On the Style of Floras: some general considerations*

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Summary

The most satisfactory style for a Flora at the present time should be one of conciseness and practicality, with "correctness and clearness of method and language [being] the first qualities requisite," to quote Bentham (1874, p. 50). This should be inventory, identification, and provision of essential data. Large-scale flora projects, of which there are perhaps too many on the stage today, should be examined very carefully; in many cases their bulk (and cost) may defeat any real usefulness or impact, and their basis is shaky, leaving many to be terminated incomplete or only completed after more than a generation. Such incomplete works, with which the pages of floristic bibliographies are replete, are ultimately of less value than one which may be more modest but is complete, and in fact should perhaps a viewed as a wasting of botanists' time and resources. Furthermore, with the EDP-IR communications, and media revolutions (the full impact of which has yet to be felt in systematic biology), it may be questioned whether much of the specialized data found in large-scale floras need be tied up in the print medium but could better be handled in other, less familiar ways; at the same time, such methods would lead to fewer losses than is usually the case at present in translating taxonomic and floristic research into conventional floras. The FNA represented a step in the right direction, but it faced public relations problems and an unfavourable administrative climate and it may have been too big a step at that time and place. Some smaller but similar projects are still under way in other parts of the world and it is these "guinea-pigs" that will be watched with interest in the next few years. However, there is still plenty of scope for the more modest, concise work, which, because less time is usually taken in production, stands a better chance in the present economic climate of gaining support and carrying through to completion, although technically it might be less "prestigious". It is thus to be hoped that works such as *Flora Europaea, Flora of Turkey, Flora Iranica,* and the *Tree Flora of Malaya* will be successfully completed in the next decade, and others like them undertaken, even for lesser-known tropical regions. There is also, in my view, scope for good annotated enumerations, preferably with keys; the recent *Prodromus einer Flora von Südwestafrika* is a good example.

The completion of a revised and expanded version of my Guide to standard floras of the world, which first appeared in a limited cyclostyled edition in 1964, has provided the opportunity to make a review of the purpose, design, and content of floras, manuals and enumerations; additional stimulus for this has come from a series of recent articles dealing with various aspects of the subject (Fisher, 1968; Heywood, 1973; Shetler, 1971; Taylor, 1971; Watson, 1971). These in turn resulted from a consideration of the "information explosion" in systematics (see also Anonymous 1974), the introduction of the new methodologies of taximetrics (numerical taxonomy) and EDP-IR during the 1960's and early 1970's, the progress of *Flora Europaea,* the development of the Flora North America Program (before its termination in 1973), and the increasing demands on the systematics profession made by other biologists (notably ecologists) and by "environmental scientists." Together, these papers represent the first major reconsideration of the principles and the style of floras and other floristic works for a century or more, with a few exceptions (van Steenis, 1954; Davis & Heywood, 1963). The present review gives

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a summary of these contributions and traces the historical development of Flora-writing as well as analyzing current trends and making some suggestions for the future.

Historical survey

Most of the more important floristic works in current use around the world by and large adhere to principles gradually laid down in the mid-19th century and succinctly summarized by Bentham (1861, 1874) and de Candolle (1880). Bentham's principles are contained in the first five aphorisms of his "Outlines of Botany", which appeared in nearly all of the colonial floras in the series issued from the Royal Botanic Gardens, Kew, as well as some contemporary works such as Hillebrand's *Flora of the Hawaiian Islands*. Their influence was widespread and lasting, and because the first three are particularly apropos to the present discussion I repeat them here:

> "1. The principal object of a Flora of a country, is to afford the means of determining (i.e. ascertaining the name of) any plant growing in it, whether for the purpose of ulterior study or of intellectual exercise.
>
> 2. With this view, a Flora consists of descriptions of all the wild or native plants contained in the country in question, so drawn up and arranged that the student may identify with the corresponding description any individual specimen which he may so gather.
>
> 3. These descriptions should be clear, concise, accurate, and characteristic, so as that each one should be readily adapted to the plant it relates to, and to no other one; they should be as nearly as possible arranged under natural divisions, so as to facilitate the comparison of each plant with those nearest allied to it; and they should be accompanied by an artificial key or index, by means of which the student may be guided step by step in the observation of such peculiarities or characters in his plant, as may lead him, with the least delay, to the individual description belonging to it."

The second part of the fifth aphorism is also of some interest and is likewise quoted:

> "The botanist's endeavours should always be, on the one hand, to make as near an approach to precision as circumstances will allow, and, on the other hand, to avoid that prolixity of detail and overloading with technical terms which tends rather to confusion than clearness. In this he will be more or less successful. The aptness of a botanical description, like the beauty of a work of imagination, will always vary with the style and genius of the author."

The first of these aphorisms clearly reflects Bentham's view of a flora; and it was in this spirit that much of the "Kew Series" of colonial floras was prepared, as with the contemporary floras of the British Isles prepared by him and by Hooker (these latter, even today, are still appreciated for their method and conciseness). Bentham's principles, with modifications, also gave rise through the example of Torrey's and Gray's classic works on North American plants of the late 1830's and 1840's to the standard format of many current North American Floras and manuals. Other major works of the period strongly influenced by these principles — as acknowledged by their authors — were Miquel's *Flora indiae batavae* (1855-59), Boissier's *Flora orientalis* (1867-88), and Willkomm & Lange's *Prodromus florae hispaniae* (1861-93).

In kindred spirit to the concisely descriptive floras of the Anglo-American (and Franco-Swiss) "school", but with somewhat different methodology and aims, there arose the Continental "manual-key". This represented a substantially

independent development, stemming from the simple dichotomous analytical keys devised by Lamarck for the first edition of his *Flore française* in 1778 (Voss, 1952; quoted in Radford et al., 1974). Lamarck intended this work to be nothing more than a handy means of plant identification (Stafleu, 1971), and all manual-keys which have appeared since then have been motivated by this principle. In such works, the format of separate keys (or synoptic devices) and descriptions typical of works of the Anglo-American "school" was bypassed in favour of diagnostic analytical keys which (in later years) also variously incorporated brief, partly symbolic notes on habitat, distribution, life-form, phenology, karyotypes, etc. As the 19th century progressed, bringing with it greatly improved means of transportation and more leisure, the manual-key style became very widespread in Europe, often going under the name of "excursion-flora." Through Central European influence, this kind of flora penetrated to Russia and eventually became an ubiquitous feature in the comprehensive network of regional floras which developed in the Soviet Union from the 1920's onwards. (The Russian term for such works is *opredelitel'*, sometimes translated as "the keys" or "determinator" but better rendered in English, I feel, as "manual-key", being more expressive and idiomatic.) However, no matter where they are produced, manual-keys are to a large extent based on more comprehensive "research" or "creative" floras; because of their largely derivative nature and (in some parts of the world) periodic issue to meet public demand, they (along with local descriptive manuals) have been termed "routine" floras (van Steenis, 1954; Davis & Heywood, 1963). As a style, the manual-key is not often seen outside Europe of the Soviet Union; good recent examples by non-Continental authors include *Flora of the Sydney Region* by Beadle et al. (2nd ed., 1972) and *Flora of the Pacific Northwest; an illustrated manual* by Hitchcock and Cronquist (1973).

An interesting link between the two "schools" was provided by the floras written by Bentham (and those influenced by him). Although these works were basically concisely descriptive, like most of those written by the de Candolles, the Hookers, Torrey and Gray, Bentham consistently used analytical keys in place of (or in addition to) the synoptical devices which characterized the works of the other authors (and those influenced by them). This reflects the strong influence of the *Flore française* of Lamarck (by 1815 under de Candolle's authorship), with its analytical keys (or "indexes", to use Bentham's term), and other French works during Bentham's formative years as a botanist (1817-26), which were spent in France (Bentham, 1974). By contrast, J. D. Hooker apparently believed that such keys made things too easy in that students would pay little attention to diagnoses and descriptions. This view may well have been shared by A. de Candolle, who failed to mention them in his *La Phytographie* of 1880 (van Steenis, 1954).

The next major development in floristic writing to be considered here is the detailed semi-monographic flora, which also had its origins in the mid-19th century. It seems likely that the motivating forces for such works were prestige (something which also lay behind the many sumptuous sets of "scientific results" of voyages and expeditions in this period) and a belief that a flora should act as a detailed compendium and repository of information about the plants of an area and not solely as a practical handbook for identification and essential information. In other words, it should be a specialized kind of encyclopaedia, with sub-monographic accounts containing detailed descriptions, synonymy, specimen citations, extensive notes, and (often) illustrations in large plates. This concept of a flora seems to have arisen (or taken strongest hold) in the Central European intellectual sphere, and cannot fail to have been influenced by the Germanic prediliction for detail rather than conciseness. It was here that the Linnean system persisted longest, due largely to the strength of the scholastic tradition (and the *ex cathedra* professorial system) and the continuing demand for general compendia of the plant kingdom (Bentham, 1874). The first truly original systematic work in Central Europe which

professed a "natural" system was Endlicher's *Genera plantarum* (1836-40). Soon after, Endlicher joined forces with von Martius to work on the first "modern" semi-monographic flora, the king-sized *Flora brasiliensis,* begun in 1840. In this way, the endemic mania for large compendia was shifted into significant new channels, the results of which were to have a major influence over the next two generations.

The greatest flora of the 19th century dragged its detailed pages slowly on for 66 years, a time span exceeding that of most British colonial floras of the same period, and was for long a dominant factor in European phytography. As with *Flora Europaea* a century later, its organization consisted of editors, technical co-workers ("Privatassistenten"), and numerous specialist contributors. Amongst the many botanists so involved, there were three — Eichler, Engler, and Urban — who brought the Berlin "school" of systematics into being after 1870 and imbued it with the *Weltanschauung* and scholarship which were to make it so influential. All had been, or were actively, editors or co-workers or both on *Flora brasiliensis.* Under the general direction of Engler after 1889, the Berlin "school" came to specialize in large-scale monographic works, detailed series of regional revisions, plant-geographical studies, and related contributions, culminating in that supreme monument of German systematics, *Die natürlichen Pflanzenfamilien* (1887-1915; 2nd ed., 1926+, not completed). Contemporaneously with much of *Flora brasiliensis,* but on the domestic front, there was another large-scale work, the Reichenbachs' *Icones florae germanicae* (1834-70).

In spite of all this effort, and the stimulus provided by the development of the German colonial empire after 1880, few, if any, concise practical works ever appeared; there was nothing comparable to the "Kew Series" or the range of regional manuals in North America. Indeed, the influence of the Berlin school under Engler led to a very widespread emphasis on synthetic work, and less attention was paid to floras in the late 19th and early 20th centuries, at least in Europe (Davis & Heywood, *l.c.,* p. 33.) One example of a German colonial flora is Schumann and Lauterbach's *Die Flora der deutschen Schutzgebiete in der Südsee* (1900-05) for German New Guinea, Micronesia, and Samoa. This is essentially an enumeration, containing a useful repository of geographical and other data but lacking in methodical organization and largely innocent of keys. It is all but useless for identification and cannot be compared with a work such as Merrill's *Flora of Manila* (1912). Perhaps, indeed, the Central European predilection for detail was of such a nature as to have precluded (or retarded) the development of a practical philosophy towards floras, at least outside Central Europe and its many "excursion-floras." Writing in 1874 of German botany, Bentham remarked, "The country abounds in those plodding minds which revel in the working out of minutiae of detail, and, to find their way, are satisfied with a sexual, alphabetical, or any other artificial index . . ." A similar lack of method also marred much of von Mueller's writings on the Australian and New Guinean floras, and the same could be said of some Dutch works on the East Indies. In France, no characteristic "school" developed apart from the influences of Lamarck and the de Candolles and, indeed, few important floras appeared under French auspices in the mid- and late 19th century. The suppression of any chair at the Sorbonne or the Paris Museum specifically responsible for systematics and classification between 1853-73 and the associated loss of the Delessert Herbarium to Geneva in 1869 were serious setbacks (Leandri, 1967) and present French activity in the writing of floras is largely a development of the 20th century and one showing few original features.

The final key development in floristic writing to be considered here was the annotated enumeration or checklist. These began to appear from the late 19th century onwards as an outgrowth of the "synopsis" or "systema vegetabilium", and are essentially catalogues. Generally they were viewed as an interim measure, so that something of the results of floristic research could be made available to the

public in a concise, easily prepared form, or as works in which much descriptive detail was considered unnecessary, such as local or insular florulas. While the majority of such works cover relatively small areas, there have also been produced a goodly number of extensive annotated enumerations for large, often botanically poorly known areas, especially in the tropics. Notable examples of large enumerations include *Enumeration of Philippine flowering plants* (Merrill, 1923-26); *Conspectus florae angolensis* (Carrisso et al., 1937+); *Enumeratio spermatophytarum aethopicum* (Cufodontis, 1953-72); and *Catalogus florae domingensis* (Moscoso, 1943). Many of the authors/editors lacked the means and/or time to prepare full descriptive works but believed some kind of consolidated publication, even if imperfect, was necessary. While they have been criticized by some writers, such works should be regarded as better than no consolidated work at all, and in many cases have fared, or may fare, better than semi-monographic floras.

The preferred contents of floristic works have been well summarized for our time by Blake and Atwood (1942, p. 8–9) and Davis and Heywood (*l.c.*) and need not be reiterated here. The question of content has also been considered by van Steenis (1954) and Brenan (1963). The most important additions and refinements to the standardized formats of Flora-writing have been in the areas of nomenclature, ecology, chorology and distribution, mapping, karyology, critical commentary, and illustration. The findings of palynology and comparative phytochemistry have left their imprint largely above the species level. In general, it may perhaps be said that standards with regard to content have gradually improved in the years since World War II.

On the other hand, the present century has by and large witnessed a concomitant — and perhaps inevitable — increase in the bulk (and cost!) of Floras and, often, a decrease in utility. There has perhaps also been a tendency in many cases not to think out clearly the aims and purpose of a given floristic project. Such trends have been deplored by van Steenis (*l.c.*) who believed that "recent Floras often differ considerably from Bentham's scheme". Davis and Heywood (*l.c.*) further note that there are a number of works called "Flora" which contain keys but no descriptions, as well as some with descriptions but no keys; instances of such works still may be found amongst even very recent floristic literature. Some floras contain an exceptional amount of non-phytographic matter and must be viewed more as encyclopaedias than as practical manuals. In this connexion, it is interesting to note that very few writers after 1880 (and until recent years) appear to have seriously reconsidered the philosophy and methodology of floras, despite their great importance as a means of phytographic communication (van Steenis, *l.c.;* Heywood. 1973). Perhaps, as van Steenis notes, the older writers (especially Bentham) "had at the time exhausted the subject in such an admirable way that nobody found occasion to discuss it any further." He noted that Diels in his *Methoden der Phytographie* of 1923 did not give special attention to this question — a curious omission in view of the large contributions to floristic literature by German and Central European botanists but perhaps explicable in view of the relative lack of concern with method and conciseness in so many of these works.

Since World War I, and even more so since the last war, there has been a distinct tendency towards the creation of large-scale, multi-author flora series for many countries or regions where knowledge of the plant life is imperfect in one way or another, particularly in the tropics. In addition, with an increasing amount of material to be covered as well as increasing specialization, more and more of the larger floras have been issued in serial parts, without regard to systematic order. Some of these become partial substitutes for serious monographs, for which there seem today to be few satisfactory publication outlets and which in some quarters appear to have a low academic "status" (cf. Jacobs, 1969). In many botanical circles today, it seems that large-scale floristic projects have become

"fashionable", the rise and fall of the Flora North America Program notwithstanding, and the resulting floras have a certain "prestige" value. A number of these have been set up for smaller, mostly politically delimited units (mainly within the tropics), despite the advice of van Steenis who believed that large-scale "creative" floras should be written with reference to large, natural botanical regions such as Malesia. Most larger botanical institutes in North America, Europe, and (to a lesser extent) elsewhere presently have one or more of these projects under way. Some of these works are meaningful, and as they progress represent real contributions to knowledge, although perhaps in some cases progressing too slowly; examples include *Flora Malesiana, Flora Iranica, Flora Neotropica, Flora SSSR*, and some of the African floras. Others are too detailed or otherwise long-winded, too grandiose, cover unnecessarily small areas, or have an insecure basis. The length of time taken, or likely to be taken, to complete many of these works is quite considerable; this in itself raises questions about financing as well as individual and institutional motivation (de Wolf, 1963, 1964). The time-span of *Flora brasiliensis* has already been mentioned; other examples are the *Flora of Peru* (40 years, still incomplete and interest fading); *Flora capensis* (74 years, with a 31-year break from 1865 to 1896); *Flora of Tropical East Africa* (23 years and quite some way from completion); *Flora Polska* (56 years, although all but complete); *Flora SSSR* (30 years); and *Flora Malesiana* (27 years, only some 30-40% completed, and some families unlikely to be published). For these and other reasons, De Wolf has questioned the wisdom of many large-scale projects, suggesting instead that more attention be paid to the preparation of "concise" works (although the objection would be raised that for many little-known regions, a substantial amount of basic monographic and revisionary work is required in connection with a flora project and this must be expressed in some way in the published flora, because there may be no alternative). Fortunately, some over-elaborate works have been discontinued; a notable example is *Genera et species plantarum argentinarum* (1943-56). I consider, however, that the whole question of large-scale floras should be looked at more closely, with a view to making further cuts and consolidations and storing a considerable percentage of data outside the print medium (or at least outside the realm of the standard flora).

Floras at the present time

At the beginning of this paper, I noted that in recent years there has been an information explosion in systematics, from which Floras have not been spared. The impact of this, together with the introduction of EDP-IR methods, has led to considerable recent discussion of the content and style of floras and the philosophy and methodology of flora-writing — the first substantial debate for some 100 years in this area, with only very few key contributions in the intervening period. As this is very much a current issue, which Heywood (1973) believes to be of "crisis" proportions, it seems useful to consider the progress and problems of Flora-writing at the present time and to make some suggestions about the future, with particular reference to infra-tropical regions.

The continued acceptance — perhaps uncritically — of long-standing and stereotyped formats and sets of questions for floras and related works by generations of botanists is not only evidence of their general utility but also a reflection of the conservatism inherent in much of the taxonomic profession; in other words, tradition has perhaps been as strong a force as any intrinsic merit in these parameters. Taylor (1971) states that these are some 200 years old but as I have shown in this paper the design principles and content of most present-day descriptive works are largely based on principles laid down between 1830 and 1860 (with manual keys and enumerations (or catalogues), as well as ligneous Floras, evolving later to meet particular needs or to cope with difficult situations like the inventorying and classification of Floras of humid tropical regions).

An examination of the relevant literature cited at the beginning of this paper as well as personal observations suggest that at present there are essentially two views, both of long standing and to some extent at odds, concerning the central purpose of descriptive floras. This, in some way, parallels van Steenis's view that most floras are "dualistic" in nature, i.e. they attempt to serve two different ends, the one archival or encyclopaedic, the other for identification (van Steenis, 1962). He argued that this problem could be resolved in north temperate regions, but not in the tropics. A similar theme has been central to the current ongoing discussion.

The first philosophy — one which sees Floras as tools for identification — harks right back to the first aphorism of Bentham quoted early in this paper. The relative value of this philosophy has again been emphasized by Heywood (1973) as well as indirectly by Watson (1971). Heywood suggests that Floras should address themselves to the following questions about the plants of an area:

(*a*) what there is,

(*b*) how they may be recognized, and

(*c*) where they may be found

and that this involves keys, descriptions, auxiliary data, and necessary nomenclatural apparatus. It is argued that Floras were not necessarily intended to serve as sources of strictly comparative data. This philosophy is in general also adhered to by Brenan (1963) in his review of the rôle of Floras in developing countries.

The second philosophy — in which floras are seen as essentially archival or encyclopaedic — has its roots in the *Flora brasiliensis* tradition, is exemplified in many large-scale flora projects today, and considers that floras should be "a physical repository of descriptive data about plants which are organized and formatted, usually in book form, so as to answer to time-tested set of prescribed questions . . ." (Shetler, 1971).

The differences between these two philosophies as related to developments in the 19th century have already been discussed, with several examples. In our own day, the first philosophy is well exemplified by *Flora Europaea*, which will ultimately deal with some 15,000 species in five quarto volumes. Other examples of recent floras where an attempt has been made at conciseness are *Flora iranica, Flora of Turkey, Flowering plants of Jamaica, Prodromus einer Flora von Südwestafrika,* and *Flora of West Tropical Africa* (2nd ed.) as well as many smaller descriptive floras and manuals.

In this connexion, it may be noted that the longest time that will have been taken for these projects is about 25 years (*Flora Europaea*), something hardly ever achieved by most of present-day large-scale flora projects, which in most cases will take anywhere from 20 to 40 or more years to complete (cf. De Wolf, 1963). In addition, the creation of large-scale works, involving lengthy research and preparation and sometimes interinstitutional cooperation, involves a considerably greater investment of time and manpower (averaging 50 species per year per taxonomist) as opposed to the production of "concise" works (averaging 250 species per year per taxonomist) (De Wolf, 1964).

Sometimes the two philosophies are confused. In the "Introductory Notes" to the Flora of Papua New Guinea Concise Handbook Project (of which nothing has yet been published) it is stated that, in order to make available "information" on the flora (which is presently very scattered apart from what is available in *Flora Malesiana*), the sponsoring institutions have "embarked on a project to produce, in a handbook format, a *concise* Flora . . ." By contrast, the one sample family treatment seen suggests that the work, even with some information previously relegated to "technical supporting papers", will be somewhat encyclopaedic in nature; four pages of text are required to deal with three species. This is hardly "concise" in the sense of the Benthamian tradition or the *Flora of Turkey*

but more like the *Flora of Guatemala* or even *Flora Malesiana* — both essentially large-scale works in the von Martian tradition. In our days, relatively few concise floras for tropical regions have been successfully completed and published, and some are still marred by awkward formats; apart from the *Flora of West Tropical Africa*, mention can be made of *Flora of Java* (1963-68), *Flowering plants of Jamaica*, and *Tree flora of Malaya* (1972+ , still in progress but with good prospects for early completion). All of these are (or will become) widely-used standard works and will be of more real value than many grander but unfinished floras.

Fisher (1968) has called attention to the proliferation of data which faces systematic botanists today. This has had an effect on large-scale independent monographic work, particularly in large families (Jacobs, 1969), and it has become more convenient in many cases to do this work through the medium of large-scale regional or national Floras, there being fewer independent outlets or special monographic series than was the case in past decades. Fisher has also drawn attention to weaknesses in verbal descriptions, stressing the importance of illustrations; this has special relevance to the humid tropics where there are so many different kinds of plants to be considered and where the perception of most people is much more visually than literarily oriented. This point has been clearly recognized by the author of such Asian works as *Cay-co mien-nam Viêt-Nam* (Pham, 1970-72), *Iconographia cormophytorum sinicarum* (Anonymous 1972+), and *Choson singmul myongchip* (Chŏng, 1956-57). These are all atlas-floras comprising small figures and parallel text, with analytical keys playing a supporting rôle; although they are modelled on "Western" atlas-floras, I believe that something of the Asian (and particularly Chinese) botanical tradition has also played a rôle in their creation. Some of them are also relatively "concise" as Floras, here owing something to the traditions of Bentham and his contemporaries.

Watson (1971) has called for just a return to the Benthamian tradition of "concise" Floras, and makes the significant suggestion that the kind of information which now tends to go into elaborate "archival" Floras is more appropriate to other kinds of taxonomic publication or for storage and retrieval through data banks or other non-print media. Believing that the two philosophies of Flora-writing — the information/archival and the practical — should be separated and that a given work should follow one or the other, Watson considers that many Floras are confused in this respect and in the end represent unhappy compromises, failing in both areas; they are neither useful sources of comparative data nor practical tools for identification (and still expensive!), and have not conceded that under present conditions these functions must be virtually separated. He concludes by stating that "we have all these advantages [computerization, philosophical analysis, masses of data, etc.], yet have more difficulty in getting to grips with real problems than Bentham did."

A step in the direction suggested by Watson was taken by the development after 1968 of the FNA Program (Shetler, 1971; Shetler et al., 1973). This was to be a relatively sophisticated information storage-and-retrieval system which would be linked with a concise conventional flora in some 5-6 volumes in the manner of *Flora Europaea;* the production of a hard-copy flora was viewed in part as a recognition of the strength of convention and tradition in Flora-writing. However, the project was killed in 1973 as a result of administrative pressures on science and internal and external politics; it later became evident that the new methodology threatened to become the master rather than the servant of the operation (Shetler, 1974) and at this writing it is a moot point whether EDP-IR will become a really effective tool in Flora-writing in the way hoped for by its advocates. Some smaller projects are, however, under way, e.g. for Vera Cruz, Mexico (Gómez-Pompa & Butanda 1973; Gómez-Pompa & Nevling 1973) and in South Africa (Hall, 1974) and it is these upon which attention will be focused in the years to come. Related schemes involve the complete encoding of essential data from the specimens in

the Queensland Herbarium at Brisbane and the South African National Herbarium at Pretoria; from these it may eventually be possible to produce *inter alia* preliminary floristic catalogues for these areas.

FUTURE DEVELOPMENT

The above references to the introduction of EDP-IR methodology — claimed to be the most important change to the philosophies of Flora-writing for a century — lead naturally to the final question: what of Floras in the future? The impact of new methodologies could eventually bring about the revolution hoped for by their advocates, but firstly some key philosophical (and practical) questions must be resolved.

Floras today, as Watson has noted, are often confused in their philosophy and are deficient in many ways as a result. Most of them, unless they are really elaborate, large-scale works with a consistent format and standard of information content, are of little use for comparative data because of the pull of traditional essentialist conventions in the writing process; most authors still see identification as a principal aim (supplemented by limited information of relatively general interest such as habitat, distribution, life-form, phenology and karyotypes) but in many cases are obliged, or feel obliged, to include more comprehensive information, resulting in a confusion of objectives. Keys are often highly selective, too, and in floras where the manual-key format prevails (such as *Flora of Java*) it becomes very difficult to extract useful comparative data.

What, then, might be the best way to resolve the apparent impasse? Firstly, there should be much more effort given in planning new projects to the *philosophy and objectives* of the proposed work as well as to the *means, manpower,* and *motivation* available (especially for larger works which may take, even in a concise form, many years to complete). Secondly, more concern should be given to the standardization of data accumulation and organization and the avoidance of the losses that occur when work is published. In this, connexion, much depends upon continuing improvements in EDP-IR methodology, further introduction of data-processing in herbaria and in individual research, and an improved political understanding of the value of such methods in systematic publication (and their limitations!).

Personally, I believe that the best rôle for a Flora as such today remains the practical one: inventory, identification and essential related data. To the "essential data" of Bentham's time there should now be added that from ecology and karyology (cf. van Steenis, 1954) as well as plenty of illustrations. In addition, there should be a clear indication of where taxonomic or biosystematic problems occur as has been so well handled in *Flora of New Zealand* by Allan *et al.* (1961, 1971). If lesser-known areas are involved (as is the case with most of the humid tropics), it may be desirable to expand supporting data and commentary (including citations) somewhat, as is being done with the *Flora of Turkey* (which, in my opinion, is one of the best of current larger floras dealing with lesser-known areas and one very kindred in spirit to the famous "Kew Series" of the 19th century). In addition, concise floras should always have references to standard monographs, revisions, floras and other contributions under each family and genus heading.

By contrast, large-scale floras should be viewed as having an entirely separate function; they should not be undertaken except for large natural regions such as Malesia or for very large political entities such as the U.S.S.R. They should perhaps even be run as open-ended serials rather than as "closed" works, as was done with *North American Flora* some years ago and is being done with *Flora Neotropica.* Furthermore, much of the archival function of such works, with their

often elaborate synonymy, could be assumed by non-print media and EDP-IR systems (as was envisioned by the FNA Program), doing away with the need for storing much relatively specialized data in increasingly costly print media; instead, such information could be generated in microcard or microfiche form (readers are now becoming relatively inexpensive and widespread) or as processed output. Detailed information in this form could then be used for the preparation and publication in print media of conventional "concise" floras (as well as for the production of major systematic treatments).

For some little-known areas where time or local conditions may not permit the preparation of more extensive works, I believe it desirable to continue to produce annotated enumerations or checklists. These should preferably be in the manner of Merrill's *Enumeration of Philippine Flowering Plants,* though if keys can be added, so much the better. Such a format would have perhaps been the best method at the present time for a complete listing of the Papuan flora. An excellent example of what can be done in a relatively short time for a comparatively little-known areas with limited manpower is *Prodromus einer Flora von Südwestafrika* (Merxmüller et al., 1966-72), previously referred to. There is no room, however, for improperly annotated or unannotated checklists.

In many tropical regions (and developing countries generally) careful consideration should be given to making the results of systematic botanical work readily available to the public — in other words, to the concomitant preparation of works which will have a wide impact and can be seen to be useful. Atlas-Floras such as those already noted, where most or all species are illustrated, may have a greater audience than more conventional works. Keys should be simple and practical; descriptions should be concise, clear, and provide the essentials (easier if illustrations are used consistently). In these areas, it will only be a small number of persons who would prefer a detailed treatment, and this could be provided from other sources. Where the total flora is very large (and comprehensive works often correspondingly costly, especially in local terms), there is also scope for a number of works of more limited scope. Thus continuing attention should be given to forest floras and tree books (which often have considerable public appeal) as well as works on grasses, weeds, etc. One humid tropical country, Malaysia Barat (Malaya), is particularly well supplied with such partial works. For teaching purposes, it may often suffice to have a compact, illustrated school-manual covering a range of more easily accessible species (van Steenis, 1962). One of the finest of tropical manuals ever published remains E.J.H. Corner's *Wayside trees of Malaya* (2nd ed., 1952); this is considered a favourite by my students in New Guinea because of its interesting text, many illustrations, and clear keys. This should be revised and updated, and more of its kind (there being lamentably few in the tropics) should be written. In New Guinea, because the "official" botanists have been interested more in specialized, mostly technical floristic works than in books aimed at local people, the University Herbarium at Port Moresby has commenced work on a series of illustrated teaching booklets on the local flora, each dealing with a given habitat or life-form.

There will certainly be instances where it is necessary or desirable to make encyclopaedic information readily available on a given group (or groups) of plants. In these cases, this is better done outside the realm of floras, i.e. as separate publications or in serials. The best systematic encyclopaedia ever produced was *Die natürlichen Pflanzenfamilien,* and it would be highly desirable if the means and manpower could be found to complete the second edition of this work or undertake a new version in English. However, it should avoid becoming too bogged down in detail, a fault shown by the second edition here and there. Much of such detail could better be handled by non-taxonomic publications (Heywood, 1973) such as *Biology and Chemistry of the Umbelliferae.*

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