



What is Economic Botany?¹

G. E. WICKENS²

The history of economic botany is briefly discussed. Economic plants are defined as those plants utilized either directly or indirectly for the benefit of Man. Indirect usage includes the needs of Man's livestock and the maintenance of the environment; the benefits may be domestic, commercial, environmental, or aesthetic. The relationships between economic botany, agriculture, forestry, horticulture, and ethnobotany are discussed as well as the regional approaches to economic botany around the world and by the Royal Botanic Gardens, Kew, in particular.

Quelle est Botanique Économique? La histoire de botanique économique est discuté brièvement. Les plantes économiques sont définit comme ces plantes qui sont utiles directement ou indirectement pour la profit de l'Homme. Usage indirectement comprendit les nécessités des animaux domestiques et le conservation de l'environnement; les profits pourrait être domestiques, commerciaux, environnementals, ou esthétiques. Les relations entre botanique économique, agriculture, aboriculture, horticulture, et ethnobotanique sont discuté comme aussi les approches regionales à botanique économique autour du monde et particulièrement dans les Jardins botaniques royaux de Kew.

Plant life is essential for the survival of all animals on earth, including Man. Plants directly, or indirectly through a carnivorous food chain, provide food and other life-supporting commodities. Plants also protect and maintain the environment against erosion and atmospheric imbalance. Man has always been dependent upon plants for the necessities for his survival, not only the three big Fs, Food, Fodder, and Fuel, but also for medicines, fibres, chemical products, and other commodities.

HISTORICAL BACKGROUND

The evidence for Man's dependency on plants for his survival can be demonstrated by palaeoethnobotanical findings from prehistoric archaeological sites (Renfrew 1976; Smith 1986). Written evidence from early civilizations includes the Sumerian ideograms dating back to 4000 B.C.; the Ebers Papyrus of c. 1500 B.C. from ancient Egypt; from China, the Ehr Ya of 3000 B.C., the Shu Ching of 1000 B.C., and the Pen Tshao Ko Kua of 1295 A.D.; and from India, the sacred Vedas from c. 1500 B.C. (Needham 1986; Schultes 1960) and the Ayurvedic Pharmacopoeia, Charaka Samhita of 600 B.C. (Khoshoo and Subrahmanyam 1985).

From the knowledge of Western Asia and the pre-Hellenic civilizations evolved the herbals of ancient Greece. The herbal lore of Dioscorides, first century A.D., is interpreted in terms of present-day knowledge by Riddle (1985). Stearn (1976) traced the history of the herbals of Theophrastus (370–c. 285 B.C.) through to the modern floras of Greece. These, like so many other floras written today—with a

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² Retired Head, Economic and Conservation Section, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, United Kingdom.

few notable exceptions such as the uncompleted encyclopaedic *Flora of Egypt* (Täckholm and Drar 1941–1969) and the *Flora of Iraq* edited by my colleagues C. C. Townsend and Evan Guest (1966–)—are produced solely for the classification, description, and identification of plants, ignoring their utilization.

According to Arber (1912), “A herbal has been defined as a book containing the names and descriptions of herbs, or of plants in general, with their properties and virtues. The word is believed to have been derived from a mediaeval Latin adjective ‘herbalis’, the substantive “liber” being understood. It is thus exactly comparable in origin with the word ‘manual’ in the sense of a hand-book.”

Documentation of Anglo-Saxon herbal lore in the 4th and 5th centuries is described by Vriend (1984); the evolution of the printed herbal in Europe during the late 15th to 17th centuries is discussed in great detail by Arber (1912). Their gradual separation into exclusively medicinal pharmacopoeia and exclusively botanical floras is difficult to date since medical practitioners had to rely on their botanical knowledge for their pharmaceutical preparations until the beginning of the present century. Certainly by the 18th century many “floras” were including not only herbal remedies but also plants for food, dyes, fabrics, and other domestic necessities while others were exclusively botanical.

Economic botany, because of its association with Man’s needs, has not always been considered a respectable scientific subject. Thus Barrau (1971, 1982) cited Rivinus (1690) as proclaiming that botany should be restricted to the study of plants and not their properties. Even Linnaeus, possibly ill at ease with the systematics of plant domesticates, philosophized that domestic plants are unworthy of study. However, he (1737, 1745) included observations on plant usages in both his *Flora Lapponica* and *Flora Svecica*, which, as the titles suggest, are primarily floristic works. The economic uses of Swedish plants were specifically dealt with in a thesis defended by Elia Aspelin (Linnaeus 1748). Other publications of that period include Billberg (1815), Buc’hoz (1800), Hornemann (1796), Lindley (1849), Ludwig (1800), and Suckow (1777). These tend towards floristic catalogues describing the uses of plants found or grown in the author’s own country and in many cases included agricultural crops.

The first modern attempts to group plants according to uses rather than taxonomic order appear to be by Archer (1853, 1865), Boulger (1889), and Candolle (1882). Boulger was Professor of Botany at London College; his study of economic plants would appear to have strongly influenced Albert Hill, Research Fellow in Economic Botany at Harvard University, for there are considerable similarities in presentation; Boulger is cited in the bibliography of the first edition of Hill’s *Economic botany* but not the second (Hill 1937, 1952). *Economic botany* has for a long time been the standard textbook on economic botany in the English language and has only fairly recently been superseded by works by Schery (1972), Simpson and Conner-Ogorzaly (1986), and other North American economic botanists. *Tropical agriculture* by Purseglove (1985, 1987) is the closest to an economic botany textbook in the U.K. today. Not surprisingly such textbooks tend to be biased towards the economies of the western world. More ethnic treatments are to be found, for example, in I. H. Burkill (1935) for Malaysia, and by his son, H. M. Burkill (1985) for West Africa.

Papers on economic botany have tended to be scattered through a number of academic and institutional journals specializing in botanical subjects, anthropol-

ogy, sociology, agriculture and forestry. Over the years such journals often undergo considerable changes in subject matter so that what might have originally been a prime source of information on economic plants becomes a minor source; the reverse also occurs. For example, the *Annales de l'Institut Colonial de Marseille* (1893–1906), continuing as the *Annales du Musée Colonial de Marseille* (1907–continuing), has changed from a multidisciplinary journal to one concerned largely with taxonomy, and with the flora of Malagasy in particular.

The change in emphasis from economic plants to taxonomy, or from taxonomy to economic plants, occurs in a number of journals cited later in this paper and reflects the close relationship between the two disciplines. The correct naming through sound taxonomy is absolutely essential to economic botany and other applied disciplines, i.e., taxonomy is a foundation discipline and not intended solely for the self-gratification of taxonomists!

The major international journal that is unequivocally dedicated to economic botany in all its facets is *Economic Botany*, a publication founded by Dr. Edmund H. Fulling of the New York Botanical Garden. First issued in 1947, 12 yr later it was to become the official publication of the newly established Society for Economic Botany (Anonymous 1984). A limited selection of other noteworthy journals will be briefly discussed later in this paper under "Regional approaches to economic botany."

According to Hawkes (1970), it was the classical work of Darwin (1868) and the global studies of Alphonse de Candolle (1855, 1882) that placed the study of cultivated plants on a scientific basis. Although Candolle is generally regarded as the founder of economic botany, due credit should be given to the global studies in this field by Duchesne (1846) and Lindley (1849). The most outstanding modern contribution to our global knowledge of economic plants is undoubtedly by the Russian agricultural botanist and plant explorer Professor Nikolai Ivanovich Vavilov and his identification of centres of diversity (Vavilov 1927). The excellent work of the International Board for Plant Genetic Resources and other organizations in conserving our plant genetic resources for the future owes much to Vavilov's work.

The history of the naming of cultivars since Cato's *De agri culture* in c. 160 B.C. to the present is discussed by Stearn (1986).

ECONOMIC BOTANY

Economic botany is the study of the identification, properties, uses, and distribution of economic plants. The Society for Economic Botany in its original constitution defined economic botany as "all activities which pertain to the past, present, and future uses of plants by man. It is recognized that this broad definition includes all or parts of many established disciplines—e.g., agronomy, anthropology, chemistry, chemurgy, economics, ethnology, forestry, geography, geology, horticulture, medicine, microbiology, pharmacognosy, and pharmacology—in addition to the established botanical disciplines (Anonymous 1984).

In S.E.P.A.S.A.T. (1982) I defined economic plants as those plants utilized either directly or indirectly for the benefit of Man. Indirect usage includes the needs of Man's livestock and the maintenance of the environment; the benefits may be domestic, commercial, environmental, or aesthetic. From the above def-

inition it follows that economic botany is a multidisciplinary study and involves not only the purely botanical disciplines of taxonomy, ecology, physiology, cytology, biochemistry, etc., but also certain aspects of agriculture, forestry, and horticulture concerned with the propagation, cultivation, harvesting, manufacture, and economics of production and marketing. Wells and Stirton (1977) commented that unless botanical research is orientated towards the economic utilization and control of plants, a great deal of information from other botanical disciplines would be under-utilized.

The above definition of economic plants slightly extends the concept first suggested by Fosberg (1948) to include any area "where plant science impinges on the economic life of man." Furthermore such a wide breadth of understanding ensures that economic botany presents a totally practical approach to the use of plants. The intensity of involvement ranges from in-depth knowledge on the use of plants in the wild (ethnobotany) through to an appreciation of the requirements for commercial production. Schery (1972) also believed that "agriculture and industrial processing are a part of economic botany."

The inclusion of agricultural crops and their cultivation in the early books on economic botany has already been mentioned. The segregation of agriculture, forestry, and horticulture as separate scientific disciplines seems to have taken place in the latter half of the 19th century, when the German school made an issue of the separation of "pure" botany from applied agricultural science (Heiser 1986).

According to the *Oxford English dictionary*, agriculture is "the science and art of cultivating the soil; including the allied pursuits of gathering in crops and rearing livestock"; horticulture is "the cultivation of a garden; the art or science of cultivating or managing gardens, including the growing of flowers, fruits and vegetables"; and forestry is "the science and art of forming and cultivating forests, management and growing timber." Such definitions no longer have global acceptance. Thus, the U.K. Agricultural Act, 1947 defines agriculture as including "horticulture, fruit-growing, seed growing, dairy farming and livestock breeding and keeping, the use of land as grazing land, meadow land, osier land, market gardens and nursery grounds, and the use of land for woodlands where that use is ancillary to the farming of land for other agricultural purposes" (Dalal-Clayton 1981).

According to Janick (1986), the first use of the Latin *horticultura* is by Lauremberg (1631); its first use in English is to be found in Phillips (1678) *The new world of English words*. Horticulture, which in strict terms involves the scientific cultivation of fruit, vegetables, flowers, and shrubs, is used to describe the commercial production of such crops as part of normal agriculture as well as on specialized holdings (Dalal-Clayton 1981). It also includes domestic gardening and civic amenity plantings. In some countries the growing of such amenity trees and shrubs is considered to be one of the functions of forestry rather than horticultural departments.

Forestry includes not only the management of plantations and reserves for their timber and associated products but also the management of forests according to its original meaning as unenclosed woodland or open, mainly treeless areas for recreational and grazing purposes (Dalal-Clayton 1981). Opinions differ as to whether range management for grazing purposes should be controlled by agri-

culturalists or foresters. For example, the former British Colonial Service assumed the former, the French Colonial Service the latter. In some countries, forestry departments may also manage and maintain natural water catchment areas, often treeless but rich in native species, and thereby become responsible for plant and animal conservation.

From the above discussion it is apparent that there is no clear differentiation between the three disciplines; they all overlap as well as involving economic botany. Their relationships are shown diagrammatically in Fig. 1.

ETHNOBOTANY

There have been several attempts to distinguish between the study of plants used by so-called primitive societies and those used by developed societies. The American Stephan Powers (1875) coined the term "aboriginal botany" in his description of plants used by the Neeshenam Indians of the Bear River, California, "for medicine, food, textile fabrics, ornaments, etc." The term was readily accepted by North American fieldworkers for the next 25 yr (Ford 1978). Meanwhile, in Europe the French botanist Rochebrune (1879) used the term "ethnographie botanique" for the study of plants from archaeological sites. Neither term however gained universal acceptance.

It was another American, Dr. John Harshberger of the University of Pennsylvania, who, in an address to the University Archaeological Association, suggested "ethnobotany" to describe the study of "plants used by primitive and aboriginal people" (Anonymous 1895). This widely cited newspaper reference has, in a number of publications, been wrongly attributed to Harshberger, and as the text is not easily available, the first paragraph is given below.

Some new and interesting ideas were presented by Dr John Harshberger in his last lecture on "Ethno-Botany" before the University Archaeological Association at the University. Ethnobotany deals with the plants used by primitive and aboriginal people, such as the Indians of America, and has for its object the study of the vegetable products employed for various purposes, as fibre and food. The main difficulty presented is that of the identification of the materials. Ethno-botany is of service in elucidating the culture position of primitive people. We can divide the races of mankind into the pastoral, agricultural, semi-civilized, and civilized. The American Indian never occupied the pastoral stage, never had herds of domesticated animals, but emerged directly from the hunting into the agricultural condition.

The full text of the address is given in Harshberger (1896). The term was immediately popular and widely accepted. He defined the purposes of ethnobotany as:

- (1) An aid to elucidating the cultural position of tribes according to their use of plants.
- (2) Evidence of past distribution.
- (3) Evidence of trade routes.
- (4) Useful in suggesting "the valuable properties they have utilized in their wild life may fill some vacant niche in our own."

Nearly a century later, Heiser (1985) defined ethnobotany as the study of plants in relation to people, while economic botany concerned plants and modern human society. He further argued that as ethnobotany embraces both fields, economic botany should be considered as a subdivision of ethnobotany with monetary

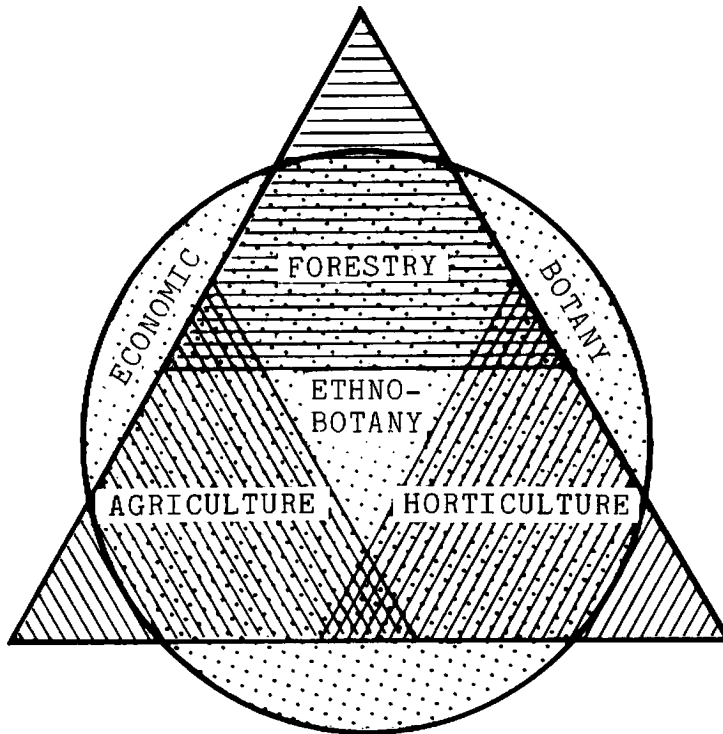


Fig. 1. Diagrammatic representation of the relationship between economic botany, ethnobotany, agriculture, forestry and horticulture.

implications. He was attempting to rationalize the commercial and non-commercial aspects of economic botany in a somewhat revolutionary manner.

Economic botany has already been defined as the study of economic plants, an umbrella definition that must also include ethnobotany. I prefer to consider ethnobotany as the study of useful plants prior to their commercial exploitation and eventual domestication. The study of archaeological evidence on the use of plants is sometimes appropriately termed "archaeoethnobotany" and often less appropriately as "palaeoethnobotany." Thus, ethnobotany now includes the use of plants by both tribal and a tribal communities without any implication of primitive or developed societies. The recent study of the Seri Indians of Mexico by Felger and Moser (1985) is a classic example of such work, documenting the past uses of plants and the impact of modern technology.

Unfortunately the term ethnobotany can still contain, especially to the layman, a slightly derogatory flavour, the implication of racially inferior societies. People of the western world still prefer to refer to the present-day usages of wild plants handed down from their ancestors as "folk" or "herbal medicine," "wild food plants," "useful plants," etc. Thus, plants used by the Greek and Roman civilizations would be similarly considered as herbal medicine, etc. rather than ethnobotanical, whereas plants used by the so-called primitive European tribal societies of that period would be regarded as ethnobotanical. Barrau (1989), however,

working among the peasants of southeastern France, was happy to regard his studies as ethnobotanical research.

By implication, the uses of commercially domesticated plants may, by historical usage, be referred to economic botany, or, for the pedantically inclined, commercial economic botany; their origins however are ethnobotanical. It is again stressed that the role of economic botany is not clear cut; there are grey areas. The degree of involvement inevitably decreases as the agriculturalists, for example, become increasingly concerned with the technicalities of husbandry. Economic botanists nevertheless need to retain an interest in the principles of husbandry extending to the marketing of the final product, since they have the knowledge regarding the basic plant sources (ethnobotany) that could influence every stage along the production chain.

REGIONAL APPROACHES TO ECONOMIC BOTANY

The status afforded economic botany differs from continent to continent; these differences can be attributed to socio-historical considerations. In Europe, agricultural and forestry crops and practices are well established, in some cases dating back over 2000 yr. There has been little incentive to introduce new crops, although in recent years the crop surpluses within the E.E.C. countries have led to an interest in seeking new alternative crops, especially oilseeds. Those countries with former tropical colonial interests had sought commercial export crops for their colonies. While such plantation exploitation indirectly aided the development of individual countries during the period of colonial rule, ethnobotanical studies and domestic crops tended to be neglected. The former colonies are now competing against each other and actively seeking commercial export crops in order that they may remain economically viable within a world of changing tariff barriers and at the same time develop crops for internal consumption in order to reduce imports.

North America, South Africa, and Australia were colonized by Europeans who initially attempted to introduce European crops and standards of husbandry. Where these have failed they have been forced to seek more appropriate crops, such as maize from Central America, soya bean from China, etc. The search by ethnobotanists for new lucrative crops such as jojoba, guayule, tepary bean, and medicinal and oilseed plants continues.

The French approach

Portères (1961) considered economic botany as the study of useful cultivated or non-cultivated plants as regards their taxonomy, ecology, uses, and end-products for modern civilization; a concept based on the pioneer works of Alphonse de Candolle (1855, 1882). He regarded ethnobotany (l'ethnobotanique) as an interpretive discipline concerned with the progress of human societies based on their uses and stages of plant domestication. Barrau (1971) also agreed that ethnobotany is concerned with the study of relationships between plants and civilization but placed greater emphasis on ethnology. This emphasis is further stressed in Barrau (1984) who, citing the "new ethnography" school of American anthropologists, considers ethnobotany as part of ethnoscience.

Barrau (1971) also commented on the lack of interest shown by French botanists during the last and present centuries on useful plants in general, particularly cultivated plants. This he attributed to a botanist's lack of enthusiasm for such plants unless they are now rare or spontaneous, thereby reflecting the earlier views of Rivinus (1690) and Linnaeus (1751) mentioned previously. The absence of any urgent need to introduce new crops is a contributing factor.

The major international French journal, published by the Laboratoire d'Ethnobotanique et d'Ethnozoologie of the Museum National d'Histoire Naturelle, Paris, started as the *Revue de Botanique Appliquée et d'Agriculture Tropicale* (1921–1945), continued as *Revue Internationale de Botanique Appliquée et d'Agriculture Tropicale* (1946–1953), then as the *Journal d'Agriculture Tropicale et de Botanique Appliquée* (1954–1972), which from 1973–1976 was subtitled *Travaux d'Ethnobotanique et Ethnozoologie*; in 1977 it was renamed as the *Journal d'Agriculture Traditionnelle et de Botanique Appliquée. Travaux d'Ethnobotanique et d'Ethnozoologie*. The changing titles well illustrate the adjustment from colonial to non-colonial France, from tropical agriculture, ecology, and other aspects of applied botany to the ethnic needs of the French-speaking peoples.

The Indian approach

The study of traditional economic plant use on the Indian subcontinent is particularly well developed. It evolved through the sacred Vedas and the study of herbal remedies to commercial European involvement beginning with the opening of the botanic gardens at Howrah, Calcutta in 1786, followed shortly after at Madras and Peradeniya, Sri Lanka, in 1821, and largely staffed by men trained at Kew, such as Christopher Smith, who was appointed botanist at Calcutta in 1794 (Russell 1958). The role of the Indian Botanic Garden at Howrah is discussed in some detail by Hastings (1986).

The granting of self rule to India, Pakistan, Bangladesh, and Sri Lanka meant that these countries ceased their export economies in jute, tea, cotton, sugar, etc. based on the internal needs of the British Empire and have had to change over to self sufficiency in many plant products. The Green Revolution in India is a remarkable achievement in increasing existing agricultural output by improved varieties and management. To a lesser extent it included the better utilization of local natural resources; for example, paper manufacture now relies less on imported timbers and more on indigenous species (Sen 1975).

Economic botanists continue to be active in their search for new species of potential economic importance. Since many of these species have an Afro-Asian distribution, African countries, often lacking in adequate research facilities, would be well advised to study developments on the Indian subcontinent.

The economic plants of India are well documented in the encyclopaedic *Wealth of India* (Anonymous 1948–1976), currently being revised by Chadha (1985); a condensed version was published by Anonymous (1986). The medicinal plants, which are a speciality of Indian economic botanists, are recorded in Satyavat et al. (1976–). Recent textbooks include Jain (1987), Kochar (1981), and Pandey (1984). Papers are scattered through a number of local and national journals, the *Journal of Economic and Taxonomic Botany, Jodhpur* (1980–continuing) aiming at international status, albeit with a strong taxonomic bias.

The Australian approach

Australia, despite its rich flora (more than 20,000 species), has singularly failed to produce any new agricultural food crops apart from macadamia nuts (*Macadamia* spp.), and these almost accidentally because they were introduced and domesticated in Hawaii. This failure is probably because settlers were unable to accept that the indigenous hunting-and-gathering aborigines knew any plants worthy of cultivation; the culture gap was too wide. Some effort is now being made to rectify the situation, initially with the domestication of the quandong, *Santalum acuminatum* (R.Br.) DC. (Rivett et al. 1989).

Cattle and sheep are an important component of Australia's agricultural economy. Native vegetation, the basis of the pastoral industry, still accounts for more than 85% of the animal production in northern Australia (Mott and Reid 1985). Unlike that of other continents, Australia's flora has evolved without ruminant herbivores and is consequently ill adapted to their introduction. The search for new fodder plants, especially from tropical America and Africa, is becoming increasingly important.

On the credit side, Australia is important for its forest species; *Eucalyptus* spp. and wattle, *Acacia* spp., are now grown in many parts of the world. Forestry researchers continue in their search for new species to be brought into cultivation, especially from the drier parts of the continent.

The distinct impression is of a situation similar to that in the U.K. where the agricultural botanist, pastoralist, and forester are responsible for all research on new crops, and economic botany is not recognized as a discipline.

The economic plants of Australia have been checklisted by Hartley (1979); a more ethnic approach is to be found in Cribb and Cribb (1981). There is also a considerable emphasis on utilization of the indigenous trees and shrubs, e.g., Turnbull (1979). Papers are scattered through a number of national and popular (agricultural) journals, which, although reflecting an interest in aboriginal plantlore, retains the suspicion that many scientists have yet to appreciate the economic value of many of the aboriginal uses of the Australian flora.

The South African approach

South Africa differs markedly from Australia in distinguishing between European agriculture based largely on Mediterranean crops and native agriculture based on indigenous crops; mealies (*Zea mays* L.), groundnuts, and cotton are notable exceptions in both societies. Unlike Australia, a few indigenous food plants—including the three staples, sorghum, pearl millet, and watermelon—are being cultivated for local consumption; interest in such plants is increasing.

South Africa has a long history of research in economic plants, much of which is applicable elsewhere in Africa, especially for pasture plants. Economic botany may not be sufficiently recognized as an academic subject; government economic botanists however are employed to study the flora and search for potential economic plants; they are also responsible for research into the control of weeds (Wells and Stirton 1977; Wells et al. 1986).

Plants do not recognize national boundaries, and consequently a regional approach to southern Africa presents a better overview of the economic plants of

South Africa. Trees and shrubs are discussed in Coates Palgrave (1977) and in Palmer and Pitman (1972), while medicinal and poisonous plants are documented, together with their more mundane uses, in Watt and Breyer-Brandwijk (1962), a publication whose usefulness extends as far afield as West Africa and the Indian subcontinent. The major national journal in which papers on economic botany are to be found is the *Botanical Survey of South Africa, Memoirs* (1919–continuing).

The United States approach

Unlike Europe, economic botany is widely recognized in the United States as an important subject at both the academic and the governmental levels. Harvard University has taught economic botany as a subject since 1876 (Schultes 1977). Academic courses offer little distinction between economic botany and agricultural botany, although, in schools of agriculture, courses may be given on a more practical basis (Schultes, pers. comm. 1986). It is not unusual for a geneticist, for example, to regard himself as an economic botanist rather than a geneticist.

The U.S. Department of Agriculture, through its Plant Introduction Bureau, has long been active in the search for new plants, both at home and abroad. As early as 1862 the Commissioner for Agriculture declared that an objective of the department was to “procure, propagate, and distribute among the people, new and valuable seeds and plants.” (U.S. Department of Agriculture 1862). An historical review of the search for new plants is given by Ford (1978).

New crops are required either to produce an economic return on land where traditional crops are unproductive, or as alternatives to strategic crops grown in other parts of the world, such as Pará rubber in Asia. In the former category, ethnobotanists have provided tepary bean, *Phaseolus acutifolius* A. Gray, buffalo gourd, *Cucurbita foetidissima* Kunth, jojoba, *Simmondsia chinensis* (Link) C. Schneider, and meadowfoam, *Limnanthes alba* Hartweg ex Benth. The second category includes guayule rubber from *Parthenium argentatum* A. Gray, which is being encouraged because it is the only known alternative to Pará rubber for restraining planes landing on aircraft carriers; it is also twice as expensive as Pará rubber.

The emphasis is on plants that can be grown in the United States, a notable exception being the growing of *Vernonia galamensis* (Cass.) Less. in Africa as a source of epoxy acid for the plastics industry, attempts to introduce it into the New World having been unsuccessful (Perdue et al. 1989).

As mentioned earlier, the premier international journal is *Economic Botany*; a further, irregular publication from the New York Botanical Garden is *Advances in Economic Botany*, a series established in 1983 to present monographs and symposia concerned with economic botany. A second major journal, concerned largely with medicinal plants and their chemical constituents is *Lloydia*, from 1938 to 1960 subtitled *A Quarterly Journal of Biological Science*, rather more taxonomic than economic in content, and published by the Lloyd Library and Museum. Since 1961 it has been jointly published with the American Society of Pharmacognosy and subtitled *A Quarterly Journal of Pharmacognosy and Allied Biological Sciences* (1961–1969), and finally *A Quarterly Journal of Natural Products* (1970–continuing), thereby reflecting changing interests.

The United Kingdom approach

Research into the uses of plants in the United Kingdom has evolved into four branches: agricultural botany (which includes economic botany of tropical crops), forestry, medicinal plants, and indigenous wild foods. This evolution can be traced from the Latin herbals through the occasional brief notes on uses included within floristic treatments such as Withering (1776) and Hogg and Johnson (1863–1880), and the cataloguing of useful plants by Salisbury (1822), Lawson and Son (1852), and Johnson (1865). Thereafter, interest in the wide spectrum of uses of indigenous, non-agricultural plants waned, probably reflecting an increased reliance on industrial and imported products. According to Celoria (1987), the Victorians referred to that branch of economic botany concerned with the use of natural products as “vegetable technology.”

The study of agricultural crops became the provenance of the newly established discipline of agriculture. Edinburgh established the first Chair of Agriculture in the U.K. in 1790, but was not followed by other universities until the 1880–1890s (Colyer 1982). Research by these new university departments on crop plants developed into what has become known as agricultural botany. In some schools of agricultural botany this even included the study of major tropical crops, a study which for many became regarded as synonymous with economic botany. This unfortunate interpretation owes much of its origins to the economic botanists at the Royal Botanic Gardens, Kew, concentrating their activities on introducing new commercial tropical crops for the colonies, and the late establishment of agriculture as an academic subject, with tropical agriculture as an even later development. The identification of economic botany with tropical crops was thus unwittingly established. Economic botany per se is not and never has been regarded as a major scientific discipline in the U.K. Few, if any, academics would regard themselves as economic botanists, although some will admit to being ethnobotanists; it is largely a subject for a series of lectures within departments of agricultural botany rather than of botany.

The world's first public Museum of Economic Botany was opened at the Royal Botanic Gardens, Kew, in 1847 (Boulger 1889; Hepper 1982). The Museum contained, for example, a collection of economic plants of Scotland, an account of which was published by the Edinburgh nurserymen Lawson and Son (1852) and contained many references to agricultural crops. It also acquired large collections from overseas, from the Colonies in particular, whose botanic gardens were largely staffed by men chosen by Kew. Considerable collections were also acquired from the International Exhibitions of London of 1851 and 1862, and Paris of 1855, as well as from the India Office in 1878, etc.

During this period Kew became increasingly involved in the selection and introduction of new crops for the Colonies: *Cinchona* spp. for quinine and *Hevea brasiliensis* (Willd. ex A. Juss.) Muell.-Arg. for Pará rubber are the two most quoted examples; they involved a considerable amount of trial and error before finally being selected as species suitable for economic development (Sampson 1935). See Huxley (1918) for details of J. D. Hooker's contribution to economic botany and tropical agriculture and Wickens (1987) for a historical review of economic botanists at Kew; current research is discussed in Wickens (1989).

Because of a well-established agriculture there has been little incentive to seek

new crops for the U.K. The influx of various ethnic communities during the past 3 decades has however led to the introduction of a number of new horticultural crops. But, as has already been mentioned, recent grain surpluses have shown the need to seek alternative new crops of known potential, such as evening-primrose and sunflower from the New World, and linseed, lupins, and oilseed rape from Europe (Carruthers 1986; Dover 1985). Primary research on new crops of unknown potential is noticeably absent.

In addition to this new interest in agricultural crops there has also been a revival of interest in medicinal and wild food plants during the past decade. Their present popularity is associated with an increasing desire for "natural" rather than synthetic medicine and wild or organically grown foods. This has led to a number of popular publications, such as Chiej (1984), Launert (1981), Mabey (1972, 1975), and Scott (1979).

Apart from the publications of the Royal Botanic Gardens, Kew to be discussed later, the only other British journal concerned with economic plants was the *Bulletin of the Imperial Institute, London* (1903–1948), continued as *Colonial Plant and Animal Products* (1950–1956) and *Tropical Science* (1950–continuing), and published by the Overseas Development Natural Resources Institute.

Kew's house journal, the *Bulletin of Miscellaneous Information, Royal Botanic Gardens, Kew* was started in 1887 as an occasional publication on economic products and plants. Publication temporally ceased in 1941 following the accidental death of the Director, Sir Arthur Hill, together with the contributing influence of a wartime shortage of paper. In 1946 the publication restarted as the *Kew Bulletin*; with the temporary decline of interest in economic plants following the loss of the colonies, the *Kew Bulletin* has become increasingly taxonomic in content, today almost to the exclusion of other botanical disciplines. There is now an urgent need for an additional in-house publication to cater to the revival of interest and research in economic botany.

ECONOMIC BOTANY AT KEW TODAY

Research in economic botany in Kew declined rapidly with the granting of self rule to the former Colonies, partly because these new countries understandably wished to prove their independence and partly because they were relatively affluent and saw no need to consider their local plant resources, the use of which implied a low living standard, an implication that is obviously untrue. The situation has been further complicated by the political necessity for export cash crops balanced against the need for self sufficiency in crops for food and internal manufacture based on globally recognized crops that may or may not be suitable for that country, e.g., the growing of wheat in the Chad Basin in West Africa.

In recent years the slump in world economy, together with disastrous droughts, has created an awareness of the need to survey and utilize local plant resources more fully. This is especially relevant to the arid and semi-arid regions of the world. The ever-increasing generation gap between an older population that knew local plant lore and the present younger, largely urbanized population has increased the urgency to record the information before it is forgotten.

In 1981, with the help of OXFAM funds, the Survey of Economic Plants for Arid and Semi-arid Tropics project was initiated at Kew, to document and dis-

seminate information on the use of plants, their taxonomy, habit, habitat, and geographical distribution. In 1985 the project was taken up for a further 3 yr by the Clothworkers' Foundation and the area was extended to include all arid and semi-arid lands. In the same year the economic plant collections and the responsibility for all research in economic botany was transferred from the former Museums Division to the Herbarium Division. The collections, together with the now renamed Survey of Economic Plants for Arid and Semi-arid Lands and the unit concerned with the Convention on International Trade in Endangered Species, formed the newly created Economic and Conservation Section (Wickens 1986). This re-alliance with the Herbarium repeats the origins of economic botany research at Kew and reinforces the necessity for economic plants to be correctly identified and their relationships with allied species properly understood. It also serves to demonstrate that taxonomy is not an esoteric subject but a meaningful and essential research tool.

Computer databases have been created to deal with all this information, to respond to the basic question and the various permutations thereon of "which plant will produce what and where does it grow?" Information from the cataloguing of the economic plant collections will be added to the database and ultimately it is expected that Kew will be able to provide computer printouts on all economic plants of the world, together with selected bibliographies (Wickens n.d.).

No use is regarded as too insignificant that it should remain unrecorded, for economic botany is never static. Some uses may be superseded by synthetics; others may lie dormant for want of the appropriate technology for their development, or a better economic climate. Still other uses have yet to be identified; the economic botanist must always be alert for new alternatives. One of the reasons for maintaining the collection of economic plants at Kew is to try and identify useful plants for both today and tomorrow. The classic example of this philosophy is the kernels of the jojoba, which were first used for a beverage and hair restorer before it was discovered that the oil had a chemical structure similar to that of sperm whale oil (Saunders 1976).

CONCLUSIONS

What is economic botany? It is the study of plants utilized directly or indirectly by Man (S.E.P.A.S.A.T. 1982). The necessity for such studies is related to the standards of development of a nation in terms of its agriculture in the broadest sense, its culture, and its economy. The developed countries of Europe with a history of 2000 yr of established agriculture are less concerned with the search for new plants than the developed countries of North America, Australia, and South Africa with 300 or fewer yr of introduced European crops and large areas of land where such crops cannot be profitably grown. The developing countries meanwhile are still striving to discover the correct balance between self sufficiency in food and profitable export without detriment to the environment.

Naturally the environment is the concern of all nations but it is the developing countries generally where the pressures are greatest and it is ultimately in the interests of all nations to both make available and to utilize the plant resources of this planet through the study of economic botany.

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