

THE PRESENT STATE OF TAXONOMY AND FLORISTICS IN INDIA AFTER INDEPENDENCE

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ABSTRACT

The following is an account of development of Plant Taxonomy and Floristics in India after 1947. Taxonomy has been regarded as a sort of second rate botany, and in consequence has not attracted students; there have been, however, a number of distinguished scholars and schools that have continued the work on Taxonomy in spite of the general discouragement.

INTRODUCTION

Up to practically the end of last century in most European and American countries, and well into the twenties of this century in India, taxonomy constituted a very large part of the botany curriculum in universities; other branches of botany were but ancillaries to the main subject. Gradually, as advanced countries completed the botanical exploration of their territories, they turned their attention to newer and perhaps more exacting branches of botany; Cytology and Physiology became the dominant branches in many parts of the world; Embryology then began to develop, then Ecology and other branches. In this way gradually Taxonomy was relegated to a second place, except for some very distinguished institutions, which have kept the interest in Taxonomy very much alive; honourable mention must be made in this respect of the Royal Botanic Gardens, Kew in Britain; of the Botanical Museum and Garden, Berlin-Dahlem in Germany; of the Arnold Arboretum in U.S.A.; of the Komarov Institute of Leningrad in U.S.S.R.

As a very natural consequence of this development in the more advanced countries, Taxonomy came into disfavour in India. And this has been a great calamity for India. It is worth mentioning here that whilst most Indian Universities are doing excellent work in various branches of Botany, under the guidance of experienced professors, there are many universities where Taxonomy is not taught above undergraduate level; some universities do not even have a professor able to guide research in Taxonomy of the Higher Plants. Advanced countries have studied their plants and their distribution in the country, until a research worker has little scope in this line of study. In India, unfortunately we do not have enough information on the plants occurring in the country, or their distribution; we have not explored our country sufficiently. This is why, when in the recent past Indian botanists were asked to give an account of the distribution of e.g. *Rauvolfia serpentina* Benth., we could not supply the country with the necessary information.

With the re-establishment of the Botanical Survey of India there has been a very healthy change for

the better in Taxonomy. Soon after the Survey was revived in 1954, a meeting was held in Delhi, at which representatives of our universities discussed their difficulties mainly on account of the non-availability of books on the flora of India. It was then decided to reprint, unaltered, the five major provincial floras, all of which had gone out of print for some time. So far we have reprinted Cooke's *Flora of the Presidency of Bombay*, Gamble's *Flora of the Presidency of Madras*, and Duthie's *Flora of the Upper Gangetic Plain*; these books have been published at a price that is well within the pocket limits of our M.Sc. students. Prain's *Bengal Plants* and Haines' *Botany of Bihar and Orissa* are expected to be ready before the end of this year. The publication of these books has given great impetus to botanical exploration, particularly in those parts of India that are covered by these floras.

THE PUBLICATION OF FLORISTIC PAPERS

There are in India several journals which accept papers on taxonomy and floristics; but in general editors are somewhat reluctant to accept such papers, mainly on account of their length. Two journals in particular deserve mention as having been of great help to Indian botanists: I refer to the *Journal of the Indian Botanical Society*, and the *Journal of the Bombay Natural History Society*. These two journals have a sort of national character, in that they accept papers from the whole of India; there are a number of others that reserve space only for their provinces or universities. In the present revival of interest in Taxonomy, such journals cannot cope with the needs of the country. This is why after mature consideration it has been decided to throw open the *Bulletin of the Botanical Survey of India* to botanists generally and to lift the restriction that in its first two years made this Bulletin the special preserve of the officers of the Botanical Survey of India. For lengthier papers we do have the *Records of the Botanical Survey of India*, which in the past did yeoman service to Indian taxonomy and floristics. We are trying to expedite publication of the Records and to make it a regular publication.

REVIEW OF TAXONOMIC AND FLORISTIC WORK DONE IN INDIA

In this review I purposely omit mention of the Botanical Survey officers, as a rule; it is our duty to work on floristic and taxonomic research, and on this type of work our very existence depends. I wish to mention the work done in our universities. Several of these can be pointed out as particularly active in the field of taxonomy.

Dr. M. L. Banerji of Panjab University has explored large areas in East Nepal, and produced an interesting thesis, which is at present awaiting publication; further he has published a number of papers on his explorations of over six years in Nepal (Banerji, 1952-58).

Delhi University has produced the first complete flora of any of our university towns, the Flora of Delhi, by Dr. J. K. Maheswari, which is now in the course of publication by the C. S. I. R.

The University of Saugar has brought out a number of papers on ecologico-floristic studies on the flora of Sagar, in the journal of the botanical society of the University, R. Misra and his students deserving mention for their contributions. (Misra 1953; Misra & Johri, 1952; Pandeya, 1952). Similar work has lately been undertaken by the University of Nagpur, in which the botanical society has shown itself very active in the exploration of the flora of an area otherwise much neglected by the older generation of taxonomists of India. Prof. M. V. Mirashi has been the leader in these studies in Nagpur. (Mirashi, 1954-60).

Calcutta University has a paper by K. Biswas (1950) on the flora of South Calcutta. G. D. Srivastava (in 1938) published something like a flora of Allahabad; this work does not rightly belong to the period under review, except for a supplement of 20 pages published in 1949. S. K. Pillai (1941) published the first part of a flora of Annamalainagar, but the work seems to have been given up after the first part, or at any rate I have been unable to trace the continuation of the work. At present Andhra University, Waltair, under the direction of Dr. J. Venkateswarlu, is busily engaged in the preparation of the flora of the university campus, but so far the work has remained unpublished. Madras has a flora, prepared by Mayuranathan (1929) covering the 'flowering plants of Madras City and its immediate neighbourhood'; that the work of Mayuranathan is not complete is borne out by the fact that Barnes (1938) was able to publish a supplement of over 40 pages. Agra district, as against Agra university, has a short 'descriptive key to the Flora of Agra' by N. A. Watts (1953). Banaras Hindu University has produced a number of papers on the botany of the campus and neighbourhood, and on the ecology of the same area; Dr. R. Misra has been responsible for this work (Misra, 1946).

In the University of Bombay the traditions set up by Blatter and his school have been kept up; we

have had a flora of the island of Bombay covering the woody plants (unpublished); also a very complete and detailed flora of the Krishnagiri National Park, Borivli and of several smaller areas near Bombay, these floras are now in the course of scrutiny for publication; further the university of Bombay, under the guidance of the present writer, has extended its area of exploration to Saurashtra (1953 & 1962), the Gir Forest (Santapau & Raizada, 1954 & 1957), the Dangas Forest (1954-55), Mahabaleshwar (1952, 1962), Khandala (1953), Purandhar (1958), etc. and the results of these explorations have been published in book form or in various journals of India.

Poona University, under the direction of Dr. S. P. Agharkar has done good work, particularly on the geographical distribution of plants of the hills near Poona; and now under the energetic guidance of Dr. T. S. Mahabale. Poona is doing splendid work on the Palms of India, recent and fossil, a rather difficult group. Among the Poona workers on taxonomy and floristics, two names stand out as deserving special mention: B. A. Razi (1952), at present of Bangalore, and V. D. Vartak (1953-60), of Poona University. Mysore university has published a few papers on the flora of the area, under the names of Thirumalachar (1949, 1952, 1960); Govindu (1949, 1950), Razi (1946, 1962), and others. Rajasthan is a difficult part of India for botanical exploration, mainly on account of the intense heat of the area; lately extensive floristic work has been done under the direction of Shanti Swarup (1951, 1954), Nair (1956-1960), Bakshi (1955), Ratnam (1951), Krishnaswamy & Gupta (1952), Mathauda (1958), Mathur (1960), Sankhala (1951), Sharma, S. S. (1952), Sharma, V. G. (1958) and others.

MONOGRAPHIC WORK IN INDIAN UNIVERSITIES

The grasses of India have been studied from the beginning of taxonomy in India, on account of their importance as fodder or crop plants. But omitting mention of older monographers, we must name Dr. N. L. Bor, formerly of Dehra Dun, now of Kew, who forms the connecting link between the past and present generations of agrostologists. Of modern botanists, who have published important work on the grasses of India or some part of India, mention must be made of M. B. Raizada (1954), as the foremost agrostologist in India; S. K. Jain with Raizada and Bharadwaja has studied the grasses of the Upper Gangetic Plain (1961); S. D. N. Tiwari (1954-55) those of Madhya Pradesh; A. B. Chaudhury those of West Bengal (1959-60). The genus *Saccharum* has attracted a good deal of attention on account of its economic importance; monographic work on the affinities of *Saccharum* species or their cytology, etc. has been lately done among others by S. K. Mukherjee (1956-1957), E. K. Janaki Ammal (1936-59) and others. D. Chatterjee has dealt with *Oryza* (1947, 1948). Raizada has contributed a

lengthy paper on name changes in common Indian grasses (1959); S. K. Jain (1961) has just published a bibliography of the Gramineae of India. The most comprehensive work on the grasses of India published lately is that by N. L. Bor entitled 'Grasses of Burma, Ceylon, India and Pakistan (excluding the Bambuseae)' (1960).

Another difficult family, the Orchidaceae, seems to have been left alone by modern Indian Botanists; we do have some excellent books on the subject by older botanists, published before Independence, or even before the turn of the century, such as Brühl's 'Guide to the Orchids of Sikkim' (1926), Duthie's 'The Orchids of the North Western Himalaya', Gammie's 'The Orchids of the Bombay Presidency' (1905), Hooker's 'A century of India Orchids' (1895), King and Pantling's 'The Orchids of the Sikkim Himalaya' (1898). Among the more recent contributions on the family stand those of B. N. Ghose (1953) on the orchids of Sikkim, of J. Ara (1954) on the orchids of Chotanagpur, Santapau and Kapadia (1959 . . .) on those of Bombay and S. K. Mukerjee on the orchids of Manipur (1953).

The mango tree is one of the most important trees of India; it is no wonder than that some serious work has been done on the taxonomy of the same. Among modern authors mention may be made of S. K. Mukherjee (1948-53), K. C. Naik (1941), or Naik & Gangoly (1950), and Gangolly, R. Singh, S. L. Koryal and D. Singh (1957); the latter have given us what for some time will be considered the last word on the subject.

The Compositae are a complex and difficult family. The more striking papers on the taxonomy of the same published in India recently are those of Govindu (1947), on the Compositae of Bangalore; of Venkatesh (1947) on the Compositae of the same area; of Santapau (1946) on the Compositae of Bombay. Miss A. J. Randeria has just brought out a solid and very comprehensive monograph on the genus *Blumea* (1960), on which the authoress took her Ph.D. in Michigan University. The Conifers are not a common subject with Indian taxonomists on account of the relative scarcity and restricted distribution of the family; however, lately Raizada and Sahni (1960) have published the first part of their beautiful monograph; we are eagerly awaiting the publication of the second and last part of the work.

The Convolvulaceae have attracted the attention of the Bombay botanists, who have published a general revision of the nomenclature of the family (Santapau, 1947), a monographic review of the genus *Cuscuta* in Bombay (Santapau & Patel, 1957), and a number of papers giving a fair number of additions to the Bombay flora discovered during the complete revision of the family in Bombay (Santapau & Patel, 1958, 1961). A. K. Sharma and P. C. Datta of Calcutta (1958) have studied the cytology of the genus *Ipomoea* from the taxonomic point

of view. Other families have also been worked out; Santapau published a revision of the Acanthaceae (1952) in the Botanical Memoirs of the University of Bombay, and then the revision of the genus *Dipteracanthus* in India (1953). H. L. Chakravarty has worked so much on the Cucurbitaceae of India that today he stands as the authority on the same family; he has published several interesting papers (1946, 1952) and a comprehensive monograph (1959). *Gnetum* has been monographed by Maheshwari and Vasil (1961), and it is needless to say that this book is a model of what such monographs should be like, even though they do not deal with the taxonomy of the genus to any relevant degree.

This list could be prolonged almost indefinitely; for the sake of brevity I may mention a few institutions or universities where research in taxonomy and floristics is carried out to an outstanding degree. The officers of the Forest Department and especially those of the Forest Research Institute, Dehra Dun, have in the past been doing excellent work, and continue to do so in the present. The Botanical Survey of India, with its branches in various parts of the country is gradually taking a leading part in these studies. Their work has not been mentioned in these pages, because as a rule they do not teach nor conduct research in any of our universities, and my main aim is to bring out the work of the latter.

DIFFICULTIES IN MONOGRAPHIC WORK

One of the greater difficulties encountered by Indian botanists in their work is the scarcity of scientific literature and references. To some extent, and as far as recent publications are concerned, our needs have been satisfied by the publication of the various lists by UNESCO and lately by INSDOC. For many years we have found Pritzels *Thesaurus* (first edition 1851, second edition 1872-77), or Jackson's *Guide to the Literature of Botany* (1881) of great help. In India we do possess excellent guides; among them the *Literature on the Races of Rice in India* (anon. 1910); Blatter's *Bibliography of the Botany of British India and Ceylon* (1911), which was completed and brought up to date by the present author (1952-53). I have already mentioned Jain's *Contribution to the Bibliography of the Gramineae* (1961). The latest book on the subject is Narayanaswami's *A Bibliography of Indology*, vol. 2, *Indian Botany*, just brought out by the National Library, Calcutta (1962).

In the field of taxonomy, even greater than the scarcity of literature, is the fact that many of the type specimens of Indian plants are not preserved in this country. This absence of the type material renders much of our work almost valueless. In the 1956 edition of the *International Code of Botanical Nomenclature* it is laid down (Princ. II) as one of the main

guiding principles that 'the application of names of taxonomic groups is determined by means of nomenclatural types'. We are not acting correctly when in our monographic work we base our conclusions merely on published descriptions or even illustrations, without a reference to the type specimens. I shall return to this point in a moment; it is too important to leave it at just a passing reference.

THE TAXONOMY OF THE LOWER PLANTS

My specialisation for years has been the study of the Phanerogams, or Higher Plants; normally speaking I could scarcely be able to discuss progress in other branches of Taxonomy, except for one happy circumstance: Art. 34 of the Internat. Code Bot. Nomen. 1956 edit. (Art. 36 of the 1961 edition) requires for validity of publication that all new taxa of recent plants, the bacteria excepted, be accompanied by a Latin diagnosis; this work of translation I have been doing for years for practically every new taxon published in India. This has kept me informed of developments in branches which are not my own special study.

Our position as regards Lower Plants is not so satisfactory, if we except the Fungi and Algae; these two groups have been studied intensely in India, no doubt because of their economic importance. India can be proud of the work recently done on Fungi by the late Dr. B. B. Mundkur and his pupils; Dr. M. J. Thirumalachar, at present of Hindusthan Antibiotics, Poona, a student of Dr. Mundkur, has now gone from theoretical to applied Mycology and has with co-workers succeeded in producing most of our national requirements in Penicillin. Madras can boast of the researches of such men as Dr. K. Ramakrishnan and Dr. C. V. Subramanian; the latter has now become one of the leaders in the field for Lower Fungi. Allahabad University, the Tocklai Experimental Station at Connemara in Assam, the Mycology Section of the I.A.R.I., New Delhi, and a few others have done and are doing very good work on Lower Fungi. I am happy to see among us today Dr. C. V. Subramanian, who is going to address us on the subject of his speciality, to which he has made such distinguished contributions.

Economically Higher Fungi are of relatively little importance, except for the damage they cause to forest trees and stored timber. Dr. K. Bagchee, formerly of Dehra Dun, has done distinguished work in this field (1954). At the other end of India, Dr. S. R. Bose of Calcutta has been studying the Higher Fungi particularly from the point of view of their edibility or poisonous qualities (1940). I very much regret that the culture of mushrooms has not been taken up in India seriously; recently the Botanical Survey of India received a request from a foreign firm that wished to buy one

thousand tons of Indian edible mushrooms if available.

In the field of Algology, the leader in India is Prof. MOP. Iyengar of Madras (1929), who even in his retirement is doing such intense work on the subject as to put some younger men to shame with his industry; he is the founder of a school of algological studies in Madras, from which we have today a worthy representative in the person of Dr. T. V. Desikachary. The latter has in the course of years brought out a number of papers on the subject, and has lately crowned his work with a monograph on the Cyanophyceae. Dr. Bharadwaja did very good work at Banares and elsewhere, and like Prof. Iyengar has become as it were one of the immortals, in that in his retirement continues his research on Algae without stopping. Prof. Mrs. E. Gonzalves of Bombay has concentrated her efforts mainly on the Oedogoniaceae, on which she is now preparing a monograph; she has been followed by a number of students of the Bombay school, among whom mention may be made of H. P. Gandhi, who has worked on the Diatomaceae of Bombay. Dr. M. Randhawa of the Planning Commission has all his life been devoted to the study of Algae, and even now in the middle of a very busy official life has had time to bring out his monograph on the Zygnemaceae. From among the younger algologists of India, I may mention P. C. Vasishta of Hoshiarpur who is at present bringing out a series of papers on the Blue-green Algae of his university area.

The Mosses of India have been studied by Dixon and Brühl, but these authors belong to another period of history. We have among us here today one of the grand old men of science, I refer to Rev. George Foreau, of Shembaganur College, who for over 50 years has concentrated his efforts and those of his students on the mosses of the Pulney hills, and has crowned his life work with a splendid paper enumerating all the Mosses of these Hills (1961). Mosses taxonomically are difficult mainly on account of the fact that our moss literature in India is extremely scanty. It will be left to the younger generation to bring out monographs on the various groups of Mosses; this work, I am happy to say, has already been started by H. Gangulee of Calcutta.

The serious study of Indian Bryophytes may be said to have started with S. R. Kashyap of Punjab and his pupils. Lately India has lost an internationally recognized figure in the person of Dr. S. K. Pande, who personally and through his research workers has done more for Indian Bryophytes than any other living person. Poona University, under the inspiring guidance of Dr. T. S. Mahabale has been doing meritorious work in the same branch of research.

Lichens have been much neglected in Indian universities, until very recently. For the solution

of our problems in the identification of our specimens we have had to go to Sweden, or to Japan, or the U.S.A. Of late Dr. D. D. Awasti of Lucknow, whom we tried to bring to you here for this Summer School, has been making a name for himself on Lichens, but I fear that we are still very much at the beginning in this line. I do not remember receiving any new diagnoses for translation, except for a few published by Dr. Awasti.

Cytology as applied to Taxonomy has made great strides among us. The name of Dr. E. K. Janaki Ammal is too well known to need any further boosting on my part. Her contributions to cytotaxonomy, cytogeography, etc. have been internationally recognized for years. We may also mention among the more eminent cytologists Dr. T. N. Khoshoo of Kashmir University, and Dr. S. V. S. Sashtri of I. A. R. I., New Delhi; both have made notable contributions to the cytology of Indian plants, the first on *Sisymbrium* and other Crucifers, the second on *Oryza*. Without prejudice to the claims of other centres, I may be allowed to mention the following: Dr. P. N. Mehra and his school at Chandigarh of Panjab University have worked particularly on fern cytology; Dr. A. K. Sharma of Calcutta University has worked on a number of families, and is training a school of able cytologists; the Botanical Survey of India has contributed on this line mainly through the Eastern Circle on fern cytology and the Western Circle on taxonomy of Commelinaceae. Travancore University has made interesting contributions especially on the cytology of the Liliaceae and allied families. In the field of cytology, chromosome counts are probably one of the more intense fields of activity in many Indian universities, to judge from the number of papers that are being regularly published in Indian journals; no mention is made of such papers, since they do not deal directly with cytotaxonomy.

Bacteria and viruses have received no attention or practically no attention from Indian botanists, probably on the plea that both groups belong to Plant or Animal Pathology and not to Botany. Dr. T. S. Sadasivan is one of the exceptions among botanists; he is going to give us a paper on viruses in the course of this School. It was only after the introduction of the electron microscope that such minute organisms could be taken up for detailed morphological study. For a long time to come, however, viruses may continue to be left alone by Indian botanists simply on account of want of either facilities for their study or of skill for the use of the facilities available. We wish Madras University every success in this new line of work.

Embryology under the inspiring guidance of Dr. P. Maheshwari (1958) has reached mature stature in India and has made serious contributions to plant taxonomy; it is particularly in groups of plants of difficult placing or of difficult affinities that Embryo-

logy has come to the rescue. Many of our Indian Universities do work on Embryology; but it is mainly the University of Delhi that has made distinguished contributions to Taxonomy through Embryology. The work that has been done in Delhi on the taxonomy of the Lorantheae and Santalales is one of the finest pieces of painstaking 'detective work' done anywhere in the world in these last few years. (See under Johri and Bhatnagar, 1960).

Pollen analysis is another young branch of botany that is contributing much to taxonomy; in our first steps we have been guided and encouraged by G. Ernstman, a giant in this field; Dr. C. E. C. Bremekamp of Holland was one of the pioneers to apply pollen structure to the study of Acanthaceae. In India the Birbal Sahni Institute, Lucknow, and the Oil and Gas Commission, Dehra Dun, are easily the leaders in this field. Both institutions are now engaged in the preparation of an atlas of recent and fossil pollen of Indian plants.

Work on Pteridology progressed in a remarkable manner under R. H. Beddome in the second half of the nineteenth century; but there seems to have been a lull after Beddome only broken by such small contributions as those of Blatter and D'Almeida (1922). Interest in ferns has revived in India; we have at present two main schools of research dealing with Indian ferns: Dr. P. N. Mehra of Punjab has concentrated on W. Himalayan ferns, and with his assistants and pupils has produced a large number of serious papers; we shall have occasion to hear Dr. S. S. Bir during these days, as a representative of the Panjab Fern School. The other school is not localised in one place and is made up of the numerous pupils of Dr. S. Manton of Leeds University; these research workers are very active in fern taxonomy through cytology in various parts of the country.

MORE ABOUT DIFFICULTIES IN OUR WORK

I spoke a few minutes ago of the difficulties arising from the fact that most of the older types of Indian plants are not available in India. It would be very desirable to obtain duplicates of all such types for our national herbarium, I mean to say iso- or para-types of the original material; or if this be impossible, as not seldom species were built on a single herbarium sheet in the past, then we should at least obtain good photographs of all such types. In Blatter Herbarium, Bombay, we do have photographs of most of the types of Bombay plants, and such photos have proved of great help in critical work on the taxonomy of our plants. Failing both types and photographs, it should be possible to take many of our plants and compare them critically with the actual types; such specimens then become 'authentic', which on many occasions may become as good as or even better than the often rather poor type specimen.

In our floristic work, we also suffer from the fact that our collections from any given area are usually too small to be of any use for statistical studies. This deficiency is gradually being made up by many studies on the autoecology of our plants. We shall have these days a paper that shows that *Bothriochloa pertusa* (Linn.) A. Camus may be the same plant as *Dichantium annulatum* Stapf, the differences between the two so-called species being but ecological variations of one and the same species.

Another difficulty is that often plants from a given area come all more or less from the same period or season in the year. In my own experience, for many years I had great difficulty in identifying the *Curcuma* species of the W. Ghats; the main cause of my trouble was that published works divide the genus *Curcuma* into sections, depending on the position, central or lateral, of the flowering spike in relation to the leaves. After over four years of careful field observation, I finally noted that the position of the spike depend on the season for one and the same plant, it being lateral at the beginning of the flowering season, and central in the second half; double spikes were found about the middle of the season. Herbarium specimens on which most monographs are based may be imperfect, since they show the plant from only one season. We need better collections of specimens, larger collections of data for our national herbaria.

Possibly the greatest difficulty we encounter in our taxonomic work in India is the scarcity of literature, as mentioned before. I can only say here that in the last few years I have had great help from INSDOC, from which or through which I have been able to obtain microfilm copies of foreign literature, old or new. The quality and the cost of INSDOC services compare very favourably with the best in foreign parts.

SUMMARY AND CONCLUSION

We are in India witnessing a great revival of taxonomic and floristic studies; some of the work is but an extension of that done previously; other work had never been done in India before, such as e.g. on Lichens, or on pollen structure or on cytology. To improve our work we do need the types or duplicates of the types of our Indian plants. Floristic studies can certainly improve, and they do need improvement; we have to concentrate on collecting large numbers of specimens, with appropriate field data on their ecology, life history, etc. The future is very bright, and the discussions to come during this Summer School will, I am sure, make it brighter and scientifically more valuable.

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