such would have to be given a recognition. Linnaeus's artificial classification was so simple that it eased the first botanizings of tyros and that is why it was so immensely beneficial for a while. Indian botany perhaps owes more in proportion to the number of botanists who appeared in India than most parts of the World, for India had such a considerable proportion of tyros. These were they who, with but an elementary knowledge, thrown into isolation in India turned to the plants around them for a kind of companionship in their leisure. Crawford has written of them in his *History of the Indian Medical Service,* expressing the weight of their monotony and the need of relief. The direct cause of their arrival in India with an elementary knowledge was the way in which Botany had become popular in Britain among the more educated. The Linnean classification was that given to these.

Incidentally, it may be recalled that a pupil of Linnaeus reached India and brought his enthusiasm with him. This was Johann Gerhard Koenig (1728-1785).

XVIII. SUMMARY

An analysis of the botanists of my second period begins here. I have found cause to mention no fewer than 457 persons as connected with my subject, and I have sought to classify them by the occupation which brought them to India, on which their occupation was changed, as for instance Benjamin Heyne who arrived as a missionary but was employed as a botanist, accepting that in which each was longest. The results are interesting, and perhaps unexpected. Out of the 457 for the second period, 111 were either administrative officers or officers of the Army, and 104 were surgeons almost all at one time of the Army. The two added together amount to 3 in every 5. This is a large proportion and it is surprising not to find the surgeons outnumbering the others as elementary Botany had been in their curriculum. Perhaps we may say that the opportunities for botanizing after the officers had reached India had not been discriminatingly unequal. The East India Company never engaged an officer as a Botanist. After it had passed away some appointments were made of professed botanists. Again, out of the 457 one in eight visited India as travellers and the same as horticultural collectors; their purposes dictated the length of their stay.

These are some of the more prominent of the administrators or army officers : Beddome, Champion, Cathcart, Colebrooke, Drummond, Edgeworth, Harwicke, Hay, Jenkins, Law, Madden, Pinwill, Sykes, Tanner ; and these are among the surgeons : Alcock, Aitchison, Thomas Anderson, Barclay, Sir George Birdwood, Buchanan Hamilton, Giles, Griffith, Sir George King, McClelland, Sir David Prain, Royle, Scully, Stocks, Stewart, Thomas Thomson, Wight, Wallich. It is interesting that the sum of the surgeons is only just larger than the sum of the other groups, for that shows, or rather suggests, that a proportion had taken to medicine through an interest in Natural History ; and the earlier love came out.

It is seen that the University of Edinburgh played a great part in providing the surgeons. Therefore, it interests us who the Professors were. John Hope (1725-1786) was a man of ardour who embraced and taught the botany of Linnaeus. Robert Graham (1786-1845) drove into his pupils a recognition of the parts by which he classified plants, and was therefore the teacher of how to collect for the purpose of classification. John Hutton Balfour (1808-1884) got nearer to the living plant than his predecessors and gave to the many who received his teaching ecological ideas—these were very elementary ; had they been more advanced, it had been easier to staff the Forest Service.

When the individuals are gathered together and rearranged by their botanical work, the general impression is that the surgeons did the most for the advancement of the subject.

ACKNOWLEDGEMENTS

I cannot close without some words of gratitude to those who have helped me in my undertaking. I began to write because it was so obvious that the Indian botanists needed a guidance I could give them, and that information was wanted all through the scientific institutions of the world.

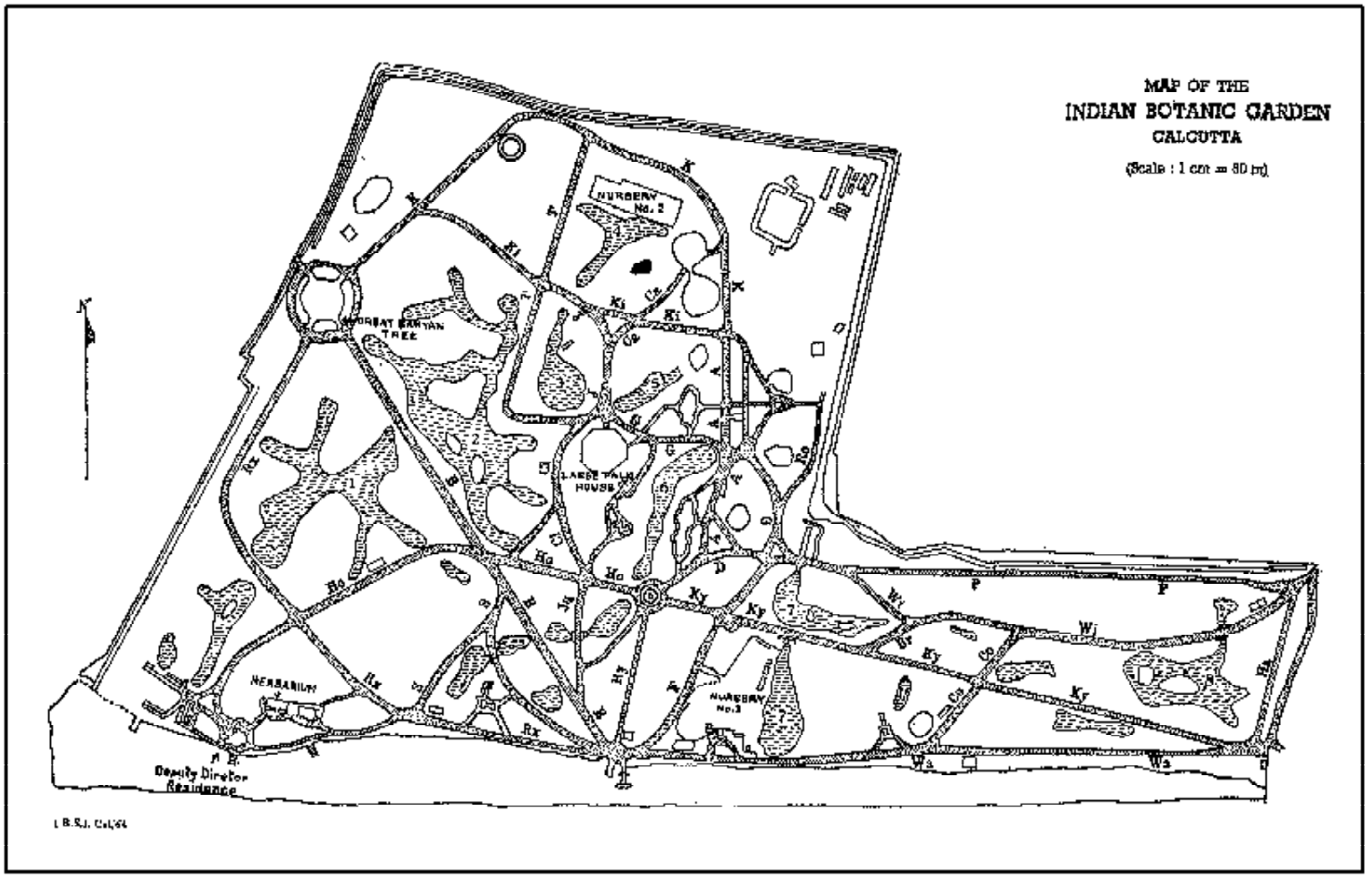
The first chapter was offered to the Bombay Natural History Society with mention of other chapters to follow. To my gratification the Society undertook the publication of the Chapters, subsequently revised, which my reader has before him. Financial stringency prevented the Society from a re-printing which was proposed. The re-printing was undertaken by the Botanical Survey of India. Among those who promoted this my thanks are particularly due to the Rev. Father H. Santapau, Director of the Survey. I have been singularly fortunate in enjoying a close connection with several Directors and officers of the Royal Botanic Gardens at Kew. I was in the East from 1901 to 1925, and can claim familiarity with much of the tropical East.

In 1961, I began to go blind. Some alterations in my work were caused by this. To my wife, and to Dr. R. E. Holttum, who gave me much help, I express my indebtedness.

KEY

A	=	Anderson Avenue
B	=	Banyan Avenue
Br	=	Brandis Avenue
Ca	=	Carey Avenue
Cl	=	Clarke Avenue
Co	=	Collett Avenue
D	=	Dyer Avenue
F	=	Falconer Avenue
G	=	Griffith Avenue
Ha	=	Hamilton Avenue
Ho	=	Hooker Avenue
J	=	Jack Avenue
Jq	=	Jacquemont Path
K	=	Kurz Avenue
Ki	=	King Avenue
Ky	=	Kyd Avenue
P	=	Palmyra Avenue
Ro	=	Rottler Avenue
Rx	=	Roxburgh Avenue
Ry	=	Roystonea Avenue
S	=	Scott Avenue
T	=	Thomson Avenue
Wa	=	Wallich Avenue
Wi	=	Wight Avenue

1) Prain Lake
2) King Lake
3) Kunstler Lake
4) Scortechini Lake
5) Diwan Lake
6) Janardan Lake
7) Shadir Lake
8) Leram Lake


MAP OF THE
INDIAN BOTANIC GARDEN
CALCUTTA
(Scale : 1 cm = 80 m)
N
NURSERY No. 2
BANYAN TREE
LARGE PALM HOUSE
HERBARIUM
NURSERY No. 3
Deputy Director Residence
I.B.S.I. Cal/64

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D

H

I

J

K

L

M

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iii	29	and	an
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40	12	personnel	personal
40	12	Cambesséds	Cambessedes
40	19	Cambesséds	Cambessedes
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89	38	pas	pass
94	35	Anaimalai,	Anaimalai
110	1	sanatordia	sanatoria
110	3	Lloyed	Lloyd
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157	22	*it*	it
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