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Plant Taxonomy in India - A Developmental Process

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ABSTRACT

With the development of agriculture in ancient India, plant science took firm roots in our soil. In the Vedic period (2000-800 B.C.), the people of this land cultivated Barley, Cotton, Date, Melon, Millet, Wheat, etc.; a knowledge of descriptive botany and elementary plant physiology was believed to be necessary at that time.

If the Vedic literature is studied, one may encounter many terms used in connection with the description of external features and internal structures of plants or plant parts. Moreover, there is a mine of information concerning medicinal plants and their application against diseases. In this very remote age, crop rotation and fertiliser dressing were practised for soil improvement.

From the scientific viewpoint, one of the earliest treatises dealing with plant life is Parasara's Vrikshayurveda. In ancient India, this book fulfilled the requirements of botany preparatory to the study of medicine.

A system of classification was propounded, being based on the study of the comparative morphology of plants. Many families (ganas) were recognised and distinguished by the characters of sepals, petals, stamens, carpels and fruits.

Attracted by the vast potentialities of the country's flora, the Portuguese were the first to arrive in India and thus initiated the modern study of Indian plants. The first important contribution came from Garcia d'Orta (1565) who gave detailed accounts of some of the more striking medicinal plants from firsthand knowledge in his Coloquios dos Simplos e Drogas da India. The next book published was Tractado de las Drogas in 1578 by C. Acosta.

The Dutch succeeded the Portuguese in India and developed an interest in the plants of this country. An amateur botanist by the name of Hendrik van Rheede tot Draakenstein (1660-1699) became the Governor of the Dutch possessions in India.

He made large collections of plants and published descriptions of them in Hortus Malabaricus. "Linnaeus saw this book when he was a student in Holland and it is mainly on Rheede's Hortus that Linnaeus based the nomenclature of Indian plants". Other interesting books appeared after this publication; mention may be made of John Burman's Thesaurus Zeylanicus, Nicholaus Burman's Flora Indica and Paul Hermann's Paradiscus Batavus.

KEYWORDS: *taxonomy, plants, India, ancient, development, literature, books, botany, medicine*

Introduction

John Gerard Koenig (1728-1785), a pupil of Linnaeus, came to India in 1768. He joined the Tranquebar Mission in South India as a Surgeon and naturalist. He formed a society called "The United Brothers" in order to promote the study of Indian plants. The members of the brotherhood made splendid collections in the vicinity of Madras and sent specimens to eminent botanists in Europe.

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While botanical activities gained momentum in Madras, things were not lying idle in Bengal. The Royal Botanic Garden came into existence in 1787 due to the munificence of East India Company in general and to the interest of Col. Robert Kyd (1746-1793) in particular.[1,2]

The Garden was founded "not for the purpose of collecting rare plants as things of mere curiosity or furnishing articles for the gratification of luxury, but for establishing a stock for disseminating such articles as may prove beneficial to the inhabitants".

It soon became a centre of taxonomic and phytogeographic research and an agency of plant material of economic importance between India and farthest corners of the world. Kyd became its first superintendent.

Kyd was succeeded by William Roxburgh (1751-1815), the Linnaeus of India. By his immense zeal and scientific interest in Indian plants, he made the Botanic Garden known to the scientific world at large. Two of his monumental work include Flora Indica and Plantae Coromandelianus. He also made 2,382 large coloured drawings of Indian plants, but these were not published.

After Roxburgh's death. Francis Buchanan-Hamilton (1762-1829) succeeded him. He was a naturalist of great repute, making extensive tours in Nepal and elsewhere. His collections were described in Prodromus Florae Nepalensis by D. Don in 1825.[3,4]

In 1817, Hamilton was followed by Nathaniel Wallich (1786-1854). A man of tremendous energy, he botanized in various and difficult parts of India, Malaya and Nepal. His collections were made into several sets and distributed to a number of herbaria in Europe. He himself prepared a catalogue of these collections, listing 9,148 species; this catalogue is referred to as Wall. Cat. (Wallich, Catalogue of Dried Specimens). His another great contribution was Plantae Asiaticae Rariores.

William Griffith (1810-1845) officiated as Superintendent of the Garden during Wallich's absence on leave. Unfortunately, he died in 1845 while on a botanical expedition to Malaya. He spent 13 years in India, collected 9,000 species and described them. During this period, Robert Wight (1796-1872) was active in the study of Peninsular flora. He published a part of his work as Icones Plantarum Indiae Orientalis. He spent 35 years in India and described nearly 3,000 species of plants.

Wallich's successor was Hugh Falconer, M.D., F.R.S., a palaeontologist who held office until 1855. Early in 1858 during G. McClelland's officiating period, Sir Joseph Dalton Hooker visited the Garden on his famous journey to Sikkim and again in 1860 on his return to Calcutta.

Falconer was succeeded by Thomas Thomson, a traveller and botanist of proven ability. He was the President of the Agri-Horticultural Society and co-author of the first volume of Flora Indica. Thomson retired in 1861 and was followed by Thomas Anderson. The latter was not only the Superintendent of the Garden and Professor of Botany, but also the first Conservator of Forests for Bengal.

He was largely instrumental for the introduction and cultivation of Cinchona in India. Subsequent to Anderson's departure from India, C. B. Clarke, an Education Officer, Government of Bengal, acted as a Superintendent and during his time he began a series of botanical publications on his vast collection of plants. He was also one of the important collaborators of Hooker's Flora of British India.

In 1871, George King took charge of the Garden and started the journal, The Annals of the Royal Botanic Garden, Calcutta in 1887. He was responsible for the establishment of the Botanical Survey of India in 1890.

This organisation was necessary to co-ordinate the botanical work which was being done in different parts of India at that time. The inception of The Records of the Botanical Survey of India also owes

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much to the inspiration of King. Incidentally, till then, five of the seven volumes of the Flora of British India by J.D. Hooker et al. had been published.

Regional offices were established at Pune with T. Cooke as Director for western India, at Saharanpur with J.F. Duthie as Director for northern India and at Madras with M.A. Lawson as Director for southern India. In 1911, the office of the Reporter of Economic Products and the Industrial Section of the Indian Museum at Calcutta were also brought under the Survey.

The first half of this period saw the fulfillment of the plan to publish local or provincial floras for the various regions which were without them until then. In course of time, due to lack of funds and manpower, the activities of the regional centres gradually shrunk and almost came to a standstill throughout the country.[5,6]

After the retirement of C.C. Calder in 1939, even the post of Director at Calcutta remained in abeyance and the organisation survived almost in name. The scientific personnel of the Botanical Survey comprised only the Curator, Industrial Section and a Systematic Assistant in the herbarium at Sibpur (Howrah).

Bengal continued to be at the top of taxonomy in India. At the beginning of the century, David Prain published his Bengal Plants and made several other important contributions. The Records of the Botanical Survey of India, which had put out one volume up to the end of the previous century, brought out the second volume. The Annals of the Royal Botanic Garden appeared in six volumes between 1900 and 1950, the latest being on Dioscorca by I.H. Burkill and D. Prain.

At the turn of the century, Poona was the centre of the Botanical Survey of India for the western part of the country. In Bombay itself, E. Blatter formed a school of taxonomy: in the company of his students, he collected extensively in different parts of the province. Saxton and Sedgwick made thorough explorations in Gujarat: the latter also concentrated his attention to the plants of Dharvvar. W.A Talbot studied the forest flora of the North Kanara districts. Other contributions include those from R.K. Bhide, G.A. Gammie, G.M. Woodrow, J.I. Thaker, etc.

G. S. Gamble published the first seven parts of his Flora of Madras: after his death in 1925, C.E.C. Fischer completed the work in 1936. The Nilgiris and other high hills of South India were explored by P.E. Fyson. P.V. Mayuranathan in 1929 put out Flowering Plants of Madras City and E. Barnes in 1938 added a supplement to this book.

The botanists attached to the Forest Research Institute at Dehradun were mainly concerned with the flora of our forests. Their work also extended to the Upper Gangetic Plain and other parts of North India. Here the notable contributors comprise N.L. Bor, J.N. Parker, C.E. Parkinson, M.B. Raizada and others.

H. H. Haines explored much of Chotanagpur as well as Bihar and Orissa. His work was continued by H.E. Mooney.

The flora of Assam was written by a large team of botanists under the energetic supervision of U. Kanjilal. Independently, Bor did good work on the grasses of Assam and Fischer published a number of papers on plant-novelties of the province.[7,8]

Discussion

Recent developments in the study of taxonomy are very encouraging. Our Universities are paying attention to this much neglected branch of Botany. Papers have appeared from Allahabad, Bangalore, Bombay, Calcutta, Delhi, Gauhati, Jodhpur, Meerut, Mysore, etc. Teachers and students take great interest in botanical excursions these days.

Several journals have contributed much to the knowledge of the country's flora. Among foreign journals, Journal of the Arnold Arboretum and Kew Bulletin has published some very interesting

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papers on Indian plants. Of the Indian journals, Journal of the Asiatic Society of Bengal, Journal of the Bombay Natural History Society, Indian Forester, Indian Forest Records and Bulletin of the Botanical Society of Bengal deserves special mention.

Realising the great dependence of many fields of science on raw material derived from the Plant Kingdom, the Government of India decided to revive the Botanical Survey of India. In 1952, E.K. Janaki Ammal was appointed as Officer on Special Duty to reorganise it. The Central Botanical Laboratory was the first Unit to be set up, with Janaki Ammal as the Director.

Four Regional Circles at Shillong (Eastern), Dehradun (Northern), Pune (Western) and Coimbatore (Southern) were also simultaneously started for the study of plant resources in the respective regions. While the Dehradun office of the reorganised Survey had to start a new herbarium, the old herbarium of the Survey at Pune and Coimbatore and the forest herbarium of Assam at Shillong were transferred to the Botanical Survey.[9,10]

Consequently, on shifting of the Central Botanical Laboratory from Allahabad to Calcutta in 1962, a new regional station for Central India was initiated at Allahabad. In 1972, the Andaman and Nicobar Circle at Port Blair and the Arid Zone Circle were created.

The Arunachal Pradesh Circle at Itanagar and the Sikkim Himalaya Circle at Gangtok were established in 1977 and 1979 respectively. In 1984, two more circles were established—Deccan Circle at Hyderabad, Andhra Pradesh and High Altitude Circle at Solan, Himachal Pradesh. The National Orchidarium at Shillong maintains a documented live collection of orchids.

A Scientific Programme Implementation and Evaluation Committee advises the Government on the research programmes of the Survey and periodically evaluates its functioning.

The main objectives of the Survey can be summarised as follows:

A. Exploration of unexplored and underexplored regions for new plant resources;

B. Preparation of floras at the local, district, region and national levels;

C. Floristic and taxonomic researches;

D. Preservation of types and other authentic specimens by establishing herbaria and musea and exchange of plant specimens in India and abroad;

E. Maintaining germplasm of economic, rare and interesting plants for conservation and education;

F. Study of phytogeography and ecological changes in flora and vegetation;

G. Investigation of threats to floras and habitats and conservation of ecosystems; and

H. Advising the Government on all matter relating to the utilisation and conservation of natural plant resources of the country.

The headquarters office of the Survey, at Calcutta co-ordinates the activities of all units according to the scientific policies of the Central Government and in consultation with senior scientists of the Survey. It maintains liaison with other research institutions of the country, e.g., Council of Scientific and Industrial Research (CSIR).

Indian Council of Agricultural Research (ICAR), Indian Council of Medical Research (ICMR) and Universities. It awards about 50 senior and junior research fellowships for floristic and taxonomic work. One senior scientist of the Survey is posted at the Royal Botanic Garden, Kew, acting as a Liaison Officer for reference work, loans and technical enquiries on identification and nomenclature relating to the proposed flora of Free India.[11,12]

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The Central National Herbarium acts as a repository of all type specimens gathered from any area in India. The Central Botanical Laboratory is engaged in some biosystematic studies involving anatomy, cytology, ethnobotany, palynology and plant physiology. In the Cryptogamic Unit, studies have been undertaken on the fern flora of South India, mosses of the Himalayas, lichens of West Bengal and taxonomic revisions of some genera.

A dictionary of fern genera and a census of threatened ferns and fernallies of India are under preparation. In the Ecology Unit, studies have been undertaken in Kanara, Coorg and coastal regions; some work has been done on leaf-sclereids and eco-anatomy. The Pharmacognosy Unit has studied bark drugs and conducted a detailed survey of Coptis teeta in Eastern Himalaya; the latter study helped in regulating the export trade in this medicinal herb. Limited facilities of chemical screening of plants have been organised. The high solasodin content in Solarium viarum was found in these laboratories.

Industrial Section at the Indian Museum, Calcutta, undertakes the study of economic plants. About 15,000 exhibits of commercial vegetable products attract researchers, students and tourists. They also constitute reference material for thousands of technical enquiries from drug dealers, exporters, Excise and Customs Department, etc.

The Documentation and Library Units provide bibliographic support in research activities. The Publication Section projects the work of the Survey through the Bulletin of the Botanical Survey of India, Records of the Botanical Survey of India, Annual Reports and News Letters. Many special publications are brought out from time to time.

Besides over 2,200 research papers published by scientists of the Survey during the last 30 years of its reorganization, major activities in publication include reprinting of the regional floras of Bombay (T. Cooke), Madras (J.S. Gamble), Bihar and Orissa (H.H. Haines), Bengal (D. Prain) as well as publishing a Check List of Indian Plants, a dozen fasicles of the Flora of India, Roxburgh's Icones, Aquatic Angiosperms, Illustrations of West Himalayan Flowering Plants, Flora of Rajasthan, Phycologia Indica, Dictionary of Flowering Plants in India, High Altitude Flowering Plants, Flora of Bashahar Himalayas , Flora of Punjab Plains, Orchids of India, Flora of Jowai, Medicinal Plants, etc.

The botanical collections and publications of the Survey have been used not only by scientists of India but also monograph writers all over the world cited these research findings.

More than 150 new taxa have been described and several new taxa recorded from India by scientists of the Survey. During the last 30 years, the Survey has organised the collection of more than 300,000 field numbers and the herbaria of the Survey hold over 2 million plant specimens.

The Botanical Survey is intimately connected with the assessment of impact of several developmental or other projects on ecosystems. The Survey provided material to the Government on projects related to Silent Valley, Idukki Valley, Lalpur Dam, Tehri Dam, Sutlej-Beas Link Canal, etc. and on all prospective biosphere reserves, National Parks and game sanctuaries and thus assisted the State and Union Government in many policy decisions.[13,14]

Reviewing the progress of plant taxonomy in India for the last 50 years, Maheshwari and Kapil (1963) made the observations:

"In the past Indian work in plant taxonomy has been purely observational and descriptive based mainly on the examination of external characters. However, Indian taxonomists now realize that substantial help can accure to taxonomy from other branches of botany … Inspite of the feelings in the minds of younger botanists that taxonomy is a finished area of knowledge, there is still a great scope for such work in India". The outlook appears promising and the future may unfold infinite possibilities for plant taxonomy in India.

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Results

The work of Theophrastus, Dioscorides, Brunfels, Cordus, Ray, etc. profoundly influenced the development of plant taxonomy and is regarded as landmarks in the history of botany. The plants of an area, in the aggregate, are referred to as the flora. We may speak about the flora of Japan or flora of Rajasthan or flora of the Eastern Himalaya. The term is also synonym of the botanical manual. A flora or manual of Assam is a description of all the plants known to occur in that State.

The species in a flora or manual are arranged according to one or another of the available systems (Engler, Bentham-Hooker, etc.), giving for each plant the scientific name, author citation, reference to the source of the original publication, synonymy and geographical distribution within the area in question.

1. A usual part of the flora or manual is the determinator or diagnostic key, a device to identify an unknown species easily and quickly. Confronted with series of couplets or mutually exclusive pairs of leads or statements, the user arrives at the name of the unknown by following the right track. Two kinds of construction are in practice. The plants used in the following example are common genera of the Capparidaceae, using exactly the same data.
2. Keys may be artificial (based on clear cut and conspicuous characters) or synoptic (based on a bare minimum or diagnostic characters which may be cryptic or difficult to determine). Artificial keys are of two chief types: single access or sequential keys (which possess a single commencing point) and multi-access keys (which can be started at any point). Multi-access keys are usually produced on separate punched cards and not on pages in a book.

3. Notes and Observations:

A survey of the taxonomic literature will reveal the existence of notes and observations concerning the range of plant forms, deviations from the normal structure and the new species or genus. This kind of information is significant, although the publication is often unsuitably titled and of varied nature.

4. Monographs and Revisions:

A monograph is a treatise, covering a family or genus with valuable information of morphological or taxonomical nature. Though a monograph should include the group as it is found all over the world, the term is often loosely used and is applied to treatments limited to a continent, a country or even a small area.

For this type of work, the term revision should be employed. Moreover, a revision is based on the studies of herbarium specimens. A monograph should embrace morphology, embryology, anatomy, palynology, cytology and ecology of the group, together with its taxonomy.

5. Popular Treatments:

Those who would like to consult nontechnical work might find pleasure in flower books. A merit of such books is that they enable any person to identify the common plants or ornamentals by means of pictures alone.

A demerit is that they do not cover all the plants of a given area and are generally incomplete. The Macmillan Wild Flower Book by C.J. Hylander and E.F. Johnston as well as Wild Flowers of America are good samples of highly illustrated flower books.

6. Botanical Serials:

A huge amount of taxonomic literature comes out in the serial publications of educational institutions, learned societies and other organisations. Those out at regular intervals are termed periodicals and those out irregularly bulletins. It has been estimated that there are about 1,000 serials publishing articles on plant taxonomy, the most important among them being Baileya, Brittonia, Kew

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Bulletin, Madrono, Rhodora, Taxon and Torreya.

7. Index:
They aim to index all plant names. They serve to pinpoint the source of the original publication of a name; to state to which order, family or tribe a given species may belong and to learn if a particular name has been applied before.

The following list is a part and parcel of a taxonomist's library:

Index Kewensis. Oxford, 1893-1895 and supplements to date;

Index Holmensis. Sweden, since 1969;

Gray Herbarium Card Index. Cambridge, Mass., USA, since 1873;

Genera Siphonogamarum. Berlin, 1900-1907;

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies. Oxford, 1920-1941:

Guide to the Literature of Botany. London, 1881;

A Bibliography of Eastern Asiatic Botany. Jamaica Plain, Mass., USA, 1938.

8. Dictionaries:
Dictionaries and glossaries form the nucleus of any taxonomic library. A botanical glossary is a list of botanical terms arranged in an alphabetical order and provided with their interpretations.

To taxonomists, Lindley's Glossary of Botanical Terms, Asa Gray's Structural Botany, Le Maout and Decaisne's A General System of Botany and Steam's Botanical Latin are helpful for the definition of the technical terms. On the other hand, a botanical dictionary is an alphabetical list of all known genera of certain taxa with their descriptions, e.g. A Dictionary of Flowering Plants, and Ferns by J.C. Willis.[15,16]

9. Rules:
Since 1867, botanists have met somewhat regularly at the international level and agreed upon legislation in plant names. These rules and regulations are contained in the ICBN = International Code of Botanical Nomenclature.

They are subject to clarification or revision at each Botanical Congress and a new edition is then prepared. "The ICBN does not adjudicate upon taxonomic matters" and "merely lays down the criteria for naming a taxon whose circumscription, position and rank have been taxonomically decided".

10. Maps and Cartography:
Though this item may seem out of place here, taxonomists should have a knowledge of maps and their availability for the area under investigation or should be able to prepare maps based on their studies involving particular taxa.

Conclusions

Of late, plant chemistry has made its inroads to taxonomy. There is a tendency to consider chemical characters as more fundamental than other characters, but it has only a limited use. Perhaps it is incoherent to think that smaller and more cryptic the character, the more important it is for indicating relationship. Chemical characters may exhibit a chemical relationship in the same way as morphological characters do for morphological relationship.

The value of individual chemical constituents varies from one group to the other and from one compound to another. Much labour is involved in the study which has been branded as luxury diversifications or expressions of biochemical virtuosity.

The attractiveness of chemical characters lies in the fact that sometimes the chemical evolution of a character has taken place in a particular way and this kind of evidence may be helpful in understanding the course of evolution rather than phylogeny.[16]

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