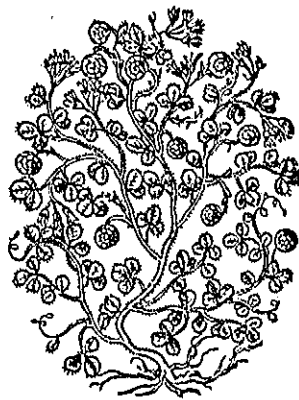




MEDICINES FROM THE EARTH

A GUIDE TO
HEALING PLANTS

EDITED BY
WILLIAM A.R. THOMSON, M.D.



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PUBLISHING

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CAUTION

This book is not intended for prescribing medicines nor for curing afflictions. Its purpose is not to replace the services of a physician but rather to serve as a reference source on medicinal plants. We emphasize that the use of any of the information in this book for purposes of self-treatment without consulting a physician can be dangerous.

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CONTENTS

HOW TO USE THIS BOOK	6
THE KINGDOM OF PLANTS	7
RICHARD EVANS SCHULTES	
THE 247 MOST BENEFICIAL PLANTS	17
URTE KNEFELI	
(Reference Section I)	
Plants and the ailments they can ease	
LEXICON OF THE HEALING PLANTS	33
EUGEN BOSSARD	
Brilliant color illustrations and detailed descriptions of the 247 principal plants	
COMPLAINTS AND ILLNESSES	113
URTE KNEFELI	
(Reference Section II)	
Plant remedies for common ailments	
THE HERITAGE OF FOLK MEDICINE	137
RICHARD EVANS SCHULTES	
The contribution of folk healers to the modern science of ethnopharmacology	
THE BASIC TECHNIQUES OF HERBAL PREPARATIONS	151
BRUNO VONARBURG	
How to prepare teas, compresses, and salves from herbs	
HEALING SUBSTANCES AND THEIR EFFECTIVENESS	161
URTE KNEFELI	
(Reference Section III)	
When and how to harvest plants; the contents and properties of each plant	
EPILOGUE: THE FUTURE	185
WILLIAM A. R. THOMSON	
PLANT INDEX	198
BIBLIOGRAPHY	207
PICTURE CREDITS	208



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HOW TO USE THIS BOOK

This guide to healing plants can be considered two books in one: as both a botanical and a medical reference. It can be approached from either direction.

TO FIND INFORMATION ABOUT A PLANT:

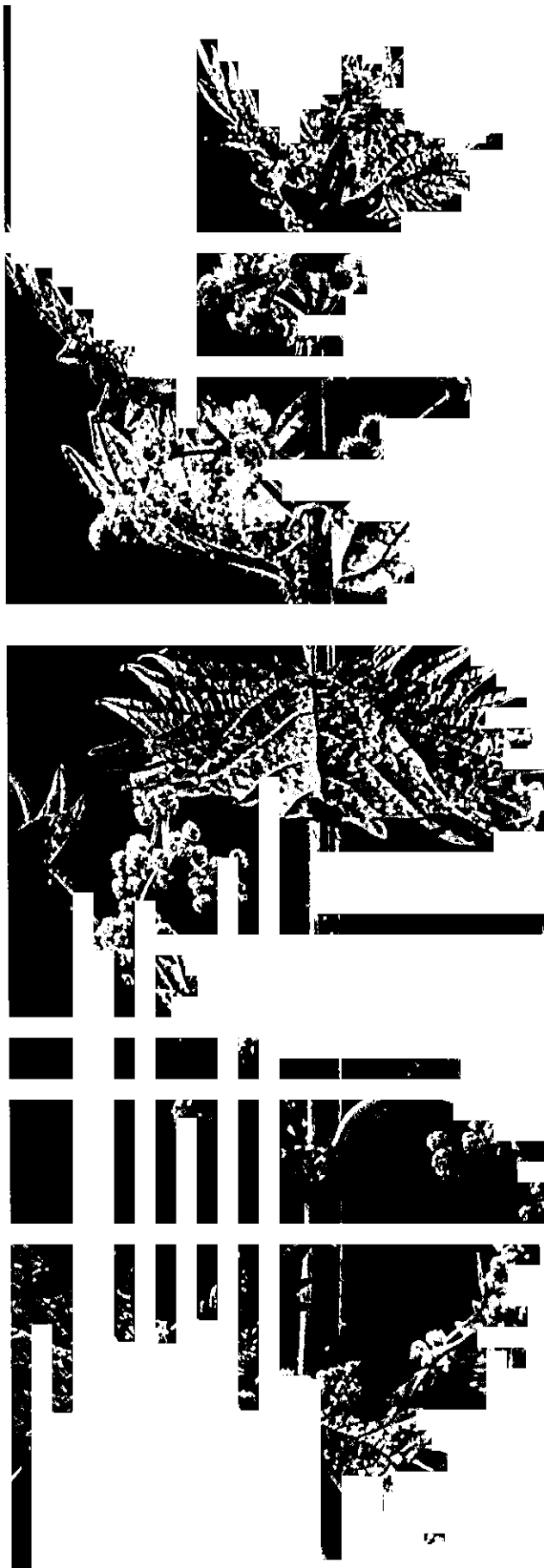
1. *Botanical information—a description of the plant, with its distribution and location and a full-color illustration—is given in the Plant Lexicon (pp. 33–112). Standard English names of the Lexicon's 247 plants are indexed on pages 36–37. If a name does not appear there, it can be looked up in the English-Latin Plant Index at the end of the book, where many alternative English names for the 247 healing plants are listed and cross-referenced.*
2. *Medical information on plants is found in Reference Section I (pp. 17–32): a listing of the ailments and complaints for which each plant can be used. For further detail, see Reference Section III (pp. 161–184), in which the constituents of each plant and their healing properties are given.*
3. *Practical information on the gathering and processing of plants is also furnished in Reference Section III (pp. 161–184). For basic techniques of plant remedies, see the How-To section (pp. 151–160) on teas, decoctions, gargles, poultices, salves.*

TO FIND INFORMATION ABOUT A COMPLAINT OR ILLNESS:

1. *Common ailments and physical problems are listed and discussed in Reference Section II (pp. 113–136). For each ailment the reader is told whether prompt professional care is needed, whether a prescription or patent medicine based on plants is available, and whether he can use the homemade plant remedies given in detail here. The physician's preliminary word of caution (p. 113) should be observed.*
2. *For additional guidance in the treatment of ailments, the reader can refer to the chapter on basic techniques for the preparation of herbal teas, gargles, poultices, salves (pp. 151–160).*

Background information on healing plants can be found in the chapters beginning on pages 7, 137, and 185.

A great
gained
breath
about f
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THE KINGDOM OF PLANTS

... god of his goodnesse that is creatour of all thynges
hath ordeyned for mankynde (whiche he hath created to his owne lyknesse)
for the grete and tender love,
which he hath unto hym to whom all erthely he hath ordeyned to be obeysant,
for the sustentacyon and helthe of his lovyng creature mankynde
whiche is onely made egally of the foure elementes
and qualities of the same,
and whan any of these foure habounde or hath more domynacyon,
the one than the other it constrayneth ye body of man to grete infyrmytees or dyscases,
for the whiche ye cternall god hath gyven of his haboundante grace,
vertues in all maner of herbes to cure and heale
all maner of sekenesses or infyrmytes
to hym befallyng through the influent course of the foure elementes beforesayd,
and of the corrupcyons and
ye venymous ayres contrarye ye helthe of man. . . .
O ye worthy reders
or practicyens to whome this noble volume is present
I beseche yow take intellygence and beholde ye workes and operacyons of almyghty
god which hathe endowed his symple creature mankynde
with the graces of ye holy goost
to have parfyte knowlege and understangynge of the vertue of all maner
of herbes and trees in this booke comprehendyd.

The grete herball whiche geveth parfyt knowlege and understanding of all maner of herbes and there gracyous vertues . . .
Colophon: Peter Treveris. London, 1526.



Throughout the development of human cultures, the relationship between man and his ambient vegetation has been intimate and vital. Man truly has lived with and depended on his green plants. It therefore is understandable that throughout all of prehistory and most of history, *botany* and *medicine*, for practical purposes, have been synonymous fields of knowledge. The shaman or medicineman—usually an accomplished bota-

nist—represents probably the oldest professional man in social evolution. Most of the medicines, as well as foods, which we now use from the Plant Kingdom were not discovered by the sciences of modern, sophisticated societies, but by trial and error over millennia in unlettered cultures. Archaeology tells us that some of today's most highly prized drugs are heritages from the dim past of prehistory.

WHAT ARE HEALING PLANTS?

How did man ever learn of healing plants? With the intense experimentation that early man certainly practiced with plants, it had to be inevitable.

Man probably put most plants into his mouth. Many were innocuous, a few nourished him, and a number made him ill or killed him. Some, however, relieved symptoms of discomfort or sickness and a very few, through hallucinations, took him from this mundane existence to the realms of ethereal wonder. The plants in the last two categories became his medicines.

Every culture had individuals ready to take advantage of the gullibilities of their fellow men. At an early period, knowledge of the presumed medicinal properties and virtues of plants became associated with certain individuals: the medicine men. They rose to exalted positions, thanks to their actual knowledge of healing herbs, and exercised a form of primitive blackmail resulting from a fear of their supposed powers. The use of healing plants gradually became linked with superstition and magic and, finally, with the Doctrine of Demonology. This doctrine exploited the concept that health could not be restored until the demon causing the disease was expelled. Consequently, what was bad for the demon was good for the patient. Often, the



The shaman, or holy man, served as doctor in many so-called primitive societies, because of his thorough knowledge of the effects of plants. The illustration shows a Siberian shaman.

A HOLY STORY

Told by Chief Maza Blaska (Flat-Iron, meaning a piece of flat iron). Maza Blaska is one of the oldest living chiefs of the Ogallala band.

From Wakan-Tanka, the Great Mystery, comes all power. It is from Wakan-Tanka that the Holy Man has wisdom and the power to heal and to make holy charms. Man knows that all healing plants are given by Wakan-Tanka; therefore are they holy.

To the Holy Man comes in youth the knowledge that he will be holy. The Great Mystery makes him to know this. Sometimes it is the Spirits who tell him. The Spirits come not in sleep always, but also when man is awake.

With the Spirits the Holy Man may commune always and they teach him holy things.

The Holy Man goes apart to a lone tipi and fasts and prays. Or he goes into the hills in solitude. When he returns to men, he teaches them and tells them what the Great Mystery has bidden him to tell. He counsels, he heals, and he makes holy charms to protect the people from all evil. Great is his power and greatly is he revered; his place in the tipi is an honored one.

The people were encamped in a circle with the opening towards the east. In the middle of the circle they set up a great tipi made of several tipis put together. On one side of the tipi sat the women, on the other side the men. And they made ready a great feast. Beyond the central fire, opposite the doorway, the Holy Man made mystery. With a stick like an arrow he made a line of holes in the ground a finger's-length deep. Then he

more nauseous the drug, the more efficacious it was believed to be. It is no coincidence that the earliest medicinal plants were direct action drugs (e.g., emetic, purgatives).

Very early, however, man discovered plants with curious psychic effects: the hallucinogens. These "supermedicines"—usually tools of the shaman—became his medicines *par excellence* and enabled him to diagnose the cause and treat the disease through contact with the supernatural.

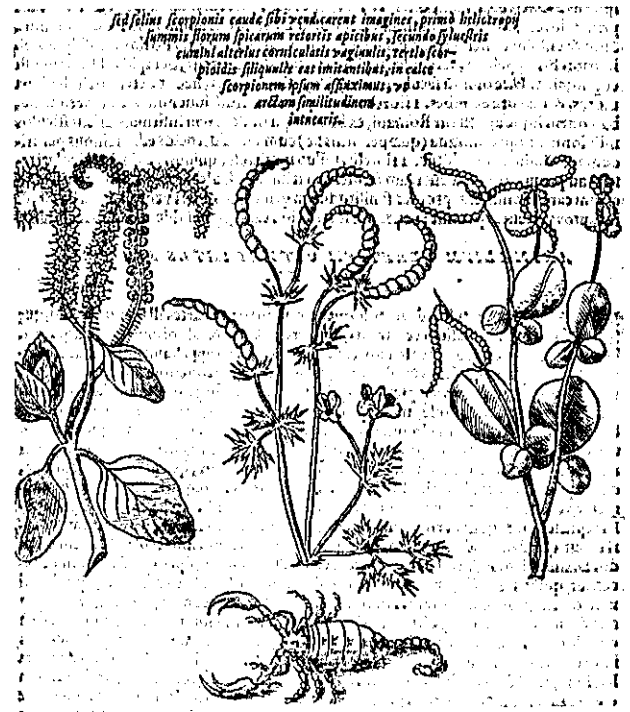
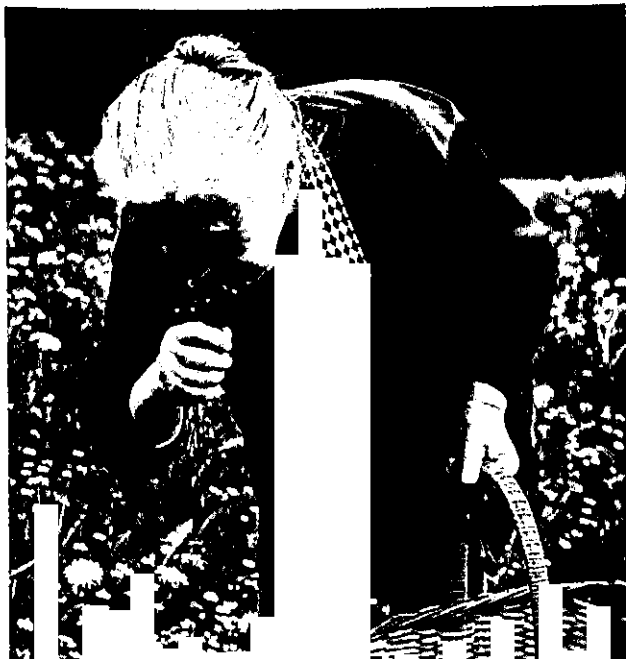
Primitive societies believed in healing by similarity. Red resin, for example, meant that the plant was good for the blood. This curious notion came down through classical Greece and Rome to Europe where, in medieval times, it was formulated as the Doctrine of Signatures by Paracelsus. All plants, it was believed, were placed on earth for man's benefit. The Creator had pu

touched the ground in front of all the people and came back to the doorway and sat down. And he bade the people hasten to prepare the mystery. So they took clay and filled the holes with it and covered the holes with earth. When they had done this the Holy Man touched the ground. Then he came back to the doorway and was about to sing. And the people watched the ground where the clay was buried, and behold, young plants began to sprout. Then, before he sang, the Holy Man said:

Far to the west,
 Far by the sky
 Stands a blue Elk.
 That Elk standing yonder
 Watches o'er all the females
 On the earth.

Thus he spoke; then he said, "Now I will sing," and beating on his drum he sang a holy song. When he had sung he bade the people pull up the sprouts, and they did so; one by one they pulled them up. And behold, the roots were holy mystery-power. And the people took the mystery-power and laid it on sprigs of sage, for sage is holy because it will heal. This mystery would protect the warriors in war. No arrow could pierce them, no arrow could strike them, unharmed would they pass through every danger.

So have I told of how a Holy Man made mystery to help the people. Now may Wakan-Tanka help me, because I have spoken truly of how Wakan-Tanka bade the Indians to do in the olden times.



According to the Doctrine of Signatures elaborated in the sixteenth century, a plant's external appearance offered clues to its effectiveness. Thus the "scorpion-tail" heliotrope and similar plants were believed to cure scorpion bites: drawing from Giambattista della Porta's *Phytognomica* (1558).

a sign, or signature, indicating their use on plants not obviously valuable for food, fiber, etc. A heart-shaped leaf signaled its cardiac properties; a liver-shaped leaf was a sign of efficacy against jaundice. This doctrine was taken to even more absurd lengths by Porta, who discovered the most recondite of signatures and associated medical botany with astrology. Modern concepts of healing plants began in Europe with the appearance of herbals in the sixteenth century, resulting in great volumes of true and false information about the healing properties of plants. Progress was only slow and gradual, but a good percentage of our currently esteemed drug plants go back to this era and, in many cases, to even earlier times and more primitive societies.

Women in some rural areas maintain the tradition of collecting medicinal herbs.

THE SIZE OF THE PLANT KINGDOM

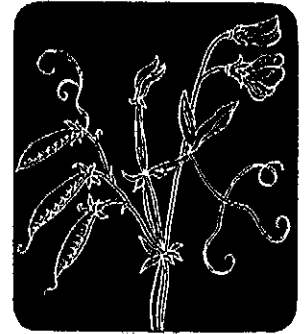
No botanist, with certainty, can give an estimate of the size of the Plant Kingdom. Modern estimates vary between 250,000 and 500,000 species or more. Which-ever figure is accepted, it represents a very large and heterogencous assemblage of organisms—each different and each a distinct chemical factory; consequently, each of potential interest from the view point of utility. In 1753, Linnacus, the Father of Systematic Botany, classified what he felt was the whole Plant Kingdom, stating that the “number of plants in the whole world is much less than is commonly believed,” calculating that it “hardly reaches 10,000.” A century later, in 1847, Lindley credited the Plant Kingdom with a total of 100,000 species in nearly 9,000 *genera*.

There has been a growing belief among botanists during the present century that previous estimates fall far short of the real extent of the Plant Kingdom and that a minimum of 500,000 species may give a truer picture of its size.

A few estimates by modern specialists in the different groups will indicate how far botanical knowledge has advanced since Lindley’s estimate of 130 years ago. It is now believed that there are some 1,500 species of bacteria. The fungi are calculated at from 30,000 to 100,000; their study in the wet tropics, where they abound, has just begun and one contemporary mycol-ogist has stated that even 200,000 might come nearer the grand total of species. An ancient group, the algae, are variously estimated at from 19,000 to 32,500 spe-cies, with one group—the diatoms—accounting for 6,000 to 10,000. The lichens are credited with 16,000 to 20,000 species. The bryophytes—mosses and liverworts —may have as many as 25,000 species, and the ferns and their allies 10,000. The gymnosperms are still a small group of some 700 species in 65 *genera*. The most extensive group of plants now dominant on land and man’s principal source of healing plants, the angio-sperms, comprise at least 250,000 species in 10,500 *genera* in 300 families. Of the angiosperms, one-quarter are monocotyledons; three-quarters dicotyledons.



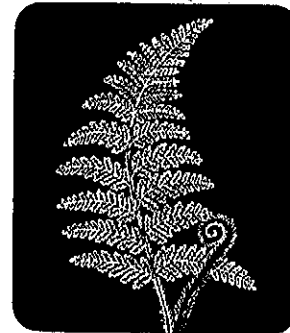
MONOCOTYLEDONEAE



ARCHICHLAMYDEAE

ANGIOSPERMAE

Flowering plants
250,000 to 500,000



PTERIDOPHYTA

Ferns and their
allies
12,000 to
14,000



BRYOPHYTA

Mosses and liverworts
14,000 to 25,000

SPERMATOPHYTA

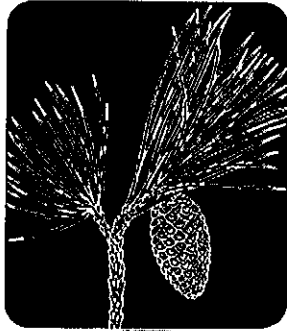
RELATIONSHIP OF THE



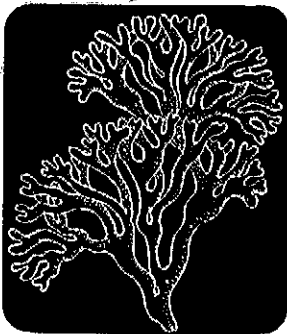
ACTIVE PRINCIPLES OF HEALING PLANTS



METACHLAMYDEAE



GYMNOSPERMAE
Cone-bearing plants 700



ALGAE
Seaweeds and similar types 19,000 to 32,000



FUNGI
Molds, mushrooms, etc.

seed-bearing plants

THALLOPHYTA
Plants with a thallus body: not differentiated into stems, roots, leaves

MAJOR GROUPS OF PLANTS

PLACELATA

The medicinal value of drug plants is due to the presence in the plant tissue of a chemical substance—an active principle—producing a physiological effect. Many of the active principles are highly complex and their exact chemical nature occasionally is still unknown; others have been isolated, purified, and even synthesized or simulated. They most commonly fall into one of six categories: alkaloids, glycosides, essential oils, gums and resins, fatty oils, and antibiotic substances.

Alkaloids and glycosides are defined elsewhere (see p. 14). Essential oils usually have various chemical constituents; usually terpene derivatives or aromatic compounds. They rarely consist of a single constituent, but often contain alcohols, ketones, aldehydes, phenols, ethers, esters, and other compounds, as well as, sometimes, nitrogen and sulphur. Many are highly germicidal, this property being due to their volatility and ability to penetrate into proto-



plasm, but they usually are too insoluble in water to be important in medicine as antiseptics. They are valuable as carminatives, in cough drops, mouth washes, gargles, sprays, and healing ointments. Gums are polymers of various rarer sugars and resins are oxidation products of essential oils; both are employed as purgatives and in ointments. Fatty oils or lipids—esters of fatty acids—are used in emulsions and as purgatives. Antibiotic substances are various complex organic compounds—usually from molds, actinomyces, and bacteria—capable, in small amounts, of inhibiting life processes of microorganisms.

Healing plants may act in a great variety of ways. Many (e.g., carminatives) exert a soothing action. A large number act on the nervous system (e.g., belladonna). Others have neuromuscular (e.g., digitalis) or muscular (e.g., false hellebore) activity. The antibiotics heal by killing or inhibiting pathogenic microorganisms, especially bacteria.

THE IMPORTANCE OF HERBARIA, BOTANICAL GARDENS, AND EXPLORATION

Rare herbs and new fruit and vegetable varieties from all over the world have been studied and cultivated in the botanical gardens and *herbaria* that were constructed in Europe. The Physical Garden in Chelsea, England (*right*), founded in the mid-eighteenth century, is still in use. Shown at bottom right: the botanical garden in Leyden, Holland, around 1610.

The 150 years from Linnæus's time throughout the nineteenth century was a period of intensive botanical exploration in many virgin territories. Even today, botanists are delving into ever more distant regions, especially the tropics, and are describing upwards of 5,000 new species and varieties of plants a year.

Many causes contributed to this post-Linnæan upsurge in plant exploration. Newer and faster methods of travel, population pressures in Europe, the growing need for exotic products from the warmer parts of the world, colonialism, and other socio-political factors had their effect. Yet intellectual and commercial inter-



The Swedish naturalist Carl Linnaeus (1707–1778) established the binomial system of biological nomenclature and laid the groundwork for the study of ecology. In 1905 his pioneering botanical classification system was adopted internationally, and zoologists accepted his *Systema Naturae* (1758) as an authority in the scientific naming of plants and animals.

est in the plant world must also be counted as a major factor. For, after the Linnaean period, great botanical gardens and herbaria were established and their function and purposes underwent changes from similar institutions that existed in the past.

Botanical gardens usually are not recognized as a vital element in the study of medicinal plants. Quite generally they are considered solely in terms of horticulture: the introduction into cultivation and improvement of plants for their beauty. From earliest times, however, botanical gardens, which gradually grew out of olive groves and temple gardens, have played a major role in medical botany. The Egyptians had a utilitarian garden at Karnak in 1500 B.C. A botanical garden in Athens, of which Theophrastus was director in 350 B.C., received seeds of useful plants—many being medicinal—sent by Alexander the Great from his conquests as far east as

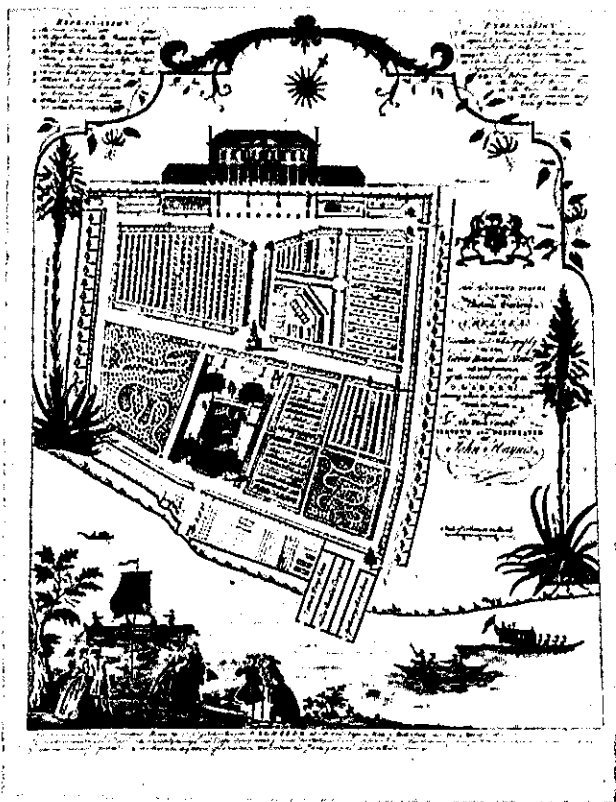
India. Throughout the Dark Ages and early Middle Ages, monks in Europe maintained herb gardens. Beginning with the appearance of the herbals in Europe, many herbalists—the botanists of their time—maintained their own gardens. John Gerard of London had one of the most famous gardens in the seventeenth century. One such garden, the Chelsea Physic Garden in London, is still in operation.

In the New World, the ancient Aztecs had their garden outside of Mexico, devoted partially to medicinal herbs, but it disappeared after the Spanish conquest. Charles III established a botanical garden in Mexico in 1788 and, during this period, three famous botanical expeditions were sent from Spain to several parts of the Spanish possessions in America for a study of the flora, with special reference to useful plants: Sessé and Mociño to Mexico, the Royal Expedition to New Granada (Colombia and Ecuador) under the direction of Mutis, and the Royal Expedition to the Kingdom of Peru and Chile conducted by Ruzf and Pavón. The two royal expeditions to South America devoted very special attention to a study of Cinchona, the source of anti-malarial quinine.

There are now more than 400 botanical gardens throughout the world, in many of which research is in progress on some aspect of medicinal plants.

The vital importance of botanical gardens in the establishment and study of medicinal and other economic plants is best illustrated by recalling several examples. Coffee, native to Abyssinia, was first introduced to Brazil, now the source of 75 percent of the world's supply, during the 1700s from the Jardin des Plantes in Paris. Botanical gardens maintained by the British and Dutch played major roles in the establishment of plantation quinine trees in Asia from wild material collected in the Andes of South America. Without a chain of efficient botanical gardens, such as those at Kew and in Ceylon, the introduction of the rubber tree from the Amazon to the Old World would never have been effected successfully.

Linnaeus made several contributions to botany, but two seem to be of fundamental importance: the establishment of a binomial system of nomenclature, and the establishment of an *herbarium* to authenticate the system of nomenclature.



The *herbarium*—an archival collection of pressed, dried plant specimens—changed botanical classification from an inexact art to an exact science. For the first time in scientific history, the naming of plants could be standardized, leading to the use of one name for a species around the world. Vouchered specimens, upon which the name and first description of the species were based, filed away in permanent collections, could be available to research scholars of future generations.

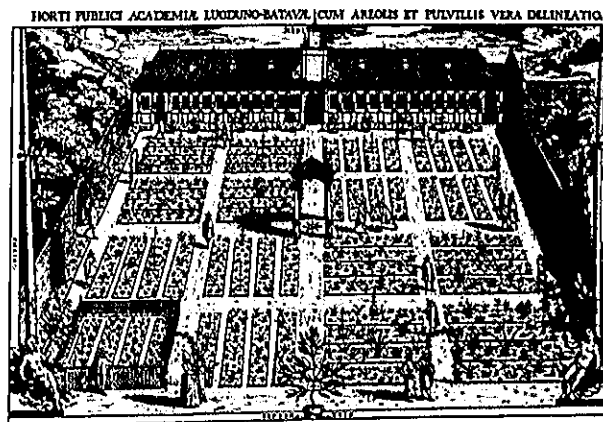
In pre-Linnaean times, plants often were not known by a short word or two, but by long descriptive phrases of several or many words in different languages. Linnaeus, who employed Latin as the scientific language of the period, adopted the custom of describing a species and assigning each species to a higher category of related organisms—the *genus*. Each plant was given a species name and a generic name. Thus, the foxglove, belonging to the *genus* *Digitalis* and representing the species *purpurea*, was known as *Digitalis purpurea* and easily could be set apart nomenclaturally from the related woolly-leaved member of the *genus* known as *Digitalis lanata*. By international agreement, Latin—a dead language not subject, like living languages, to changes in meaning of words—is still the official language of botanical classification.

Linnaeus was not the first to create an *herbarium*, but he used his plant specimens as a basis for describing and naming species. His book *Species Plantarum*, published

in 1753, is accepted universally as the starting point of modern botanical nomenclature. Although botanists are still actively classifying and naming plants new to science, they generally follow the parameters established by Linnaeus. Linnaeus's own *herbarium*, preserved in the Linnaean Society of London, can be consulted by contemporary botanists to clarify the use of a binomial or historical background in classifying large groups of plants.

The *herbarium* is now an essential adjunct of botanical institutions, not only for theoretical research into plant classification and evolution, but also as an almost untapped resource into collectors' notes on the uses of plants in primitive societies around the world. This information is not only firsthand, but the data concerning locality, people, and time are precise. Furthermore, unlike many citations of native uses in literature, there exists the voucher specimen for authentication of the identity of the plant. Several "*herbarium* searches" for aboriginal medicinal uses of plants recently have been carried out with very promising results. One search yielded more than 7,500 reports, many of which bear investigation by modern phytochemical and pharmacological methods.

The size of several of the larger *herbaria* illustrates how vast may be the potentiality for discovery from collectors' notes of ethnopharmacological hints. Among the largest are the Paris *herbarium* with 7.2 million specimens; Leningrad and Geneva, each with 5 million; the Royal Botanic Gardens in England with 4 to 5 million; and Harvard University with approximately 4 million.



PLANTS AS CHEMICAL FACTORIES

A plant is the site of intense activity: photosynthesis turns carbon dioxide and water into sugars by means of solar energy, and metabolic action then creates many secondary organic compounds from the sugar.

More than 12,000 of these secondary organic plant principles have been isolated, and many of them have proved useful in medicine. The most important principles from the medical viewpoint are the alkaloids and glycosides.

Alkaloids are a diverse group of alkaline compounds with marked physiological activity; their ring structure is usually complex and always contains nitrogen. The alkaloids include morphine (first isolated in 1805), cocaine, nicotine, and quinine, and more than 5,500 others; more than 90 percent of the known alkaloids are found in flowering plants.

The plant families richest in alkaloids are the Nightshade, Pea, Madder, Logania, Lily, and Amaryllis Families and above all the Dogbane Family, which alone contains 18 percent of all known alkaloids. The richest genera are *Nicotiana*, *Vinca* (source of the antileukemic compounds vincristine and vinblastine), and *Strychnos*; rich single species include the poppy, *Papaver somniferum* (source of opium), with 25 alkaloids, and the Indian snakeroot, *Rauvolfia serpentina* (source of the tranquilizer reserpine), with approximately 30.

Glycosides are compounds which, when hydrolyzed, yield a component of one or several sugars (i.e., glycone) and a nonsugar component (aglycone).

There are 11 types of glycosides, classified according to their aglycone moiety. Among the most important in modern medicine are the cardiac glycosides (in the Dogbane, Milkweed, Lily, Mulberry, Buttercup, Figwort Families). *Digitalis*, one of our most widely prescribed drugs of plant origin, owes its activity to cardiac glycosides. Cyanogenic glycosides yielding hydrocyanic acid have been reported from some 2,000 species in 112 angiosperm families. Recently, steroidal saponinins (in the Pea, Figwort, Nightshade, Caltrop, Amaryllis, Lily, and Yam Families), have been reported from some 2,000 species in 112 angiosperm families.

To anyone working in the ethnopharmacology and phytochemistry of the Plant Kingdom, it must appear obvious that our discoveries of Nature's wonder drugs have only just begun.



Zaner Ganff.

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THE VERSATILE BENEFITS OF PLANTS

MEDICINE

Cannabis has been valued from earliest times for its powerful psychoactive and physical effects. In lands that possessed Cannabis, the plant was credited with healing properties. Throughout medieval Europe, it was very important as a medicinal herb, and was included in the United States Pharmacopoeia as a tranquilizer until 1937. Today, approximately 50 cannabinolic constituents have been discovered, of which some are promising as medicinally valuable compounds.

FOOD

In times of scarcity or famine, the akene (fruit) of Cannabis, though not very palatable, has been used as food for both animals and man. Today, it is a major constituent of bird feed in the United States. Cannabis fruits may have been domesticated originally for use as a food plant.

OIL

The fruit of Cannabis is very oil-rich. In central Asia, the oil has been extracted and used for centuries for domestic purposes (e.g., oil lamps). The greenish-yellow oil is excellent for paints, varnishes, and soap-making and in the leather industry. It resembles cottonseed oil, with 75 percent unsaturated and 25 percent fatty acids.

FIBER

Hempen fibers, one of the most useful products of the Plant Kingdom, have been found in some of the earliest archaeological sites from China to Asia Minor. Many strains of this plant were developed for long and strong fibers throughout history since they are well suited for cordage. The fibers are processed by retting.

NARCOTIC

In some areas of Asia, the narcotic influence of Cannabis placed it, very early, as a sacred plant for ceremonial use. It was known in India and China as early as 1500 B.C., but apparently was unknown in classical Mediterranean countries and medieval Europe. The ancient Scythians, who used it in a narcotic vapor bath, spread its use from central Asia.

CHEMICAL COMPOUNDS FROM PLANTS



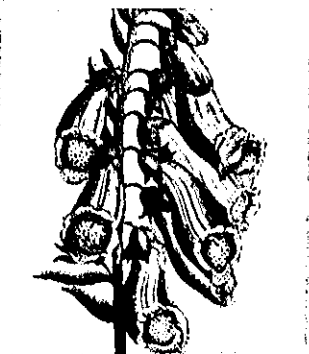
Mold (*Aspergillus herbariorum*)



Yam (*Dioscorea villosa*)



Yellowbark cinchona (*Cinchona succirubra*)



Foxglove (*Digitalis purpurea*)

ANTIBIOTICS

One-quarter of the prescriptions written in the United States call for antibiotics. The word means "against life" and describes the destructive or inhibiting activity to life processes of microorganisms by interfering with the metabolism of the organisms. They are complex chemical compounds. Penicillin, the first discovered and still one of the most important, produced by *Penicillium notatum* and *P. chrysogenum*, is not a pure compound but a mixture of several fractions.

STEROIDS

Steroids are found in plants and animals and may be synthetic. They have complex structures, but all have a 4-membered hydrocarbon ring system: *perhydrocyclopenta phenanthrene*. They are colorless, crystalline solids differing in the substitution of groups attached to the nucleus.

ALKALOIDS

The bark of several species of *Cinchona*, Andean trees of the Madder Family, contains some 25 related alkaloids with a quinoline nucleus; principally quinine, quinidine, cinchonine, and cinchonidine. These alkaloids have febrifugal properties and have been employed for many years in treating malaria—especially quinine. Totaquine is a mixture of all cinchona alkaloids (cheaper to produce) sometimes used instead of the purified quinine or quinidine.

GLYCOSIDES

Foxglove—*Digitalis purpurea*—owes its cardiotonic activity to a number of glycosides; principally digitoxin, a microcrystalline white powder that increases the tone of the cardiac muscle, causing the heart to be more effectively emptied, and is extremely toxic. The same and other glycosides—gitalin, digoxin, lanatoside C, deslanoside, etc.—occur in other species, especially the commercially valuable *D. lanata*. Digitonin, a glycoside from foxglove, combines with cholesterol.

THE FUTURE OF PLANTS IN MEDICINE

It has been estimated that only 10 percent of the organic constituents in the Plant Kingdom have been discovered. Modern phytochemistry, with extraordinarily new sophisticated techniques, must assure astonishing new finds in the next few years, when larger segments of the Plant Kingdom are thoroughly examined. For, to date, chemical studies have been desultory, erratic, and incomplete.

For the future of medicine, more intensive studies are imperative. Even though former times saw a great percentage of medicaments come from plants, a few statistics about the present will indicate the bright future that looms ahead for medical botany. In 1973, 38 percent of the 1.5 billion prescriptions filled in the United States contained active constituents from higher plants or employed microbial products, and drugs from the higher plants amounted to a \$3 billion business.

The period of 1930 through 1960 was remarkable in medical botany, characterized by the successive discovery of many startlingly effective "Wonder Drugs," almost all of which were of vegetal origin. Beginning with the muscle relaxing alkaloids derived from South American arrow poisons and the discovery of penicillin and many other antibiotics from molds, actinomycetes, bacteria, lichens, and other plants, the series continued unabated. There came cortisone precursors from sapogenins; hypotensive agents from *Veratrum*; cytotoxic principles from *Podophyllum*, *Vinca*, and other sources; khellin from *Ammi Visnaga*; reserpine from the Indian snake root; and others, not to mention the numerous psychoactive compounds of potential value in experimental psychiatry. Not only have new drugs been discovered, but studies have led to novel uses of older drugs.

If so many revolutionary discoveries have come about within the past few years, why assume that, with ever more sophisticated chemical and pharmacological techniques, the future will see an end to such progress? The chemical examination of the Plant Kingdom—as Linnaeus prophesied two centuries ago—truly has only just begun.

RICHARD EVANS SCHULTES



Man, ever desirous of Knowledge, has already explored many things; but more and greater still remain concealed; perhaps reserved for far distant generations, who shall prosecute the examination of their Creator's work in remote countries, and make many discoveries for the pleasure and convenience of life. Posterity shall see its increasing Museums, and the knowledge of the Divine Wisdom, flourish together; and at the same time all the practical sciences . . . shall be enriched; for we cannot avoid thinking, that what we know of the Divine works are much fewer than those of which we are ignorant.

Linnaeus



The Heritage of Folk Medicine



The tree of the knowledge of good and evil, a symbol of the strength and power of plants: "For in the day that thou eatest thereof thou shalt surely die" (Genesis 2:17).

Below: Healing plants used by the Neanderthals 60,000 years ago, according to archaeological evidence from Shanidar in Iraq.

Human beings have always had to rely on plants for their foods and many other necessities, including their medicines. Folk medicine based on plants, originally the only healing known to man, has never entirely disappeared. In rural outposts or among ethnic minorities of modern industrial society, it has persisted as a poorman's complement, or alternative, to the inaccessible physician. It flourishes, above all, in the pockets of surviving aboriginal cultures, where modern medical science has remained unknown and where plants still provide the only medicines.

We owe a great debt to folk medicine: it is the source of our knowledge of many, if not most, of the healing plants. The wealth of lore accumulated for millennia by folk medicine has developed into the modern discipline of ethnopharmacology, the critical study of native medicines, which has only recently come into its own. Although the identification of pharmacologically active plants and plant derivatives is far from complete, it is nevertheless very extensive. Science can continue to learn and profit from the practices of the folk healers—provided we do not allow this rich source of knowledge to dry up.

The aboriginal cultures still extant in the world today—in remote areas of Africa, Asia, Latin America, and elsewhere—are

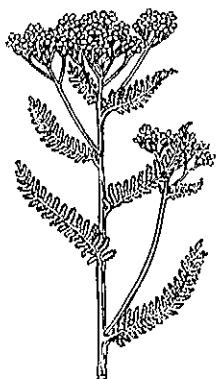
rapidly disappearing. There is a danger that much of the knowledge and practice of the alleviative properties of plants will vanish with these cultures. It is not too soon to pay serious attention to this popular healing tradition and to review some examples of the pharmacological contributions it has made in the past—and can go on making—to modern medicine and our knowledge of plants.

PREHISTORIC SOCIETIES

The scanty archaeological remains of plant materials that have come to light indicate that, after foods, construction, and clothing materials, healing plants were man's primary interest in the Plant Kingdom. There is evidence from several widely separated parts of the world.

Archaeological studies at Shanidar in Iraq indicate that the Neanderthals living there may have had a rudimentary pharmacopoeia. Of the eight species of plants identified through pollen grains from remains in this site, seven represent plants still prominent in ethnomedicine in this locality and elsewhere in Asia. Included in this 60,000-year-old burial site are Yarrow (*Achillea*), Hollyhock (*Althaea*), Groundsel (*Senecio*), Grape Hyacinth (*Muscari*), St. Barnaby's

YARROW
Achillea



HOLLYHOCK
Althaea



GROUNDSEL
Senecio



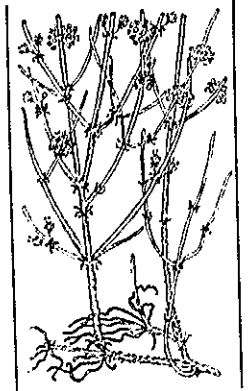
GRAPE HYACINTH
Muscari

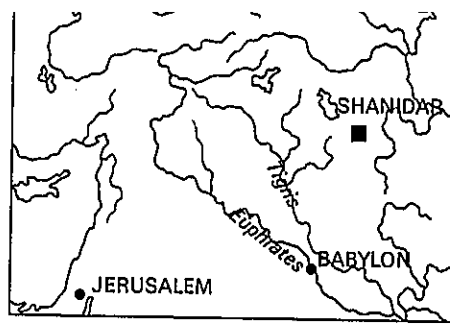


ST. BARNABY'S THISTLE
Centaurea



JOINT PINE
Ephedra





Excavations at Shanidar, Iraq, indicate that prehistoric peoples even 60,000 years ago may have had knowledge of medicinal plants. Such evidence could cause traditional estimates of the Neanderthals' intellectual capacity to be revised.

Thistle (*Centaurea*), and Joint Pine (*Ephedra*). Ralph Solecki, the archaeologist who excavated this site, maintained that the finding of so many plants with known medicinal properties may well cause "speculation about the extent of the human spirit in Neanderthals" leading to the acceptance of the opinion that they indeed did possess an extensive knowledge of the effective medicinal properties of their flora.

In Peruvian graves 2000 years older than the height of the Inca Empire (which occurred some 2500 years ago), bags for Coca leaves and the *lliptu* or lime used with Coca-leaf chewing have been found. Coca leaves discovered in Inca mummy bundles and dated some 1500 years ago have been examined and chemically show the presence of alkaloids. While Coca chewing was practiced widely in pre-Hispanic times from northernmost Colombia down the Andes and in adjacent parts of the Amazon and the eastern slopes of the Argentinian Andes, its main hedonistic use was as a stimulant and narcotic—as it still is. It had, however, in olden times as today, a host of purely medicinal uses, and as in the case of many sacred hallucinogens and narcotics, it is difficult to separate narcotic from medicinal use (in the aboriginal sense of "medicine").

A series of shelters in Coahuila, Mexico, spanning some 8000 years of occupation, have yielded material of the peyote cactus, mescal beans, and Mexican buckeye seeds. All may have been employed as medicines by the early inhabitants, since all are known to possess active principles. Peyote, employed mainly as a hallucinogen today, may have had ceremonial use this far back in time; but it is still valued by Mexican Indians as a physical medicine to hasten the healing of bruises, cuts, and wounds, and it has recently been shown to possess antibiotic activity. Study of dried peyote dated A.D. 810-1070 from these sites—possibly the oldest material yet subjected to chemical analysis—has demonstrated the enduring presence of alkaloids.

OLD HIGH CULTURES

No matter where historical records are consulted—in Babylonia, Egypt, India, China, Greece, Rome—the earliest sources contain numerous references to healing plants.

The Sumerian Ideograms, dated at approximately 2500 B.C., enumerate various medicines of plant origin, including opium, which was known as the "plant of joy." The Assyrians had at least 250 species of plants in their pharmacopoeia.

Perhaps the earliest extensive and tangible records are those in the Code of Hammurabi, who was King of Babylonia from 1728 to 1686 B.C. He caused various records to be carved in stone, some of which are still extant. Now deciphered, they contain many references to the use of healing plants—cassia, henbane, licorice, mints—all of which are used in modern medicine.

Mesopotamian pharmacy was equally dependent on plant drugs, naming some 250, including poppy, belladonna, mandrake, henbane, hemp, saffron, thyme, garlic, onion, licorice, cassia, asafoetida, and myrrh.

In Egypt, the Temple of Karnak has carvings of medicinal plants brought back from as far away as Syria in 1500 B.C. by an expedition sent out for this purpose by Thothemes II. The earliest written records can be traced back to Egypt and are preserved on scrolls of papyrus, a kind of precursor of paper made from the pith of the bullrush of the Nile. The most famous scroll, the Ebers Papyrus dating from the sixteenth century B.C., is a compilation of earlier works. It has a large number of prescriptions and recipes—877 to be exact. Among the many drugs mentioned are cannabis, opium, frankincense, myrrh, aloe, juniper, linseed, castor oil, fennel, cassia, senna, thyme, and henna. Many of the prescriptions employed gums and resins of plant origin.

The Egyptians may have used antibiotics: mud—probably with soil-inhabiting acti-



Healing plants are mentioned in the Code of Hammurabi (ca. 1700 B.C.), one of the earliest written historical sources.



An Egyptian queen holds a mandrake flower, in this fourteenth-century B.C. relief from Echet-Aton. The mandrake (*Mandragora officinarum*) was believed to possess many medicinal qualities, but they have not been confirmed by modern research.



Valued by the ancient Greeks as a spice and a healing agent, the so-called *silphion* (shown on a coin of 480 B.C.) is now extinct. It was an Umbelliferae, possibly of the genus *Thapsia*.

nomyces that produced antibiotic substances—was applied as a poultice to ulcerated sores. Moldy bread was another Egyptian healing agent, which owed its activity perhaps to fungi. Had modern medicine taken these early practices seriously, man might not have had to wait until the 1930s for the almost accidental discovery of the bactericidal properties of these life-saving substances.

In India, where naturalistic medicine co-existed with superstition and metaphysics, the oldest written records are comparatively recent, but they put us in touch with much older traditions, going back to 1400–1500 B.C. They were passed down orally from generation to generation and were finally formalized in sacred poems or *vedas*. The *Rig Veda*, for example, has more than poems dedicated solely to the supermedicine and god-narcotic *Soma* (only recently

FLY AGARIC
Amanita muscaria



SNAKEROOT
Reuvolfia



HEMP
Cannabis



identified as the mushroom *Amanita muscaria*) which soothed pain, increased vital forces, and was hallucinogenic. The *Charaka Samhita*, a later Indian herbal, mentions more than 500 plant remedies, richer in number than the Egyptian pharmacopias. Many of the drugs mentioned

The medicinal plants illustrated above figure prominently in the ancient Indian sacred poems called the *Vedas*, and in other Indian as well as Chinese writings.

Indra, one of the major Vedic deities of ancient India, drew his extraordinary strength from the consumption of *Soma*. This drink, praised as a supermedicine and hallucinogen in the *Rig Veda*, is believed to have been an extract of the mushroom Fly agaric (*Amanita muscaria*).



official in the United States Pharmacopoeia as a tranquilizer until 1937.

Some 5000 years ago, the Chinese were probably utilizing a strange leafless desert vine known as *ma-huang* in treating pulmonary ills. The earliest Chinese medical work, the *Pen Tsao* of Shen Nung, written about 2900 B.C., represented the accumulation of centuries of earlier folk uses of plants. Listing a total of some 365 drugs, it recorded the virtues of *ma-huang*: a tea said to improve circulation, reduce fevers, aid in correcting urinary functions, calm coughing; but its main attributes related to its efficiency in relieving pulmonary or bronchial problems. Although chemical studies isolated the alkaloid ephedrine as early as the 1880s, it was not until the 1920s that



In this Persian miniature of the fourteenth century, a woman smokes hashish (from the *Cannabis* plant) in a hookah.

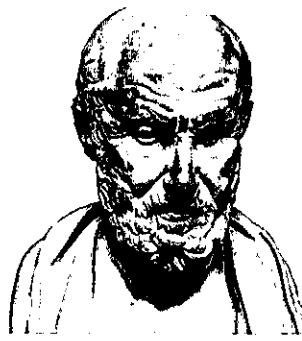
As early as 2500 B.C., the Chinese were using plant medicines to treat pulmonary complaints, poor circulation, fever, leprosy, and many other ills. The aged wise man shown in the foreground of the Chinese painting at the right is handing a fruit to a child. Behind him hangs a small gourd filled with medicine.

in this document eventually were adopted in Egypt, used later in Greece, and finally found their way into European folk medicine.

The number of references to healing plants in the *Vedas* is very great. One species mentioned there—the Snake Root or *Rauwolfia*—with 4000 years of use in India in treating snake bite, mental disorders, and epilepsy as well as a host of lesser ailments, has, during the past forty years, literally revolutionized western medicine as a tranquilizer and hypotensive agent. Largely as a result of the interest of Indian research workers in native ethnopharmacological lore, it was possible to isolate the principal alkaloid of Snake Root, reserpine.

While known now primarily as a narcotic, *Cannabis* or Hemp has had a long history in folk medicine, and all modern evidence points to the probability that some of its 50 cannabinolic constituents—or semisynthetic analogues of them—may become important in western medicine. One of man's oldest cultigens, Hemp is a five-purpose plant. Its use as a medicine goes back in Chinese tradition 4800 years, and to Indian writings dated about 3500 years ago. These sources reported the therapeutic value of Hemp in treating many ailments. Throughout the Middle Ages, in Europe, it was extolled as a medicine, and Hemp was





pharmacological investigations established its real value in relieving the discomforts of asthma, hay fever, and the common cold. Other Chinese drugs of wide and early use were Rhubarb as a mild laxative and *Dichroa febrifuga* to reduce fevers. Castor Oil, Camphor, and Cannabis or *ta-ma* were major items in the Chinese pharmacopoeia. Although surgery was not generally practiced in early China, Hua To in the third century A.D. is said to have employed a mixture of Monkshood and Hemp to narcotize patients about to undergo the very painful trepanning operation.

Leprosy has been feared as a fatal disease from earliest times—a plague without cure. Yet the Chinese, as early as 2500 B.C., and the Indians somewhat later, reported the value of Chaulmoogra Oil in their folk pharmacopoeia. The source of the seed oil, however, was not known with certainty until the 1920s, when an American botanist, penetrating the interior of China, identified it as a product of several species of *Hydnocarpus*. Effective in curing incipient cases of leprosy, Chaulmoogra Oil was the first breakthrough in the fight against this ancient plague.

While not an ethnobotanical document, the Bible, both the Old and the New Testament, refers to the medicinal use of plants. The number of healing plants is, however, very reduced—approximately thirty being specifically mentioned, including garlic, onion, leek, oleander, cumin, oleaster, galbanum, bay, mandrake, mints, and nettles. It appears that the Jews may have utilized far fewer healing plants than neighboring peoples of the Near East, despite their long residence in Egypt and Babylonia.

Among the ancient Greeks four men contributed significantly to medical botany. Known as the Father of Modern Medicine, Hippocrates (in the late fifth—early fourth century B.C.) mentioned some 300 to 400 medicinal plants—fewer than those used in Egypt. He believed that the human body, to a large extent, is self-healing, needing

but a little help from drugs and a proper diet to restore normal health. Hippocrates is notable, almost uniquely so, in not associating demonology with the healing properties of herbs. Aristotle (384–322 B.C.) ascribed to each plant the properties and virtues then known. Theophrastus (d. ca. 287 B.C.), primarily a botanist, described many Greek and foreign plants, with accounts of their use. His treatise *Enquiry into Plants* had a profound influence on the progress of botany and medicine for nearly

“The Father of Modern Medicine,” Hippocrates (460–377 B.C.) has left 87 treatises in which he mentions more than 300 healing plants.

Aristotle, Theophrastus, and Dioscorides carried on the Greek medical tradition. Dioscorides (first century B.C.) had



ARISTOTLE



THEOPHRASTUS

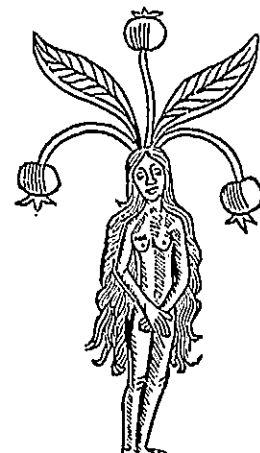


DIOSCORIDES

twenty centuries. The most influential medico-botanical writer, however, was Dioscorides (first century A.D.) whose book *De Materia Medica* not only set the pattern for the great European herbals of the Middle Ages but became the prototype of our modern pharmacopoeias. The influence of Dioscorides was overpowering: up to the Renaissance, it was the infallible authority in both medicine and botany. The earliest version, transcribed about A.D. 512, is known as the Codex Juliana. Much of the plant lore of Europe stemmed directly from the writings of Dioscorides. Rome, unlike Greece, produced little in medical botany. Pliny the Elder, in his *Natural History* (first century A.D.), offered no original ideas. The great value of his work is that it represents a compilation of about 2000 treatises written by some 326 Greeks and 146 Romans. Much of Pliny's folk medicine passed into the folklore of Europe and the New World.

the greatest influence on European medicine up to the Renaissance.

For the Middle Ages, a plant's appearance was decisive. The roots of the mandrake (*Mandragora officinarum*) resemble a human body, and the likeness was often exaggerated in drawings of the plant, such as this fantastical woodcut from an herbal of 1498.



The great herbalists from antiquity to the Middle Ages are shown assembled around the Greek Dioscorides, at center, in this illustration from an herbal of 1485. Seated in the foreground are the Roman Pliny (left) and an Arabic herbal doctor. The photographs at right show two of the most frequently used plants in medieval medicine, all with tropane alkaloid content.



ERGOT
Claviceps purpurea



BELLADONNA
Atropa belladonna



MEDIEVAL CULTURES

Early European knowledge of healing plants filtered down through the Middle Ages, some of it persisting until modern times. The solanaceous Belladonna, Henbane, and Mandrake, for example, were employed in the earliest folk medicine of

the Continent for a wide range of medicinal purposes, because of their tropane alkaloid content. They likewise played important roles in witchcraft and sorcery in the Middle Ages; this is perhaps one of the reasons why such medicinally valuable plants as Belladonna and Henbane were not accepted in the London Pharmacopoeia until 1809.

One of the most widely prescribed cardiac drugs, Digitalis, was used in England and Wales as far back as the tenth century. The cardiotoxic properties of Foxglove were introduced to modern medicine only in 1775, when Dr. Withering discovered its edema-reducing effects from treatments prescribed by country women in Shropshire. The plant had been official, however, for other uses as early as 1650 in the London Pharmacopoeia.

Perhaps the most astounding contribution made to modern medicine by folk pharmacy is Ergot. Used medicinally in Asia from ancient times, this fungal infection of rye and other cereals was valued during the Middle Ages in Europe by midwives in cases of difficult childbirth. Furthermore, when fruiting bodies of the fungus were accidentally milled into flour and baked into bread, whole towns were poisoned, many people died, some hallucinated, and some became permanently insane. Today, alkaloids from ergot are still used as relaxants of involuntary muscles to help induce childbirth and, as strong vasoconstrictors, to arrest postpartum hemorrhages and to treat migraine. There is evidence that ergot, because of its intoxicating properties, may have been involved in the Eleusinian mysteries of ancient Greece.

It was Pliny who was responsible for crystallizing an idea which originated probably with the Greeks, although it was found, in one form or another, in cultures around the world: (1) that nature serves man; (2) that plants were created to satisfy

St. Anthony's Fire is the medieval name for the violent reaction caused by the ingestion of Ergot (*Claviceps purpurea*), which was sometimes accidentally milled with flour. The "plague" took the form of mass poisoning, or sometimes hallucinations and permanent insanity. The seventeenth-century picture below shows St. Anthony withstanding satanic temptations and other ills.



man's needs; and (3) that, therefore, all plants not obviously useful (as foods, fibers, lumber) might well possess medicinal properties.

This was the germ of an idea that in Medieval Europe developed into the famous Doctrine of Signatures. The idea was promulgated as a doctrine by Paracelsus, a Swiss physician who lived from 1443 to 1541.

Paracelsus postulated not only that herbs were put on earth for man's use, but that many were stamped by the Creator with a clear sign or signature of the purpose for which they were to be used. A heart-shaped leaf, for example, meant that the

plant was a remedy for cardiac diseases. Many of the vernacular names of plants in Europe stem from belief in the Doctrine of Signatures: beard grass, crowfoot, foxtail grass, horsetail, goose foot, etc.



Illustrations for Giambattista della Porta's 1588 treatise on the Doctrine of Signatures draw analogies between plants and animals, suggesting that consumption of a particular plant could make a person either more energetic or calmer.

Foxglove (*Digitalis purpurea*), source of the digitalis used in heart ailments: an herbal contribution to modern medicine.



It was not until about 1470 that the hold that Dioscorides and other classical writers had on European botany and medicine began to weaken. At that time, the herbalists began to study plants themselves and to provide original descriptions and illustrations, and herbals—compendia of true and false information—began to appear. At first, they were but garbled versions of Dioscorides. It was not until about 1670 that botany began to divorce itself from medicine, to the mutual advantage of both sciences. It was not long before the Doctrine of Signatures was totally discredited. Yet the reputation that plants had acquired over such a long period was not easy to displace and has often clung to them. But, through the ages, by trial and error, many plants that carried no special signatures gained fame as healing agents, and some of these have lingered on and, as in the case of Foxglove, have been supported by the impartial searchlight of modern chemical and pharmacological research.

PROTOHISTORICAL SOCIETIES OF THE PRESENT

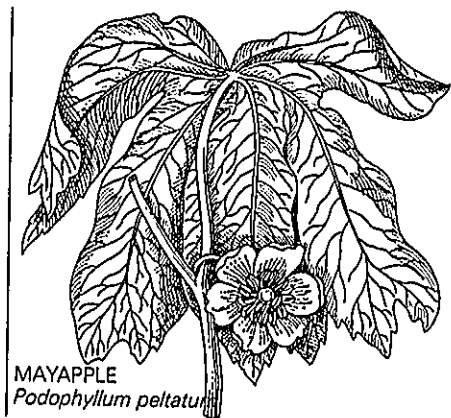
A continent of rich and varied tropical floras—and apparently the home of man—Africa harbors millions of natives still living in primitive societies. Yet ethnobotanical studies are totally lacking for great areas of the continent. Recent publications on the toxic and medicinal plants of east, south, and west Africa suggest that investigations of some of the healing plants still used by the natives would lead to medically valuable discoveries.

Undoubtedly, one of the most important gifts of Africa to modern medicine has been physostigmine, an alkaloid isolated from the Calabar Bean of Nigeria. Exceedingly toxic, this bean, product of a forest liana, was administered as one of the many or-

deal poisons of Africa and Madagascar to determine guilt or innocence. The beans have also had other uses in native healing practices. Physostigmine, the principal alkaloid, is now a major tool in modern ophthalmology, used to cause protracted dilatation of the pupil and as an aid in treating glaucoma.

Another African gift to modern medicine comes from several species of *Strophanthus* which, with a variety of medicinal uses as well, were employed by the natives in preparing arrow poisons and contain potent glycosides acting on heart muscle. One species is the source of ouabain, a cardiac stimulant now administered for acute heart failure and pulmonary edema. Another species yields glycosides valuable in the emergency treatment of acute cardiac asthma. It was the famous British explorer of Africa, Dr. David Livingstone (1813-

Four plants used in aboriginal civilizations.



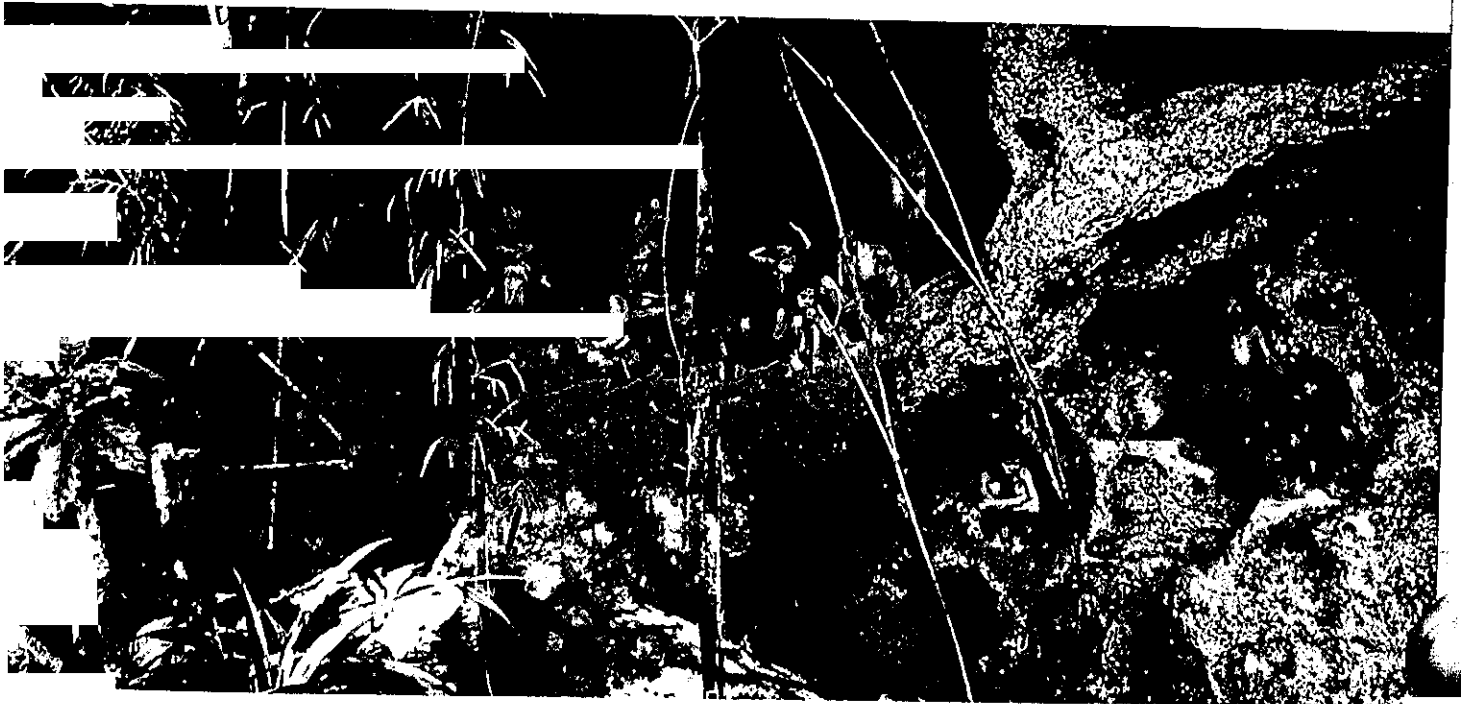
MAYAPPLE
Podophyllum peltatum

1873), who first noted the toxicity and cardiac activity of *Kombe*, one of these species.

It was an African species of *Rawolfia*—the so-called African Snake Wood—that, to a large extent, replaced the once supreme Indian Snake Root as a source of reserpine. This African species had a host of indigenous medicinal uses, including the treatment of snakebite, leprosy, jaundice, venereal diseases, rheumatism, and skin rashes, and it was valued as a vermifuge, purga-

The Tasaday tribe, 27 persons living a Stone Age existence in caves in the Philippine rain forests, were discovered by anthropologists in 1966. In their isolation, tribes such as this one preserve customs that had long disappeared from most parts of the earth; they thus offer a wealth of historical testi-

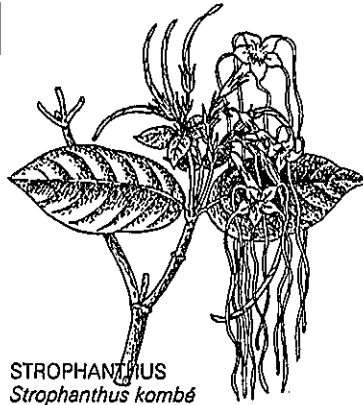
mony about life in the Mesolithic and Neolithic cultures. In some cases, these anachronistic communities are a valuable source of information concerning herbal medicine, since plants are the only means of healing available to them.



CALABAR BEAN
Phytostigma venenosum



FALSE HELLEBORE
Veratrum viride



STROPHANTIUS
Strophanthus kombé

Indians smoking: one of the curiosities of the New World reported by a Frenchman named Thevet in his book *Singularités* (1558).



tive, emetic, and abortifacient and as an excellent inducer of sleep.

The flora of the Americas has been a prodigious provider of economic plants now used the world around. This has been true especially of healing plants.

Although its flora is rather limited, North America has given modern medicine a number of drug plants, most of them with histories of folk uses among the Indians.

Early Spanish missionaries along the Pacific coastal areas learned from the native inhab-

itants about the virtues of a bark employed as a mild cathartic. They called it *Cascara Sagrada* or "sacred bark." This medicinal plant has maintained its position as a major item in the United States Pharmacopoeia.

The North American Indians are responsible also for two healing plants that have only recently assumed importance in medicine: the False Hellebore and the May Apple.

Podophyllum—the May Apple or American Mandrake—had numerous uses in native

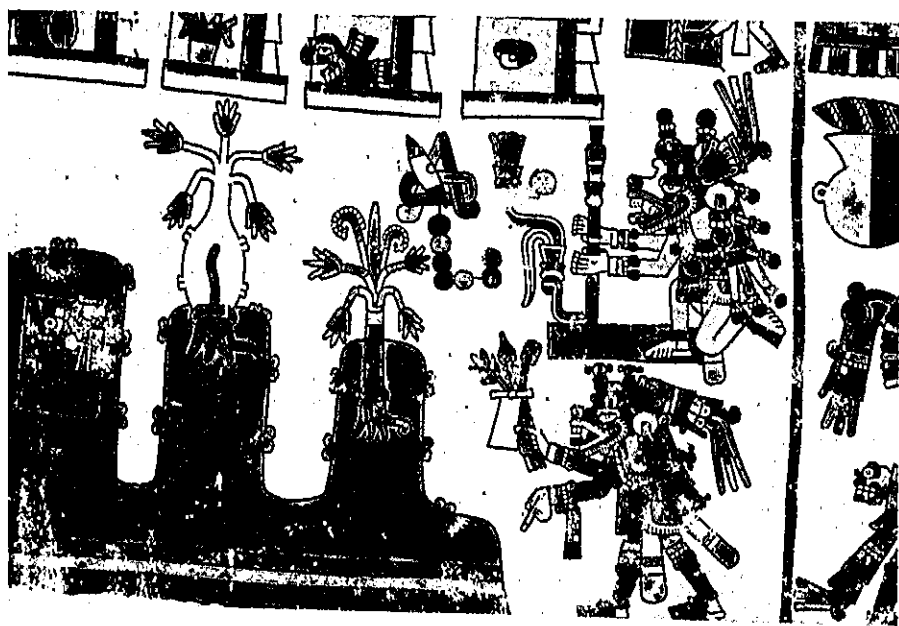


Tobacco was first introduced to Europe as a medicine. This is the first printed illustration of the plant to appear in England (1570).



medicine: the Cherokee employed the juice of the rhizome to relieve deafness; the Iroquois committed suicide by ingesting the raw rhizome. Despite its toxicity, it was valued likewise as an emetic, purgative, and anthelmintic (expelling intestinal worms). Adopted by the early white settlers for a host of purposes—including treatment of typhoid, dysentery, and hepatic

The so-called Indian Tobacco, once smoked by North American natives and employed against pulmonary disorders, now yields alkaloidal constituents used in preparations to help break the cigarette smoking habit. Some of the New World cultures, subdued and in great part destroyed by the Europeans, in many respects knew more than their conquerors about actual healing plants and their utilization. The first herbal of the New World, the *Badianus Manuscript* of 1552, recently discovered in the Vatican Library, illustrated in color, described the medicinal values of nearly 200 species: one interesting aspect of this early work is that its author was himself a Mexican Indian. In 1865 a Spanish physician, Monardes, wrote an extensive book on Mexican drug plants, based partly on personal experimentation with them on patients. The King of Spain sent his own physician, Dr. Francisco Hernández, to study Aztec drug plants: the result was an encyclopedic work on the natural history of "New Spain," in which some 1200 healing plants were discussed, usually in great detail, and many of them so carefully illustrated that their identification is rarely in doubt. The dried root and resin of Jalap, a Morning Glory, was, for example, the source of a powerful cathartic that is still employed. Sarsaparilla was esteemed highly in the treatment of bladder and kidney problems because of its strong diuretic properties. Tobacco powder served to relieve headache, stupor, dizziness, and nasal problems—and it should be noted that tobacco was first introduced to Europe as a medicine and was so used until the present century. The ecclesiastical writer Sahagún, whose *Historia de las Cosas de Nueva España* considered every aspect of Mexican life, devoted many pages to native medicine, including brief discussions of the



Pictures of healing plants in the *Badianus Manuscript* of 1552, the first herbal to appear in the New World. Written by a Mexican Indian, the work discussed nearly 200 species.

tis—the drug yields a resin now considered effective against venereal warts. Other species with similar chemical constituents have likewise long been employed in folk medicine in several parts of Asia.

Another extremely toxic plant valued by the Iroquois Indians to treat nasal catarrh was False Hellebore. It was adopted by white settlers as a veritable cure-all. Recent research has isolated alkaloids now widely used—often with reserpine—to relieve hypertension.



The shaman or medicine man was a dominant figure in many aboriginal civilizations in both hemispheres.

The four photographs at left depict (from left to right):

A North American Sioux Chief gathering medicinal herbs.

A shaman of the Mexican Hui-chol community in the western Sierra Madres holding a newborn baby.

A Karagass shaman of Siberia, who beats the deerskin drum and consumes fly agaric mushrooms to induce a trance.

A masked witch doctor in Nioka-Kakese, former Belgian Congo, performing a ritual dance as he holds a basket filled with dried seeds and an antelope horn full of powder.

healing properties of local plants and plant products.

It was in Mexico that the use as "supermedicines" of psychoactive plants—the hallucinogens—was developed to an extraordinary degree in magico-religious and medical rituals. Of the many species of hallucinogenic plants so employed in Mexico, three groups are preeminent as "divine remedies": Peyote, Teonanacatl, and Ololiuqui. Employed ritualistically—even to the present time—and for healing purposes, they all have chemical constituents of value in modern medicine: mescaline from Peyote and psilocybine from the two dozen or so species of sacred mushrooms known to the ancient Aztecs as *teonanacatl* ("divine flesh") have found use in modern psychiatry; the ergoline alkaloids—chemically related to LSD—from the Morning Glory known to the Aztecs as *ololiuqui* are the same compounds occurring in Ergot, which has been employed by midwives in Europe from early times right up to the

present day in the management of child-birth. These ergoline alkaloids constrict involuntary muscles and are vasoconstrictors—both properties being of extreme importance in modern gynecology. But their use as hallucinogenic "medicines" among the Mexicans was of the greatest importance to these people.

South America is the world's principal



center for the use of arrow poisons or curare. Almost every tribe and sometimes almost every medicine man has a special formula. Although many plants enter into these formulas, the major active ingredient belongs usually to the genus *Strychnos* or to species of several menispermaceous genera. It is from extracts of the latter that alkaloids, especially tubocurarine, have become so important in modern medicine. Tubocurarine is a potent muscle relaxant. Supplies of the active constituents are still extracted from curare, a brownish paste prepared by Indians in the western Amazon. Although tubocurarine has been syn-

In Venezuela, a shaman treats an illness by sucking out the spirit or "sickness projectile" believed to have been sent by a mysterious power.

Left: The Cola plant, the most famous medicine in Peru. It was used as an analgesic, anorectic, and stimulant, and may even have been effective as an anesthetic. The plant's active principle, cocaine, is important in modern medicine.



thesized, the synthetic alkaloid is inferior to the natural alkaloid for medical use. Thus, here we have a major drug that is closely linked to folk medicine: the drug was discovered from native toxicology, and the Indian population is still its source. Since the ancient Peruvians did not develop anything approaching written records, we know less about their pharmacopoeia.



Quinine, western medicine's greatest debt to ancient Peru, is extracted from the bark of the Cinchona tree. Used by Ecuadorian Indians to relieve fever, the plant came to be called Jesuits' Bark in the seventeenth century and was later cultivated by the Dutch and British in Asia.

Their flora was replete with medicinally valuable plants, but unfortunately we know little about the extent of its use. The Incas had a bevy of "doctors": *hampicamayoc*, *oquetupuc*, or *sircac* (possessors of medicine and surgery) and *colla-huaya* (traveling apothecaries who dispensed medicines).

Undoubtedly the most famous medicine in Peru was Coca, which was prescribed generally for its analgesic, anorectic, and stimulating properties. Once confined apparently

to the priestly and noble castes, Coca was released for general use shortly before the Spanish conquest of Peru. There is even the suggestion—still unproven—that the Incas employed a poultice of masticated Coca leaves to relieve pain prior to the common Peruvian trepanning operation. The active principle of Coca, cocaine, has assumed an important role in modern medicine, especially in ophthalmology. Modern Indians living in the Andes still take a tea of Coca leaves to relieve many common ailments, especially digestive ills. The Peruvian pharmacopoeia had many healing plants, including tree Daturas and Ipecac. The Incas likewise had strong purgatives: *Huillcautari* fruits, and the root of *Huachanca*. *Huachanca* enjoyed fame also as an effective abortifacient. To relieve certain eye infections, the leaves of *Mactellu* were esteemed. The most important medicine plant to have come to western medicine from ancient Peru, however, is Quinine, from the bark of several species of *Cinchona*. It was highly valued as a febrifuge by Ecuadorian Indians, from whom Jesuit missionaries learned of its properties in the early 1600s. Known from that time on as Jesuits' Bark, it was exploited for many years by this religious order. For two centuries, all bark was supplied by wild trees, until the Dutch successfully brought it under cultivation in their tropical Asiatic colonies. And today, despite very effective, synthetic antimalarial drugs, quinine maintains a place among our major drugs of plant origin. This Indian fever bark has saved probably more lives than any other drug. These are but a few of the important healing plants that can trace their modern medical use to protohistorical societies of the present or very recent times. There are many more, and there are literally scores of modern drugs of lesser importance that have come to the healing arts from beliefs and customs of medicine men and from uncivilized man. Can there be any doubt that many more potential life-saving medicaments remain unnoticed by modern

MORNING GLORY (*Ipomoea violacea*), the pride of so many gardens in all parts of the world, is a native of South America. Known there as ololiuqui, it has a long history as a hallucinogenic agent.

science in the wealth of folklore lurking in the hinterlands of the world?



Serious and critical evaluation of native uses of plants still provides science with a remarkable and extensive reservoir of new ideas and potentialities when it is wisely interpreted. The extent is great: one investigator has noted more than 700 species of plants medically employed in the northwestern part of the Amazon alone—a region still very poorly explored.

The overwhelming number of our medicines coming from plants used in proto-historical societies should convince modern scientists of the value of ethnopharmacological investigation. There still lingers in many scientific circles, however, distrust of the value of a study of primitive medicine. Recent analytical evaluation of Aztec medicine has indicated that "although magic and religion were quite important in the Aztec treatment of disease, there was a strong empirical underpinning which has not received the attention it merits" (B. Ortiz de Montellano, *Science* 188 [1975] 215). Of 25 plants studied, 16 were found to produce the effects claimed in native medicine; 4 would possibly be active; 5 seem, from present knowledge of their chemistry, not to possess the effects claimed. This study thus implies that 80 percent might in reality be effective medicines. More research must obviously be done to assure that such a high percentage



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