Plants that walk

By Mark C Glassy, Ph.D.

Life forms that should not walk but do are an enjoyable overlooked subgenre.

Introduction

As proper stewards of Planet Earth we must understand all forms of life, including the plant world. Botany, the study of plants, is an area of biology that has been largely overlooked in the greater sphere of SF film analysis. Not sure why this is so. Perhaps we all look at plants so casually that thinking of them as monsters just does not seem right. (I am reminded of a scene from the film, *Angry Red Planet*, where the just landed crew are looking out a window of their rocket ship and clearly see Martian plant life commenting, "frozen vegetables…crazy plants", but don't really consider them a life form. Plants get no respect.)

Sunshine drives life on Earth and the primary method of capturing the sun's shine or light is by photosynthesis and photosynthesis comes from plants. So, without plants there would be no life on Earth.

Carboniferous era

Plants have been on the planet longer than animals. The Carboniferous Era, when plants ruled the younger planet, is a geologic period that spans 60 million years from the end of the Devonian Period 358.9 million years ago (Mya), to the beginning of the Permian Period, 298.9 Mya. The name Carboniferous means "coal-bearing" and derives from the Latin words carbo ("coal") and fero ("I bear, I carry").

Most of the coal and oil we harvest came from the Carboniferous Era where plants and vast forests dominated the Earth. Once these species began to die out and convert into future oil other species took their place.

During the Carboniferous Era the vegetation primarily consisted of giant club mosses, tree ferns, great horsetails, and giant trees with strap-shaped leaves. After millions of years the organic deposits of this vegetation formed the first coal and oil deposits. Coal came primarily from bark-bearing trees that grew in vast lowland swamp forests. The growth of all this vegetation and forests removed large amounts of CO_2 from the atmosphere leaving a surplus of oxygen. With increased oxygen levels, around 35% (compared to 21% today), the size of insects also increased.

Plant biology 101

Plants make up one of the six major Kingdoms of life. Plants are unique in that they can make their own food and have roots. Familiar plants include bushes, ferns, grasses,

green algae, herbs, mosses, trees, and vines. So far, about 350,000 species of plants have been described. Just so you know, fungi and non-green algae are not considered as plants.

Just about all plants grow in the ground with roots underground and stems in the air. Plants are considered being sessile meaning they are permanently attached to a base (usually by roots) though some plants float on water such as lily pads. Roots absorb water as well as some nutrients. It is the evaporation of water from pores in leaves that pulls water from roots through the plant, a process called transpiration.

To grow, plants need sunlight, carbon dioxide (CO_2), minerals, and water to drive photosynthesis, the major energy source of plants. Plants get energy from the sun, carbon to build biomolecules of life from CO_2, and water and nutrients from the soil.

Photosynthesis

Photosynthesis only occurs in leaves and is the process where plants capture the sun's energy and converts it to food with free oxygen (O_2) as a by-product. Green plants trap the sun's energy through chlorophyll, which is mostly found in leaves. Leaves are green due to this chlorophyll which has a magnesium metal ion at its protein heme center (much like an iron ion, at the center of animal hemoglobin protein, which makes it red). The leaf is considered the plant's food factory and once the leaf converts CO_2 to food it is transported to other parts of the plant such as roots and stems. Adding more CO_2, light, water, and chlorophyll will make plants grow faster. It makes sense that plants must photosynthesize more than they burn through normal metabolism in order to grow otherwise they will exhaust energy and die.

Photosynthesis depends on the plant, including carnivorous plants, being able to synthesize very large amounts of the nitrogen-rich enzyme, ribulose-1,5-*bis*-phosphate carboxylase/oxygenase, RuBisCO, the most abundant protein on Earth. All our plants that walk would also have RuBisCO in abundance.

Plant nutrition

Like all life forms proper growth needs nutrients and plants are no exception. For optimal plant growth they need both macro- and micronutrients. Macronutrients include nitrogen for carbohydrates, phosphorous for energy production, potassium for water regulation, calcium for transport of other nutrients, magnesium for enzymes, sulfur for amino acids, and silicon for cell walls. Micronutrients include chlorine for osmosis and ion balance, iron for photosynthesis, boron for sugar transport, manganese for building chloroplasts, and sodium, zinc, copper, nickel and molybdenum, all for various enzyme activities. Plants need nitrogen for protein synthesis, calcium for stiffening of cell walls, phosphate for DNA synthesis, and iron for chlorophyll synthesis.

The root cause

Roots of plants have two main functions. They anchor the plant to the ground and they absorb water and other nutrients in soil. For the most part, gravity guides root development. Water is transported from the roots to the rest of the plant. Water is

needed to make food and to provide plant support. Without water plants become limp and the stems cannot support leaves. A process known as halotropism is how roots actively grow away from areas of high salinity in water. Those plants that thrive in desert ecosystems, called xerophytes, have a specialized root system for water absorbtion.

When there is easy access to water plants tend to have shallow roots. Poor access to water usually means deeper roots. Larger plants such as trees have deep roots for stability.

Plant genes

The human genome has about 20,000 genes that comes from about 3.5 billion base pairs of DNA (protein-coding sequences account for only about 1.5% of the human genome). By contrast, plant genomes vary enormously in size, from 64 million to 150 billion base pairs. Through a process known as polyploidy, in which genomes are expanded again and again, usually in response to some sort of stress, plants have been successful in adapting to all environments. (Polyploidy arises from errors in cell duplication.) The largest plant genome, the Japanese canopy plant (*Paris japonica*), has an octaploid four genome composition. The largest plant, the giant redwood (*Sequoia sempervirens*) is a hexaploid. Definitely plant genomes gone wild.

Another process to consider is called transposable elements in which plant genomes can increase their size and swap genes (ala, *Alien*) and take up foreign DNA from other plants (or perhaps humans). Lastly, genes being genes, mutations do occur and some plant species show remarkably high levels of natural mutation events.

Plant hormones

Plant hormones, properly known as phytohormones, are chemicals or signal molecules that regulate plant growth. Plant hormones determine the formation of flowers, stems, leaves (and the shedding of leaves), and the development and ripening of fruit. Plant hormones affect seed growth, time of flowering, the sex of flowers, senescence of leaves and fruits. They also affect how plant tissues grow upward as well as downward including longevity. Plant hormones are simple chemicals and not the complex biomolecules seen in mammals, such as insulin. It should also be noted that not all plants respond to hormones and that plant hormones are not nutrients.

Classes of plant hormones

There are five classes of plant hormones that vary from plant to plant. Their chemical structures are significantly different suggesting specific and defined actions. Each hormone class has positive as well as inhibitory functions that often work in tandem. The five major classes are: abscisic acid (an important plant growth regulator produced in leaves, especially when plants are under stress. It plays a role in leaf and seed dormancy by inhibiting growth.), auxins (influence cell enlargement, bud formation (converting stems to flowers) and root initiation), cytokinins (a group of chemicals that influence cell division and shoot formation), ethylene (a gas produced as a metabolic breakdown product that influences leaf expansion, stem diameter and height. It also affects fruit-ripening.), and gibberellins (a large range of chemicals important in seed

germination, promoting flowering, and growth of new cells). Though there are other known plant hormones they are highly specialized for specific plants such as defense mechanisms, pollen compatibility, shoot branching, and nitrogen fixation.

In addition to the above there are also synthetic plant hormones that are used for plant propagation from cuttings, grafting, and various tissue culture procedures.

Turgor pressure

Turgor pressure or hydrostatic pressure is the force that pushes the plasma membrane of a cell against the plant cell wall. Turgor pressure is the result of the osmotic flow of water and gives branches their strength. It is turgor pressure that causes Venus flytrap leaf blades to close once activated by prey (see below).

Basic food chain

Plants eat sunlight, animals eat plants, and bigger animals eat smaller animals. This is the cycle of life. However, Nature is full of exceptions and plants who eat animals, whether insects, snails, or small lizards, are an exception. After all, the basic food chain of the "carbon cycle", of plants taking in CO_2 and converting it to O_2, makes all life possible. These carnivorous plants use a minimum of CO_2 since most of their energy does not come from the sun (see below) and as a result make very little O_2.

Carnivorous plants

In the curious world of carnivorous plants, though rare, they are located all over the world, primarily found in soil lacking nitrogen nutrients, and depend upon moist, acidic soil and high humidity for growth. Habitats include bogs, coastal plains, swamps, and wetlands. In nutrient poor soil they get nutrients from eating insects and other small animals since live prey are rich in nitrogen-containing compounds. In nitrogen rich soil these carnivorous plants do not need to feed on animals. They still need water and sunlight.

By definition, carnivorous plants derive some or most of their nutrients from trapping and digesting animals, usually insects and small arthropods. These plants use animal proteins as a primary source of nitrogen though they still derive their energy from photosynthesis. Due to their ability to obtain nutrients from animals these plants have adapted to grow in areas of nutrient-poor soil and are therefore sensitive to excessive soil-born nutrients. It is of interest that Charles Darwin himself wrote the first treatise on carnivorous plants in 1875 titled, *Insectivorous Plants*. In all, there are at least 583 species of carnivorous plants that attract, trap, and digest prey to absorb nutrients. To accomplish this these plants must also have animal properties like movement, digestion, and senses.

For carnivorous plants, the leaf not only serves as the location of photosynthesis but it also serves as a trap. As such, changing the leaf shape to make it a better trap generally makes it less efficient in photosynthesis. Once prey is trapped carnivorous plants then digest and absorb the nutrients, mostly amino acids, phosphorous, and ammonium ions from the dead prey. For these non-photosynthetic processes the plant

must expend extra energy for structures pertaining to trapping and digestion which is the primary reason carnivorous plants are small. Instead of converting sunlight energy into biomass much of this energy is diverted to trapping and digestion.

Variables that impact carnivorous plant growth are amount of sunlight available, relative humidity, and soil moisture. Also, most carnivorous plants require rainwater or distilled water; regular tap water which contains minerals such as calcium will kill the plant.

Carnivorous plants do have natural enemies. Certain parasites such as aphids and mealybugs can damage or kill these plants. What is even more of a problem for carnivorous plants is grey mold (*Botrytis cinereal*) which quickly kills.

Digest a meal

Captured prey can be digested several ways by carnivorous plants. Digestive enzymes, water hydrolysis, and symbiotic digestion help from mites or bacteria, both inside the plant and those that live on plant surfaces, all help in digesting prey. Most of these plants usually catch more than enough prey to stay healthy. Even those that catch no prey rarely die though their growth would be limited.

To digest an animal meal carnivorous plants have special glands that digest the prey and absorb the nitrogen through leaf structures. Once prey is captured the inner surfaces of the plant lobes are stimulated causing additional responses, such as increased turgor pressure, forcing the lobes together to form a sealed sack, essentially a stomach where digestion occurs. The release of these plant digestive enzymes are stimulated by the hormone, jasmonic acid, which further activates other degradative enzymes. (For those of you biochemically inclined, a pre-digestive mechanism is oxidative protein modification, an auto-oxidation process, which makes the prey proteins easier to digest via proteolytic attack. This process helps rupture animal cell membranes for ease of digestion by the plant.)

All in all, after about ten days of digestion all that is left of the prey is a husk of exoskeleton chitin. The leaf trap then re-opens waiting for another meal.

Attracting Prey

Carnivorous plants need to attract prey and they do this through a variety of means, most of which involve animal senses. Attracting elements include colors and patterns, small droplets of shining liquid, giving off attracting odors, having tasty nectar, and possibly using ultraviolet patterns that may confuse the animal or insect into coming near. Attracting prey is important since many carnivorous plants reproduce by insect pollination or outcross pollination which helps increase genetic diversity.

Carnivorous traps

To capture and keep prey carnivorous plants have a variety of traps. Examples include plants that have mouths which open and shut with hair-lined tined edges and when touched triggers the trap to snap shut. Some have suction traps with a cupped top with trigger hairs and once touched a trap door opens and the animal is dropped into a sack

of liquid. Pitfall traps have tube-like structures with slippery interiors into which prey fall and cannot get out. Sticky traps use a sticky mucus-like material called mucilage similar to fly paper and once stuck cannot struggle free.

Types of traps carnivorous plants use to capture prey include bladder traps, combination traps, flypaper traps, lobster-pot traps, pitfall traps, and snap traps.

Carnivorous plants are becoming more common in cultivation with the advent of mass-production tissue-culture propagation techniques. Techniques that our annoyed botanists use in their creation of walking plants.

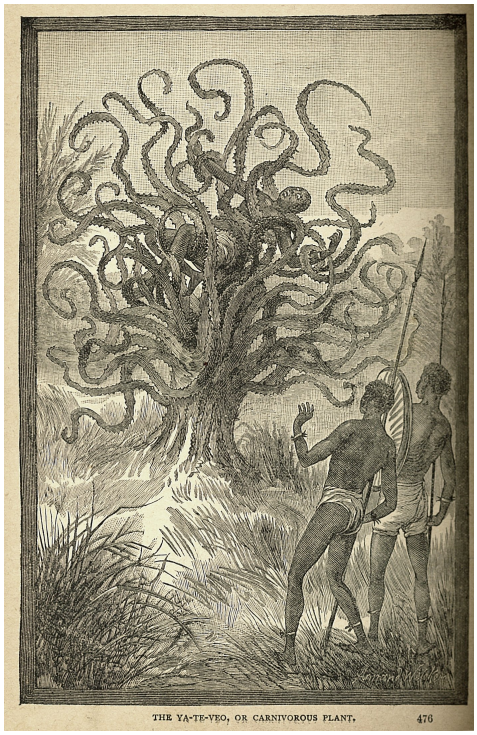
Archetype Carnivore
The Venus flytrap, *Dionaea muscipula*, the carnivorous plant most are familiar with, grows in soils virtually devoid of nitrate and calcium, and mostly found on U.S. East Coast wetlands, primarily the Carolinas. Charles Darwin, in describing *D. muscipula* commented, “the most wonderful plant in the world.”

When prey, mostly insects and arachnids, lands on the plant’s leaves tiny hairs are triggered which causes the leaf blade to close around thereby trapping the meal. This allows the plant to trap and digest prey for additional nutrients. The trap is rapidly shut by changes in internal cell pressures, called turgor pressure. After digestion the leaf blades need to grow slowly to reset for new prey.

The diet for *D. muscipula* consists of 33% ants, 30% spiders, 10% beetles, and 10% grasshoppers with the rest flying insects.

The Dirty Dozen
There are 12 carnivorous plants that eat animals.
Brocchinia
Butterwort
Cobra lily
Corkscrew plant
Moccasin plant
Portuguese sundew
Roridula
Trigger plant
Tropical pitcher plant
Tryphiophyllum
Venus flytrap
Waterwheel plant

Man-eating plants – something to chew on.
In popular culture the first reported instance of a plant eating a human was in 1878 in Madagascar where it was said a man-eating tree ate a woman. Though this account was debunked as myth it did start a trend and became real to many.



Depiction of a native being consumed by a Yateveo ("I see you") carnivorous tree of Central America, from the J.W. Buel book, *Sea and Land: An Illustrated History of the Wonderful and Curious Things of Nature existing before and since the Deluge*, Philadelphia, Pennsylvania: Historical Publishing Company, pp. 475–477 (1887). (above image from the book section: "The World Ashore"; Chapter 26: "Wonders of the Vegetable World", pg 476: section, "Man Eating Plant")

Plant movement

It should be noted that in 1880 Charles Darwin published his book, *The Power of Movement in Plants*, detailing how plants respond to external stimuli and how these govern plant growth and life. Darwin correctly reasoned that in responding to natural selective forces such as light and water plants demonstrated an extensive ability to adapt.

In the real world there are two types of plant movement, slow and rapid. Rapid plant movement occurs for brief periods of time such as when the Venus flytrap closes it trap in about 100 milliseconds; the mechanical stimulation of prey creates an electrical action potential with a release of elastic energy through turgor pressure which causes the leaf to close. Flowers like the dogwood bunchberry opens its petals and fires pollen in less than 0.5 milliseconds. The rapid plant speed record belongs to the white mulberry tree that has 25 microsecond flower movement and spits pollen from its stamens at speeds half the speed of sound! Such speeds involve increasing internal pressure usually by dehydration. In general, rapid plant movements are reversible.

The more common slower plant movements are called 'tropisms' which can lead to physical or permanent alterations. Some of these slow movements are due to changes in water (osmotic) pressure in the plant tissues which in turn are controlled by the fluctuation of ions in and out of cells.

Tropism and nastic movements
Plants essentially have two forms of slow movement, either directional or non-directional. Responding to a direct stimulus such as gravity or sunlight is called tropism (from Greek τρόπος, *tropos*, "a turning"). Tropisms are an innate tendency, natural inclination, or propensity to act in a certain manner towards a certain stimulus, either positive (towards the stimulus) or negative (away from the stimulus). Tropisms generally result from an interaction between the environment and plant hormones and are done without conscious thought. Tropism is primarily the result of plant cell growth often times manifested in cells on one side elongate more than those on the other side which causes the plant to bend or turn.

Tropisms are usually named for the particular stimulus and common forms are:

Aerotropism: growth of plants towards or away from a source of oxygen

Chemotropism: movement or growth in response to chemical

Exotropism: continuation of growth outward

Geotropism: allows the roots of a plant to determine the direction of gravity and grow downwards

Heliotropism: diurnal motion or seasonal motion of plant parts in response to the direction of the sun, such as seen with sunflowers

Hydrotropism: the root cap of plants sense differences in water moisture in soil which sends hormonal signals causing the root to curve towards the higher water content

Magnetotropoism: movement or growth in response to magnetic fields

Phototropism: the bending of a plant towards light, which allows maximum photosynthesis

Thermotropoism: movement or growth in response to temperature

Thigmotropism: movement or growth in response to touch or contact

A response to a non-direct stimulus, such as humidity or temperature, is called nastic movement and is primarily the result of differential cell growth or changes in turgor pressure in plant tissues. A common form of a nastic response is called thigmonasty which, in the Venus flytrap, is a response to touch. Tropisms depend upon the direction of the stimulus whereas nastic movements do not so they are non-directional.

Fictional carnivorous plants have been featured in many popular culture realms such as books, film, TV, and video games. These carnivorous plants, born out of artistic license, typically feature some sort of exaggerated characteristic one of which is the ability to walk.

The Films
DAY OF THE TRIFFIDS (1963)

This film is based on the book by John Wyndham of the same name. Plant seeds/spores arrived from space on a meteorite (a meteor that arrives on Earth is called a meteorite. Did the excessive heat of an incoming meteor help spore survival much like tree seeds survive fires?). As Mr. Coker says, “The original triffid was known to come to Earth from a meteorite.” Where did the original meteorite land? From news reports during the film triffids are all over Europe as well as Japan so this represents extensive world-wide bombardment both during day and night (day on one side of the planet and night on the other).

A second wave of meteorite bombardment carrying more triffid seeds arrives resulting in a colorful cosmic display. Those who watch the display went blind. Either the optic nerve or how light is processed by the eye retina of the humans who watch the cosmic display are affected (for details on how the eye works please see the article, “X- the Man With the X-Ray Eyes”, in *Scary Monsters* #109). A radio announcer comments, “The entire population of England appears to be afflicted with blindness as a result of watching the meteorite shower last night…(then) all of England appears to be infected with a strange new plant that can inflict a fatal sting. It is also rumored that this plant can uproot itself and move about.” It is noted that a dog and a horse are seen behaving normally so they were apparently not affected. It is unknown if other animals such as birds or primates were affected. This suggests the cosmic blindness is human specific.

It is noted that humans appear to all go blind at once no matter where they were on the planet. This is based on the many scenes of cars piled up on roads. So, how long was the incubation time to blindness once exposed to the cosmic rays? How long did it take to destroy the optic nerve? Was it immediate or did it take a few hours?

Triffids spread like kudzu and appear in just about all environments. Triffids are seen moving not only on soil, but on tile floors and strong enough to crawl up cement steps (how did it know to go up steps?). It did not take long for the triffids to proliferate all over the planet so this suggests the growth conditions on Earth were very favorable for triffid development. It is unknown if triffids leave a mucous/slime trail under its base for ease of movement, much like a snail who leaves slime tracks.

Triffid as drawn by author John Wyndham (note 'feet')

From the film, a triffid, named *Triffidus celestus*, is about 7 feet tall, mobile, prolific and a quite venomous predatory plant. Triffids have three components of a base, head, and trunk and mature triffids appear to be several hundred pounds of weight. The venomous sting is located in the head which appears to be prehensile. The flower on the head opens its petals to shoot its stinger. The stinger shoots a green paralyzing slime. The triffid base appears to be a large muscle-like root that has three appendages. The trunk is segmented like a spine so capable of bending and twisting. When not moving these appendage roots obtain nutrients from soil as a normal plant. When moving these same appendages propel the plant. Triffids appear to be all plant with no 'human' characteristics. Of interest is triffids appear to make gurgling/hissing sounds when they sense prey is close so how are these sounds made?

Once grown to mature size triffids begin to move. The triffids rip out their roots and their "feet" search or sense the soil surface. When triffids walk they appear to move like a man on crutches. The main root appendage slides forward while the rear root appendages help the plant advance for movement. This movement looks both difficult and strenuous. Based on the movement it is a wonder how leaves and branches do not break off. Even so, the triffids appear to move or 'walk' at a normal human walking pace.

Appearance and habitat

For nutrition the upper part of a triffid is like a pitcher plant in that there is a funnel-like structure containing a sticky substance which traps small prey. Triffids have flaying strap-like tentacles below their stems which act as weapons. The triffid stinger can measure about ten feet when fully extended and contact with bare skin can be deadly. The stinger appears to be gas-propelled instead of a more common coiled tendril. For

reproduction triffids release white seeds into the air for dissemination. As explained, “One light wind and they’re (triffid spores) everywhere.”

Triffid plants show tropism movement towards prey. Once prey is captured triffids use their stems like a whip to wrap around the victim in its clutches. Later in the film triffids were seen following a truck with loudspeakers on its roof with loud music playing which the triffids were seen to clearly track as it, Pied Piper-like, moved along. This suggests sound is a key element in driving triffid movements.

Bill Masen had eye surgery (cataracts?) and his eyes were covered for 10 days for healing so he did not see the cosmic display and therefore is not blind. Masen was in England when the cosmic display occurred. Later, he made it to Paris so this begs the question of how he made it across the English Channel with everyone blind? He must have taken a small boat for the journey since no plane was available.

Tom Goodwin, a marine biologist, and his wife, Karen are located on a “deserted lighthouse off the coast of Cornwall”. This is a small rocky island. Inside the lighthouse is a modest lab containing appropriate accoutrements of a biologist. Of note is a superb binocular microscope. Many triffids are seen on this tiny rocky island so this begs the question of where did they get nutrients to grow to maturity from seeds which had to arrive on the winds?

Triffid autopsy
Goodwin, a careful scientist, performs an autopsy on a captured and supposedly killed triffid (Goodwin cut its head off). After dissecting a large stem Goodwin comments, “Cortex of the root system” (the cortex is the outer layer of neural tissue of the cerebrum of the brain). Karen observes, “Is it a plant or an animal?” Goodwin responds, “If we find out how this thing functions then we might figure out an easier way of killing it.” Then, after further dissecting, Goodwin says, “It doesn’t seem to have any central nervous system. No circulation. Karen adds, “Then how does it move?” Goodwin responds, “All plants move but they don’t usually pull themselves out of the ground and chase you.” Karen continues, “They live. They grow. They have sensory response. Consume and expend energy. No matter what they’re made of there must be something that interrupts their life cycle.”

After the autopsy the triffid re-assembles itself by some sort of rejuvenation. Goodwin comments, “Like annelids, worms. You can cut them in half and you can’t kill them.”

Back in Paris, when asked, “why should they eat people?” Coker replies with, “Most plants survive on animal waste but I’m afraid this mutation possesses an appetite for the animal itself.” Which brings up an interesting question. What do triffids eat when in the wild with no humans present?

In the end, triffids were controlled and killed by ordinary sea water and when sprayed much gas is released as they dissolve into a gooey mess. Sea water has a salinity content of about 3.5% (35g/L, 599mM) which means every liter of sea water has about

35 grams of dissolved salt, mostly sodium. Would just salt only, thrown at the triffids, or put in its path, much like salting winter roads, be able to kill them? Also, if sea water can kill triffids then how did they get to this tiny island in the sea? Natural movement of ocean water releases sodium into the air and the triffids should have been able to sense this.

NAVY vs THE NIGHT MONSTERS (1966)
Mutated plants
During a Navy survey of Antarctica they discover a warm zone, a "300 square mile of ground heated by underground lakes and containing a unique type of vegetation." Samples of the vegetation, "specimens of animal and plant life from the bottom of the world", were taken and transported by plane from McMurdo Station, located on the South tip of Ross Island, to a navy base on Gow island, which according to Google is an island off British Columbia and is northeast of Kingscote Point and south of Matilda Island. Gow Island has an elevation of 65 meters and is nearby to Peter Bay. British Columbia is quite a distance from Antarctica and anything resembling a tropical climate. In the film, it is implied the island is located in the (tropical) South Pacific and described as a "rock surrounded by water".

Nevertheless, once landed on the island it is noted that all the airplane passengers were missing - they jumped out of the plane in mid-air - and the vegetative cargo was gone. On the floor of the plane is some green goo slime described by resident scientist Dr. Beecham as "some sort of liquid strong enough to eat through the floor", (sound familiar *ALIEN* fans?). After some analysis the goo is described as "very corrosive" and "acting like an enzyme".

Beecham has a nice, well-equipped and stocked lab on the island. Also present is a very nice microscope. While examining one of the plants brought back from Antarctica Beecham comments, "look at these root fibers…suggests the possibility of an exposed root system." The tree is described as looking "like undernourished cactus or something." Lieutenant Chandler is concerned about the condition of the plant, which does not look good, and Beecham comments, "plants are susceptible to shock just like animals…I could plant them in the warm soil around our hot springs that's close enough to their own environment and it just might pull them through." Another scientist comments, "these plants are most extraordinary. Like living fossils. Based on a structure unknown in present vegetation."

The tree monsters are seen on the island tarmac so they are able to move around on non-soil surfaces. The trees use branches to grab victims which it consumes/dissolves in seconds. The trees actively move, have a thick trunk, appear to be about five to seven feet tall, and have a Rastafarian-like mop top of long belt-shaped leaves. Military brass describe the trees as an "animal like plant that secretes a deadly fluid" that are "capable of crawling about on root-like tentacles." The tree branches look like hands with fingers. CPO Fred Twining was on patrol and attacked by a tree which rips off his left arm ("his arm's been torn from its socket") demonstrating the branches of the tree have a strong physical force.

Tree seedlings, appropriately nicknamed “crawlers”, are seen creeping around both on soil and on concrete. Also, “those things are multiplying. No telling how fast”, suggesting growth conditions are ideal.

When a tree is seen in a new area nurse Nora asks, “How did it get here?” Beecham responds, “In plain English, it walked here.” Nora further adds, “hard to imagine carnivorous trees that move on their own roots.” These plants reproduce through their leaf stalk crawlers, “the young of the tree”. It was also noted that the trees are all devouring omnivores and not carnivores since the trees will “eat anything, even other trees.”

One of the island residents asks, “what would create a monster like that?” Beecham responds, “Antarctica. A place where the nights are six months long. You see, normal plants can’t survive in darkness. Our friends have surface roots and a capillary system that allows them to take only the food from the very top of the soil…when winter and the long nights come they start roaming for food.”

In the end, the trees and crawlers were destroyed by napalm.

THE REVENGE OF DOCTOR X (1967)
Plant into human
For the Synergy Archives Series DVD of this film the opening credits list John Ashley and Angelique Pettyjohn as actors in the film but they never show up. The main actor, James Craig, is not listed anywhere. Amusingly, there is no revenge motive and no “Doctor X”. Nevertheless, there is something of interest here in this film.

Dr. Bragan is NASA’s chief aerospace engineer. He is clearly overworked, under too much stress, and on his way to a nervous breakdown. Bragan has worked, “365 days a year for five years” without a vacation. No wonder he is so cranky. To help, a colleague suggests Bragan spend the Summer in Japan, recuperating. Bragan agrees.

Though a NASA engineer Bragan’s interest in botany is explained, “In college, botany was my major. I was to study the relationship between the giant sequoia in California and an ancient tree in Japan.” Bragan further comments that World War II changed his view and he became a mathematician.

To start his R&R, Bragan drives up the East Coast from the Kennedy Space Center to Wilmington, NC. In the low country swamp Bragan finds a Venus flytrap which he gets. It is noted that the surrounding area where he found the Venus flytrap plant has extensive vegetation suggesting the soil is rich in nutrients, which is not conducive to flytrap growth.

In what may be difficult to understand in this post-911 age Bragan has no problem smuggling the Venus flytrap to Japan. He has the plant in a box which he carries on the

plane and *no one* in customs questioned the box nor looked inside! Once in Japan Bragan takes his plant-in-a-box everywhere, even a restaurant.

In a secluded location in the Japanese mountains Bragan and his assistant, Noriko, set up a lab in an isolated greenhouse for their work. Bragan equips his lab with all the necessary items for his planned work. Also present are major pieces of electrical apparatus, condensers and amplifiers. For this, Bragan sets up a lightning rod on the roof of the greenhouse. In describing his Venus flytrap to Noriko, who had never seen such a plant, Bragan comments, "digestive fluids more powerful than a human's." (not true; they are the same).

Bragan believes the Venus flytrap can "think, reason", and he wants to use it to prove his hypothesis that man evolved from plants (!). In anticipation of what Bragan wants to accomplish, he wants to convert the plant into a walking, carnivorous specimen, he states, "your mother was the soil and perhaps the lightning will become your father", echoing the words of Ygor's (Bela Lugosi) comment in the film, *Ghost of Frankenstein*, "Your father was Frankenstein and your mother was the lightning!". Later in the film, in reference to his creation, Bragan modifies this comment to, "Your mother was the Earth. The rain your blood. The lightning your power."

Bragan's idea is to cross-breed the Venus flytrap with a marine carnivorous plant which he called, *Venus vesiculosa*. Well, there is no such plant. However, there is the *Aldrovanda vesiculosa* or waterwheel plant, which is a carnivorous aquatic plant that captures small aquatic creatures similar to the Venus flytrap. The *A. vesiculosa* traps are arranged in whorls around a central, free-floating stem, which explains the common name. This plant species is capable of rapid movement.

A. vesiculosa is a root less aquatic plant and does not resemble the '*V. vesiculosa'* seen in the film. While scuba diving Bragan sees a sample of '*V. vesiculosa*', which appears to be about six feet long with a mop-top of long Rastafarian-like stems. The plant appears to have a hold-fast to keep it attached to the sea floor.

In his greenhouse lab Bragan takes a fluid sample (!) of the plant and injects it into the stalk of his experimental Venus flytrap commenting, "the life fluid of both plants mixed together with the highest potency of vitamins known to science." Bragan then adds, "These plants have glands (!) just like humans (he should stick to NASA engineering). Glands that determine their growth and health. I propose first to change the entire structure of those glands with these injections. Later, when I feel its strong enough I will fuse the Venus flytrap with the *Venus vesiculosa*, creating a whole new species of plant. As human as the human element itself." This is one of the more remarkable comments in all of SF cinema. Fusing two carnivorous plants which somehow makes them human! Quite the stretch and one of the many reasons why I personally love these films with their totally whacky and outrageous comments.

After hearing the above comment Bragan's assistant, Noriko responds, "But that's impossible doctor." Bragan, ever the braggart, then says, Don't tell me anything is impossible! I refuse the word impossible."

After appropriate horticulture care and feeding the Venus flytrap Bragan has been working on is quite large. Bragan removes top stems from the *V. vesiculosa* he obtained from the ocean and attaches them to the Venus flytrap. During a lightning storm the body of Bragan's creation is strapped to a gurney and lifted up to an opening in the greenhouse roof to expose it to a lightning strike. The condensers and amplifiers infuse a 'spark of life' into the creature, ala Dr. Frankenstein. The creature resembles a giant stalk of celery wearing giant red boxing glove 'hands' that open like flytrap leaf blades. These hands grab and trap. This creature is humanoid in shape with a 'face' and shoulders. The two 'feet' appear to be fleshy and bulky flytrap leaf blades. Also, large spikes or thorns extrude from its main torso and it has a leaf-like collar. This creature also develops a thirst for blood. Bragan essentially turned a Venus flytrap into a man-eating humanoid creature.

The first meal of the creature appears to be a puppy. Bragan also feeds it rabbits and rats. After further analysis of the creature's fluids Bragan comments, "Your granular count is the same count as the blood around the human heart." Not sure what that means though it sounds interesting. Bragan notices that the creature can now move as well as feel. To further nurture the creature Bragan now needs human blood to feed it. In talking to the plant Bragan adds, "There will be proof without a shadow of a doubt that man is descended from plant life…those stumps, your legs, they're strong enough to carry someone ten times your weight."

For a human blood sample for the creature Bragan commits a serious crime, murder. He sneaks into a nearby sanitarium and takes a patient's blood directly from her heart resulting in her death (blood from anywhere would have been the same; the heart gives no advantage). Back in his greenhouse lab Bragan injects the blood sample directly into the mid-torso of the creature. Seeing this Noriko comments, "You are no longer Doctor Bragan, scientist. You are becoming Doctor Bragan, madman. It is affecting your mind."

The creature releases a 'sleeping gas' from the top of its head rendering Bragan and Noriko unconscious. The creature then uproots itself and begins to move on its own volition. It is noted the creature also walks on non-soil surfaces like cement and rock terrain it its search for prey.

In the end, both Bragan and the creature fall into a lava pit. End of story.

THE FREAKMAKER (1974)
Human into plant
Also known as, "The Mutations", which is essentially a Frankenstein twist via a remake of Tod Browning's 1932 film, *Freaks*. Professor Nolter's (Donald Pleasance) world changing idea is to devise a way for man to evolve into hybrid plant/human mutations so

humans can better survive an uncertain future. To test his hypothesis Nolter kidnaps college students and injects them with plant fluids thereby creating mutations.

The opening sequences of the film show remarkable time lapse photography of various plants in motion, some more dramatic than others. Also shown are seeds taking root which gives the viewer some amazing images.

Nolter is a botanist and while giving a lecture to his college students he says, “We are all products of mutations…there are carnivorous plants that behave like animals…we do know that mutations can be induced so that instead of endless accidental changes [called evolution] we may be able to create mutations of our choice and change our species…to be induced by genetic manipulation [this would be directed evolution]. The mysterious essence called nucleic acid theoretically can be blended to create new strains, new forms of life or to recreate extinct forms of life.”

Later, at another lecture to his class Nolter says, “Imagine a new species composed of both plant and animal…plants able to move in lack of better conditions of light, soil, water. Animals able to harness the rays of the sun directly through photosynthesis. Absorbing nourishment through the exposure of light…the secret is in the DNA” (no truer words have been said, all life comes from DNA).

The laboratory we see in the film is located upstairs in Nolter’s expansive home. All annoyed scientists have labs in their home and his is just as remarkable. It is extensive and well equipped with copious glassware and instruments, including nice microscopes. Animal cages are present (he feeds rabbits to his plants). Also scattered about are his many plants some of which are unique carnivorous mutations that he developed. One entire wall has a series of glass containers interconnected with tubes that run fluids through them the purpose of which is unknown. Perhaps this setup is a purification station. The main room appears to be a greenhouse where most of his lab is located. The most remarkable is Nolter has an operating theater upstairs in his home complete with white tile walls and many electrical gizmos!

Using a syringe we see Nolter removing a sample of a poison and dropping this directly on a seed. Via time lapse photography we see the seed take root and develop. This is the essence of Nolter’s work in using some type of chemical to alter, transiently or permanently, some metabolic process in plants. In essence, create mutants. Nolter’s plants of choice are the carnivorous variety. For some of the plants Nolter comments, “Taken me years to produce.”

In one fabricated though still fun to watch scene we see Nolter using a scalpel and cuts into a branch of one of his special (fake) mutated plants. Red fluid squirts (!) out like blood (for blood to spurt means pressure so what drove this pressure in the plant?). The point being made is Nolter has figured out a way to make plants more human like complete with a blood system. He then grafts a stem with leaves into the cut he made and seals the work with tape. To support his mutated plant growth there are several hanging I.V. bottles feeding fluids to the plants. Amusingly, these fluids are of various

colors. Since plants get water from the soil via roots then Nolter has created mutated plants that are capable of getting fluids (water) sent directly into branches.

In one interesting scene Nolter is giving a colleague a tour of his lab. At one point Nolter holds a sealed glass container with a formaldehyde-preserved rat that has branches and leaves growing out of its left flank dramatically demonstrating his success in creating animal/plant hybrids, an animal with plant properties. Nolter tells his colleague, "I have spent my life trying to achieve the synthesis of two life forms. The creation of a new race of man with all the miraculous properties of a plant…we are on the verge of accelerating the mutation process."

In Nolter's lab one particular plant has the appearance of a tree trunk and is about six feet tall. Around what could be loosely called the mouth area is a horizontal Venus flytrap-like structure that opens its maw when Nolter feeds it a fully grown rabbit. This plant seemingly makes a high-pitched squealing noise so what plant anatomical structures make this noise and, more importantly, what stimulated the noise?

While the above is going on there is a subplot of members of a circus freakshow and how they are being treated by Mr. Lynch, "the ugliest man alive". Of interest, Lynch also serves as a lab helper to Nolter. It is Lynch who gets the human victims for Nolter with the vague promise that Nolter will fix Lynch's face.

Once Nolter has his victims in his lab he infuses them with various plant fluids extracted from his mutated plants so he can create "characteristics of both a plant that can move and think." After an injection a female student became the "Lizard Lady" and put on display at the circus freakshow whereas a male student became Nolter's 'plantiman'.

This plantiman that walks and talks (!) appears slightly more human than plant. When plantiman escapes Nolter's lab he leaves a bloody trail. Anatomically, plantiman has digestion processes located on special structures on his chest which resemble suction cups on an octopus. Protruding on each side of his chest are structures that, Venus flytrap-like, capture and close on prey in addition to his arms. Once captured he quickly digests his prey with lots of ooze and slime.

In Nolter's lab we get to see a point of view shot of a microscope preparation. What is amusing is the organism shown is actually a hydra, *Hydra linnaeus*, which is a small, fresh-water organism of the phylum Cnidaria and class Hydrozoa and not even close to a plant; it has no chlorophyll.

In the end plantiman attacks Nolter, dissolving and killing him, and then is burned along with Nolter's house.

What would it take for plants to walk and stalk?
To walk plants must be motile and move in response to a specific stimulus often called taxis or directed movement. In comparison, kinesis is non-directional movement. In

animals, proper walking requires muscle movement, lever action of appendages, and contraction/expansion of tissues. Without these then how can a plant move? Even slithering like a snake requires a give and take among tissues so something like this must be in the plants for them to walk.

Taxis movement is usually in response to an external stimulus such as light or food and represents innate behavioral reactions. Taxis is different from tropisms since taxis implies some sort of motility or guided movement toward or away from a stimulus. The most common form of taxis is chemotaxis which is a response brought about by chemicals (read: a chemical concentration gradient). Such chemical inducers of locomotion are referred to as chemoattractants; pollen is a chemoattractant to bees.

Plants that move need muscles or something similar to push and pull. In animals, the actin/myosin complex are proteins that push and pull to give muscle its actions. A similar mechanism, some sort of push and pull action, should be in plants that walk. Moreover, there must also be some sort of mechanism whereby the rigid cell walls of plants can be more flexible and the easiest way would be segmentation like the human spine. It is noted that the triffid stalks are segmented.

Even piston-like actions would be possible to make the plants seemingly walk where turgor pressure could build up and, in a rapid response, release it which would propel it in a directed taxis movement.

For plants to move they must have a reason to move. This means some sort of sensory system that detects something which in turn causes the plant to move in a particular direction. Do the plants sense human odors or human sound like the triffids? Perhaps the plants feel vibrations in the ground with someone walking nearby and respond.

An unresolved question is how to explain away the lack of roots for plants that walk. In the films we can readily see the plants push themselves out of the ground essentially ripping out the roots and then become ambulatory. As seedlings each of these plants started with roots for development and once reaching maturity the roots no longer became necessary since most of the adult plant nutrition would come from human prey. Another possibility is that the plant, once matured, has captured and stored enough nutrients (similar to a camel's hump) that roots are no longer necessary for nutrition or growth.

Honorable mention

I would be remiss if I did not mention other plants who move. One in particular does not walk but, rather, rolls to get places. The main stars of *Attack of the Killer Tomatoes* (plus sequels) roll everywhere, even uphill. Also, *Little Shop of Horrors* (1960) where branches and stems move and talk. Then there is Tabanga, *From Hell It Came* (1957). Tabanga is a tree that walks, does not digest, and does not appear to have any leaves so no photosynthesis occurs. Its tree roots were severed so the monster could walk. However, it was determined that Tabanga does have a pulse which is near the human rate. Tabanga has eyes, mouth, teeth, arms that bend at an "elbow", fingers that bend,

legs that bend at “knee”. This walking tree has flexible bark and it walks with a purpose so a thinking bark tree. Also, there is the *Maneater of Hydra* where a crazed botanist creates unusual carnivorous plants. He bombards plant germ plasma to create his mutants such as a cucumber that tastes like meat. Though there are other films these are a good representation of what SF plants offer.

Summary

What is of interest here is much of what we know about plants that move and eat can be attributed to Charles Darwin and though there are many such plants our particular focus here is on plants that walk. For that to happen would require some interesting biology. Even so, science does have its limits and plants that walk exceeds those limits. Nevertheless, we all know it’s not nice to fool with Mother Nature and she does not like plants that walk.

For initial growth from seeds the level of nutrients obtained from soil must be enough to sustain rapid plant growth to develop to the maturity of being carnivorous. For continued growth their level of nutrient acquisition of food as well as innate photosynthesis must be more than their respiration and energy spent moving. In adult forms feeding on an entire human would provide enough protein and water (us humans are essentially walking bags of water) for sustenance.

We clearly see triffids pollinate and the navy monsters have their crawlers for propagation but it is unclear if Doctor X’s or Professor Nolter’s plant monsters have the ability to reproduce. Being mutants these plants could be like a mule, though a functioning animal, it is sterile and so may be these plants. Doctor X’s and Nolter’s plant creations may be seedless.

Humans eat plants for ruffage so do plants that walk eat humans for ruffage? Which brings up interesting questions like what do these carnivorous plants do with human clothes? How about jewelry, rings, watches, shoes, and tooth fillings?

For plantimals, human prey provides nutrition and energy while rapid response combined with turgor pressure could be one way in which these plants can walk. Chemoattractants would orient the plantimal into a specific direction. Maybe the best defense against these plants would be adding salt and calcium to Roundup. Scary indeed.

Thank you for reading. It’s back to the lab for me. Stay healthy and eat some plants.