# *More* Herbal Scraps

**an unpublished book *by***
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**(1942–2001)**



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**by Arthur Lee Jacobson in 2007**

# INTRODUCTION

”The fragrance and the color and the form, and the whole spiritual expression of goldenrods are hopeful and strength giving beyond any others I know. A single spike is sufficient to heal unbelief and melancholy.”

John Muir.

I began this series of books by being interested only in medicinal plants. As the study progressed, I began a “scrap box.” This grew into two books on many aspects of useful plants covering medicine, science and ethnobotany. These two books are ***Herbal Scraps*** and ***More Herbal Scraps***.

Plant life serves as the foundation for animal life and by consequence human life. When I was a child, a popular question game asked: “What are the three kingdoms? The answer was supposed to be “animal, vegetable and mineral.” The reality is that there are several other kingdoms; namely the world of insects, bacteria and viruses.

The point of this discussion is that the higher kingdoms couldn’t exist without plants. Plants capture the energy of sunlight and use it for making their tissues. Carbon dioxide is removed from the air and replaced with life sustaining oxygen.

Our planet is in a state of constant balance between carbon dioxide and oxygen. Long before modern humans, plants kept the earth in balance. There is speculation that the ice ages were caused by too much carbon dioxide and other gases in the atmosphere. We are rapidly shifting the carbon dioxide balance by burning fossil fuels, and we could be in for some unpleasant surprises if the balance is disturbed too much.

Peter Collins showed me a picture of a wild grassy plant that he had discovered in a Huichol Mexican cornfield. The seed head was similar to many other grasses and I didn’t recognize it. “This is known to the natives as the mother of corn,” he explained. Unlike corn, which dies yearly, its wild ancestor acts like grass. This discovery excited scientists who were interested in corn that didn’t have to be planted year after year.

The early farmers were the first to deal with plants. They selected good varieties, looked for mutations and improved food plants. They theorized on which plants were good for sick animals. They applied the knowledge of sick animals to help sick humans.

The shifting sky and the moon were involved in early plant science. In northern regions farmers didn't have a numerical calendar. They depended on phenology—which is the study of plants and birds in relationship to the seasons. Through the use of the seasonal markers they knew when to plant and harvest. The markers were birds and flowers.

A whole series of stories of plant magic evolved. The legendary soma removed the cares of people in India. The mandrake became the plant which granted wishes and protected the person who had it. Ergot and henbane were herbs of the devil, while other plants were involved with the angels.

In earlier times, it was a matter of survival to be able to tan leather or poison arrows. Hunting was not a reliable source of food, until poisons were discovered that made the hunt much more certain. Herbs were used to attract animals and occasionally drive them away.

The earliest forms of soap were made from the roots of plants. Boats were made to float from the gum resins of trees. Humans began to replace leather with "wool" from "trees" (cotton), in the centuries before the time of Christ. The early measures of weight came from plants, and the English pound was once defined as the weight of 9,216 grains of wheat. In writing this book I began to realize how civilization was built on the green mantle surrounding our planet. At the same time we are learning to appreciate the diverse forms of life, we are destroying by unwise practices plants that have lasted for millions of years.

Although this book contains little medical information on herbs, it is important that those using herbs should consult a doctor or recognized health practitioner. Correct diagnosis and standardized medications are the marks of modern medicine. Often these have been lacking in those using nonstandard therapy. While most plants are safe, a few should be used with great caution.

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# 1. STONE AGE GENETICS

"The future will no doubt be a more natural life than this. We shall be acquainted and shall use flowers and stars, and sun and moon, and occupy this nature which now stands over and around us. We shall reach up to the stars and planets and pluck fruit from many parts of the universe. We shall purely use the earth and not abuse it —God is in the breeze and whispering leaves, and we shall then hear Him. We live in the midst of all the beauty and grandeur that was ever described or conceived. We have hardly entered the vestibule of nature. It was here, be assured, under these heavens that the gods intended our immortal life should pass—these stars were set to adorn and light—these flowers to carpet it."

Journal for Aug. 26th 1843 Henry David Thoreau

"As I study it all over I begin to think of Nature's processes as endlessly flowing streams in which varied strains of heredity are ever pouring through the riverbeds of environment; streams that, for ages, may keep to their channels. Each stream is apt, at any time, to jump its banks and find a new outlet. Just about the time we decide that one of these streams is fixed and permanent, there is likely to come along a freshet of old heredity or a shift in new environment. An overflow occurs, a gap widens in the channel, a flood sweeps over the surrounding field of plant or of life activity. We must rebuild our bridges and revise all our maps!."

*The Harvest of the Years* Luther Burbank

The second half of the twentieth century was marked by the ability to genetically modify plants. Our new vocabulary includes common words like DNA, gene splicing and restriction enzymes. Our grandfathers never heard of these words, but they did know that new varieties of plants arose. Every fruit and vegetable that we use came about through mutations and selection by farmers and gardeners.

Linnaeus believed in the fixity of species, but he thought about the question of the origin of species. When a student brought him a toadflax *Linaria vulgaris*, which was obviously altered from the common plant, Linnaeus wrote: "The ancients imagined that rye could become transformed into barley, barley into oats and oats into tares." He considered the simple change of the toadflax to be "even greater than such transformations."

These sudden changes in species had been found before. A pharmacist in his medicinal herb garden had noted one major change. In 1590 Herr Sprenger found a very different celandine in his garden in Heidelberg, Germany. The plant was distributed to other gardeners, and it escaped into the fields and grows with the usual Chelidonium majus. Botanists gave it the name of *Chelidonium laciniatum*, although it is now titled *C. majus* var. *laciniatum*. This case is unusual, because we know when and where the first one originated.

Linnaeus was a religious man who believed that God had created a fixed number of plant species 5,700 years before. But he recognized that people were apparently creating new garden and ornamental species by selecting plants for their looks or properties. If he had found some of the selected varieties on a botanical expedition, they would have received a new species name. Many plants sold commercially do not closely resemble the original plant that gardeners began to work with. Botanists generally ignore the changes in common plants, and they are not given new species names.

The genetics of the Stone Age was selecting plants with large fruits and seeds, and using these for food. Growing groups of plants together resulted in more cross-pollination and the opportunity to select the best seeds for planting. Domestic plants had slow improvement over thousands of years, until the revolution of the last three centuries.

Charles Darwin took some of the mystery out of the variation of plants by introducing the concept of natural selection. Animals and insects have long been selecting plants before humans. At the same time Darwin was working on his idea, Gregor Mendel discovered the laws of genetics by breeding peas. It wasn't until we discovered how DNA works, that Mendel's experiments came into true focus.

One species that has mutated greatly is the common apple tree. Stephen Facciola lists 351 varieties of applies available from nurseries in his comprehensive listing *Cornucopia*. The 1994 *Seed Savers Yearbook* lists 663 varieties of apples ranging from 'Adam's Pearman' to 'Zuccalmaglio.' When a hard freeze damages apple trees in the spring and kills off the branches, the new shoots coming out from the trunk often produce new sports. Most of the varieties of 'Red Delicious' that we have in the stores came from spring freezes in the early 1950's that produced new sports. If you prune an apple tree very heavily, the new shoots coming from the trunk are often mutated.

The first step in understanding mutations came when Harold Miller exposed fruit flies to x-rays. A whole new series of changes in color, size and form resulted from breaking the DNA. He was awarded the Nobel Prize for this work in 1927. He inspired a whole generation of radiation biologists who bombarded seeds of every useful plant to obtain a new series of variations, which might produce more food and fiber, or be more resistant to insects.

Barley seeds were exposed to the hydrogen bomb at Bikini in 1946. The seeds received about 25 times the lethal dose for humans. There were fewer seeds per spike and three mutations. There was no difference between the mutations from the atom bomb and x-rays.

X-rays were applied to corn as the seeds were forming. The treatment of 2,800 seeds produced 53 mutations. About 90% of the mutations could be recognized in the seedling stage. Some 60% of the mutations were white and 15% were yellow. They x-rays had mutated the chlorophyll process which turns carbon dioxide into sugars with energy provided by sunlight.

Many of the seeds now used by farmers are the result of these radiation experiments. The mutations are different on wet seeds than dry seeds. An x-ray mutation produced yellow-leafed barley that yielded 25% more in northern Sweden, but it yielded less than regular barley in southern Sweden.

Cosmic rays are radiation from space that produces the same mutations. With slight radiation about two plants out of every 10,000 seedlings are unable to use chlorophyll because of DNA changes. If plants are bombarded by 100,000 roentgens of radiation, this increases to 200 chlorophyll mutants.

Ultraviolet light contains enough energy to alter the DNA. By exposing pollen (the male genetic material) to high-energy light, the DNA can be altered. This has been used to produce new cereal grains.

Scientists discovered that there were chemicals within certain plants which had the power of changing the chromosomes, to create new and possibly better plants. Work on the alkaloid colchicine from *Colchicum autumnale* began with articles by Pierre Dustin on treating sarcoma in 1934. He noticed that the chemical affected the chromosomes of cells. Laslo Havas joined him and they tested the chemical on plants and found that it affected cellular divisions. He wrote a short note in *Nature*, sharing the discovery with biologists.

In 1938 Orie Eigsti, a professor at the Department of Genetics at the Carnegie Institute of Washington noticed that the cells in plant roots doubled after colchicine solutions were applied. The autumn crocus *Colchicum autumnale* contains colchicine. The methods used to produce mutants are to soak the seeds for up to ten days in 0.1% to 1.5% colchicine. It has been found that 0.2% is generally the most effective solution, and higher amounts are too strong for some species. The bulbs of the autumn crocus may also be mashed and mixed with the potting soil. The first generation of plants are often dwarfed and deformed. The generation following may have superior genetically altered plants.

Since the chemical produces doubling of the chromosomes, it often produces large plants with larger flowers, which are desirable to florists. In 1937 newspapers ran a story on colchicine calling it a "growth elixir," that could create giant rats or carnivorous caterpillars. It is nearly impossible to do this.

Growers seeking better plant varieties usually don't need to visit foreign lands. When the chromosomes of the plants are doubled, they have larger and more textured flowers, larger leaves and thicker twigs. Most plants in Arctic regions are polyploid, because they can adapt better to harsh conditions.

The dry corms of the autumn crocus normally contain about 0.4% colchicine. In order to double a plant's chromosome number, a colchicine solution must come in contact with the apical tip-growing cell of a seedling. This must happen during active cell division, not when the cell is dormant. If the apical tip cell is affected, the colchicine doesn't damage the new plant.

A 0.5% stock solution is made by mixing a half gram of colchicine in 100 cc. of water. Then 20 cc. of the stock solution is mixed with 180 cc. of water. Then a stock solution of dilute surfactant is made by adding 1 drop of dish washing liquid to 10 drops of water. One drop of this is added and 1 cc. of dimethyl sulfoxide to wet the surface of the cells and break the surface tension.

The seeds are planted, and when the cotyledons poke through the ground they are misted twice daily for the next 7 to 10 days until the leaves are visible. It is most effective when the solution is prevented from drying out. So the seedlings are kept moist for most of the day with a relative humidity at or near 100%. The new sprouts are kept in a controlled chamber under white fluorescent light for 18 hours a day at 75° F. With similar methods, many improved varieties of plants were developed.

It is a curious fact that four of the chemicals capable of creating new plants by doubling the chromosomes also have some use in fighting cancer. These chemicals apparently mess up the rapid duplication of DNA in the dividing cancer cells. They are: colchicine; sanguarine from the bloodroot *(Sanguinaria canadensis); Catharanthus roseus*, which is used in leukemia; and Veratrine from *Veratrum viride*. Also, the sap of mistletoe *Viscum album* stimulates roots and root hairs and then arrests growth. Plant breeders have the possibility of obtaining new mutations by applying the juice of these plants or pure alkaloid solutions to the seeds, flowering parts or buds of plants. Many of the resulting mutations are not going to result in better plants, but given time, a more desirable plant is likely to result.

During the process of cell division, the chromosomes thicken into spider-like bundles and then separate into another cell. If they do not separate cleanly, i.e. if there are breaks or bridges, then new mutations result. Both the seeds of spinach and beets contain chemicals that alter the stickiness of the chromosomes, so they cannot separate cleanly. This is an easy way for a plant breeder to produce new mutations.

A curious way of mutating wheat and grass seeds was discovered in India. Researchers were testing x-ray mutations on cereal grains, when mixed with common oils. They soaked the seeds of bread wheats in castor oil, mustard oil and peanut oil before x-raying them. As a control they planted some seeds that had not been radiated. It turned out that peanut oil was more effective in producing mutations than x-rays, and the other oils were also able to produce new varieties.

Seeds of bread wheat soaked in peanut oil showed a great variation in head shapes and sizes. Some heads were longer, thicker or thinner and heads without beards were produced. If the seeds were soaked too long some of the wheat would not germinate. The best results were obtained by soaking the seeds for six hours, then wiping off the excess oil and planting them.

A lichen from India is the source of a strong mutagenic chemical. *Pyxine petricola* produces sticky chromosomes, bipolar nuclei, clumping of chromosomes and split spindles. The higher the concentration of the active chemical, the more mutations.

In New Zealand a blight known as *Dothistroma pini* began to affect the pine trees *Pinus radiata*. Scientists isolated the chemical dothistromin from it, and found that it caused mutations in bacteria and damaged the chromosomes in mammalian cells.

Water extracts of the mushroom *Paxillus involutus* have a strong chromosome-breaking substance. Mushrooms gathered in the fall can be used to treat seeds to mutate them. The mushroom *Lactarius necator* has a high mutagenic potential on salmonella bacteria.

Modern genetic engineering originated in the speculations of Gottlieb Haberlandt. Around 1900, he suggested that every cell ought to be able to form an entire plant, because all cells have the same DNA. He arrived at this idea after studying the regeneration capability of wounded plants. He was unable to do this, because he didn't have the right nutrients.

The next step in plant regeneration was the work of William Robbins and Philip White. They discovered that individual roots could be made to form an entire plant. They sterilized roots in laundry bleach (sodium hypochlorite diluted to $\frac{1}{10}^{th}$ normal strength), so they were free of harmful organisms. The roots were placed in a medium of sugars, minerals and thiamin, in order to become plants.

Around 1935 Roger Gautheret and Pierre Nobécourt developed single plant cell cultures. They sterilized carrot roots and placed slivers of the roots in nutrient solutions. With the newly discovered growth hormone indole-3-acetic acid, growth continued indefinitely.

The next step took 20 years but Folke Skoog and Frederick Steward showed that single cells could form thousands of embryoids. Coconut milk was the magic nutrient that produced the plants. They found that herring sperm produced rapid cell division. They isolated the chemical and found that it was kinetin.

Ilaha milk from the *Hyphaene natalensis* also has the property of making single cells divide. This palm has pear-shaped fruits. It takes a 5% concentration of the milk to stimulate cells, but it only takes 0.1% coconut milk. The stimulation substance seems to be zeatin riboside.

Around 1960 E.C. Cocking tried dissolving the cell walls of plants. He produced pure enzyme preparations known as pectinases and cellulases from fungi that produce "soft rots." After dissolving the cell wall, the cells would form callus tissue, which yielded entire plants without special conditions.

James Shepard used these discoveries to form protoplasts from the leaves of potato plants. He thought that he could produce thousands of identical clones from a single leaf, but to his surprise, the individuals were not identical. They varied in size, shape, yield, resistance to drought and salt tolerance. This form of variation is known as somaclonal variation. It is now known that small pieces of DNA known as transposons change position and produce new variations.

A scientist produced 230 clones of the tomato and there were 13 variations resulting from the shuffling of DNA. Nature changes the DNA by crossing slightly different plants, but this was surprising to learn that the DNA changes significantly in one out of twenty plants. Varieties of salt-resistant barley were selected by subjecting the cells to increasing levels of salt. The survivors were grown into complete plants and the process was repeated.

DNA can be isolated from plants with a chemical mixture and carbolic acid. This is precipitated by alcohol, and cut with bacterial enzymes known as "restriction endonucleases." The cut pieces can be spliced into DNA with enzymes known as ligases. The new DNA can be carried into other species of plants with crown gall bacteria.

By testing the genetic variants with disease and hostile conditions, new plant varieties can be found. We can add genes for vitamins and proteins. We can produce medicinal chemicals or toxins. We can make plants distasteful to insects.

Commercial plant breeding has become the domain of scientific experts, but there is a good chance that an amateur gardener might come up with a better apple or a juicer tomato. With persistent work, there is an excellent chance of producing new varieties of flowers. The plants which produce mutagenic chemicals, can help you to produce your new plant varieties.

The newly discovered restriction enzymes cut DNA and leave sticky ends that can be combined with other pieces of DNA. It is now theoretically possible to change life in any manner. The Supreme Court has ruled that new life forms can be patented. Each individual is a new life form, based on the genetic combination of two individuals. But you can't patent yourself, for in the legal language of the patent office, you must prove that you are "new, useful and unobvious."

# 2. GROWTH HORMONES

"Our bodies are our gardens, to the which our wills are gardeners; so that if we will plant nettles or sow lettuce, set hyssop and weed up thyme, supply it with one gender of herbs or distract it with many—either to have it sterile with idleness of manured with industry—why, the power and corrigible authority of this lies in our wills. If the balance of our lives had not one scale of reason to poise another of sensuality, the blood and baseness of our natures would conduct us to most preposterous conclusions. But we have reason to cool our raging motions, our carnal stings, our unbitted lusts; whereof I take this that you call love to be a sect or scion."

Iago in William Shakespeare's *Othello*

The idea that plants have hormones began with Charles Darwin's book *The Power of Movement in Plants*. During most of his life he suffered from an illness which he had picked up on the voyage of the *Beagle*. When sick, he would lie on his couch and watch the movements of his house plants. Soon he began controlled studies of their speed and direction of movement when they were struck by light.

Plants have no muscles or nerves, so there can be no controlled movement, as we know it. Darwin found that when he cut the tips of canary grass seedlings, they lost their power of reaction. This observation led to the idea that some substance was present which bent the pant to capture the maximum amount of light.

In 1926 the Dutch botanist Frits Went thought of a test to prove that natural growth stimulants existed. He cut off the top of an oat seedling, and put it on a block of gelatin for several hours. Then he attached the block of gelatin to the side of the decapitated seedling. When the substance absorbed by the gelatin stimulated growth where it was attached, he knew that an unidentified growth hormone existed. These substances were shown to be generated by yeast and then by the fungus *Rhizopus suinus* in 1934.

In the northern climates plants have a dormant period and they won't grow, even in spring conditions, unless they have been dormant for a length of time. When yeast is mixed with alcohol, heated and then filtered, the extract has hormones, which will break the dormant period of the buds of peaches and pears. Different yeasts have variations of the growth hormones.

These substances, known as auxins, were first isolated from urine by German chemists. They extracted 40 milligrams of auxins from 33 gallons of hospital urine. The substance was tested for its ability to elongate oat cells. Urine auxin had the same ability to bend the stems of plants towards light as the natural substance.

The old Dutch gardeners were probably first to discover the effects of growth-stimulating auxins. When they cut tree branches for use in starting new trees, they slit the cut end and inserted cereal grains. When the wheat or oats sprouted, it released auxins, which stimulated the end to produce roots, and soon a new tree was growing.

There was a French proverb that woody cuttings would take root if planted on St. Catherine's Day (October 25). A French botanist asked all the guests at a resort to save their peach, apricot and plum stones for him. He was planning on planting a number of trees on October 25th. He split all the woody shoots and inserted a fruit stone. This stimulated the cutting.

All sprouting seeds have auxins: the hormones which stimulate the production of a new plant. Immature chestnuts and milky corn kernels have large amounts of growth-stimulating auxins. Coconut milk is a rich source of auxins and growth factors. Normally plants can only be grown from seeds or cuttings, but by putting a single cell of a carrot in coconut milk, an entirely new plant will start.

The auxins have many agricultural uses. Some seeds are difficult to sprout, but after being dipped in auxins, they sprout quickly. Leaves can be cut from common plants and rooted with auxins. When auxins are sprayed over a pineapple field, the entire field flowers at the same time. This makes it possible to harvest the entire field at the same time. Certain fruit trees drop their fruit before it can be picked. Spraying with very dilute solution of auxins keeps the fruit on the tree.

There are five major regulatory hormones in plants. These are auxins, abscissic acid, cytokinin, ethylene and gibberellins. In addition, the walls of the plants have linked sugars known as polysaccharides. Fragments of the cell walls are known as oligosaccharins. Enzymes, auxins or gibberellins release these. The oligosaccharins defend against disease, and cause growth and differentiation.

The phenomenon known as fairy rings is an interesting example of the growth-stimulating ability of natural molds in the soil. The fungus begins spreading from a single point, and grows outward by about a centimeter a year. The area touched by the fungus is much greener and plants and grass becomes taller in this area. Unknown substances produced by leaf molds have the same plant-stimulating properties.

In 1809 a Japanese farmer dictated an agricultural book, which was published in 1828. Konishi described an odd disease which farmers called “baka nae” meaning “crazy seedling.” He explained the disease by the “in-yo” philosophy in which everything is a balance between positive and negative factors. It turned out that the disease was known in many parts of the world under various names. It was called “man” rice in Papua New Guinea and “wanda peedema” (sterile ripening) in Ceylon. The characteristic of the disease is tall thin yellowish plants with poor root development. Any good wind would knock down these plants.

There was a great deal of difficulty in determining what fungus was producing the effect. In 1926 a Japanese scientist showed that a filtrate of *Gibberella fujikuroi* would induce overgrowth in rice seedlings. If the rice seeds were infected with the fungus “bakanae” resulted, which meant tall, yellow plants. If the plant was infected during flowering, “akakabi” symptoms resulted, which were red fungus spots on the rice grains. The effect on peas is very marked and they may increase by five times in height.

A group of workers at the University of Tokyo found an inhibitor in the fungus, which wilted rice; and biological stimulants, which they named gibberellins. Eventually American and British chemists found that the most active material was gibberellic acid.

This led to a great deal of interest by farmers, for some workers claimed that spraying only ten grams of gibberellic acid on an acre of grass, could increase the production of forage by nearly 50%. However, the use of powerful hormones weakens the plants. They couldn’t get enough nutrition to support the stimulated growth. Gibberellins are still used by horticulturists, but they are only useful in special farming applications.

The pollen of rape *Brassica napus* contains growth hormones known as brassins. These stimulate metabolic activity when applied to the tips of plants. A small amount of the compound produces a 20% increase in growth.

Methanol, known as "wood alcohol," is an unusual plant stimulant. It is very toxic to humans and small amounts will make people blind. When plants are misted with a 10% solution of methanol, there is a huge increase in size and yield. A few dollars of methanol will nearly double the yields of some crops.

There are a number of plants, particularly water plants, that stimulate the growth of rice and wheat and other commercial plants. Duckweed *Lemna aequinoctialis* extracts stimulate rice and barley. Extracts of water lettuce *Pistia stratiotes* stimulate the growth, germination and development of roots and shoots. The presence of hormones had been suspected in these water plants, because they divide and grow so rapidly. The green pigment caulerpin from the alga *Caulerpa* species is a strong auxin, which stimulates at low levels and inhibits plant growth at high levels. Even watermelon seeds contain gibberellin-like substances when they sprout.

Aspirin comes from salicylic acid, and putting an aspirin into a vase of water reputedly keeps cut flowers fresh. Botanists studied the voodoo lily *Sauromatum guttatum*. When it flowers, the blooms become much warmer than the air, and it gives off the odor of rotting meat. This brings carrion flies and they pollinate the plant. Scientists studied it for years to find the mystery chemical that activated the heat, and found that it was salicylic acid. This chemical (aspirin) acts as a flowering hormone in many plants.

There are a number of substances that act as rooting hormones. Rooting substances can be extracted from cuttings of *Cotoneaster, Euonymus*, holly, honeysuckle and ninebark. If you put a cut branch in these extracts it will begin to send out roots.

Several vitamins act as auxins, and can be used as root stimulants. Honey and vitamin B6 act as rooting agents. You can force a cut leaf to root by dipping in these agents, or you can use commercial auxins. The highly active form of vitamin D from *Solanum malacoxylon* is a strong rooting agent and stimulates growth in plants.

A study was done at the Boyce Thompson Institute on rooting substances. It found that potassium salts or talc gave better rooting than the well-known growth hormones. Another study was done with the rooting properties of honey. The best treatment was putting the cuttings in a 25% solution of honey for 24 hours before planting. This produced results almost as good as the best mixtures of hormones.

Willow trees send out thousands of tiny roots. Willow fence posts or sticks stuck in wet ground, easily take root and turn into a tree. This rooting substance has been identified as rhizocaline. If you want to root cuttings of roses or other plants, brew up some strong tea from willow tree shavings. Dip the ends in the cool tea, and roots will readily sprout when they are planted.

German experiments were done with human hormones on hyacinth bulbs. Estrogen, progesterone, androsterone and testosterone were applied to plants. Estrogen was the most beneficial for increasing growth and preventing wilting, while progesterone was the next best. Both of these increased blooming time and growth over the controls. Testosterone was somewhat harmful to the plants. Askell and Doris Love found that plants treated with estrogens produced more female plants, while plants treated with testerone produced more male plants. In 1947 Monckeburg found that plants given a placental extract had vigorous stem and leaf growth.

The simple gas ethylene (CH2=CH2) is a growth stimulant. This was discovered in Puerto Rico in 1930. It was observed that brush fires adjacent to pineapple fields could make the plants flower. The burning vegetation released some ethylene gas. There were attempts to use bentonite clay to absorb ethylene, and sprinkle it around to bring the fields into simultaneous flowering.

Ethylene gas acts like a growth hormone, and stimulates the roots of many plants. It is released by ripening fruits and it is used to ripen bananas. They are picked completely green and shipped thousands of miles in cooled storage containers. When the stores need more ripe bananas, ethylene gas is put into the containers and the bananas ripen.

An ex-British policeman told me the story of the rubber plant mystery. In England, beginning "bobbies" traditionally got room and board at the local police station. Since all rooms were occupied, he found a room with a landlady. The woman had a foot high rubber plant *Ficus elastica* over her fireplace, which grew about an inch a year. After a few months he found normal police lodgings. A year later he stopped by to chat with his former landlady. "Is that a new rubber plant?" he asked. "No," she replied, "the plant started growing like crazy after you left." The plant was now over six feet tall, and was pressing against the ceiling. He thought about this as he sipped his tea. Six months before, that area of England switched from coal-generated gas to North Sea gas.

He asked the woman: "Do you have your old gas receipts from the last year?" She got the records and he found a jump in the amount of gas used. The new gas had larger amounts of ethylene, and the leaking gas gave the rubber plant a powerful stimulus. The gas people came that day and fixed the leak. The giant rubber plant must have needed the ethylene, for it died a few weeks after the gas leak was fixed.

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