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Medicine from Plants

Beginning when they are infants, human beings will put almost anything into their mouths. It is not surprising that medical effects of many plants have long been known and used. Even today about 75% of the world population still relies on plants, plant extracts, and other tools of traditional medicine. There are about 121 clinically useful prescription drugs worldwide that are derived from higher plants. About 74% of them came to the attention of pharmaceutical houses because of their use in traditional medicine. Among the drugs derived from plants are the anticancer agents vinblastine and vincristine. Morphine, codeine, quinine, atropine, and digitalis come from plants.

About 10% of the dry mass of some plants is made up of chemicals designed for defense against predators. Evolution of plants has proceeded in many directions, leading to the creation of novel uncounted substances, only some of which have been identified. Fewer of them have been synthesized in the laboratory. The defensive chemicals interact harmfully with the biochemical apparatus of predators. While many biochemical pathways of living matter are common to all forms, there are differences that can be exploited. What is one creature's poison can be innocuous or helpful to another. What is toxic to one tissue or a neoplasm may not be toxic to the rest of an animal.

Natural product research has been conducted for more than a century. In 1985, worldwide, a total of 3500 new chemical structures was discovered. Some 2619 of the chemicals were isolated from higher plants. The techniques for isolating and identifying chemicals in natural products are now many and powerful. Various forms of chromatography, mass spectrometry, and nuclear magnetic resonance are particularly useful.

The National Cancer Institute (NCI) has created a superior technology for screening for anticancer drugs.* It employs 60 different tumor cell lines in its test procedure. The lines have been selected to represent the various forms of cancer, for example, brain tumors, leukemias, and melanomas. The NCI has also developed a screening procedure for chemicals that might be effective against the AIDS virus.

The new method of screening for anticancer drugs is proving more successful than an earlier procedure in which only mouse leukemic cells were used in the initial screen. Between 1955 and 1982 chemicals from 35,000 plants were tested. Some of the extracts were active, but they brought with them harmful side effects. Many of the older plant extracts will be screened with the new procedure, and NCI will be examining both natural substances and laboratory synthetics. Ultimately the test panels will be expanded to include about 100 cell lines, and substances will be tested at the rate of about 20,000 per year.

In terms of research designed to discover new plant-based pharmaceuticals, the United States has lagged. In 1987 Japan captured 56% of natural product patents summarized in *Phytotherapy Research*. West Germany has been much more active in this field than the United States.† During the past decade West Germany developed many phytopharmaceuticals that have proven effective in a wide variety of medical problems. Only a fraction of them has been approved for sale in the United States. In the United States costs of development of a drug have risen to the vicinity of $100 million with 10 years often required to prove efficacy and safety. In West Germany the safety of long-used natural products is generally assumed if no side effects have been reported. Proof of effectiveness is more readily achieved in West Germany than here. Heavy emphasis is placed on reports of general practitioners, and extensive clinical trials are not required.

In spite of the considerable research activity in the identification of chemicals in natural products, the potentials for medicine have not been fully exploited. Norman Farnsworth of the University of Illinois' College of Pharmacy has estimated that only 5000 plant species have been studied exhaustively for possible medical application. This is a minor fraction of the estimated total of 250,000 to 300,000 species. Most of the plants that have not been analyzed and tested grow in the tropics—a large fraction of them in the rain forests. Insofar as the forests are being destroyed, species are being lost that might yield useful medicine. This potential loss is a matter of grave concern to botanists and is one of the matters being emphasized in efforts to spare the tropical rain forests.—PHILIP H. ABELSON

*M. R. Boyd, *Princ. Pract. Oncol.* **3**, 1 (1989). †V. E. Tyler, *Econ. Bot.* **40**, 279 (1989).