Chapter 2

Origin and Development of Plants

IT is believed that after the moon broke away from the still hot earth it had a diameter of about 8,100 miles. Since that time it has shrunk in size, partly due to loss of heat, but to a still greater extent due to an internal rearrangement of its molecular structure, until its present diameter is but 7,918 miles. During the cooling the viscous material slowly continued to boil, and as a crust would form, hotter material from the interior would break through and the heavier portions of the crust would sink toward the center.

The fact that solid rock does not float on molten rock like ice on water, but tends to sink, is but one argument against the old notion that there is a crust at the present day supported by a molten interior. Undoubtedly the heavier materials would sink to the center of the earth. It has even been suggested that, as gold is one of the heaviest metals, the earth has a core of almost solid gold. This, however, is mere speculation. But from what is known of the weight and density of the earth, and of other celestial bodies like meteors, it is not improbable that the earth has a core some 4,000 miles in diameter mostly composed of iron. Other metalliferous and basic rocks, due to their relative weight, would lie above this iron core, while the acid rocks, chiefly granites, being much lighter, would rise to the top of the molten metal.

It is now quite well established that the continents are built of much lighter material than the ocean beds, the ocean bottom being of basaltic rock some 3% heavier than the granitic rocks forming the continents. Some now think that the region of the Pacific Ocean is where the moon broke off from the earth, the opposite section of the earth being where the tidal bulge was simultaneously formed on the other side of the earth. This then became the region where the granite frosting floating on the plastic and heavier basalt beneath, like the frosting on a custard pie, was left after the moon broke out from close to the surface on the other side.

Professor Wegener advances a theory that is finding considerable acceptance, that the continents were anciently much nearer together than at present. Nearly all geologists now believe that underlying the crust of the earth, say some 60 miles below sea level, there exists between the more metallic interior and the outer cover a rather thin layer of basaltic rock It is also known, because the process has been duplicated in the laboratory, that under the pressure and heat known to exist in the flowage zone—below about 60 miles depth—that the rock flows like ice in a glacier, through recrystallization. While still as rigid as steel, it nevertheless flows under pressure without breaking, just as a piece of hard pitch or asphalt may be made to assume any form without breaking by subjecting it to gradual pressure. Yet the same pitch or asphalt or the same rock, if subjected to quick strain, will break like glass.

Professor Wegener believes that South America, Antarctica, Australia and India were once much closer to South Africa than at present. In fact, they seem to fit to South Africa when their shore lines are brought together. And in like manner North America seems to fit Europe. This proximity of the Old World and the New does not fail to take into account Atlantis, for its existence is well established. Certain it is, from the similarity of their flora and fauna, that the continents were connected by land at no very distant date, geologically speaking. Professor Wegener believes that these blocks of granite frosting, floating on the viscous basalt beneath, broke apart in the Tertiary Epoch, and that America drifted westward away from the Old World. Such westward floating might naturally arise from the eastward rotation of the earth on its axis, and from other known forces.

Greenland at the present time is moving away from Europe at the rate of 50 feet a year. The American continents in their westward movement are supposed to have buckled up the crust toward the west, due to the resistance offered the advancing continental edges. This gave rise to the great mountain chains of the Rocky Mountains and the Andes. Along the western, or advancing, edge of the continents there would be a tendency to many minor adjustments of the floating crust. To the east of the Old Continent, however, there would be no pushing, but the eastern edge would drop off abruptly where it juts onto the heavier basaltic ocean floor. And in reality Japan and the Philippine Islands rest on the brink of a precipice, the deepest portions of the ocean adjoining them. On the edge of such a precipice we might expect sections to slide off, or other adjustments to take place frequently. Such disturbances undoubtedly give rise to the numerous earthquakes in the region mentioned.

Professor John F. Hayford of Northwestern University and Dr. Wm. Bowie, Chief of the Division of Geodesy in the U. S. Coast and Geodic Survey, have worked out certain facts that help us understand the cause of the rise and fall and buckling of the earth's crust. They have shown that were the earth's crust cut into blocks 100 miles square and 60 miles below sea level, the various blocks would weigh the same, irrespective of the fact that some containing mountains would have larger volume. They have proved this both by astronomical and by geodic calculations, and explain that unless such an equilibrium exists the Rocky Mountains would doubtless break down the terrestrial shell. They also point out that the lightening of a block as much as 3% would be sufficient to elevate the mass 9,000 feet. And as above explained, the lighter materials are close to the surface; for a weight of a cubic foot of earth at the surface is but 21/2 times that of water, while the weight of the entire globe is 51/2 times that of water.

With a few exceptions, such as the Alabama Hills in Inyo county, California, practically every portion of the globe at one time or another and usually numerous times, has been at the bottom of the sea. The silt and sand then deposited and later compressed into shales and sandstones, or other sedimentary rock may, after the region has become dry and lifted into a mountain chain, have been removed by erosion, leaving bare the granite mountain core. But land areas in general periodically rise as mountains, to be worn down by erosion and again form sea bottoms. This is due, not only to the possible westward drift of continents shoving up regions toward the front of their movements, and to the shrinkage of the earth causing the crust to become too large and thus wrinkle like the skin of a drying apple, but also to the constant shifting of weight of the land areas.

According to the ideas of Hayford and Bowie, above mentioned, as the mountains are worn down by erosion and carried into the sea, there is an increase of weight in the region where the material of erosion is deposited and a decrease of weight in the region from which it was removed. Now if the load on a raft is moved to one side, that side of the raft sinks and elevates the other side of the raft. Land areas are rafts of rock floating on a plastic ocean of basalt. But there is this difference between them and ordinary rafts, in that the region pushed down below some 60 miles depth becomes part of the flowage zone, melts off the bottom of the raft and moves to some region of lesser weight, there to push up some other section of the earth. According to the U. S. Geological Survey there is delivered into the seas and oceans from the United States alone 783 million tons of rock materials every year.

It will be seen that as the present mountains are due mostly to a shrinkage of some 200 miles in the diameter of the earth, that before such shrinkage there were probably no mountains. This is borne out by much evidence, and there is no doubt as time passes and new mountain ranges are formed that the new ones are larger than those of an earlier date. Throughout geologic time lands have gone down as well as up, but the sum of their movements have been upward, and the sea areas have gone up as well as down, but the sum of their movement has been downward. The land is gradually getting higher and the sea is gradually getting deeper.

At the commencement of geologic time it is thought our earth had an atmosphere similar to the present one except that there was very little oxygen in it. Although the oxidation of the rocks has consumed some oxygen, the influence of plant life has steadily been to increase the oxygen content of the atmosphere and make it more suitable for animal life. It has done this by utilizing the carbon and freeing the oxygen of the carbon dioxide gas in the earth's gaseous envelope.

This carbon dioxide gas is constantly replenished by volcanic activity. Volcanoes which are now thought to be due to local regions beneath the earth's crust becoming overheated through the activity of radioactive minerals, are not unmitigated evils as they are generally regarded. Instead of being vents through which the molten interior of the earth flows, they are vents for molten pockets of rock that have become intensely heated by radioactive minerals in particular regions. And they contribute carbon to the atmosphere. Carbon is one of the three fundamental materials at the basis of life, and were there double the life on earth that there is at the present time, all life would cease; for all the carbon in the atmosphere would be in the bodies of plants and animals, and death would overtake all. Furthermore, should volcanic activity cease it would not be long before the existence of life would be impossible because of lack of carbon.

The water also, so the newer geology teaches, came out of the earth as the earth cooled, through volcanic activity and warm springs. Much of it was added, there is good reason to believe, in later geologic time. Thus the waters of the ocean tend to encroach upon the land, even while the water falling from the sky wears down the mountains and carries them out to sea.

Two mountain ranges in North America, bigger than the Rockies, were lifted up and then worn down by such agencies before the present mountain ranges were lifted up. Sand and clay and mud are all the products of rock worn down by frost and wind and rain and glaciers. From the depth and size of such sedimentation can be calculated with much accuracy the size of the mountains required in their formation. The water constantly tends to wear down and deposit land areas in the sea, and Sir Archibald Geikie calculates that if the continents were thus deposited in the sea the sea level would be raised 650 feet, and if North America remained stationary half of it would be covered by the sea to a depth of several hundred feet.

Small warpings of the earth's crust are going on all the time, due to the shifting of the weight of areas through sedimentation. Such warpings usually elevate local regions only a few hundred feet. Erosion continues on a continent until the land area is but a little above sea level—a condition which has prevailed during most of geologic time—and then, largely due to astrological tensions, the crust yields to the strain of shifted weight and slowly, near the margins of the continents, folds and breaks in the formation of ranges of mountains from 1,000 to 1,500 miles long. These are called Minor Crustal Adjustments, and at least eight are known to have occurred in North America.

At still greater intervals—also largely determined by astrological conditions—there is a more complete adjustment of the land areas the world over. As the result huge mountain ranges are formed and the continents are elevated to a much greater height above ocean level. These are called Major Readjustments, and at least six are known to have occurred during geologic time.

The elevation of such masses of land has a decided effect upon the climate. New land areas change ocean currents, new mountain ranges change air currents, and even as now it is cold on a mountain top, so excessive elevation of land areas causes the climate to become so cold that the snow does not melt as fast as it falls. The mountains first become covered with glaciers, and these lowering the temperature of surrounding territory tend to spread the glaciers until a continent may be covered with an ice sheet from the north down to a latitude where melting takes place faster than the snow falls. Geologists know of several such periods in the past— each following a very long time of warm climatic conditions—when there were decided coolings of the climate, at least four of these periods being glacial.

A moment's reflection will reveal what a terrific effect such a change has upon life that has been living in a warm climate. A glacial winter lasting thousands of years causes the seas to deepen yet decreases their area, causing swift running torrents to flow where there was only sluggish water before, shutting off moist winds from the interior and turning that interior into desert, and in a dozen other ways upsets the conditions to which life has long become accustomed.

Origin of Physical Life

So far as known, at the present time all living things come from previously existing living things through some method of reproduction. In obedience to the second law of thermodynamics (the Carnot-Clausius law) inorganic evolution moves from the more complex to the simple. But life in its evolution follows the opposite course, and moves from the simple toward the more complex. Whether it had its origin here, or was carried to the earth from some remote sphere as a spore or seed embedded in a meteoritic fragment, material science has been quite unable to account for its beginning. Lecomte du Nouy in 1947 showed by probability calculations the inconsistency of believing the appearance of the first living cell to be due to a chance combination of inorganic molecules.

Psychical researchers have found, however, that whenever physical conditions were present that would permit the manifestation of intelligence, intelligence was always present there to manifest itself. Thus has it now been demonstrated that there is an inner plane, nonphysical in nature, and not subject to physical laws, where intelligences of incalculable grades at all times persist. It is on this plane that the unconscious mind or soul of man exists while it functions through his physical body, and it is on this plane that it will continue to function and develop after the dissolution of the physical vehicle.

As psychokinesis, the power of the mind to move and manipulate physical objects, has now been amply demonstrated in many university laboratories, and psychical researchers have observed the production of ectoplasm and materializations under the influence of the mind of a medium or some other entity, there is no valid reason to believe that under proper physical conditions influenced by suitable inner-plane weather, an inner-plane intelligence could not combine the necessary molecules to form a single-cell organism, and continue to manifest through this primitive cell Such "demonstrating" a physical vehicle by an inner-plane soul longing for physical experience would be no more remarkable than the occasional amazing "demonstration" by the psychokinetic power of the mind of health or some other physical condition that most of us have had opportunity to observe. The soul, launched on the Cycle of Necessity, as explained in Chapter 4, Course 2, *Astrological Signatures*, has the power, now called psychokinesis, of attracting, molding and repelling the various forms that it needs for experience.

Whether it is the soul of a bacterium or the soul of man, it at all times resides on the inner plane. And so long as it manifests through a physical body it maintains its union with it through psychokinetic power. When, due to the stress of unfavorable inner-plane weather, which is mapped by astrology, external conditions offer sufficient resistance to the psychokinetic control of the body that it can no longer manipulate the physical functions and handle the electromagnetism—which is the boundary-line energy that links its high-velocity to the low velocity of the physical—we say the body is dead.

That, however, merely signifies that it has lost this particular physical vehicle. It still persists on the inner plane, and if it is a form of life lower than man, it strives to make contact with the germ of another and somewhat more complex physical life-form through the physical existence of which, as it grows to maturity and perhaps to old age, it can gain still other physical experiences.

The soul has two faculties that have now been amply demonstrated in university laboratories. It has the faculty of acquiring information through what is now called extrasensory perception. It can, without the aid of physical senses or reason acquire information about the distant present, the past and the future. Clairvoyance, telepathy, postcognition and precognition have now been thoroughly demonstrated. Extrasensory perception, including telepathy, is the normal manner in which information is acquired by inner-plane entities. But when an inner-plane entity forms a union with a physical body, it largely focuses its extrasensory power on the responsiveness of the physical organism and acquires most of its information from what happens to the physical body.

By the time it has acquired experience enough to be able to become united to a human being it depends very largely for its information on the sense organs and the brain. It retains its ability to get information other than through the nervous system; for it has been shown that while they may be objectively unaware of the information thus acquired, both man and animals often act successfully to adapt themselves to approaching situations of which they could have no knowledge through physical channels.

While its physical body lives, however, the soul of any life-form, including man, uses its extrasensory faculty chiefly to keep aware of what happens to that physical body. It is united with that body to get physical experience, and its extrasensory faculty is chiefly concentrated on becoming aware of physical experiences, which in man, of course, include the electromagnetic processes within the brain that give rise to objective consciousness.

As university experiments also demonstrate, when a soul unites with a physical organism for the purpose of material experience, it does not lose its power of psychokinesis. It can still, on occasions, move and manipulate physical objects without physical contact. But while thus united to a physical body, its psychokinetic power is chiefly exercised in keeping in contact with that body, and controlling its movements. Every voluntary movement made by man is due to the soul on the inner-plane exercising psychokinetic power over his motor nervous system.

What has here been stated also explains why when people exert themselves to get information through extrasensory perception they usually fail. The willing effort has been conditioned throughout a long past to concentrate the extrasensory faculties on the reports of the physical senses. What is needed, instead, is a strong desire on the part of the soul, or unconscious mind, rather than of objective consciousness, to get the information more directly without the intermediation of the physical senses.

And it also explains why intense willing usually thwarts the effort of those who try to demonstrate something through mental power. The willing process has been conditioned throughout a long past to concentrate the psychokinetic power on moving the muscles to accomplish what was desired. But what is needed is a strong desire on the part of the soul, rather than of objective consciousness, to accomplish the demonstration more directly without the intermediation of physical movement.

Other factors, which will be considered in subsequent lessons, play a part in the evolution of life-forms on the earth; but certainly the power of the soul to move and manipulate physical substance is a highly important factor in this progress from the simple to the more complex.

The First Life on Earth

Apparently as soon as the earth had sufficiently cooled and other conditions developed that made it possible for life to function here, about 1750 million years ago, inner-plane life succeeded in using its psychokinetic ability to get a foothold on this sphere. At that time the temperature probably was considerably higher than now, there was little free oxygen in the atmosphere, and sunlight was shut off by dense clouds. It is estimated that there is in the sedimentary rocks and in the fuel deposits of the earth, 30,000 times as much carbon as there is at present in the atmosphere. Higher forms of life could not live under such conditions as doubtless existed when all this carbon as carbon dioxide was in the atmosphere. Together with water vapor it must have formed an atmospheric blanket that absorbed the rays of the sun and kept the heat of the earth from radiating. Under these conditions bacteria, the lowest form of life of which we have any knowledge—although Coenocytes, Mycetocytes, certain molds and certain algae are amorphous living matter not divided into cells, while bacteria are unicellular but lacking in definite nucleus—would thrive and prosper.

Plants are dependent upon light for the assimilation of the carbon dioxide of the air, which is their chief and most essential food supply. The nitrogen bacteria have the power of assimilating free nitrogen from the air and at the same time and without the aid of sunlight can decompose carbon dioxide. They thus can live on inorganic products without the aid of sunlight, which plants are incapable of doing.

All life on earth—bacteria, plants, animals, and man—is associated with protoplasm. The four most important elements in protoplasm are nitrogen, carbon, oxygen and hydrogen, which the primitive bacteria obtained from the free nitrogen and carbon dioxide, and the water, of the air.

Among the oldest rocks of the earth formed after the process of erosion set in and conditions developed that made it possible for life to gain a foothold—estimated by the most competent authorities as 1750 million years ago—at the commencement of the Archeozoic era, are to be found immense deposits of mineral that have been formed by bacteria which have developed from the simpler form. Iron bacteria, such as Lepothrix, obtain their energy from the oxidation of iron compounds. The iron oxide so obtained being insoluble, stays in the bacteria, and when the bacteria die this iron oxide remains as a mineral deposit. Vast beds of iron ore formed in this manner are known. Sulphur bacteria in a similar manner oxidize hydrogen sulphide, and the remains of their dead bodies form huge ancient mineral deposits.

Plant Evolution

From its first appearance on earth life possessed and expressed the three hereditary drives (Chapter 5, Course 5, *Esoteric Psychology*)—the drive for significance, the drive for reproduction, and the drive for nutrition—which are the most powerful motives in human life. From the very first there is exhibited in the effort to develop new and more complex forms not required for survival—for iron bacteria and innumerable other forms of life still exist abundantly in practically the same condition that their ancestors existed when their earliest remains were deposited in ancient rocks—the drive for significance, the drive to ascend to something better. And in so doing not only did some individuals develop more complex structures, but the direction of movement of all such forms as are the ancestors of existing life-forms on earth, was toward the fulfillment of God's Great Plan (Chapter 1, Course 5, *Esoteric Psychology*). It is true that inner-plane and outer-plane environmental changes at times forced certain life-forms to alter structure and habits or perish. But there is evidence also of the drive for significance satisfied by more complex experience.

Animals are entirely dependent upon organic food for their existence, for they are not provided with chlorophyll. This organic food is supplied by plants. There are some plants—mushrooms, molds, mildews and rusts, as well as certain flowering plants—that have no chlorophyll. They must depend upon the organic food which has been gathered—that in some cases has decayed through the action of bacteria and in others yet exists in the living plant—for their food supply.

While some of the bacteria in the world today are injurious to mankind, through leaving their by-products where they poison him, yet organic life is dependent upon bacteria for continued existence. Bacteria not only assimilate free nitrogen, and change certain nitrogen containing substances in the soil into forms that can be used by higher plants, but they bring about the decomposition of dead organic material, which is essential if it is to be used by plants. All organisms give off waste products, but with the exception of carbon dioxide little of this waste matter can be used by plants until it has been decomposed, or rotted, through the action of bacteria.

The nutritive liquid of animals is blood, and this in the higher animals contains the red pigment hemoglobin. It is chemically quite similar to the nutritive liquid of plants, but differs from the latter in that a molecule of hemoglobin contains one atom of iron, whereas the simpler molecule of chlorophyll contains one atom of magnesium. And there are certain lower type animals, including some snails, in which the blood molecule, instead of either iron or magnesium, contains an atom of copper.

There are also elementary forms of life that seem to have the outstanding characteristics of both animals and plants. The dinoflagellates are algae so small as to be visible only under the microscope. They are abundant in stagnant water. They move quickly through the water by the aid of long flexible tails, and as they breathe their cellular body inflates and deflates. In these motions they resemble animals. But they resemble plants in that they are single-celled organisms containing chlorophyll and surrounded, as are many plants, by a cellulose membrane.

Life was not content with such simple existence as the bacteria. There was the urge for more complex expression. Under the stimulus of inner-plane and outer-plane environment its psychokinetic power produced alterations in some individuals which were transmitted through cell division. A very elementary plant appeared, the blue-green alga, which still exists today. In some of these, which in form and reproduction resemble bacteria, there is no nucleus and no chlorophyll. Their pigment is phycocyanin.

Certain of the blue-green algae occur as slimy blackish green films. They, like bacteria, reproduce by simple cell division. Some of them, similar to bacteria, are able to endure heat that would be fatal to ordinary plants. The sinter deposits, or formation, of the hot springs and geysers in Yellowstone Park are due to such algae. So also in cooler water the presence of a free floating form of blue-green alga, so-called but in this case red, gives the Red Sea its characteristic color.

The next step was the development of a nucleus in the cell and the ability to manufacture chlorophyll. Green plants are able to use chemical elements in such proportions as to manufacture the substance which gives to leaves their green color. This chlorophyll, in the presence of sunlight has the property of capturing carbon from the carbon dioxide in the atmosphere and releasing free oxygen. The process by which it does this is similar to that by which sunlight causes chemical changes to take place on a photographic negative, and is called photosynthesis.

The early plant, such as the green algae, consisting of but a single cell, needed a certain amount of protection, and this desire directed psychokinesis to the formation of a cellulose wall about the protoplasm within. The protoplasm in all but the very lowest plants, even as is true in all animal cells, contains a well organized nucleus. Growth in plants and animals alike takes place through cell division in which both nucleus and the cytoplasm—the protoplasm of the cell exclusive of the nucleus—split, a portion of each going into the production of new cells. The protoplasm in the body of man today may contain an infinitely small amount of the protoplasm of a primitive one-celled form of life that existed more than a billion years ago; for—even though psychokinesis was necessary to form the first primitive cell—so far as has been observed new cells are formed only by the division of cells previously existing.

Even as today it is necessary that nations cooperate, so it is evident that in many cases groups of cells could gain an advantage by co-operating. This need, recognized by the soul's extrasensory perception, was met through the psychokinetic power of its desire. As a result we find the next step in progress to be, instead of single celled plants, plants composed of a number of cells. The simplest of these are the filamentous algae, consisting of rows of cells somewhat like a chain, barely attached to one another. When such a colony of cells finally became established, the next step would be toward a division of labor, and we find a tendency in somewhat higher forms of algae for certain cells to specialize in gathering carbon from the air, and others to specialize in the storage of the food so gathered, and still others in protecting it from the evaporation of its water and the inclemencies of its environment.

Before we pass to the next step in the development of plants of more than one cell, let us pause a moment in awe before the vast work of the primitive algae that early in the geologic history of the world must literally have swarmed the seas. We are somewhat familiar with coral polyps, minute colonial animals which build islands and shore lines with their dead bodies; but such land building does not compare in its extent and importance with that of certain lime secreting algae. These calcarious algae, as they are called, are held to be responsible for the formation of the very ancient limestones. The rocks of the Grenville Series alone, a very ancient series of rocks, are nearly 18 miles thick, and half of this is limestone undoubtedly deposited by such algae. In other cases the algae and a lime secreting bacterium are jointly responsible, as in the case of the massive limestones of the Teton region.

This habit of secreting lime, which was later adopted by animal life, has a most important bearing upon any study of the past; for before this neither animals nor plants had hard parts that could be preserved as fossils in the rocks, and their presence can only be known from inference. Such an inference as to the extent of ancient life on the earth may be found in beds of iron ore and sulphur as previously mentioned, and in the existence of masses of graphyte in exceedingly ancient formation. Graphyte is never produced in nature other than through organic activity.

Most of us are familiar with green "pond scums", which are chains of algae cells, all quite alike, floating on the water. These are fresh water algae, but certain kinds that have developed from them, and become more elaborate in structure have found their way to the sea and form the green sea weeds; and others, because they secrete lime, look very much like plant corals. The bulk of marine vegetation, or seaweeds, however, have developed other traits to suit their salt water environment and belong either to the Brown Algae or the Red Algae. The red algae, which constitute the greater bulk of seaweed, is thought to be but a more complex development from green algae. The red pigment and the brown pigment, by which the red algae and the brown algae are colored, is supposed to supplement the action of the chlorophyll in utilizing the light which filters to it through the water.

The brown algae, including the giant kelps which are so common to the Pacific Coast of America and so familiar to those who visit the ocean beaches near Los Angeles, sometimes reach a length of one-hundred yards or more. They are probably not direct descendants from green algae, but from the animal-like Flaggelates, to which group the previously mentioned dinoflagellates belong.

The ancient seas were fresh, for the salt now in the sea was gradually leached out of the land. The adaptation of life to salt water, then, is of a later date than the more ancient rocks that have formed by sedimentation. The giant kelps and the red algae have solved the problem of living in salt water better than any other plants, and seem to have reached a point, due to the restrictions of their environment, beyond which further progress is impossible. Their texture is such, due to the manner in which the cells join, that while immersed in water it freely circulates through them, yet the outer cells have been thickened and toughened to form a leathery skin which, when exposed to sun and air, due to low tides, protects it from evaporation. Some of them, like the giant kelps, have developed not only an anchoring device, called a holdfast, by which one end is attached to a pebble at the sea bottom, but also hollow bladder-like buoys that may be as large as a child's head, by which their long stems, bearing floating leaves, may be made to reach the surface.

It is supposed by some naturalists that the fungi are descended from certain species of red algae. The fungi do not possess chlorophyll and depend upon other plants and animals to furnish their carbon food supply. They probably have degenerated from higher plant forms, finding an easy living at the expense of others. Parasitism, whether in plants, in animals, or if we may use the term thus, in man, is always followed by deterioration. These fungi—the molds, mildews, rusts, mushrooms, etc.—some 40,000 species of which are known—have degenerated to a very low level in plant life. They do not possess seeds, but propagate by means of spores. The smoke that issues from a puff-ball when pressed consists of millions of such spores. In the case of the familiar mushrooms and toadstools the spores are developed in the gills on the under side. In fact these gills, or flutings, open for the express purpose of dropping the myriad minute spores by which they reproduce.

Fresh water ponds are in the habit of drying up. In such instances the green algae living upon their surfaces, unless possessed of some method of tiding over the dry spell, all die. The mud at the bottom of such a pond, when the pond first dries, is moist, and the algae would cling to it for moisture, for active life either in plants or animals depends upon the protoplasm being supplied with moisture. The water gives to protoplasm a semi-fluid consistency which is absolutely essential to its movement.

Green algae, resting upon the drying bottom of a pond, would be hard pressed to prevent all its moisture being dried out by the sun, and to get an additional supply from the drying mud. The desire for life in some of these brought psychokinesis to bear to make necessary structural changes. The algae, by a thickening of the cell walls, escaped being completely dried up, and thus when the dry spell was over was able to resume normal life. These special thick-walled cells, which foreshadowed the development of seeds, are called resting spores. Some of the algae also, in their desire to follow the water as it receded into the mud and thus provide themselves with moisture, developed cells in the direction of the moisture, and these cells becoming specialized were the first roots. This was one of the greatest and most important steps taken by life since it started on our globe, for it gave rise to the ability of life to live upon the land.

Vegetable life in the water depends upon the water for support, but as life crept from the warm and shallow ponds and fresh water seas out upon the land it found it to be a great advantage to be able to lift its chlorophyll-bearing surface to the sun, that it might draw a greater food supply from the air. Some of the liverworts, which lie prostrate upon the ground, have delicate hair-like roots, and a structure not as complex as the algae, being composed of almost uniform cells. They live today as examples of what the first land plants must have been like. But with the desire strong upon them to reach the light, certain of the cells developed a harder, more compact structure, and gradually a supporting stem came into being.

With the development of firm supporting tissues the need arose also for special tissues for the rapid transportation of water, and a softer conducting tissue was developed. Not only are the liverworts prostrate, but so are some of the other low land plants such as the mosses. And to indicate that their ancestors came from the water we find that mosses and ferns are dependent upon the presence of free water for the development of certain phases of their life histories. Even as amphibious animals must return to the water to lay their eggs, and pass through the early stages of life in water, so familiar to us in the lives of frogs and toads as the tadpole stage, so these plants also may be considered amphibious.

The ferns, although reproducing by means of spores instead of seeds, are more complex in structure and in their life-histories than the liverworts and mosses. A spore is a single cell, minute in size and without sex, and in the case of the fern a number are born in each little capsule on the under side of the frond (leaf). When this spore is released and germinates it does not grow into a fern, but into a very different plant, or prothallus, a green blade about a quarter of an inch long. On the lower side of this new plant grow the sexual reproductive organs which produce the egg-cells and sperms. The sperm has a tail of minute hair-like cells by which it swims through the film of water that must be present on the blade of the plant, to the egg, which it enters and impregnates. And from this the new fern grows. In the case of the mosses the generation that produces the sexual parts is the moss plant, the other plant essential in the life cycle being the capsule which bears the spores. This lives as a parasite on its parent. Spores are not seeds, but they serve as resting bodies through which later a generation may be perpetuated, and they serve as a convenient means for distributing the species.

Somewhat more complex than, yet evidently related to, the ferns are the curious horsetails that grow in low moist ground. Some twenty-five species are known to exist at present, representing, in a meager way, the gigantic species that once existed upon the earth before the advent of flowering plants. The club mosses, also spore bearing plants, are supposed to be related remotely to the ferns, and once provided an important part of the land vegetation.

The dependence upon water for the propagation of the species became a serious handicap to land plants, just as it did to land animals, and the problem was solved much in the same way by both. In the case of a seed plant the pollen falling on the ovule develops a little tube that penetrates the egg and brings the fusion of the male and female elements that are necessary for the beginning of a new plant. This does not require the presence of water through which the sperm must swim, and has an additional advantage in that the young plant resulting from the fusion of male and female elements remains associated with the parent plant, drawing nourishment from it, and protected from inclemancies by being enclosed in a sheath and surrounded by nourishing food. When the little plant in the seed reaches a certain stage of growth its development is stopped for the time being, to begin again when the plant has left its parent and found its way into moist soil.

Seed bearing plants release their young alive, quite as effectively as do the higher animals. The young plant, or embryo, which can clearly be seen by opening a soaked pea or bean, has another great advantage over the plants growing from the sexual union of the parts that grow from a spore. The latter must procure all their own nourishment from the start. But seed plants have an abundance of food stored up in the seed to give them a good start on life's journey. They are as well provided for as the calf which grows inside its mother from an egg to considerable size before being born, and then after birth is provided with rich warm milk for six months or more. The seed plants take excellent care of their young.

The first seed plants were ferns, now extinct, but existing in great numbers during the Paleozoic era which began about 350 million years ago. These seeds were less perfect than those of today, and no fern now exists that bears seeds. The cycads and ginkgoes, once very numerous upon the earth, are clearly descended from ferns, and represent no great modification in structure. The "sago palm" of our greenhouses is one of the cycads, and the Ginkgo, or maiden-hair tree, is quite common as an ornamental tree here in California.

It is thought that the conifer, or cone-bearing trees, are modifications of certain club mosses whose fossil remains have been discovered. A small species of club moss is common on the hills of Los Angeles. The cones of conifers seem to be mere modifications of structure common to certain extinct club mosses which are known to have borne seeds. These cone bearing plants, represented most extensively by our pines and firs, are of a lower order of existence than most of our flowering trees and plants.

The thin, long, resinous foliage of our conifers is an adaptation to prevent the excessive evaporation of moisture from the plant in dry regions. Other plants of the same group, such as the Araucaria which is common in California parks, have broader leaves. These trees came into existence upon the face of the earth at an earlier date than the common flowering plants. The seed, instead of being enclosed in an ovary, is naked like those of the cycads, and is borne on the surface of a scale. These scales, bearing naked seeds on their surfaces, form the cones of familiar trees.

Even though the conifers came into existence so long ago, they have proved exceedingly successful, as our vast northern forests prove. Some of them, too, have developed an uncanny way of anticipating the future, as in the case of the fire-type pines, which hold their seeds for a dozen years until a fire destroys all other vegetation, and then, due to the heat that has passed, the cones gradually open and the seeds are deposited in the ground that has been well prepared for their being covered, and from which the competition of other growth has for the time being been eliminated.

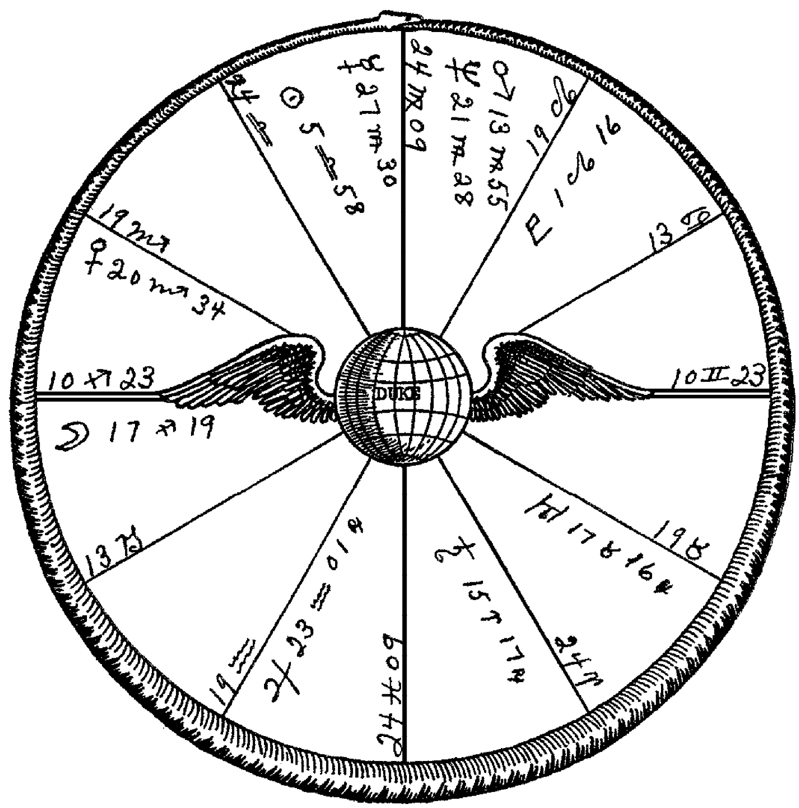
DUKE, the larger dog of Mr. and Mrs. Elbert Benjamine, was born Sept. 29, 1938, 11:00 a.m., P.S.T. 118:15W. 34:03N. Birth precisely timed. He has had only two dog friends, Pomeranians, both now dead. The smaller dog in the picture is the first of these friends for whom he showed great affection. On the dog level Duke has responded to both major and minor progressed aspects as do men. It was easy to anticipate the time and kind of ill health, good times and bad times, and the events that would come into his life.

1939, April 6, eye trouble: Mars inconjunct Saturn p.

1939, April 22, new home: Venus sextile Neptune r.

1939, May 22, injured by auto: Mars inconjunct Saturn p.

1939, July 14, long journey: Venus sextile Neptune r.



1941, Feb. 20, dog friend died: Mars semi-square Pluto r.

1942 Nov. 2, new home: Venus square Jupiter r.

1943 Aug. 2, vacation in mountains: Mars trine Uranus r.

1945, Aug. 22, master taken to hospital; refused to eat until master started to improve: Mercury semi-square Venus r.

1946 Nov. 28, dog friend died: Mercury semi-square Venus r.

1947 Aug. 22, long auto trip: Mercury semi-sextile Mars p.

1948, March 6, operation for fibroid tumor on right elbow: Sun opposition Saturn r.

1948, April 27, operation for fibroid tumor on left elbow: Sun opposition Saturn r.

1948, May 4, auto trip to Key West, Florida: Venus sextile Mercury r.

1948, Aug. 23, lost molar tooth: Sun opposition Saturn r.

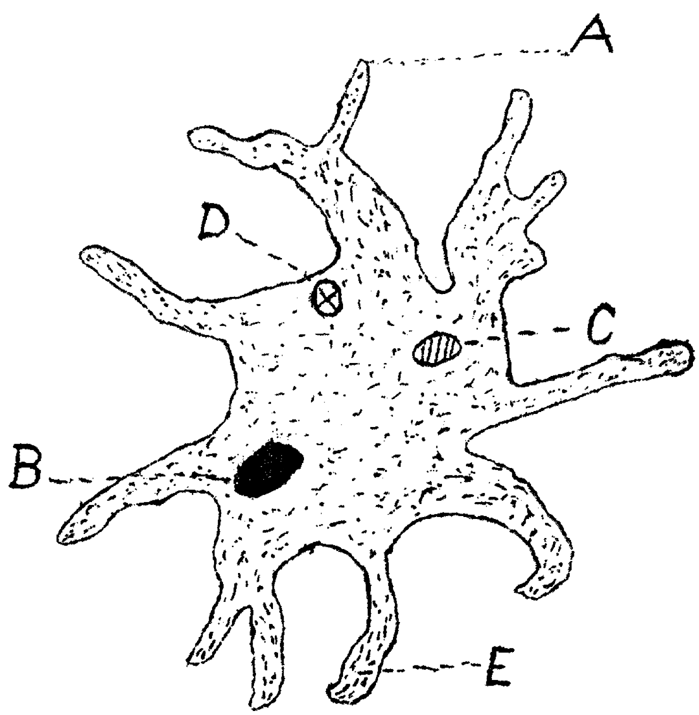


DIAGRAM OF AN AMOEBA

The amoeba is a typical Protozoan. It appears as an irregular speck of greyish jelly about 1/100 of an inch in diameter. It is common in fresh water ponds, where it oozes along engulfing other tiny specks of organic matter by flowing over them. A represents one of the outflowing lobes that surround the prey. B is the nucleus. C represents food that has been ingested. D represents undigestible pieces of food that are about to be expelled. E points to the granular structure of the protoplasm.