



## FLOWERING PLANT EXPLORATION HISTORY: IN QUEST OF BANGLADESH FLORA

Mostafa Kamal Pasha\*

*Department of Botany, University of Chittagong, Chittagong 4331, Bangladesh*

### ABSTRACT

Preparation of a flora requires a long time exploration record and related taxonomic works. Bangladesh is new emerging country located at the eastern border of the Indian Subcontinent. Like many other countries it requires a Flora of its own. In searching to its development it is observed that it has long glorious history of about 400 years. The journey started with the European Portuguese people, the first European settled in western coast of India from 1535. Then rolling snowball started increasing mostly with the works of Dutch, French, Swedish, German and the British people. Primarily the activities were along the western coasts of India and then gradually along the eastern peninsular India. After the establishment of the Calcutta Botanical Garden in 1787 the plant exploration history had greatly changed under W. Roxburgh as in-charge of the Botanical Garden in 1793. The Garden along with his established herbarium forms the nucleus of the botanical works which quickly attracted eminent plant scientists like G. Koenig, J.O. Voigt, G. S. Parrottet, R. Wight, F. Buchanan, N. Wallich, W. Griffith, J.D. Hooker, S. Kurz, G. King, C.B. Clarke, D. Brandis, G. Watt and D. Prain who worked mostly on the eastern Indian flora, during the whole of 19th century. The first half of the 20th century gleams the progress of work in comparison to previous century, but continued to be interrupted up to the partition of the then British India in 1947, resulted a new province named East Pakistan of erstwhile Pakistan, which finally in 1971 emerged as a sovereign country, Bangladesh. The newly emerged Bangladesh area had also botanized extensively by the said earlier workers followed by the present workers also. Their constant endeavour gave us knowledge about botanical treasure that eventually culminated to prepare Flora of Bangladesh. After searching and accumulating almost all the earlier works developed gradually up to the present time we are now able to know the floral elements of Bangladesh to a greater extent. It is now finally estimated that there are about 4,945 species along with 37 ssp. and 34 var., in 1,670 genera under 219 families in the flora of Bangladesh. The floral analysis and its future prospects have discussed.

### INTRODUCTION

Bangladesh is a continental landmass located at the south-east border of Indian subcontinent, situated between the latitudes of 20°34'N and 26°33'N and longitudes of 88°01'E and 94°41'E. It constitutes with an area of about 1,48,303 sq. km. The land is mostly a flat plain, of which about 7% is occupied by forests, 20% by aquatic or inland water bodies, about 5% by housing and the rest is by arable. About 86% land is flat with some great basins intersected mostly north-south by hundreds of small rivers, canals and tributaries. The remaining 14% land is hilly, partly basal part of the Khasia-Jainta Hills in north and partly Tripura, Luasai, Sitakunda and Arakan Hills in the eastern boundary, which is of eastern flanking part of the Himalayan mountain range, running mostly to north-south direction. The land is continuously connected landlocked mostly with Assam, Tripura, Meghalaya, Mizoram and West-Bengal states of India, and partly at the extreme south-east of Myanmar. The highest peak is Tajingdong, about 1450m high situated between Bangladesh and Myanmar border. Geologically the land is of recent origin and is mostly of Tertiary sediments.

Historically Bangladesh was in eastern part of the great Mughal Indian Empire (1526-1757AD) and then the British Indian Empire (1757-1947AD). After partition of the British India in 1947, an isolated far eastern province of the then Pakistan, called East Pakistan, finally emerged as a sovereign country, Bangladesh, in 1971. Therefore, the botanical history of Bangladesh is mostly interwoven and intermingled with the history of the then India as a whole which most widely share its heritage happened in Eastern India and also in Myanmar (erstwhile Ava and Burma). The plant exploration history of this area was elaborately recorded by Burkill (1965). The present work on Bangladesh is the second such attempt after Pteridophyta (Pasha 2007).

### MATERIALS AND METHODS

Bangladesh is a landlock country located at the east of Indian subcontinent, bounded by India and Myanmar. The land is geographically young. The vegetation is also of recent origin which are invaded from the surrounding. Geographically, Bangladesh is located at the south lower base of the Eastern Himalayan hill range bounded east-west by the great Khasia-Jainta hills

\* Corresponding author: E mail : pashamk49@yahoo.com

and at the north-east by the Naga-Mizo-Mishmi hills at the east (Fig.-1). Phytogeographically Bangladesh falls mostly in the Indo-Malaysian Subkingdom of Palaeotropical Kingdom (Good, 1974; Takhtajan, 1986).

To understand the floral history and flora of Bangladesh and its surrounding flowering flora *Hortus Bengalensis* (Roxburgh, 1814), *Flora India* (Roxburgh 1820-1832), *Flora of British India* (Hooker, f. 1872-1897), *Bengal Plants* (Prain, 1903), *Flora of Assam* (Kanjilal et al., 1934-1940), *Flora of Manipur* (Singh et al., 2000), *Flora of Meghalaya* (Haridasan & Rao, 1985, 1987), *Flora of Tripura* (Deb, 1981 & 83), *Flora of Burma* (Kurz, 1877), *Flora of West Bengal* (Hajra, 1997). *A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar* (Kress et al, 2003), *Flora of Nepal* (Press et al. 2000), *Flora of Bhutan* (Grierson et al. 1983-1991), *Encyclopedia of Flora of Fauna of Bangladesh* (Ahmed, 2008, 2009, and Siddiqui 2007) and *Dictionary of Plant Names of Bangladesh* (Pasha & Uddin, 2013) are considered valuable. Many other related papers published in various periodicals are also worth mentioning (mentioned in this review).

## REVIEW

### Events of plant exploration

The study of plants began as early as 4,000 years BC in some ancient cultures of Egypt, Babylon, China and India. The ancient scriptures on plants in India were mostly related to medicine, horticulture and agriculture. The Charaka Samhita (about 700 BC.) is the earliest surviving example, written by the physician Charaka. In his book Charaka described 1,500 plants identifying 350 as medicinal. With the progress of civilizations, India expanded linkage trade routes since the ancient time. Arab traders were pioneers to spread knowledge of Indian plants, not only for medicine, but also for various other cultures, especially spices and clothing from the period of Khalif Al Mansur (754-775 AD). These knowledge and culture gradually attracted Europeans to come to India for trade. In quest of these trading Portuguese were the first Europeans who also discovered the longest oceanic route to come to India via South-Africa. The events of modern plant exploration and botanical history marked here with the development of the world political and economic history side-by-side. The developmental history is divided into three eras described below.

#### 1. European Era (1498-1757 A.D.)

After the lapses of many centuries, Mughal Emperors introduced gardening during mid 1500 in many places of India for entertainment of their own and also for the

general people. This period was mostly engaged with the agricultural and horticultural practices. But no botanical recording or botanical systematics of those activities is known. During this period the oceanic trade route between Europe and India was linked to Calicut (now Kozhikode) in 1498, only after the arrival of Vasco da Gama, a Portuguese sailor. Then there started a long period of history of colonialism and new culture as well as scientific activities. For convenience, this Era is divided into five periods as follows:

#### a) Portuguese period:

Portuguese traders first settled in Goa (a far west coast of India). At that time Garcia da Orta (1490-1570), a great Portuguese pharmacist, studied in Spanish Universities and was a lecturer at Lisbon. He established a medicinal plant garden in Goa and gathered knowledge about local medical treatments. He was engaged in practice of medicine and tried to understand Indian medicinal plants. He was inspired to record the knowledge about the Indian plants in his famous book, *Os Colloquies* in 1565. Christovao da Costa, an artist and Spanish surgeon, figured those plants. There were only 10 copies of the book in Europe (9 in Portugal and 1 in Geneva), as stated by Stafleu (1967). His work was important in many aspects turning on the Indian drugs, the plant material culture and its varied uses, which opened the gateway to direct trade with Europe. Garcia was in Goa until his death at the age of about 80 years. This period can be considered as the botanical renaissance in India.

#### b) Dutch period:

This period started a new epoch in Indian botanical history. The colonial power was subsequently transferred from Portuguese to Dutch along the western coast of India (due to hostile attitude between Mughals and Portuguese) and the important spice island, the Malabar, by 1614. During this time Heinrich van Rheede tot Draakenstein (1637-1692), the Dutch Governor of Malabar, established a modern botanic garden (ca. 1664). He became interested with plants and planted many native and exotic species in his newly formed Malabar Garden which ultimately turned him to start modern study of plants. He suggested that, there should be a *Hortus Indicus Malabaricus* (a Malabar Flora) for records. In the process (1674-1675) Brahmins collected plants which sent to Cochin (at south-west coast of mainland India) now named Kochi) where Mathaeus, a Carmelite missionary, made drawing but the descriptions were in Malabar language. The descriptions were first translated into Portuguese by Emanuel Carnerio, a Cochin

Full name of the acronyms used in the text	
ASSAM: Herbarium of the Botanical Survey of India at Shillong.	CTGUH: Chittagong University Herbarium, Botany Department, Bangladesh.
BCSIRH: Bangladesh Council of Scientific and Industrial Research Laboratories Herbarium, Chittagong.	DD: Division of Forest Res. Inst. DehraDun.
BFRIH: Bangladesh Forest Research Institute Herbarium, Chittagong.	DACB: Bangladesh National Herbarium, Dhaka.
BM: Natural History Museum, London.	DUH: Dhaka University Herbarium, Botany Department, Bangladesh.
CAL: Central National Herbarium, Botanical Survey of India, Calcutta.	E: Royal Botanic Garden, Edinburgh, U.K.
	K: Royal Botanic Garden, Kew, U.K.



Figure 1. Physical map of Indo-Bangladesh-Myanmar (partly) subcontinent showing some important places of visits by the illustrious plant researchers during 16th-20th century.

interpreter, which was finally translated into Latin by Hermann von Douep, Secretary to the local Government of the city of Cochin. The whole work was supervised by a missionary, Johannes Casarius. This work was finally sent to Holland, published in Amsterdam between 1678 (not 1686, as mentioned elsewhere) and 1703 in 12 folio volumes with as many as 794 plants with figures. This publication is a landmark in the history of Botany of India. But, it is not yet clear how many of this pre-Linnaean name (polynomial) have been identified properly. Van Rheedee's work, though antedates Linnaeus, it has a place of pride in the plant history, because Linnaeus (1753), Adanson (1763-1764) and de Jussieu (1789) used this work and adopted several plant names from it. Vaczy (1980) has detailed the import of *Hortus Malabaricus* in the botanical nomenclature, while Manilal (1980) has provided a list of Indian names in van Rheedee's work that have found their way into modern botany.

In the mean time, many enthusiasts, like Hermann Nikolaus Grimm (1641-1711) of Sweden and Engelbert Kaempfer (1651-1715) of Germany, started botanical exploration, collecting specimens and then finally destined to Holland.

Hermann was posted in Ceylon as surgeon in between 1670-1677. He wrote a book *Hortus Siccus* (dried plant garden) in 4 volumes which were ultimately deposited in Leiden. Linnaeus (1707-1778) got opportunity to use the *Siccus* from where he made 429 species out of these specimens.

Paul Hermann (1646-1695) a German immigrant surgeon served Dutch East India Company. During his stay in the sub-continent between 1672 and 1679, he collected plants from South India (specimens preserved at Geneva and Leiden) and Ceylon (specimens preserved at the British Museum, Geneva, Leiden). In 1680, he became Professor of Botany in Leiden. His large number of collected specimens became the Holotypes of Indian plants in 17th century's botany (Bhattacharyya, 1982).

Engelbert Kaempfer (1651-1716) was German by birth but a Dutch physician and explorer in India. He collected plants along the lower Ganges, probably was the first collector of Eastern India. All of his collections have been preserved in Sloane Herbarium, London. He published a book *Amonitatum exoticarum Politicis physicomedicarum* in 1712, in five volumes. The sixth volume carrying 600 figures of Indian plants has unfortunately been lost (Herbert, 1832). But some of the selected illustrations of Kaempfer were published by Joseph Bank from London in 1791.

Soon after the Dutch period, the Dutch East India Company (established in 1602, defunct in 1799) started commercial business in India. Side-by-side the British-East India Company (established in 1600; defunct in 1878) began trading along the different South Indian coasts. While van Rheedee was stimulating the study of Malabar along west coast of India and Ceylon, the British were doing such activities primarily along eastern coast, viz., Madras (now Chennai). At that time the business relations between the Dutch and the British

were very intimate. The important initiative was taken by a surgeon, Samuel Browne, who came to Madras in 1688 (died in 1698). Over these years he prepared a packet of dried plants, a *Hortus Siccus* of some villages around Fort St. George and had sent to James Petiver (1658-1718) who was a businessman in London.

Petiver was maintaining a private museum; accumulating and enriching more plant samples coming from India. He worked with his friend, Leonard Plukenet (1641-1707), who started publishing these records in 1697 under the title *Phytographia*. Plukenet and Petiver continued their irregular reporting. Their efforts became slow when Plukenet died. After the death of Petiver, his *Hortus Siccus* of 74 volumes were bought by Sir Hans Sloane and added it to the accumulation that he donated to the British Museum. With the death of Petiver, the brief period of this early enquiry into the flora of India came to an end, but information regarding the specimens was added by others.

During this time, Johannes Burman (1706-1779), a physician as well as a botanist, was elected Professor of Botany at the *Hortus Medicus* (Physic Garden) in Amsterdam from 1728 onward. According to Smit (1979) "Botany had flourished in Netherlands as nowhere else in the world.... Even Linnaeus had come to Holland being attracted by the vigor of botanical science and the well-filled botanical gardens". Smit (1979) also pointed out that in 1759 the Dutch were defeated in a war by the English at Hoogly (up of Calcutta), and that was the end of the Dutch power in India, which also marked as the end of another chapter of exploration of plants in India. By this time the first attempt to publish Indian flora, *Flora Indica*, was by J. Burman's son Nicolaus Laurentius Burman's (1769), is worth mentioning.

### c) Linnaean Period:

In 1735, Carolus Linnaeus (1707-1778) of Sweden halted in the Netherlands for higher studies. N.L. Burman became a friend of Linnaeus who assisted him with his Ceylon flora (now Sri-Lanka), the *Thesaurus Zeylanicus* (1737). During this period J. Gronovius (1690-1762) and H. Boerhaave (1668-1738) were the two Dutch physicians who helped Linnaeus to get acquainted with Dutch Botany. With this treasure, he gradually got access to the botanical gardens and libraries, where he wrote his first effort, "*Flora Zeylanica*" (1747) as *Scapo nudo, squamis vagis alternis subulatis*. Later he introduced two-word names for Indian plants in his "*Species Plantarum*" (1753) and thus emerged a powerful mechanical system of plant identification, and also plant information communication system in modern world known as "Binomial System of Nomenclature".

J. Burman's son Nicolus Laurens Burman (1734-1793) was also an important contributor to Indian Botany, whose specimens are preserved at Delessert Herbarium, Geneva, Switzerland. Burman adapted Linnaean system of nomenclature in his attempt to write "*Flora Indica*", in 1769. The botanical and horticultural publications before 1753 had become inaccessible because of the Linnaean

reform of nomenclature system which soon revolutionized the botanical study in Europe; the wave was soon reflected in Indian botanical history. Libraries of the Central National Herbarium, Howrah, India; the Asiatic Society of India and the Geological Survey of India, collectively have almost all these publications [Bhattacharyya, 1982].

The contributions by Swedish-East India Company (formed in 1731) are not clearly known. Only one abortive effort by Christopher Henrik Braad (1728- 1781), a senior trader of the Company, is known. He was born in Stockholm and came to India, first in Saurat (south India) in 1753 and then in Calcutta in 1754. He went to Patna (in Bihar, north east of India) through the great river Ganges in 1755. He had contact with Linnaeus and was received by him in Uppsala. He returned in 1758; but Braad "lost... two chests with many rare natural history specimens of all the realms of nature of Asia", in the shipwreck (Franks, 2005). Finally, he destined to London and worked as Contributing Partner of British Museum.

Linnaeus can be called the last botanist of the period of Herbals, but as regards Indian Botany he was the pioneer of a new period for which Linnaeus was found as the starter of modern botanical studies.

#### **d) Post-Linnaean Period:**

After Burman, botanical world observed an explosion of expedition radiating from the newly emerged European countries gaining their footsteps worldwide for trade and colonization. Indian botany also emerged as new frontier for expedition and exploration in more deeper and wider region with the post-Linnaean wave. The collectors and investigators were East Europeans, mostly Danish and British, missionaries and non-missionaries from various countries, trained and formal botanists, amateurs, doctors, civil servants and their wives, and many trained businessmen. The British-East India Company continued to engage surgeons services who had been thought to recognize a certain number of useful plants and could be relied on to collect plants if they were assured. The first of them was the Johan Gerhard Koenig (1728-1789), a Baltic German by birth but in 1759 he became a Danish missionary by profession. He learned medicine at Uppsala in Sweden and was Linnaeus disciple. He joined the Indian Tranquebar (100 km from Madras) Mission (in 1768) as surgeon and naturalist. He soon started study of the flora of the Madras coast. He made correspondence with Carl Solander (1736-1782), a student from Uppsala, serving as Librarian to Sir Joseph Banks in London. Through correspondence Koenig started sending dried plants to J. Banks and to Andears Johan Retzius (1742-1821), a Professor at Swedish University of Lund and also to his master Linnaeus. There is no known list of what Banks received but what sent to Linnaeus was recorded in *Savage's Catalogue* of the Linnaean Herbarium (prepared in 1948). There is also a record of plants sent to Retzius in C.E.C. Fisher's list in *Kew Bulletin* (1932, pp. 49-76). All these efforts showed the characteristic flora of the coastal plain of Coromandel of East Indian Peninsula.

There was another connection of France in collecting plants of Southern India. French collectors came to Pondichery (French establishment) and enriched the National Museum in Paris. The first of them was Pierre Sonnerat (c. 1745-1814), who collected plants from South India and Ceylon in various dates after 1781. The important other explorers of these area were Theodore Leschenault de la Tour (1773-1826) and George Samuel Perrottet (1793-1870). Perrottet also collected plants from the lower Gangetic region (Serampore, French station near Calcutta). Perrottet's collections are said to have reached about 1,500 species. Alphonse de Candolle of Paris profited greatly by French collections of these people.

A new dimension started with the arrival of William Roxburgh (1751-1815), a Scottish Surgeon, in 1776. Roxburgh worked for the East India Company in Madras and soon met Koenig. Both of them studied the flora and accumulated a large collection of drawings of the collected species. He then published *Plants of the Coast of Coromandel* in 3 vols. in 1795, 1798 and 1818. He was later appointed as Economic Botanist at Madras in 1785. By this time Koenig died while traveling to Calcutta. Until now most of the botanical exploration activities were along the coast of Peninsular India and Ceylon.

#### **e) British Period in Far Eastern India (1757- 1947):**

A new political chapter had started in the history of the then great Mughal India. After a severe war between the ruler of Subeh Bengal (a Province of far East India) and the East India Company they got the opportunity to rule Bengal in 1757. Soon the Company started to conquer North East India, then South India, and finally the whole of India and Burma by the next 100 years. In 1857 after a great Indian Mutiny the power was handed over directly under British Government rule. This great political history also had greatly changed the plant exploration history of the region and India as a whole.

When many illustrious botanical works of southern India was in high position at the far Eastern India, the Bengal had still to start. Lady Anne Monson (1726-1776 ne'e Vane), born in England, was probably the first to start explore the flora of Bengal Province, the most booming business area by then. She was an English botanist and collector of plants. She married Colonel George Monson attached the East-Indian Military service. In 1760 she was already known to the botanical community as a "remarkable lady botanist". She assisted James Lee (1715-1795, founder of Hammersmith Nursery, U.K.) in translating Linnaeus's "*Philosophia Botanica*", the first work to explain the Linnaean classification to English reader (*Leea* a comm. genus name by Linnaeus). She came to Calcutta (now Kolkata), India, in 1760 and spent most of her days there.

She had correspondence with Linnaeus. In 1774, Lady Anne visited the Cape of Good Hope (South Africa) where she met Linnaeus's pupil Carl Peter Thunberg, a seasoned collector of South African plants. One of the South African plants collected by Lady Anne was named

*Monsonia* (sometimes mentioned in error his husband's name) by Linnaeus. In one correspondence Linnaeus wrote her in Latin, ".....that I may be permitted to join with you in the procreation of just one little daughter to bear witness of our love - a little *Monsonia*, through which your fame would live forever in the Kingdom of Flora" (<http://www.oxforddnb.com/view/article/57839/2011>). This letter indicated that some of the Bengal plant samples were also sent by Lady Anne Monson to Linnaeus. She died in Calcutta on 18th February in 1776.

It may be mentioned here that with the foundation of "The Asiatic Society of Bengal" (the word Bengal was added much later) at Calcutta (1784) was laid by the learned British Judge Sir William Jones to study the relationship of man, plants and nature in Asia. The "Asiatic Researcher" was the learned Society's journal first appeared in 1788 containing one botanical paper. In 1830 the Asiatic Society (of Bengal) started publication of its new venture "Journal of the Asiatic Society (of Bengal)" and the Asiatic Researcher slowly died. The other is the Royal Botanic Garden at Shibpur, Howrah (established in 1787) sprang the study of the flora in this eastern part of the Indian subcontinent. With the booming of trade in Calcutta new large ship-building industries were being setup. But, East India Company was growing increasingly apprehensive regarding the supplies of Burma Teak timber (due to high grade) for their dockyard. With ships' timber in this state Robert Kyd (1746-1793), the then Secretary in Calcutta to the Military Department of Inspector, suggested to ascertain the teak-tree in the vicinity of Calcutta which in turn might be a new Botanic Garden needed to commensurate with the Calcutta Metropolitan City's dignity also. The garden then started in 1787 in an area of about 350 acres on the other side of the city, by the side of the passing by River Hoogly, and put under Kyd's charge as an additional duty. He extensively collected and planted teak and other plants with full effort until he died in 1793. Later, William Roxburgh was summoned from Samalcottah (now Samalkot of Andhra Pradesh) on 29 November, 1793 to succeed Kyd as the first Superintendent of the Calcutta Garden. It was soon possible for Roxburgh to pick out the names of some 300 species of plants that Kyd introduced in the Garden by the use of his successor's *Hortus Bengalensis* (Catalogue of the plants growing in the East India Company's Garden in Calcutta).

Roxburgh was hardly finding a suitable journal to publish his research. That time he was able to publish his works in the volumes of the Asiatic Society's journal "Asiatic Researcher", the first volume of which appeared in 1788. Contemporaneous enterprise by Danish Christian Missionaries of the Serampore Mission (a settlement about 25 km north of Calcutta) started paper manufactory and printing press for the first time in Eastern India. William Carey (1761-1834) joined these missionaries in 1793, whose botanical interest closely attached him to Roxburgh. William Carey occupies a

distinct position in the history of the botanical and horticultural research (and also one of the pioneer missionaries and a great linguist) in Bengal. In 1820, he started Agri-Horticultural Society of India and started printing of its transactions. Soon after its foundation the society was allowed to use a part of the Calcutta Botanic Garden as a nursery until 1872. By way of gratitude Roxburgh established the genus *Careya* after him.

Roxburgh immediately fully engaged in piling of plants for the garden and as herbarium material for his visionary goal to prepare *Flora Indica*. For this purpose he engaged his sons, William and John, and others of his staff on plant collections. In a garden catalogue it presents the names of about 60 donors or friends of the Garden who sent plants or seeds to Roxburgh. He employed local artists to draw as many as 2532 colourful illustrations of Indian plants which he left one set in the Garden. These illustrations constitute the *Icones Roxburghianum*, which published lately in part by the present Botanical Survey of India, in 35 vols. by G. King. His species description part constitutes in his *Flora Indica* manuscripts. When Roxburgh left India in 1813 one set of the manuscript transferred to the hands of Carey to publish and the other set with him to hope with more additions. On his way to England he added more when he halted for a few days in Cylon (Sri Lanka). But, in England he died in 1815 before publication of his *Flora Indica*. By this time Francis Buchanan (later Hamilton, 1762-1829), a Scottish Surgeon entered the service of the East-India Company on the Bengal establishment at Calcutta in 1793. In 1794, he was attached as Surgeon to Captain Michael Symes mission to the Burmese court at Ava (in Burma, now Myanmar). He collected plants along the Irrawaddy delta. He was then posted at Patahat (at the east of lower Meghna River, near Pata Mouza, Raipur Union, Raipur Upazilla; 10 km north of Laxmipur District of Noakhali in South-east of Bangladesh) on medical service. To see the company's interest he received an assignment to undertake a journey to Chittagong area. From Patahat the trip took from March 2 to May 21, in 1798 (Schendel, 1992). This was probably the first multipurpose survey assigned by the East India Company. At the same time it was probably the first modern botanical exploration and study of the flora of this region and also of Bengal as a whole. In a letter to Roxburgh, after returning from the proposed visit dated 16th October 1798, where he mentions that he has collected ".... pretty numerous specimens of dried plants during his trip to Chittagong which he described as .... a charming botanical excursion" and had sent "..... a good many seeds and growing plants to the Garden (at Calcutta)" (Prain, 1905a). Buchanan had been in close and continual contact with Roxburgh who was also friendly. He had also studied Sundarbans vegetation, where he put the name of *Heritiera fomes*, the most important plant of the world famous mangrove forests, which show testimony of starting of floral study of Bengal before 19th century.

He collected good number of plants on behalf of Roxburgh from there. His stupendous task was commenced in 1807 with the district of Dinajpur and then the north-eastern part of Rangpur (north eastern part of Bengal). He was moving around the villages in Guwahati in Assam (1808), Rangpur in Bengal (1809), Nathpur in Behar (1810), Monghyr in Behar (1811) Patna of Behar (1812); in ascending the Jamuna to Agra and Gorakhpur (1813), then came back to Calcutta (1814). He had with him artists, who made for him a considerable collection of drawings. He stationed many places along the mighty Gangetic deltas, occupied considerably in the study of the Bengal, Behar (now Bihar) and Assam flora. Some sets of collected plants, that were in his possession, went to India House in London. Buchanan's specimens from Ava and Chittagong went to British Museum via Joseph Banks (the great British Explorer, 1743-1820). His other collections were given in bulk to Sir James Edward Smith with a second small set to Professor A.B. Lambert (1761-1842). The set given to Smith was said to hold 1,500 specimens and the 400 drawings. Smith gave places to only 13 plants in his *Exotic Botany* and buried the rest in his cabinets. Buchanan in 1821 referred to those collects as "in a sort lost". His important publication was *An Account of the Kingdom of Nepal* (1819) based on his study in Nepal in 1800-1803.

In 1809, the missionary, Felix Carey collected some living plants and sent to the Calcutta garden with many dried plants from the neighborhood of Rangoon of Burma. During the piling of the plant samples coming from different corner Roxburgh started revising *Hortus Bengalensis* (1814). The descriptions of the plants were accumulating in his working room on pile and drawings on another, for his *Flora Indica* to be published.

When Roxburgh left India in 1813, T.H. Colebrooke had taken over charge of the garden. In the same year Colebrooke asked to retire and gave the charge to Buchanan. After leaving Calcutta, Buchanan succeeded Roxburgh as Superintendent of the Calcutta Botanic Gardens. But ill health forced him to retire and return to Scotland finally in 1815. In the same year he dropped the name Buchanan and took his mother's name (from Lord Hamilton 1762-1829) Hamilton. Schendel (1992) explained that his name was never Buchanan-Hamilton as some times mentioned in error (a. comm. genus name *Buchanania* Spreng. after him).

But when Buchanan left India in 1815 the Government was in perplexity how to replace him. The way out was by the selection of Wallich. Nathaniel Wallich (1786-1854), a Danish surgeon and botanists from Copenhagen University came to India in 1807 and joined to serve the Danish Settlement at Serampore. Later he joined the East India Company and succeeded as Superintendent of Royal Botanic Garden in 1817, the post he held for nearly 30 years until 1846 (Prain 1905a; Nayar and Das, 1983).

On the other hand, W. Carey, after waiting for more than a year, consulted Wallich regarding the publication of Roxburgh's *Flora Indica* that left Roxburgh on the

hand of Carey. Wallich immediately responded to edit. Wallich was competent but not master of his time. In this way Volume-I was printed in 1820. In 1821, Wallich left for Katmandu, but on the way he was ill which caused printing to stop Volume-II. He stayed in Katmandu for a year and went to Penang (in Malaysia) and then to Singapore. There he started editing and made Roxburgh's *Flora Indica* up-to-date determining his Nepalese collections. By this time Volume-II appeared in 1824 with no addition. Later, at the instance of Roxburgh's sons, the original Volume-III of *Flora Indica* was printed in 1832 under Carey's editing without Ferns that Roxburgh had included. Griffith later in 1844 included Ferns and printed Volume-IV. Although there was no sign of Carey in the text that he edited this volume, but Carey became an active botanist by this time. Prain (1903a, b) wrote that between Roxburgh and Carey "little or nothing had been left ... for successive generations of botanists to add" in the list of higher plants that occur in Central Bengal. Carey sent Roxburgh many dried plants collected from his area to mix with his own, but proof is lacking (Burkill, 1965).

Wallich explored most of the areas of Upper Gangetic plain, Hariduar, DehraDun and Saharanpur of northern India in 1825 after his initial publication in 1820. Wallich made eastward journey to Irrawady delta and some upper part to Moulmein of Burma in 1826 that Buchanan had made 22 years earlier. In 1827 he reached to Shan plateau of Burma near Dandalay through the North-eastern Himalyan route. On his way he collected a huge number of plants from the North-eastern region of India for the first time.

Wallich went back to London in 1828 taking all the collections for further study with permission of the authority. In London, he hired a working space and gathered all of his collections there, which became the place of an expectant group anxious to discover the richness of the eastern flora of India. At this time George Bentham (1800-1884) did not delay to join there with his specimens. John Lindley (1790-1865), Professor at University College, London (1829-1860) was also constantly helpful. William Griffith, a young student of Lindley, joined with this effort. Finally, with the aid of hands of many others, the vast collection (7,693) of Wallich was sorted. Wallich arranged them, as work progressed, in his lithographed catalogue. The esteemed Linnaean Society of London faithfully carried out the responsibility of the collection until 1913. Thereafter, this huge collection was transferred to the Royal Botanic Garden at Kew. His important publication on this collection was *Plantae Asiaticae Rariaris* (1829-1832).

After a few busy years in London, Wallich returned to Calcutta in 1832. In 1835, the East India Company in an educational policy recognized taxonomic Botany as needed in medical schools, colleges and also in the forest services. It has been recorded that Wallich was nominated Professor of Botany in the Calcutta Medical College in 1837.

He had served at the same post up to 1842 and again left for Cape of Good Hope in South Africa. In 1844 he again returned to India and served there up to 1847 and finally left India for London. These remarkable achievements marked the end of Wallich's botanical days in India. He died in 1854 without finishing his huge task in the extended form of Roxburgh's *Flora India*, what he kept in mind for long time. But, his well known unpublished catalogue is, "A Numerical List of Dried Specimens of Plants in the East India Company's Museum (1828-1829) and Wallich Catalogue", retained at Kew (W-K). Despite many criticisms, Wallich Botany remains a strong foot-step in India's history of Botany.

When Wallich was in London in 1829 he met Griffith who was one of the illustrious pupils of J. Lindley. William Griffith (1810-1846) came to Madras, India, in 1832 as Surgeon of East India Company. He was engaged by the Tea Committee formed in Calcutta for searching native tea plants in Assam and to explore its commercial cultivation. The committee was headed by Wallich when Griffith and John McClelland (1805-1885, who joined the medical service in India in 1830, then became interested in Geology and Botany) left Hoogly in 31 August 1835. This time Griffith extensively collected plants and expressed his cherished goal to write his new *Flora Indica*. The team reached Sylhet (north east of Bangladesh) through Meghna River and then to Khasia Hill through Padua. Thereafter, the team reached to Guwahati (now capital of Assam) in 1835. Wallich became ill and had to return to Calcutta. But Griffith stayed in Assam to collect plants. He then moved to the further east, first to Mishmi Hills of upper Assam, then from Mogaung to Ava and finally descended the Irrawaddy to Rangoon of Burma. He returned to Calcutta by sea in mid 1838, a round trip of about three years. Within three months he left Calcutta again and followed the same route through Bengal to Khasia Hill, as had done with Wallich. But, this time from Guwahati he moved further to the North-eastern Himalayan mountainous regions. Here in Assam, Griffith became attached to the Army of the Indus which was preparing to March on Kandahar of Afghanistan. After returning to Calcutta he went again with the army Troup to Herat, Kandahar and finally to Kabul of Afghanistan. He botanized all the way, probably the longest journey in those days. On the way to return he did not miss any opportunity to visit many other places and met with many of the eminent personnel of worth mentioning who contributed to Botany in some way. After arriving in Calcutta from Afghanistan (in 1842), he began sorting and arranging his collection along with the dream to shape his "*Flora Indica*" as extensive and complete as possible. By this time, due to ill health, when Wallich's departure was urgent and Griffith was on journey, Voigt was invited from Serampore to bridge the gap.

Joachim Otto Voigt (1795-1843), a Danish surgeon joined Serampore mission in 1827 and became a disciple of Carey in eastern India. After Carey's death he took care

of his garden. He organized a herbarium which after his death was given to the University of Copenhagen and the duplicates to Sir William J. Hooker at Kew. Voigt had the charge of the Calcutta Garden for two months in 1842 which gave him the opportunity of uniting Catalogues of the Serampore and Calcutta Gardens into one under the title, *Hortus Suburbanus Calcuttensis* (Voigt, 1845).

After completing another four years journey, Griffith arrived in Calcutta in December of 1842 and was summoned to take the charge of the Garden. When Wallich again returned to Calcutta in 1844, Griffith was released and remained in Calcutta with his own affairs. By this time Griffith's important publication *Palms of British India* came out in 1845. He arranged his Assam species serially under the number 1 to 1460, Bhutan species 1 to 1191 and Afghan species 1 to 1275. Some of his duplicate specimens were sent to Sir William J. Hooker and G. Bentham at Kew. In December 1844 he went to Malacca town (of Malaysia) from Calcutta where he was ill and died there on 9 February 1845. At this stage John White Masters (c.1792-1873) came to Calcutta as a teacher of a school in 1832. Wallich engaged John White Masters as Head Gardener in the Botanical Garden. After his dismissal John went to Assam and joined as in-charge of a Tea Plantation. He later joined as Sub-Assistant in the Nowgaon District of Assam in 1843. This time he made several explorations in the surroundings and Naga Hills of Assam (now in Nagaland of India). Later he served as Extra Assistant Commissioner of Golaghat (of Assam) until his retirement in 1862. Despite his several publications, *Calcutta Flora* (1839-1840) deserves special attention.

By this time Calcutta Botanical Garden attracted many visitors to see the beauty of the garden. Students of the Calcutta Medical College visited weekly for a lesson in recognizing the source of their drugs and for them the medicinal plants were labeled in Bengali (local Bangla language). The Exotic Agri-Horticultural plants also attracted curious people. Griffith changed Linnaean garden system of classification, which was laid by Roxburgh, and adapted the natural system of his teacher Lindley. Above all, Griffith built a working herbarium (public herbarium) at the top floor of the Superintendent's house located in the Garden. During his last days in Calcutta he arranged his collections and packed them to take back to London, what he would need there while on leave. He had undertaken the task to get Voigt's *Hortus Suburbanus Calcuttensis* (1845) printed and had to visit the press, which recorded about 738 species in 327 genera. In Malacca, when all his hopes collapsed, he willed the materials of his assembled dried plants in Calcutta to the East India Company. At that time Wight and his friend McClelland came forward to materialize the dream of Griffith to make the specimens to be useful to resume and remodeling the Griffith's plan (when McClelland was in-charge of the Garden). Sir George King in an address to the British Association in 1899 said of Griffith, "No botanist (of India) ever made some extensive exploration nor himself collected so many species (estimated at 9,000) as Griffith did during



the brief 13 years of his Indian career; none ever made so many descriptions of plants from living specimens. .... Griffith was a man of genius". His small publication on grasses of Sylhet (1834) and posthumously the plants of Khassiyah (now Khasia) and Bootan (now Bhutan) (1848) is worth mentioning. The majority of his collections are preserved in the Cambridge University Herbarium, William Hooker's Herbarium and in Calcutta Herbarium.

Thomas Thomson (1817-1878) had been a pupil of Sir William J. Hooker in Glasgow and a fellow-student of his son Joseph Dalton Hooker, entered the medical service in Bengal in 1839. He was posted in many places of North-India up to Simla and northern part of Indus river and Kabul. He also followed Griffith's zeal in collecting plants of the area. By this time J.D. Hooker (1817-1911) arrived in India in early 1848, when Thomson was in Kashmir. After arriving in India he started his journey from Calcutta and proceeded first to Bihar, ascended the Soane Valley and crossed the Kymore range of Mirzapur and then, descended the Ganges to proceed to Sikkim. Hooker then stationed at Darjeeling after visiting Nepal and Sikkim (now a state in India). After about two years, at the end of 1849, Hooker and Thomson met at Darjeeling which can be said as the starting of another era in botanical history of eastern India as well as of the greater India. They then moved to Khasia Hills (Now in Meghalaya State of India) to work with great intensity. From there they moved to Sylhet, Chittagong, then to various places of lower Bengal to the Sundarbans and finally to Calcutta. Hooker returned to Britain in 1851 with their piled up collections. Their combined collections were about 15,000 specimens, representing about 3,500 specimens from Sikkim area; 3,000 from Khasia Hills area and about 1,000 from the plains of Eastern India (mostly of Sylhet, Cachar, Chittagong, lower Bengal and Sundarbans; about 600 species alone from Chittagong collection, during the month of Dec.-Jan. of 1950); 1,000 from the plains of North-western India and about 2,000 from the North-western Himalaya. The estimated total number of species was over 7,000 (Gardiner, 2005). During this time they received many specimens from different corners of India collected by several important people as present. The most important one was C.J. Simons's (a pharmacist in Assam) collection, who presented several hundred specimens from Assam. They distributed some of their sets of specimens to different herbaria, as Wallich's specimens were sent, to secure international agreement in nomenclature. Finally, they jointly published the 1st volume of their new venture the *Flora Indica* (in 1855), but their next steps were abandoned due to lack of financial support.

During this time a new inflow of specimens from every corner of India flourished Kew Herbarium. Even Government of France responded with a set of Victor Jacquemont's collection from Bengal in 1829, deposited in Paris, who also visited Peninsular India in 1832. Hooker described Wallich's distribution of his collections

of 1832 as, "the most valuable contribution of its kind to Science". In 1841 Hooker succeeded in getting Hugh Falconer's (1808-1865) collections retained in 76 cases of dried plants deposited in the India House. These were mostly the collections of Northern India after his arrival in Calcutta in 1832. On Falconer's return to India in 1847, he was appointed Superintendent of Calcutta garden till 1854. After him Thomson returned to Calcutta and took over the charge of Superintendent of the Garden in 1854. He then collected plants from this region and also received the inflow of the dried specimens from many of the personnel working in different places of India in different capacities. Thomson (1856) reported many of those floristic elements, later became ill and left India in 1861. But the *Flora Indica* is acclaimed for Hooker's introductory essay (260 pp.) which presents a masterly analysis of the vegetation and physical features of India, and imparts the foundations of the study of systematic botany here.

After giving intensive labor for about a quarter of a century Hooker finally was able to publish a monumental work, the *Flora of British India* (1872-1897), describing about 14,500 species which may be used as measuring the progress of exploration and estimation of Indian history of plant study. This work is still the only Flora to date encompassing the plants of the whole of the Indian subcontinent. His visit in India was over three years which he deemed, "involved a mystery equally attractive to the traveler as the naturalist". The genera described by Wallich (61); Wight/Wight and Arnott (38); Roxburgh (31); Griffith (21); D. Don (14); and Buchanan (12) in the Hooker's *Flora of British India* were included as credit.

At this time, Wilhelm Sulpiz Kurz (1833-1878), a German botanist, first attached with Danish establishment in Java of Indonesia who then joined the Indian Service as Curator of the Herbarium in the Calcutta Garden. He soon began to publish about Indian plants, mostly Bengal plants, in the Asiatic Society Journal. Then he intended to publish a *Flora of Bengal*. When some pages were in print in 1866 Kurz received instruction to move to Andaman Islands (in remote east of Bay of Bengal) to study timber trees. In the next year he visited Arakan (now west state of Myanmar, bordering Bangladesh) and then for the whole of the rest of his service he worked on Burmese flora which culminated his illustrious book, *Forest Flora of British Burma*, published in 1877 in two volumes. Then, on leave, he visited his earlier collecting places in the Dutch Indies. But while returning to Calcutta he died in Penang of Malaysia in 1878.

After that George King (1840-1909), a Scottish, qualified in medicine from Aberdeen in 1865, came to Calcutta as Surgeon. He was then appointed as Superintendent of the Calcutta Garden and Professor of Botany in 1872. He modernized the Calcutta Herbarium and kept specimens safer in a newly established fire-proof building. He was interested in doing regional work by which Calcutta had priority in the Eastern Himalaya, Bengal, Assam, Burma

and Eastward in general. His effort was to change the status of the Garden from Imperial Botanic Service to the Provincial Bengal Government Service. Then, he was appointed as the first Director of the Botanical Survey of India in 1891. He started publication, *Records of the Botanical Survey of India* as garden's journal from 1891. His illustrated taxonomic monographs were published as sumptuous *Annals of the Royal Botanic Garden*, Calcutta. He employed collectors almost entirely to the east of Bay of Bengal. King's horticultural interests and successful *Cinchona* cultivation in Darjeeling were widely acclaimed. His ill health ultimately forced him to retire in 1897.

Charles Baron Clarke (1832-1908), a mathematician from Cambridge, spent his first 10 years of his service life in teaching mathematics using his leisure to botanize himself in Britain, Switzerland and Madeira. He left Cambridge to join as teacher of newly opened Botany Department at Presidency College in Calcutta in 1866. He was in-charge of the Calcutta Botanic Garden for two years, when Thomas Anderson (Superintendent from 1861-1872) was on leave between 1869 and 1871. He then joined as School Inspector of Assam and Bengal province in between 1883 and 1887 after closing the Botany Department due to absence of any students. This gave him opportunity to botanize Bengal and Assam most extensively. His important works on plants of the region were published in several papers. The important one is the *Flora of Kohima and Manipur* where he described 1050 species under 533 genera, where 87 were new taxa (Clarke, 1889). As he was short-sighted, which seem to have heightened his interests to herbaceous plants commonly growing in the cultivated fields and, open waste and wetlands. So, he explored the herbaceous families like Cyperaceae, Commelinaceae and Scrophulariaceae most intensely. He took all his collections from India (field number exceeded 14,000) to Kew, while on leave, and offered his services to J.D. Hooker, when the 2nd volume of the *Flora of British India* was ready to publish. Clarke continued to write about 200 pages of volume 2 and 520 out of the 734 pages of volume 4, which he continued until 1883. But approaching the time of termination of his leave he came back to India and spent additional 2 years in Bengal and 2 years in Assam. In the final volume of the *Flora of British India*, last contribution was on the family Cyperaceae, which published in 1897. Subsequently, his monographic work on *Commelinaceae of Bengal* (1898) was highly appreciated. His further interests were on the phytogeography and Ferns of India as reflected in his many publications (*A Review of the Ferns of Northern India*, 1883). By the end of 19th century and afterwards the taxonomy of Indian spermatophytes then rests on the leadership of Kew.

Dietrich Brandis (1824-1907), educated in Bonn University, Germany, became a teacher of Botany in the same university, who came to India in 1855 and took the charge of Rangoon establishment of British Empire related to teak forests of Pegu in Burma. Then he was promoted to Inspector General of Forests of India and

visited many places of Bengal, specially Chittagong and Sylhet regions, along with many places of India. Finally, he published *Indian Trees* in 1906. In various pages in the book he gave attention to lower woody plants also. So, it can be treated as Flora where he mentioned many plants from the present Bangladesh area. At the same time T.J. Symonds (1886) studied the grasses of India and described 70 species under 25 genera. Many of those were from Bengal Presidency.

George Watt (1851-1930), qualified in medicine at Glasgow, came to India in 1873. He made good use of his time in the field in Manipur and Assam. He explored Manipur in 1881-82, which he published in series (1888, 1890) and reported wild tea plant there. He visited Cachar and Sylhet also. Then he compiled an encyclopedic work *Dictionary of the Economic Products of India* which became the classic reference book about Indian plants (1889-1896). Then, Cecil Ernest Claude Fischer (1874-1950), trained in Forestry College at Cooper's Hill (London), arrived in India in 1895 and served the entire of his service in Madras Presidency. He worked on many south Indian floras. After retirement he became Assistant for India in the Kew Herbarium (1925), where flora of Madras is his important collection. He also explored eastern Indian and adjacent Bengal flora. His important publication is the *Flora of Lusai Hill* (1938), a place just north of Chittagong Hill Tracts region.

David Prain (1857-1944) from Aberdeen of Scotland entered the Indian Medical Service and was posted at the East-India Company's factory in Laxmipur in 1884 (where Buchanan also served about 90 years before). He acted as Curator of Calcutta Herbarium in between 1886 and 1897 and succeeded G. King as Superintendent of the Calcutta Garden till 1905. His great achievement was the publication of *Bengal Plants* in 1903a, where he included 1162 genera and 2893 species of vascular plants in addition to 121 sp. of Pteridophyta from the then Bengal Province, the major part of which is now in Bangladesh. The other areas comprise the present Indian states of West Bengal, Bihar, Orissa and Part of Assam. In the *Flora of British India*, J.D. Hooker described the work as, "an attempt to sweep together and systematize a country 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 so huge an undertaking that its 7 volumes together weighed so much that an user cannot conveniently take those in the field for study". In a valedictory preface to the final volume Hooker expressed a wish that, ".....it would facilitate the preparation of local flora". By this time many others were in a position to guess the date of its conclusion, some of them were engaged in writing their own local flora. Prain was one of those preparing the different geographical flora of their interests.

Prain's *Bengal Plant* is of great importance because of the geographic section cut out of the *Flora of British India*. While engaged in writing *Bengal Plants* he prepared an

important working flora of the largest mangrove forests of Bengal is the *Flora of Sundribuns* (1903b) and the local flora in, *The Vegetation of the Districts of Hughli, Howrah and 24-Pergunnahs* (Prain, 1905b), the three districts that surround the city of Calcutta. Almost all the species of his Sundribun's Flora have been included in Bengal Plants. But his Hughli, Howrah and 24-Pergunnahs have some additional list to be added in the list of *Bengal Plants* which totals about 3,000 species under about 1170 genera.

When Prain was Superintendent in 1897 the post of Curator was succeeded by Surgeon Captain Andrew Thomas Gage (1871-1945) of Aberdeen. He was a Scottish Botanist and Surgeon in Indian Medical Service. He collected along the southern margin of the southern Lusai Hills (attached to north of Chittagong Hill Tracts, now in Mizoram State of India) in 1899 and then through the Burmese District of Minbu (east of Lusai Hills) from east to west. He went there through Chittagong and Chittagong Hill Tracts (Rangamati and Barkal, where Clarke also visited before) by boat through Karnafully River. Gage published his expedition *A Botanical Tour in the South Lushai Hills* in 1901 where he reported 291 species of angiosperms. His other publications are, *A Census of the Indian Polygonum* (1903) and the *Catalogue of Non-herbaceous Phanerogams Cultivated in the Royal Botanic Garden, Calcutta* (1916).

Prain's publication then influenced many contemporaries to go further in-depth to prepare flora of local or very smaller geographical areas. One of such is A.T. Gage's publication, *The Vegetation of the District of Minbu in Upper Burma* (1904), a place very near to east of Bangladesh. It includes various information of about 787 species under 456 genera. According to him (as of Prain) this area falls in Assam-Arakan sub-area which is at the border of Bengal (Bangladesh). Gage then published a numerical list, almost after 100 years later of Roxburgh's *Hortus Bengalensis*, accounting about 13,437 accession. While Prain was at work on his flora, John Justus Wood, a surgeon after retiring moved to Choto Nagpur and after working published the "*Plants of Chutia Nagpur* (1903), the area was also included in Prain's Bangal Plants.

G. King was able to send George Alexander Gammie (1864-1935) to a collecting trip up to the Brahmaputra Valley to Sadia of Assam. The report was then published where he described about 400 species (Gammie, 1905). He was put in-charge of the Lloyd Botanic Garden in Derjeeling in early 1891. He was then served as Curator of the Calcutta Botanic Garden. After that Henry Haselfoot Haines (1867-1945) came to India from London in 1888 as Forest Officer, who served in Northern Bengal Forests and became Divisional Forest Officer for Choto Nagpur. Haines keenly felt and extensively revised flora for Bengal. His intensive work resulted in the publication of *Forest Flora of Choto Nagpur Including Gangpur and the Sontal Pergunnahs* (1910). Choto Nagpur had come within the area that Prain covered in his Bengal Plants but that was in no way lessened the value of Haines's Flora, because his descriptions were elaborate and original. From 1914-1919 he served as conservator of Forestes in Bihar

and Orissa. His subsequent publication *Botany of Bihar and Orissa* (1921-1925) is worth mentioning. The next name is Robert Lawrence Heinig who came to India from London in 1895 as Forester. He served in the Andaman Islands, Chittagong and the Sundarbans. He collected large information required for the working plans of the forests and compiled *A List of Plants of the Chittagong Collectorate and Hill Tracts* (1925) which listed 1559 species. He gave much information to Prain for his *Flora of the Sundribuns* (Prain, 1903b) during his service in that area.

The next important contributor was I.H. Burkill (1870-1965), educated in Cambridge and trained at Kew, came to India in 1901 as Assistant Economic Botanist in Calcutta Museum. He served as the Director of Botanical Garden, explored and published the *Sikkim Expedition* in 1906 and *Journey to Nepal* in 1907. He then made the Abor exploration (1912) in upper Assam, published *The Botany of Abor Expedition* in 1924-1925 which is accepted as an excellent account of expedition to be the organized model. According to him "The Abor-land flora has a distinct relationship to that of the hills of south-eastern Assam. It has as much in common with that of the Khasia Hills...." He worked in association with D. Prain in a revision of the Asiatic species of the important food plant, *Dioscorea*, published in 4 vols. in the *Annals of the Royal Botanic Garden Calcutta* in 1936 and 1938.

While preparing a working plan in 1928 for Indian Forest service, John Macqueen Cowan published *The Flora of the Chakaria Sundarbans* of south Chittagong, where he included 98 species within 82 genera. This part is the largest isolate compact area of mangrove forests, about half way between Sundarbans of the Gangetic delta and those of the Irrawaddy in Burma. J.M. Cowan and A.M. Cowan jointly published *The Trees of Northern Bengal* in 1929. At this time Francis Kingdon-Ward (1885-1958) of Manchester, U.K., visited Eastern India several times in between 1927 and 1948. His important publication is *Forests of Manipur* (1948) on Manipur expedition.

During the World War-II, J. Sinclair (1913-1968), a Scottish Botanist graduated from Edinburgh in 1936, joined the Royal Air Force in Britain and was posted in India. Between 1943 and 1945 he explored the flora of Cox's Bazar (S.E. of Chittagong, Bangladesh). Then he joined the Edinburgh Royal Botanical Herbarium in 1946 and later joined as Curator of Singapore Botanic Garden in 1948. Again in 1949 he visited Cox's Bazar and later in 1955 he published, "*Flora of Cox's Bazar, East Pakistan*", where he included 690 species in 438 genera of Angiosperms.

During the beginning of 20th century Upendra Nath Kanjilal wrote "*Forest Flora of Dehra Dun*" in 1901 as probably the first Indian who worked on Indian Flora. He was a student of the Forest College, Dehra Dun (now in Uttar Pradesh State of India) and later joined as teacher of the same college. Then he was asked to write the *Flora of Assam*, which was published in 1934-1940 in 5 Volumes. The Flora forms a landmark in the history of floral studies in the North-Eastern region of India as whole. But, the Flora

was incomplete in the study of Monocot due to his sudden death. In continuation of his work Norman Loftos Bor wrote Gramineae in the final fifth vol. of the Flora in 1940. N.L. Bor (1893-1972), studied in Dublin and Edinburgh University and served in the Indian Forest Service during 1921-1946 as Forest Botanist in the Forest Research Institute, Dehra Dun, where he carried out research on Indian Gramineae. Then he left to Kew where he has made a detailed study of Gramineae and published the most important work, *Grasses of Burma, Ceylon, India and Pakistan* in 1960, where many species were from Bangladesh area.

The above mentioning marked the highlights the glorious starting and progress of the botanical exploration and floristic studies during the closing of 19th century and the beginning of 20th century. In Bangladesh the hilly regions are Chittagong and Sylhet, situated at the eastern border lines. These two places are most attracted by the botanists and explorer from the very early time. Because of its geopolitical importance during 18th and 19th centuries these places had good communications. Probably F. Buchanan was the first who collected many plants during his trip in 1798 and mentioned that the Chittagong flora is very similar as Burmese flora. Thinking about the flora as most interesting, Roxburgh arranged visits of his sons, William and Jones, from Calcutta to Chittagong for collecting plants. Afterwards, Wallich sent his collector, Henry Bruce, to collect plants from Chittagong region. Then a door was opened further north by water way from the mart of Bengal into Sylhet. Along this effort, the first botanical exploration was made by M.R. Smith who was a Magistrate at Pandua (now in Sylhet) near Khasia (about 25 km away from Sylhet village), where hill people would come to barter goods, in exchange of montane and submontane plants for Roxburgh. He maintained a garden for about 50 years and sent out collectors to bring plant samples. He died in 1819. Buchanan called him a faithful friend.

Wallich sent his collector, Francis de Sylva to Padua of Sylhet in 1820, who collected a large number of plants from these areas. Later, Professor John Mack from Edinburgh came as teacher in a college that Serampore Misson had founded. He and his wife visited Khasia hills in 1826 (the year of the first political approach to the Khasia) and made collection of dried plants which they then handed over to W.J. Hooker, the excellence of the specimens received high commendation. The Khasia plateau received its first visit from Griffith in 1835, who was a professional botanist. Afterwards, Hooker and Thomson in 1851 spent about seven months in Khasia Hill range with a great vigor. When they left, Falconer sent some collectors there. Thomas Oldham, (geologist), H.H. Godwin-Austein, (zoologist), Sir Joseph Fayrer C.B. Clarke, and Sir George Watt collected many plants from the Khasia hills. But, the largest collection was of Griffith, when he extended his collection area to further east to Nagaland Hills and east of Kohima Hills in 1841. Later George Gammie collected plants from these areas in 1894 and Prain and many others subsequently visited the place in

the 20th century. T.V. Dent of Forest Research Institute, Dehra Dun (in North India) made a collection trip to Chittagong and Chittagong Hill Tracts region in 1939-40. V.S. Rao, (I.F.S.) also, in several occasion, sent specimens to M.B. Raizada, Assistant Botanist of the Forest Research Institute Dehra Dun. All these accumulated collections made 64 new records from Chittagong region and was published by Raizada (1941).

Robert Lewis Proudlock (1862-1948), trained at Edinburgh and Kew, came to India in late 1889 and joined as Assistant Curator when William McHardy was Curator of the Calcutta Garden. When McHardy left India due to ill health, Proudlock was appointed as Curator of the Garden. He associated G. King who was the Director of Botanical Survey of India and at the same time Superintendent of the Botanical Garden Calcutta and later D. Prain succeeded King. In 1892 Proudlock went to a collecting expedition to lower Burma and collected 500 dried specimens. Then he was posted to Nilgiri of northern India, where he collected some new orchids, later named in his honour by others (*Oberonia proudlockii* King & Pantling and *Bulbophyllum proudlockii* J.J. Smith). He designed and established many gardens and parks in Nilgiri and Rangoon. In 1909 he arrived in Dacca (now Dhaka) as Arboriculture Expert to the newly formed Eastern Bengal and Assam Province after partition of greater Bengal. During his stay in Dacca headquarter; he made several visits to Shillong, Chittagong, Sundarbans and Darjeeling. His principal achievements were the laying-out of the new civil station and Ramna Garden, Dacca, until the close of administrative restoration of the Province of Eastern Bengal in 1912, when Dacca lost its capital status. His architecture aims was to make to turn new capital a Green City, where Ramna was the model. This beauty, though not improved, but still exists. He served until his retirement in 1918, after transfer from Dacca to Calcutta Garden.

Burkill (1965) has assessed the illustrious personnel's who founded the cause of plant exploration in India, mentioned no fewer than 457 in number. Out of the number, 111 were the administrative or army officers, 104 were surgeons of the army and 1/8th of them visited India as travelers or horticultural collectors, but the surgeons did the most for the advancement of the subject.

Activities of plant exploration and survey of flora of India were abeyance since the starting of World War-I and continued to the abolition of the Botanical Survey of India in 1937. The *Records of the Botanical Survey of India* was discontinued due to shortage of funds in 1930 and subsequently in 1937 the BSI was almost wound up with the retirement of its last Director C.C. Calder. Calder's important work was published in 1926 jointly with V. Narayanaswami and M.S. Ramaswami, (both staffs of the Botanical Garden) and K.P. Biswas (1926, 1927). Finally, Sushil Kumar Mukherjee (1909-1997), for the first time a native Indian, served as Keeper and later as Curator from 1938-1957. By this time more intensely the floristic study was underway in the form of Revision. The first such

monumental work was of S.K. Mukherjee's, *Revision of Labiatae of Indian Empire and Burma* in 1940. Unfortunately, during this long glorious phase of exploration and study, not a single herbarium was erected in eastern Bengal area of India. During the 2nd World War and Post-War period the continuity of the plant research greatly hampered and comparatively little collection has been done.

It may be mentioned here that, in 1939 the Department of Biology was founded at the newly established (1923) Dhaka University in East-Bengal. The founder head was the eminent plant embryologist P. Maheswari. He, along with his associate S.K. Sen (a Revenue Officer and first part-time Curator of D.U. Herbarium) made exploratory trip to Chittagong and Darjeeling Hills. Their collections formed the nucleus for the Dhaka University Herbarium, the 1st attempt to explore and document of its own plant resources in own herbarium.

## 2. Pakistan Era (1947-1971)

The British colonial rule ended with the partition of mainland India into two sovereign countries, India and Pakistan in 1947. In this process the then Bengal Province partitioned into a completely new demarcation that emerged into a bounded small new land named as East Pakistan, the then a Province of Pakistan. The Capital Calcutta was included to West Bengal state of India where the Royal Botanic Garden was renamed as Indian Botanic Garden in 1950. The taxonomic exploration work was then progressing very slowly until the organization of the Botanical Survey of India (BSI) was established in 1954. Father H. Santapau joined as Chief Botanist of the newly organized BSI. A synopsis of the activities of the Botanical Survey of India up to 1983 was given by Jain (1983), where many other leading Indian taxonomists had elaborated the progress of the Central National Herbarium in the Silver Jubilee Volume of the Bulletin of the Botanical Survey of Present India.

On the other hand, East-Pakistan had not inherited any continuity of the botanical activities that were in India. There was almost complete cut off facilities from the Calcutta Herbarium. Furthermore, in this part of Pakistan, there was absence of any taxonomist or enthusiast explorer to continue the glorious heritage of plant exploration. There was no herbarium, museum or even botanical garden in this part. This unfortunate effect of expression continued up to 1960's, when Md. Salar Khan, a teacher of Dhaka University, took the challenges of this task. The Department of Biology of Dhaka University then upgraded to post-graduate level in 1949 when researchers got opportunity in plant research for the first time in East Pakistan.

By this time two publications are worth mentioning. Rabindra Mohan Datta, Scientist of Jute Agricultural Research Institute, Barrakpore, West Bengal and Jitendra Nath Mitra, Teacher of Presidency College, Calcutta (now both are in India) started working on the floristic work of Dacca city and its suburban areas in 1944. The work was then published after partition, containing 1033 species in 681 genera (Datta & Mitra 1953). The other important

work was the Sinclair's *Flora of Cox's Bazar* (1955) containing about 690 species in 438 genera of Angiosperms. But again the specimens of those works are deposited outside East Pakistan. Yet these two works provide stimulus for further investigation of small areas in detail.

Up to about 1960 the exploration and taxonomic work of flowering plants were completely in dark when Khan appeared to light the lamp. Md. Salar Khan (1924-2002) born in Kakinada, Andhra Pradesh (east peninsular India), educated in Botany from Aligarh Muslim University, India and then did PhD from Edinburgh in 1962. He domiciled in East Pakistan and joined Dacca University, first as Lecturer in Botany in 1950, later promoted to Professor until his retirement in 1991. I have mentioned earlier that the opening of the Department of Botany at Dacca (now Dhaka) University in 1949 gave the opportunity for the first time to explore the plant more extensively. But, as East Pakistan was completely isolated due to absence of any inherited herbarium and expert in plant taxonomy, Khan took the leadership to start with the subject. The situation was just like the Roxburgh's days in Calcutta about 160 years before about status of Indian Botany.

Khan's first initiative was to start with Angiosperm families (Khan and Arangzeb, 1959). His first exploration attempt was in Teknaf and St. Martin's island, situated at the extreme south-east corner of the country (opposite to Rakhine State of Myanmar) and the findings were published (Khan, 1963, 1968) where only 92 angiosperm species was enlisted. Then his second exploration was in Chittagong Hill Tracts where he published 125 species in 8 genera (Khan & Banu, 1969, 1972). This time some students joined with his initiatives in mid 1960s to work on some families like Asteraceae, Euphorbiaceae and Caesalpinaceae. The outcome of their research started appearing in different journals (Khan & Huda, 1967, 1970' Khan *et al.* 1970; Khan & Hossain, 1971a, b).

By this time another relevant development is worth mentioning. Francis Raymond Fosberg (1908- 1993), was Botanist Emeritus at National Museum of Natural History, Smithsonian Institution in Washington DC, USA, came to Dhaka on a visit at the UNESCO symposium in 1964, who realized to have a Central Herbarium of East Pakistan. He presented a draft recommendation for submission to the Government of East Pakistan urging to establish a herbarium in Dacca. It was finally implemented as project when Botanical Survey of East Pakistan was also started simultaneously. The works were stationed at the Botany Department, Dhaka University, from financial support of Agricultural Research Council of Pakistan in May, 1970. At this, the ecological and phytogeographical aspects were also included in the project, which was initiated by an eminent ecologist, Professor M. Ismail of the same department of Dhaka University. The aim of the project was to publish *Flora of East-Pakistan*. The Dhaka University Herbarium served as the only starting materials for identification of plants. Khan acted as Principal

Investigator of the newly organised Central Herbarium since 1970. Two of their students, Ahmed Mazharul Haq and Md. Manjur-ul-Kadir Mia, just obtaining their M.Sc., joined the herbarium part and the ecological part respectively. It may be mentioned here that the *Flora of West Pakistan* was also started simultaneously under the same project by Professor E. Nasir and S.I. Ali (of Karachi University) with the "Stewart Herbarium" at Gordon College, Rawalpindi and Botany Department, Karachi University. But this sprouting stage was then arrested with the outbreak of liberation war in East Pakistan during March, 1971.

### 3. Bangladesh Era (From 1972 - present time)

The erstwhile East Pakistan province, after liberation war in March 1971, emerged as a new sovereign country in December 1971, named Bangladesh. The Botanical Survey of Pakistan which was initiated by M.S. Khan in 1970 and was stationed in Botany Department, Dhaka University, renamed as the Botanical Survey of Bangladesh in 1972. Under the leadership of Khan, the exploration and establishing a full fledged herbarium began with renewed vigor in 1975 under the Ministry of Agriculture. In the beginning, the herbarium worked in several rented buildings until 1995, when it was housed in the Bangladesh Agricultural Research Council (BARC) premises. Finally, with the help of British aid under ODA (Overseas Development Administration, London), a permanent superb 2-storied building with about 29,000 sq. ft. space "The Bangladesh National Herbarium (BNH)" was opened on 7 February in 2000 within the premises of the National Botanic Garden at Mirpur, Dhaka. The housing capacity of the Herbarium was about half a million specimens. Professor Vernon Hilton Heywood (born in 1927) of Reading University was acting as ODA consultant for the National Herbarium. Side-by-side, the National Botanic Garden, established in 1961 on about 210 acres of land, has been facilitating to *ex-situ* conservation of a large number of living plants. Both the establishments are now working under the Directorate of the Ministry of Environment and Forests, Bangladesh.

Despite basic academic pursuit, Khan simultaneously served as the founder Director of the Herbarium and continued until his retirement as Supernumerary teacher from Dhaka University in 1991. After retirement he remained associate as Honorary Advisor of the Herbarium till death in 2002. The directorship was handed over to his ex-student, and later Scientist of the Herbarium, M. Matiur Rahman and he continued till his retirement in 2009.

Khan's long cherished goal was to publish the Flora of the area, the 1st fascicle of which started to see light in October, 1972 under his editorship in the name of *Flora of Bangladesh*. He then successfully edited 51 fascicles of the Flora till he died. From the 40th fascicle, in 1989, M.M. Rahman acted as Joint Editor and then as Editor up to the 58th fascicle that appeared in 2009. After Rahman's retirement from Directorship of the Herbarium, Hosne

Ara has succeeded the post till now, who edited the 59th and 60th vols. of the *Flora of Bangladesh* up to 2009.

The initial publication of the Flora was mostly on the unispecific or unigeneric families. From 30th fascicles some large families like Convolvulaceae (having 15 Gn., 55 spp.), Asclepiadaceae (25 Gn., 56 spp.); Annonaceae (15 Gn., 40 spp.) and Lamiaceae (33 Gn., 85 sp.) were published. So far, up to 60th fascicles, 72 families having 266 genera and 552 species have been described. Now, BNH holds about 1,00,000 specimens, of which about 30,000 specimens are documented and arranged. The accounted species number is about 2,200.

With the initiation of BNH many young botanist joined and were trained there. But the problem was due to hindrance in publication of floral research outcome. Realizing this problem Khan again came forward. Due to his active participation, Bangladesh Association of Plant Taxonomists was formed in 1992 where Khan acted as founder president. His next testimony was the starting of *Bangladesh Journal of Plant Taxonomy*, the official organ of the taxonomists' association, started publication from 1994. Now, taxonomists get impetus to publish their findings more quickly in this journal.

The trends of the taxonomic and angiosperm floral publications from 1972 to onward have progressed not steadily but more or less horizontally up to about 1994. The total angiosperm floral publications during Pakistan period of 23 years were only seven (average 0.33/year). During Bangladesh period, the first 23 years, up to 1994, the number of the floral or taxonomic type of publications were about 70 (average 3.33/year), then in the next 19 years i.e. after 1994 to now, were about 150 (average about 9/year). This trend of publication number indicated that the angiosperm taxonomic research increased significantly but not up to the mark. A substantial number of the published papers deals with new records, checklists and inventory related. About 200 new taxa records and some new species records were credited by this time.

After Khan's retirement from Dhaka University in 1991, probably he spent his best time for the cause of plant exploration and assessment. The BNH now became the hub of the taxonomic activities and research work in Bangladesh. Khan's effort was to document the species as much as possible. As every collected specimen was to be identified as quickly as possible, some of his first generation students joined him in this critical time. Khan then went to Royal Botanic Garden, Edinburgh in a 10 months long programme in 1975-76. This resulted multifarious development, like the identification process and the searching of specimens collected by earlier explorers from Bangladesh area, since about two centuries before.

About a dozen of his first generation students took the leadership to go ahead with the Bangladesh flora. By this time some Universities and Research Institutes have been established where job opportunities opened to go further with the local flora. The illustrious active workers

were M. Naderuzzamn, Rajshahi University since 1964, A.B.M. Enayet Hossain, Jahangirnagar University since mid 1980; Md. Abul Hassan, Dhaka University since 1970, Ahmed Mazharu Huq, Manzur-ul-Kadir Mia, M. Matiur Rahman, Mahabuba Khanam, Momtaz Begum, Busra Khan and Oliur Rahman of the BNH between 1968 and 1990. On the other hand, Din Mohammad and Md. Yusuf joined in the Bangladesh Council of Scientific and Industrial Research Laboratories (BCSIR Labs.), Chittagong in 1967 and 1975 respectively. M. Khairul Alam, joined the Bangladesh Forest Research Institute, Chittagong in 1976. Due to active efforts of the raised various institutional herbaria, these became the sub-hub of the local floral studies more intensely. The above mentioned researchers started research individually with new projects. So, an organized activity then emerged with new vigor.

The author, basically studied plant physiology, but first joined the BCSIR Labs., Chittagong, in 1973, as a Botanist and was trained on Taxonomy there. He then joined as teacher in the newly opened Botany Department, Chittagong University in 1974 and started working on the flora of Chittagong, firstly of the Sitakunda Hill range. The results of his effort was first published in 1977 (Pasha & Mohammad, 1977) and subsequently in the following years (Alam & Pasha, 1999). Later, M. Atiqur Rahman, a former student who later joined as a teacher of the same Department in 1983, enhanced the taxonomic work while leading a Link Project (1997-1999) with the University of Aberdeen, sponsored by DFID, U.K., to explore the flora of south-east Bangladesh. In this way the initial floral studies greatly organized to move further steps.

### **Bangladesh Flora: a dream to reality**

The botanical history narrated above for last four and a half centuries are the highlights of the floral composition of the Eastern India, particularly of Bangladesh. The first two and half centuries, years from Diega Garcia to Roxburgh, had elapsed mostly to understand Indian Peninsular flora, the substantial part of which are phytogeographically related to Bangladesh flora. The next two hundred years had elapsed with the start of Roxburgh to present time. Roxburgh had started the dream to write up *Flora Indica* (Flora of India) which mostly concentrated on south and eastern Indian flora. To assess the Bangladesh flora, the earlier floral studies illuminated above, is to be considered first as the basis and to be evaluated. Phytogeographically Bangladesh is placed at the brink of and bridges several Asian floral elements, mostly the Indian and the South-east Asian. So, the flora of Burma (now Myanmar) and North-east Indian floral elements from the east and Indian floral elements from the west of Bangladesh have been migrated or invaded. Then these floral elements admixed and blended in the land of Bangladesh which ultimately constitutes the present Bangladesh flora.

Plant exploration and studies at the beginning was engaged mostly to assess the floral elements present in an area. In this long process of gradual development an

up-to-date Floral assessment of the country is urgently felt. The fascicles of the *Flora of Bangladesh* are being published very slowly. Until now, less than 600 species have been described out of about 5,000 species primarily estimated by Khan (1976).

The next important step in compiling a complete flora is the recent publication of the *Encyclopedia of Flora and Fauna of Bangladesh*. It is a monumental project organized into 28 volumes that compiled the known species of life of Bangladesh from prokaryotes to higher organisms. This modest venture was initiated by the Ministry of Environment and Forest and the Ministry of Finance, Government of Bangladesh, and published by the Asiatic Society of Bangladesh, Dhaka. The entries have been written with a blend of scientific rigor and popular appeal to the interest of both specialists and general readers. The volumes have been edited and contributed by a team of experts, leading scientists and researchers of the country.

The Angiosperms are included in the volumes between 6 and 13 of the *Encyclopedia* published from March 2007 to June 2009 (Siddiqui *et al.* 2007; Ahmed *et al.* 2008-2009). The *Encyclopedia* claims compilation of all the species so far reported from the present day Bangladesh or from locations that were parts of former East Pakistan, and the lower, eastern, northern Bengal, Sylhet and the lower part of the Khasia-Jaintia Hill ranges, Chittagong and Chittagong Hill Tracts. *Encyclopedia* further claims that, "...it has not only fulfilled a long-felt need but would also be of considerable relevance to the spirit of the convention on Biological Diversity adopted at the Earth Summit in 1992, to which Bangladesh is a signatory".

The taxonomic account of the Angiosperms compiled in the said *Encyclopedia* is in alphabetical orders of families, genera and species after following Cronquist's classification system (1981). A total of 199 families in 1,377 genera and 3,557 species have been recorded in the *Encyclopedia*. Of which, 158 families in 1,029 genera and 2,581 species have arranged in Magnoliopsida (Dicots), and 41 families, 348 genera and 976 species in Liliopsida (Monocots). Although, it is not a research *Flora* or the alternative of the running *Flora of Bangladesh* yet it is a gigantic task in compiling almost all the taxa, as claimed.

After the publication of *Encyclopedia* is over the present author noticed that many of the taxa are missing in the list. Many earlier literatures were not extensively studied or searched and many such invalid and synonymized species have been cited as valid names. Many of the citations of the author's name are incorrect or not properly mentioned. Many herbarium materials were not properly investigated. One such report is of Barbhuiya and Gogoi (2010). After searching the specimens in Shillong, Meghalaya state of India, they recorded 448 species in 324 genera, deposited in the ASSAM Herbarium (Acronym), which were collected by the earlier workers from greater Sylhet area (present part of Bangladesh, once Sylhet was in Assam Province before the emergence of East Pakistan). Most of the collections were of Gustav Mann (1838-1916),

born in Germany, trained at Kew, who was the first Conservator of Forest of Assam in 1863. Mann sent one set of his collections to Brandis and duplicate was kept at ASSAM. Shilong was the Headquarter of Assam where Mann's collections led the foundation of ASSAM Herbarium. Later in 1912, A. Earle, Chief Commissioner of the then Assam Province, took an ambitious project and assigned Upendra Nath Kanjilal, the then Extra Assistant Conservator of Forest of Assam to prepare "*Flora of Assam*". Kanjilal, kept stationed at Sylhet M.C. College, kept some of his duplicate specimens there (lost mostly due to mismanagement of those specimens after partition). But unfortunately the progress of work was stopped due to Kanjilal's sudden death in 1928. The unfinished project was taken over by his son P.C. Kanjilal, a Forest Officer. Many Foresters like, A. Das, S.C. Purkayastha, R.N. Deb B.C. Sengupta, G.K. Deka, N.L. Bor, B.B. Shyam, S.R. Sharma, Debnath Paul and H.K. Dastider joined hands to finish the remaining task. The efforts then was completed as "*Flora of Assam*" and was published between 1934 and 1940 as a monumental work after Bengal Plants of Prain (1903). These two large provincial flora forms the important bases to study Bangladesh flora. The collections from Sylhet area continued further by the above mentioned researchers to enrich the floral work until partition of India in 1947.

Barbhiya and Gogoi (2010) sorted out the collections from Bangladesh part after screening of 2,65,000 sheets in ASSAM. On searching, the present author observed that more than 100 (about ¼) species of this report has not been included in the said Encyclopedia of Bangladesh. This gleams the author to search a large number of literatures about the taxa to be included in future research on flora. After searching different literatures many taxa were unearthed by the present author, the results of which needs to be accumulated to revise the complete floral wealth of Bangladesh. So far, there was no extensive search at Calcutta (CAL), Dehra Dun (DD) and Sahranpur Herbarium, where many more taxa along with the type specimens were deposited and expected to be discovered more. At the same time, Kew (K), British Museum (BM) and Edinburgh (E) were the other major holders of our plants, where similar reports would be expected.

After realizing short in number of taxa, the author started to accumulate the remaining taxa to be included in the floral account. Finally, Pasha and Uddin (2013) published *Dictionary of Plant Names of Vascular Plants of Bangladesh*, where they compiled almost all the remaining Angiosperms and Gymnosperms (including Pteridophyta) of Bangladesh. Following Cronquist (1988), the taxa and the common (vernacular or English) names have been arranged in alphabetical orders in the text and in Appendix at the end, for quick search of scientific names known up to the present time. About 2/3rd of the species listed in the book have only scientific names without local or English names. For the first time all the species have also been given with a proposed Bangla name for the local identification of the plants. This dictionary can be considered as almost

the end of the expected floral account known up to present time. With this publication an era has ended the long untiring effort of hundreds of known (a few have been mentioned in this paper), less known or unknown persons who laid down stone by stone on a long path of about 500 years to reach the goal in quest of knowing the flora of this area and also of Bangladesh. The present account of the floral composition is summarized in the following table 1.

Magnoliophyta (Angiosperm) plants in Bangladesh has been distributed in 4,945 species, 17 subspecies and 60 varieties in 1670 genera under 219 families. Out of these families, 43 are represented by single genus and single species; 17 by single genus and two species and, 14 others represented by only 3 species. That means, a total of 74 families have been represented by only 74 genera and 119 species. On the other hand, only 10 largest families are represented by 643 genera which embrace about 2,000 species. Furthermore, if only the 20 largest families are considered then about 50.25% genera and 55.51 % of the total species would have been included in the flora (Table 2). The largest families are Poaceae, Fabaceae, Orchidaceae, Rubiaceae, Asteraceae, Cyperaceae and so on. But in the world context the richest floral diversity in Bangladesh flora are Lauraceae (43.74%), Cyperaceae (34.29%) and Convolvulaceae (32.73%).

The 20 largest genera in the flora are presented in Table 3, showing the highest number of species included in *Ficus*. The next largest genera are *Cyperus*, *Dendrobium*, *Syzygium*, *Fimbristylis*, *Ipomoea*, *Crotalaria*, and so on. These only 20 genera are holding more than 10% of the total species.

At least 130 genera (8%) and 400 species (about 8%) has been recorded as exotic plants in the flora (Hossain & Pasha, 2004). Majority of the exotics are of American floral elements. The endemic taxa are negligible, have only 25 species so far recorded in Bangladesh (Pasha, 2012). By this time many taxa have expected to be locally extinct. Many taxa were recorded only once, some were more than 200 years back. Now the prime task is to find out the locations of those type specimens.

Because of geographical location, Bangladesh is represented very poorly by the Gymnosperm plants. It is presented by only 21 species in 9 genera under 7 families. Out of these species 12 are exotic. The native *Gnetum* is represented by 5 species and, *Cycas* and *Pinus* by single species each.

This study revealed that although C. Linnaeus never came to India, yet he dominated in naming of our plants. It is estimated from Pasha and Uddin (2013) that out of about 5,000 species of Bangladesh, Linnaeus alone named 921 species. The next highest numbers of naming authors are Roxburgh, Wallich, Hooker f. (some with Thompson and Bentham) and Buchanan. Some of these and other major contributing author's names and the number of plant names have been presented in Fig.2. It is estimated that about 50% species of Bangladesh flora have been named by only 16 authors, which indicates their extent of involvement with Bangla plants.



**Table 1.** Synopsis of the taxonomic account of Magnoliophyta (flowering plant taxa) of Bangladesh (Pasha & Uddin, 2013).

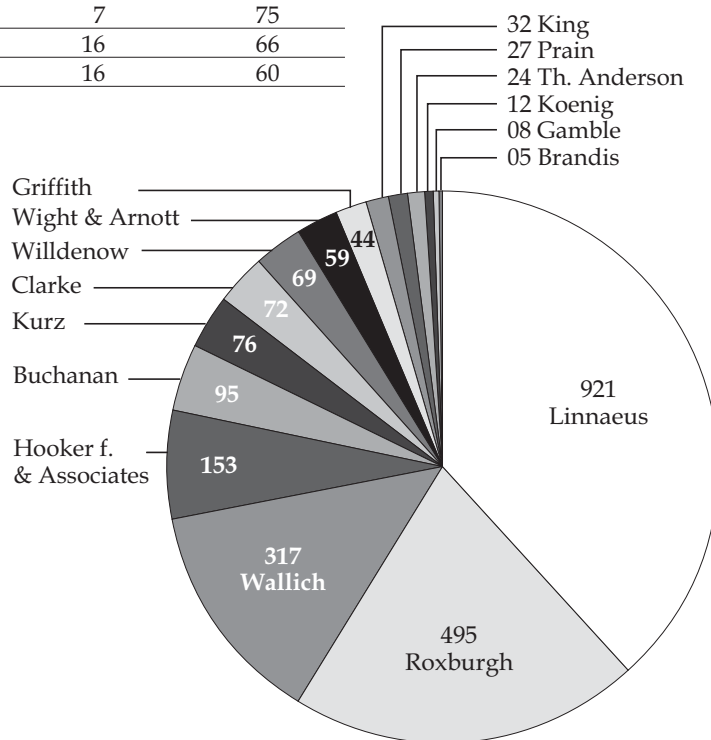
Class	Family	Total%	Genus	Total%	Species	Total%
Magnoliopsida	178	91.28	1265	75.76	3691	74.64
Liliopsida	41	18.72	405	24.24	1254	25.36
<b>Magnoliophyta</b>	<b>219</b>	<b>100</b>	<b>1670</b>	<b>100</b>	<b>4945</b>	<b>100</b>

**Table 2.** The 20 largest families with their number of genera and species present in Bangladesh flora.

S.N.	Family name	No. of Genera	No. of Species
1	Poaceae	132	342
2	Fabaceae	80	301
3	Orchidaceae	77	242
4	Rubiaceae	68	217
5	Asteraceae	104	197
6	Cyperaceae	24	166
7	Acanthaceae	40	161
8	Euphorbiaceae	50	159
9	Lamiaceae	38	104
10	Araceae	30	90
11	Scrophulariaceae	30	87
12	Convolvulaceae	20	87
13	Asclepiadaceae	35	82
14	Verbenaceae	19	80
15	Zinziberaceae	18	80
16	Caesalpiniaceae	18	76
17	Lauraceae	15	76
18	Moraceae	7	75
19	Malvaceae	16	66
20	Mimosaceae	16	60

**Table 3.** The name of the 20 largest genera with the family name and species number present in Bangladesh flora.

S.N.	Genus name	Family	Sp. No.
1	<i>Ficus</i>	Moraceae	61
2	<i>Cyperus</i>	Cyperaceae	51
3	<i>Dendrobium</i>	Orchidaceae	43
4	<i>Syzygium</i>	Moraceae	36
5	<i>Fimbristylis</i>	Cyperaceae	34
6	<i>Ipomoea</i>	Convolvulaceae	34
7	<i>Crotalaria</i>	Fabaceae	28
8	<i>Dalbergia</i>	Fabaceae	28
9	<i>Euphorbia</i>	Euphorbiaceae	24
10	<i>Strobilanthes</i>	Acanthaceae	24
11	<i>Litsea</i>	Lauraceae	22
12	<i>Hibiscus</i>	Malvaceae	22
13	<i>Solanum</i>	Solanaceae	22
14	<i>Dioscorea</i>	Dioscoreaceae	21
15	<i>Lindernia</i>	Scrophulariaceae	21
16	<i>Chlerodendrum</i>	Verbenaceae	20
17	<i>Premna</i>	Verbenaceae	20
18	<i>Diospyros</i>	Ebenaceae	20
19	<i>Indigofera</i>	Fabaceae	20
20	<i>Bambusa</i>	Poaceae	18



**Figure 2.** Major authors of the species who worked on the eastern Indian (including Bangladesh) plants and named those, still survived as valid and legitimized. This distribution chart shows the total number of plants with the respective contributing author(s) of the plants of Bangladesh (assessed from Pasha and Uddin, 2013).

## DISCUSSION

In fact, there has been little quantitative and qualitative improvement in recent publications since the many monumental publications on plants of the region during the colonial days (end of 19th and the beginning of 20th century). We are still remaining far behind outside the stream of the international taxonomic endeavor. In spite of substantial beginning efforts, only about 12% of total flora has been treated in the *Flora of Bangladesh* during a period of last 43 years. The efforts are also moving slow in publishing other taxonomy related activities. The researchers are to be active immediately with the revisionary or monographic work of the large and complex families like Poaceae, Fabaceae, Rubiaceae, Cyperaceae, Euphorbiaceae and Scrophulariaceae. Furthermore, the collection numbers are to be increased more along the existing carrying capacity of the herbaria. The existing number of specimens deposited in different herbaria of Bangladesh (DACB, DUH, CTGUH, BFRIH and BCSIRH) are not more than 40,000, indicates probably very low Density Index (average number of specimens per 100 sq. km.) in comparison to many countries in Asia. When Malay Peninsula's index value is about 150, the Philippine Islands' value about 65 and Thailand's about 35, then Bangladesh's value is only about 27, which indicates many more collections are to be done before their disappearance. At the same time, when the number of taxonomic research papers on angiosperm appeared during the last 60 years in India are about 2500, when Bangladesh has only about 225.

The specimens collected from this area by the earlier European workers can be traced in about 20 herbaria located in Europe, including Linnaean Herbarium and 3 herbaria (NY, Smithsonian and Pennsylvania) in USA. Now, a survey should be made to trace the type specimens at these collections, originated from Bangladesh area. Of course, CAL is holding about 10,000 type materials and over 12,000 Wallichian specimens, many of which must have been from Bangladesh. Further, target oriented exploration are to be done along with the increase of number of species (we have only around 50% in different herbaria). Revisionary and monographic works should be started as soon as possible. Some areas in Chittagong Hill Tracts have not yet been explored by any botanist (Khan, 1991). It is finally hoped that the jealous contributions made by the band of plant taxonomists working now would pave the way more critical and more comprehensive of this flora. Electronic version and online floristic catalogues, generating virtual keys and related information are to be developed soon for more convenient use of the rich floral wealth of Bangladesh.

## REFERENCES

- Adanson, M. 1763-1764. *Familles des plantes*. 2 vols., Vincent, Paris.
- Ahmed, Z.U., M.A. Hassan, Z.N.T. Begum, M. Khondker, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman and E.U. Haque (eds.). 2008-2009. *Encyclopedia of Flora and Fauna of Bangladesh*. Vols. 6, 7, 8, 9, 10 & 13. Angiosperms (Dicotyledons); Vol.12 Angiosperms (Monocotyledons). Asiatic Society of Bangladesh, Dhaka.
- Alam, M and M.K. Pasha. 1999. A floristic account of Chittagong University Campus. *Chittagong Univ. J. Sci.* 23(1) : 81-99.
- Ara, H. (ed.). 2009. *Flora of Bangladesh*. Vol. 59-60. Bangladesh National Herbarium, Dhaka.
- Barbhuiya, H.A. and R. Gogoi. 2010. Plant collections from Bangladesh in the Herbarium at Shillong (ASSAM), India. *Bangladesh J. Plant Taxon.*, 17(2): 141-165.
- Bhattacharyya, P.K. 1982. Beginning of modern botany in India by Dutch in 16th-18th century (basic features and characteristics). *Indian J. Hist. Sci.*, 17(2): 365-376.
- Biswas, K.P. 1927. Flora of the Salt Lake, Calcutta. *J. Dept. Sci., Univ. Calcutta.* 8:1-48.
- Biswas, K.P. and C.C. Calder. 1926. *Handbook of the Common Water and Marsh Plants of India and Burma*. New Delhi.
- Bor, N.L. 1940. Gramineae, In: *Kanjilal et al.'s Flora of Assam*. Vol.V., Govt Press, Shillong, Assam.
- Bor, N.L. 1960. *The Grasses of Burma, Ceylon, India and Pakistan* (excluding Bambusaceae). Pergemon Press Ltd. London.
- Brandis, D. 1906. *Indian Trees* (Ind. Repr., 1984). Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
- Burkill, I.H. 1924-26. The botany of the Abor expedition. *Rec. Bot. Surv. India*, 10: 1-420.
- Burkill, I.H. 1965. *Chapter on the History of Botany in India*. Manager of Publication, Govt. of India. Delhi. pp.1-245.
- Calder, C.C., V. Narayanaswami and M.S. Ramaswami. 1926. List of species and genera of the Indian Pahanerogams not included in Sir J.D.Hooker's Flora of British India. *Rec. Bot. Surv. India*, 11 (1): 1-157.
- Clarke, C.B. 1889. On the plants of Kohima and Muneypore. *J. Linn. Soc. Bot.*, 25: 1-107.
- Clarke, C.B. 1889. On the Commelinaceae of Bengal. *J. Linn. Soc. London*, 34: 1-141.
- Cowan, A.M. and J.M.Cowan 1929. *The Trees of Northern Bengal Including Shrubs, Woddy Climbers, Bamboos, Palms and Tree Ferns, Being a Revision of the List by Gamble*. Bengal Secretariat, Book.Depot, Calcutta.
- Cowan, J.M. 1928. The flora of the Chakaria Sundarbans. *Res. Bot. Surv. India*. 11(2): 197-225.
- Cronquist, A. 1981. *An Integrated System of Classification of Flowering Plants*. Columbia University Press, New York.
- Cronquist, A. 1988. *The Evolution and Classification of Flowering Plants*. Columbia Univ. Press. New York.
- Datta, R.M. and J.N. Mitra. 1953. Common plants in and around Dacca. *Bull. Bot. Soc. Bengal*, 7(1 & 2): 1-110.
- Deb, D.B. 1981. 1983. *The Flora of Tripura State*. Vol. 1&2. Today and Tomorrow's Pr.&Pub., New Delhi.
- Fischer, C.E. 1938. The Flora of Lushai Hills. *Rec. Bot. Surv. India*, 12(2): 75-161.
- Franks, J. 2005. Reports to the Swedish East India Company: The Indian and Eastern years (1748-1762) of Christopher Henrik Braad (1728-1781). *The*

- Gage, A.T. 1901. A botanical tour in the south Lushai Hills. *Rec. Bot. Surv. India*, 1: 331-369.
- Gage, A.T. 1904. The vegetation of the district of Minbu in Upper Burma. *Rec. Bot. Surv. India*, 3(1): 1-141.
- Gage, A.T. 1912. Catalogue in non-herbaceous phanerogams cultivated in the Royal Botanic Garden, Calcutta. *Rec. Bot. Surv. India*, 5: 1-367.
- Gammie, G.A. 1895. Report on a botanical tour in the Lakhimpur district, Assam. *Rec. Bot. Surv. India*, 1: 66-88.
- Gardiner, B. 2005. Joseph Dalton Hooker (1817-1911). *Linnean, The Linnaean Soc. Lond.*, 21(3): 8-11.
- Good, R. 1974. *The Geography of the Flowering Plants*. Longman Group Ltd., London.
- Grierson, A.J.C. and D.G. Long. 1983-1991. *Flora of Bhutan*, Vol.1(1, 2, 3) and Vol.2(1). Royal Botanic Garden, Edinburgh, U.K.
- Griffith, W. 1834. Grasses of jheels of Sylhet. *J. Asiat. Soc. Beng.*, 5: 570-572.
- Griffith, W. 1845. Palms of British India. *J. Nat. Hist. Calcutta*, 5: 445-491.
- Griffith, W. 1848. Itinerary notes of plants collected in Khassiyah and Bhootan mountains. 1837-1838. Calcutta.
- Haines, H.H. 1910. *The Forest Flora of Choto Nagpur, Including Gangpur and the Santal Pargannahs*. New Delhi, India.
- Haines, H.H. (1921-1925). *Botany of Bihar and Orissa*. 6 parts, London.
- Hajra, P.K. 1997. *Flora of West Bengal*. Vol. 1. (Flora of India, Series-2), Bot. Surv. India, Calcutta, India.
- Haridasan, K. and R.R. Rao. 1985, 1987. *Forest Flora of Meghalaya*. Vol. 1&2. Bishen Singh Mahendra Pal Singh, Dehra Dun, India.
- Heinig, R.L. 1925. *List of Plants of the Chittagong Collectorate and the Hill Tracts*. The Bengal Govt. Branch Press, Darjeeling, India. pp.1-84.
- Herbert, J.D. 1832. Review of Indian Botany. (In: Prinsep J., Ed.) *J. Asiatic Soc. Calcutta*. 1: 135.
- Hooker, J.D. 1872-1897. *The Flora of British India*. Vol. I-VII. Reeve & Co., Kent, England.
- Hooker, J.D. 1854. *Himalayan Journals or Notes of a Naturalist in Bengal, the Sikkim, the Nepal Himalayas, the Kashia Mountains etc.* Vol. 2. John Murray, London.
- Hooker, J.D. and T. Thomson. 1855. *Flora Indica: A Systematic Account of the Plants of British India*, Vol. I. London.
- Hossain, M.K. and M.K. Pasha. 2004. An account of the exotic flora of Bangladesh. *J. For. Env.*, 2: 99-115. <http://www.oxforddnb.com/view/article/57839>, 2011. (accessed on 20/3/2014)
- Humphrey, G. Carter and Dorine N. Carter. 1921. Useful plants of the district of Lakhimpur, in Assam. *Rec. Bot. Surv. India*, 6: 353-420.
- Ismail, M. and M.K. Mia. 1972. *Ecology of Bangladesh Vegetation-I*. Bot. Surv. Bangladesh. BARC, Dhaka, Bangladesh.
- Jain, S.K. 1983. Botanical Survey of India: 1954-1983. *Bull. Bot. Surv. India*, (Silver Jubilee Vol.), 25(1-4): 252-267.
- Jussieu, A.-L. de. 1789. *Genera Plantarum*. Hérisson and Borrois, Paris.
- Kanjilal, U.N., P.C. Kanjilal, R.N. De, A.K. Das and N.L. Bor. 1934-1940. *Flora of Assam*. Vol. 1-5. Govt. of Assam, Shillong.
- Khan, M.S. 1963. Report of the Dacca University expedition to Teknaf and St. Martin Island in October, 1963. *Dhaka Univ. Stud.*, 12(B): 32-39.
- Khan, M.S. (ed.). 1972-1988. *Flora of Bangladesh*. Vol. 1-39. Bangladesh National Herbarium, Dhaka.
- Khan, M.S. and F. Banu. 1969. A taxonomic report on the angiospermic flora of Chittagong Hill Tracts-1 (Monocotyledons). *J. Asiatic Soc. Pak.*, 14(2): 217-224.
- Khan, M.S. and F. Banu. 1972. A taxonomic report on the angiospermic flora of Chittagong Hill Tracts-2 (Dicotyledons). *J. Asiatic Soc. Bangladesh*, 17(2): 59-88.
- Khan, M.S. and M.M. Rahman (eds.). 1989-2002. *Flora of Bangladesh*. Vol. 40-53. Bangladesh National Herbarium, Dhaka.
- Khan, M.S. and N. Huda. 1967. *Psidium aracea* Reddi - A new record for East Pakistan. *Dacca Univ. Stud. B*, (15): 39-42.
- Khan, M.S. and N. Huda. 1970. The genus *Euphorbia* Linn. from Dacca. *Pakistan J. Bot.*, 2(2): 53-65.
- Khan, M.S. and S.K. Afza. 1968. A taxonomic report on the angiospermic flora of Teknaf and St. Martin's Island. *Dacca Univ. Stud.*, 16(B): 25-30.
- Khan, M.S. and S.N.H. Arangzeb. 1959. Acanthaceae of Dhaka and its suburbs. *Dacca Univ. Studies*, 9: 155-170.
- Khan, M.S., A.B.M.E. Hossain and A.M. Huq. 1971b. New Angiospermic record for Bangladesh-3. *Blumea lanceolata* (Roxb.) Druce; *Crassocephalum crepidioides* (Benth.) S. Moore and *Senecio tetrandus* Buch.Ham. ex Wall. *J. Asiatic Soc. Bangladesh*, 16(3): 227-232.
- Khan, M.S., N. Khan and A.M. Huq. 1970. New angiospermic record for East Pakistan-I. *Croton lobatus* L. *J. Asiatic Soc. Pakistan*, 15(3): 215-216.
- Khan, M.S. and A.B.M.E. Hossain 1971a. New Angiospermic records for East Paistan-2 (*Acanthospermum hispidum* DC.; *Blumea mollis* (D.Don) Merrill; and *Gnaphalium purpureum* Linn.) *J. Asiatic Soc. Pakistan*, 16(1): 107-110.
- Kress, W.J., R.A. DeFilipps and D.Y.Y. Kyi. 2003. *A Checklist of the Trees, Shrubs, Herbs and Climbers of Myanmar*. National Museum of Natural History, Washington, DC. USA.
- Kurz, W.S. 1877. *Forest Flora of British Burma*. Vol. 1 & 2. Office of the Superintendent of Govt. Print., Calcutta, India.
- Linnaeus. C. 1753. *Species Plantarum* (Facsimile ed.) Roy. Soc. London.
- Manilal, K.S. 1980. Malayalan plant names from Hortus Malabaricus in Modern Botanical Nomenclature. In: K.S.Manilal (Ed.) *Botany and History of Hortus Malabaricus*. pp. 70-77, New Delhi.
- Mukerjee, S.K. 1940. A revision of the Labiatae of the Indian Empire. *Rec. Bot. Surv. India*, 14 (1): 1-228.
- Pasha, M.K. 2012. An evaluation of endemism and endemics in Bangladesh flora. In: *Proc. Intl. Conf. on Biodiversity - Present State, Problems and Prospects*

- of its Conserv. (2011). (eds. E. Roskaf & D.J. Chivers). Norwegian Centre for Intl. Cooperation in Education, Bergen, Norway. pp. 57-75.
- Pasha, M.K. and D. Mohammad. 1977. A floristic account of Chittagong suburb. *Chittagong Univ. Studies, Part II, Sci.*, 1: 79-109.
- Pasha, M.K. and M.G. Uddin. 2007. An account of the exploration and taxonomic studies of pteridophytes in Bangladesh. *J. Taxon. Biodiv. Res.*, 1(1): 41-48.
- Pasha, M.K. and S.B. Uddin. 2013. *Dictionary of Plant Names of Bangladesh (Vascular Plants): Scientific, Common, Vernacular and English Name*. Janakalyan Prakashani, Chittagong, Bangladesh. pp. 1-433.
- Pottinger, E. and D. Prain. 1898. The botany of Kachin Hills, north-east of Myitkyina. *Rec. Bot. Surv. India*, 1: 215-310.
- Prain, D. 1903a. Flora of Sundribuns. *Rec. Bot. Surv. India*, 2: 231-370.
- Prain, D. 1903b. *Bengal Plants*. Vols. I & II. Botanical Survey of India. Calcutta.
- Prain, D. 1905a. A sketch of the life of Francis Hamilton (once Buchanan) some times Superintendent of the East India Companies Botanic Garden, Calcutta: 1 - IXXV. Bengal Secretariat Press. Calcutta.
- Prain, D. 1905b. The vegetation of the district of Hughli-Howrah and the 24 -Pergunnahs. *Rec. Bot. Surv. India*, 3(2): 143- 329.
- Press, J.R., K.K. Shrestha and D.A. Sutton. 2000. *Annotated Checklist of the Flowering Plants of Nepal*. The Natural History Museum, London.
- Rahman, M.M. (ed.). 2003-2008. *Flora of Bangladesh*. Vol. 54-58. Bangladesh National Herbarium, Dhaka.
- Raizada, M.B. 1941. On the flora of Chittagong. *Indian Forester*, 67: 245-254.
- Roxburgh, W. 1814. *Hortus Bengalensis*. Boerhaave Press. Leiden (Holland).
- Roxburgh, W. 1820-32. *Flora Indica* (W. Carey, ed.) Vol. I, 1820, Vol.2, 1824 and Vol. 3 1832. Mission Press, Serampore, India.
- Schudel, W. van. (ed.). 1992. *Francis Buchanan in Southeast Bengal (1798)*. Univ. Press Ltd. Dhaka.
- Siddiqui, K.U., M.A. Islam, Z.U. Ahmed, Z.N.T. Begum, M.A. Hassan, M. Khondker, M.M. Rahman, S.M.H. Kabir, M. Ahmad, A.T.A. Ahmed, A.K.A. Rahman and E.U. Haque (eds.). 2007. *Encyclopedia of Flora and Fauna of Bangladesh*. Vol. 11., Angiosperms (Monocotyledons). Asiatic Society of Bangladesh, Dhaka.
- Sinclair, J. 1955. Flora of Cox's Bazar, East Pakistan. *Bull. Bot. Soc. Bengal*, 9(2): 84-116.
- Singh, N.P., A.S. Chauhan and M.S. Mondal. 2000. *Flora of Manipur*. Botanical Surv. India, Calcutta, India.
- Smit, P. 1979. The Rijksherbarium and the scientific and social conditions which influenced its foundation. *Blumea*, 25(1): 5-11.
- Smith, W.W., S.C. Banerji and M.S. Ramaswami. 1913. Two decades of new Indo-Burmese species. *Rec. Bot. Surv. India*, V: 29-40.
- Stafleu, F. 1967. *Taxon*, 16: 141-142.
- Stewart, R.R. 1982. Missionaries and Clergymen as botanists. *Taxon*, 31(1): 57-64.
- Symonds, T.J. 1886. *Indian Grasses* (2nd ed.) Higginbotham & Co., Madras.
- Takhtajan, A. 1986. *Florestic Regions of the World*. Univ. California Press. Berkeley.
- Thompson, T. 1856. *J. As. Soc. Beng.*, 25: 405.
- Vaczy, C. 1980. Hortus Indicus Malabaricus and its importance for botanical nomenclature. In: K.S. Manilal (ed.) *Botany and History of Hortus Malabaricus*. pp.25-34. New Delhi.
- Vogit, J.O. 1845. *Hortus Suberbonus Calcuttensis*. Calcutta, India.
- Wallich, N. 1820. Description of some rare Indian plants. *Asiatic Res.*, 13: 369-415.
- Wallich, N. 1828-1849. *Numerical List of Dried Specimens of Plants of the East Indian Company's Museum*. (Usually referred to as Wallich Catalogue (K-W), Kew, London.
- Wallich, N. 1829-32. *Plantae Asiaticae Rariates*. 3 Vols. London.
- Wallich, N. 1840-1849. *Icones Plantarum Indiae Orientales* (Figures of Indian Plants), 6 Vols. Madras.
- Ward, K.F. 1949. *Plant Hunter in Manipur*. London.
- Watt, G. 1888. Forests of Manipur. *Ind. For.*, 12: 291-299.
- Watt, G. 1889-1896. *A Dictionary of the Economic Product of India*. 6 Vol. Calcutta, Cosmos Publication, India.
- Watt, G. 1990. Forests of Manipur. *Ind. For.*, 14 291-339 & 387-394.
- Wood, J.J. 1803. Plants of Chutia Nagar including Aspur and Sirguja. *Rec. Bot. Surv. India*, 2: 1-170.

Manuscript received : 24.5.2013

Revised version accepted : 20.02.2014