# Natural Alchemy of Religious Opinion
# Reptiles and Birds

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Part V. Reptiles and Birds
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In this lesson I shall discuss the development of reptiles and birds. But before indicating the environmental conditions that forced the amphibians to develop into reptiles, it will be well briefly to discuss the period of time following the Devonian, in which the first record of an amphibian appears. This record is the track of Thinopus antiquitus, founded in 1896 by the late Professor Beecher of Yale, and was presented by him to the Museum.

The fifth and sixth Paleozoic Periods are often grouped together as the Carboniferous Period.

The fifth period of the Paleozoic Age, the Mississippian Period, or Lower Carboniferous Period, began about 137 million years ago. The climate then became mild and moist and extremely favorable for the growth of rank club mosses in the low-lying swamps. The dominant life at that time were the sharks, that grew to an immense size. They were largely of the ancient type that fed upon shall-fish, and later became practically extinct. The first fossil bones of amphibians were found in the Edinburg Coal Measures in Scotland, belonging to this period.

The sixth period of the Paleozoic Age, the Pennsylvanian or Upper Carboniferous Period began about 117 million years ago. Seed bearing shrubs and trees of many kinds are known to have existed at that time, but their flowers were small and inconspicuous. The mild climate continued and throughout the swamps the coal plants reached their greatest size. These plants, largely club mosses, were of soft spongy wood and rapid growth. They propagated by means of spores, which were carried far and wide by the wind, given a uniform character to the forests all over the world. These coal swamps formed a suitable environment for spiders, scorpions, centipedes, ancient insects, snails and amphibians. Early in this period insects grew to enormous size. There are fossil cockroaches as long as one's finger, and dragonflies with a 29 inch spread of wings. None of these insects, however, had voices, or were much specialized in any direction. The climate and the plants were of a monotonous sameness, and the insects needed little complexity to meet such conditions. At the end of this period , as the climate became more arid, the reptiles developed from the amphibians, as there is direct evidence to show. This was the time in which the great coal deposits were formed through the burial of great masses of swamp vegetation, and is the period in which the first fossil remains of true reptiles have been found.

The amphibians, like our frogs, all must spend the early days of their lives in the water. In this early stage they have gills like fish for breathing in the water, and must secure their food supply there. They are thus well fitted for a climate in which at certain times of the year there are heavy rains that fill the rivers and pools, and at other times of the year there is an

arid condition in which the rivers and pools dry up.

Now toward the end of the Pennsylvanian Period, climactic conditions in certain sections grew increasingly arid. The pools and rivers not only dried up for part of the year, but it gradually came about in certain regions that they remained dry the year-round. Creatures that must lay their eggs in water could no longer propagate. Creatures that must live the early days of their lives in water find no suitable habitat.

The desire for life and expression must find some way to overcome this new condition. Therefore, in response to the surge, the subliminal mind, or astral brain, of the amphibians gradually evolved a solution. This took the form of making a more suitable egg. Additional yoke was supplied to the egg, so that the young might have a sufficient food supply to nourish it beyond the larval stage in the metamorphosis, in which it transforms from a tadpole with gills into an air-breathing animal. Henceforth this transformation would take place in the egg before hatching, as it now does in the embryo of all higher animals including man. And to protect the egg better from the inclemencies of the weather, and from drying out, it was provided with a covering, or shell. The gills were lost forever, in so far as the hatched animal is concerned, and no longer did it need to have water in which to lay its eggs. They could be laid in the dry sand and hatched by the sun. Thus the true reptile was developed, many species of which no doubt were adapted to the desert, as they are today, where they live and thrive far from any pond or stream or spring of water.

The seventh and last period of the Paleozoic Age--which was the age during which fish were the dominant forms of life on the earth--is the Permian Period. It commenced about 97 million years ago. The land areas which had risen somewhat toward the close of the previous period, continued to rise, so that after an arid regime, early in the period there was a glacial age even more rigorous in its cold than the one so recently passed, which was successfully weathered by man. The Ice Age of the early Permian times began in the Southern Hemisphere and then spread throughout much of the world. This is the time of the Appalachian Revolution, in which great mountain chains were forced up in the eastern section of the United States. These harsh conditions destroyed the old forms of plant life, that were ill adapted to the cold, and developed hardier stock. The new plants, starting in the Southern Hemisphere because the cold became severe there first, spread northward. They consisted of cycads, gingoes, modern ferns and conifer trees and became the dominant plants during the Age of Reptiles which was to follow.

The cold period destroyed many of the invertebrate animals, and they became extinct. Those that did survive have changed little up to the present. It was due to these severe winters that the insects, in order to weather the cold and live through a long period in which there was no food, devised the method by which the larvae incases itself in a cocoon, in which it lies dormant throughout the winter, to awaken when the weather again becomes warm and emerge transformed from a crawling caterpillar into a mature insect with wings. Insects previous to the Permian Period did not undergo this important change. They were compelled to devise some way to endure the long cold seasons of the early Permian times, and met the situation in this way.

Reptiles first appeared on the earth during the Pennsylvanian times, developing rapidly and specializing in many different directions during the period of aridity and cold of the Permian. In the layers of rock formed from mud and sand laid down in the Permian Period the presence of not less than five out of a total of 15 orders of reptiles have been discovered; and there is much indirect evidence that six or seven other orders were then present, such as the turtles, beaked lizards, and crocodiles.

This now brings us to a different geological age, the Mesozoic Age, (meaning age of

medieval life). It began about 85 million years ago and is often called the Age of Reptiles, because while both mammals and birds put in an appearance rather early in this age, they were not able to compete with the reptiles, but were forced to live inconspicuously. The age is divided into four periods of unequaled duration.

The first period of the Mesozoic Age, the Triassic Period, began about 85 million years ago. In the preceding period there were reptiles called cotylosaurs , and from these developed protosaurs, and from these parasuchia in the Triassic Period. Then, as modified forms from these came the dinosaurs, meaning "terrible lizard". They soon grew to be the most formidable and the largest land animals the world has ever known. Their remains are first found in the Middle Triassic period, thus representing a time some 78 million years ago. There were many other kinds of reptiles during the Mesozoic Age, but the dinosaurs dominated off for periods, becoming extinct at the close of the Mesozoic times. Their first development was undoubtedly hastened by a semi-arid climate, which compelled them to travel long distances for food and water. After they first became well established the climate underwent various changes and in response to it some of them develop new forms and habits. In fact, their habits were quite as varied as those of the mammals at the present time. Some of them were no larger than a house cat, and some like Brachiosaurus, reached a length in excess of 80 feet, weighing about 40 tons; being larger than any present-day animal except the whale. Some fed upon vegetation, but some were carnivorous, preying upon the herb eaters. Practically the complete skeleton of one of the carnivorous kinds, Allosaurus measuring 34' 2" in length, by 8' 3" high, was unearthed from Como Bluff, near Medicine Bow, Wyoming, and is now mounted on exhibit in the American Museum of Natural History, New York City.

The largest of the carnivorous species so far found is Tyrannosaurus Rex. It is 47 feet long and must have weighed as much as the largest living elephant. It stood 18 to 20 feet high, and the hind limbs, which as is common among them, supporting the weight of the body, were larger than an elephant's. The great jaws were set with teeth an inch-wide and from 3 to 6 inches long, and the feet were armed with great sharp curved claws. Being so large it could hardly move with great speed, and probably preyed upon the huge herb eating armored dinosaurs that lived at the same time. These had developed an armor of hard scales, and had horns with which to defend themselves.

There were also smaller carnivorous kinds, such as Ornitholestes, which was unearthed from the famous Bone Cabin quarry in eastern Wyoming. It was only 7 feet long, being slender and no heavier than a setter dog. In contrast to the bulky forms, it was fitted for great agility. A common feature of many dinosaurs is that they walked on their hind legs and use their heavy tail is a balancing organ and auxiliary support when at rest. Brontosaurus, one of the herbivorous species, is now mounted in the American Museum of Natural History, measuring 66' 8" long, with the weight estimated at 38 tons.

The oldest dinosaur relic is found in the rocks of Central Europe; but in a layer of rock almost as old, dinosaur remains have been found in North America. Scientists conclude from this that they probably had their origin in a landmass than existing between America and Europe, where later lay Atlantis. They spread to almost all parts of the world, being found in Southern Asia, Africa and Australia. What is now the Connecticut Valley late in the Triassic period was an arid region, like that now of the southwestern United States. The plant life there was rushes, pines and ferns with no sign of flowering plants. There were dry stream beds that occasionally became flooded with water; and extending down the valley was an estuary. In the mud about this body of water walked numberless dinosaurs, 150 species having been counted.

These footprints, some of which became uncovered, were first observed in 1802, but were

thought to be those of birds. Their true nature was discovered in 1835. The mud had changed to Brownstone, and a slab containing important records was for 60 years used as a flagstone with its reading matter turned down. This brownstone slab is now at Amherst College, and other slabs have revealed the presence of the 150 different species of dinosaurs mentioned.

For a long time it was a disputed question whether dinosaurs laid eggs or gave birth to their young alive; certain living reptiles following one method and certain ones the other. This problem was definitely settled by the American Expedition to the Gobi Desert in Mongolia, where, in 1923, they unearthed 25 fossil eggs belonging to several species of dinosaurs. In several of these, which had been broken, could be discerned the delicate bone of the embryonic dinosaur. (See Scientific American Feb. 1924) Further, it was discovered that these giant reptiles had gizzards for grinding food, linking them more closely with the birds than has hitherto been possible. These eggs were laid during the Cretaceous Period, about 30 million years ago. (The old method of reckoning 150 million years for totally wrote in, gives 10 million years)

To return now to the Triassic Period, in the upper layers of rock that were laid down at this time are found the fossil remains of the flying reptile, the Pterodactyl. Up to the present time the intermediate stages have not been uncovered as fossils, and like the Turtles, the pterodactyls suddenly appear in the strata are fully developed, making little improvement later. At the present time there is an amphibian, several species of which live in Borneo, that has developed the ability to volplane to considerable distance. It is a treat-frog which has large broadly-webbed feet, and also webs in the angles of the arms that sustain it somewhat in the air, increasing the distance of its leaps. There are also at the present day two kinds of lizards, or reptiles, that glide very well. One, the Draco, is a little lizard whose sides stick out into a pair of large wing-like membranes supported by a number of long ribs. This apparatus folds like a parachute, anticipating this invention of man, and being used for much the same purpose. The flying reptiles of the upper Triassic Period are not thought to be direct ancestors of the birds, although there is considerable structural resemblance between them. But both flying reptiles and birds are thought to have developed from a common ancester that lived in Permian times. Some of these flying reptiles-- and they not merely soared but wore capable of sustained flight-- were no larger than a sparrow. Other species were the largest creatures that ever flew. One from the rocks of the Cretaceous Period/ mounted at Yale, measures 18 feet wing expanse, and, others are estimated to have had an expanse of 26 feet 9 inches. The best specimens come from the chalk beds of Kansas. This is not the first instance in the world's history of an animal solving the problem-- which man only so recently -solved-- of traveling through the air. The insects first solved it, probably actuated by the necessity of escaping the amphibians that fed upon them, in the Paleozoic Age. But the wings of insects, while serving the function of flight, are very dissimilar in principle to those of the flying reptiles, the birds, and the bats. An insect's wing is merely an expanded and greatly modified section of the wall of its body. The wings of birds, bats, and the ancient flying reptiles/ as well as those of flying-fish, are modified front limbs. That flying-fish use this ability to soar to escape enemies-- sailing above the rater by means of very large membraneous front fins which they vibrate rapidly-- may he witnessed almost any day on the trip from Los Angeles to Catalina Island. The first fossil of a flying fish occurs also, as well as the first flying reptile, in the Triassic Period. The Triassic Period was ï¿½one of increasing aridity, which placed a premium upon the ability to travel far and swiftly in search of food and water. As a consequence/ certain reptiles learned to fly, and a large group of dinosaurs learned to run on two legs, just as today in arid regions modern lizards often tend to this mode of locomotion. An event of much greater importance than the development of the huge dinosaurs took place during the glacial period of Permian times, although the first records of it are not found until late in the Triassic Period. The cold and aridity not only placed a premium on great speed of movement, but also on the ability to

keep warm. Reptiles and fishes are very susceptible to cold. This in large measure is due to their imperfect blood circulation. The heart, unlike that of mammals and birds, has less than four chambers, and the oxygenated blood mixes with the impure blood before being sent to do its work throughout the body. Not only do the reptiles lack a pure blood stream, such as is present in the higher animals, but the heart is incompetent to keep the bloodstream active enough to maintain a constant temperature in the body. When the surrounding environment is warm the reptile or fish becomes warm, and when it becomes cool the fish or reptile becomes correspondingly cool and sluggish. This is a great disadvantage in a period of cold weather, such as Permian times are known to have been. The desire for Greater activity, and to keep a constant body temperature in the face of cold weather, set up changes in the astral forms of certain that ultimately changed their scales into hair, and developed a perfect four-chambered heart. This change was taking place before the Triassic Period. In the rocks of the ï¿½ Triassic Period in South Africa fossils have been found of a group of reptiles known as Cynodonts, that had discarded the type of teeth characteristic of reptiles, and had developed teeth like those of the modern dog. They well bridge the structural gap between reptiles and mammals. In addition to the incentive for warm blood and warm clothing, brought by the cold periods of the Permian times, in the Triassic Period there was increasing aridity, placing a high premium upon the ability to travel far for food and water in a short space of time. The more perfect circulation of both birds and mammals enables them not only to endure cold without hibernating, as do reptiles, but also conduces to greater activity. The first fossil remains of mammals are found in late Triassic rooks both in Germany and in the eastern United States. These early mammals were small creatures, not larger than a rat. Some had teeth like the present day insect eating animals, suitable to living on worms, insects, young reptiles and young birds; while the teeth of others were suggestive of the rat-kangaroos of Australia, indicating a herbivorous diet. Although the first mammal records thus date back about 75 million years, the mammals developed very little until after the commencement of the Cenozoic Age, some 45 million years later. That the mammals, which undoubtedly developed from reptiles that traveled on four legs, remained small inconspicuous creatures for a longer period than has elapsed since they first became the important form of life upon the earth has an astrological reason which will be mentioned later. Put from the standpoint of physical environment it was due to the immense number of varied forms of both large and small carnivorous dinosaurs that preyed upon all other living creatures. Only small forms of mare male that could dart into shrubbery, or into burrows in the ground, on a moment's notice could hope to survive the stalking terrors of that day; for no mammal that ever lived, with the exception of modern man armed with explosives, could have been success ful in combat with them. It was only when the age of reptiles came to an end, and all these monsters mysteriously became extinct, that the mammals had a chance to become important creatures. The second period of the Mesozoic Age, the Jurassic Period, commenced about 72 million years ago. It ushered in a mild, humid climate in which vegetation grew lush and rank in the vast swampy lowlands. As a result of this abundant and easily obtained vegetable food supply, many of the dinosaurs that had hitherto been rapid travelers and many that had been creatures of prey, resorted to the swamps and the easier method of living upon a vegetable diet. They became indolent, living much of the time in the water, and less and less adapted to a strenuous life on land. This possibly contributed somewhat to their extinction at a later period when a severe climate set in once again. Many of the dinosaurs of the Triassic period ran on two legs, and it is probable that food seeking and the desire to escape terrestrial enemies caused some of the smaller species to take to the trees. A dinosaur running swiftly over the ground on its hind, legs would be helped immensely in his speed by using its arms as does a human runner, if these became broadened to resist the air on the backward swing. This desire for speed may have been somewhat instrumental in changing the fore limbs into wings. But it is certain that some species went into the trees, and no doubt learned to perch there out of the way of predatory creatures below. They had, judging from their descendants, three long fingers provided with large claws which were used in climbing, even as modern birds the Hoactzin of British

Guiana, still retain such claws on its wings for this purpose. The pursuit of their prey would lead them to jump rapidly from one limb to another, and if possible from one tree to another. The desire thus to move rapidly through the trees without descending to the ground_ which was full of peril, if intense enough would act upon the astral form of the creature and on the astral body of its offspring, modifying it in the attempt to find a method of accomplishing the sought for results. The scales of the fore limbs and on the rear limbs, thus became modified to offer greater resistance to the air. Probably the Primitive bird used the hind limbs as well as the front ones for soaring; for in young birds such as squabs, there are quills that sprout on the legs so arranged as to indicate that in the remote past their ancestors had steadying feathers on the legs as well as wings. In present day birds these quills do not become feathers, but in the first fossil bird just such feathers are present. This development from reptile into bird seems to have, taken place in the arid Triassic Period, and as a result early in the Jurassic Period, which we are now considering, there may have been a four winged bird, although no fossil remains of it have been discovered. The oldest bird fossils so far found were buried in the sedimentation laid down in the latter part of the Jurassic Period, something like 60 million years ago. Two specimens of this bird have been found, both from a quarry at Solenhofen, Bavaria. This bird is known as the Archaeopteryx. In many respects it is more of a reptile than a bird. It has teeth in both jaws, for instance. The bones of the hand have not yet fused into a modern wing, and, although something of a wing is present, the fingers are yet armed with claws. The breast bone, which in modern birds must be very strong to support the flight muscles; is yet quite feeble. In modern birds the tail is short and the feathers disposed about it fanwise; but this primitive bird has a long tail like a lizard, along either side of which the feathers are arranged in apirs. It appears in the fossil records long after the first record of a flying reptile. Unlike the primitive mammals, which lived by stealth and so in constant dread of the terrible reptiles that they had no chance to develop; the birds, well fitted to any extremes of temperature by their feathery covering-- which in many respects is superior to hair or fur-- seem to have undergone a steady progress from the very first.

The third period of the Mesozoic Age, the Comanchian, or Lower Cretaceous Period, began about 56 million years ago. Luring this period the larger reptiles that had developed during the Jurassic period became extinct. The world was still replete with reptiles, but they were more specialized and the monsters had disappeared. This result may have been brought about by the change that took place in the vegetable world, although throughout most of the world the climate was still warm and much like that of the previous period Nevertheless, in eastern America the ferns, ginkgoes, and cycads began to take secondary place, and true flowering plants commenced to be the dominant form. The Comanchian Period, therefore, may be called the period of the rise of flowering plants. The fourth and last period of the Mesozoic Age, the Cretaceous Period, commenced about 45 million years ago. The reptiles were smaller than previously, but were numerous and had reached the height of specialization. There were numerous queer forms, some of which were almost unbelievably grotesque. Toward the end of the period great mountain chains rising, there was considerable climatic change and the reptiles were not so diverse in development/ many of the queer-looking ones having vanished. Here, for the first time, are records of the first placental mammals-- those that do not lay eggs-- the marsupials, being primitive forms of the opossum and kangaroo. The records of this period are mostly marine, the chalks of 7'nnsas producing the fossils of birds, as well as those of sharks, fishes, sea turtles, sea-reptiles, and fish- eating flying lizards. The birds of this period all retained the teeth of their reptilian ancestors. Two mounted skeletons of each of two birds from this period are preserved at Yale. One Hesperonnis, is a diving bird about four and one half feet long, that, like our penguin, had lived so exclusively in the water that it had lost the power of flight, although small wings are present. The other is a bird much like our modern gull except that it still had teeth. Among the dinosaurs there were two divergent races. One race that kept all four feet on the ground developed into the present day crocodile; and the other that moved

on two legs, developed into the birds. But toward the end of the Cretaceous Period extensive areas of land were greatly elevated and all the innumerable dinosaurs, for some reason not well understood, became extinct. I have now, very briefly and with scant detail, outlined the progress of life upon the earth over a period of more than 400 million years, down to the time when, due to the extinction of the dinosaurs after they had dominated the earth for 60 million years, the mammals began to have a chance to become important creatures. But beyond pointing out the part that desire, working through the subconscious mind, has had to play I have said little about the cause of structural progress. I can not discuss this in the detail that its importance warrants, in so limited a space; for many shelves in our libraries are filled with volumes dealing with each separate phase of the matter, such as heredity, natural selection, sexual selection, variation etc. Yet this seems to be the place to mention certain contributing factors. Natural selection is based upon the principle that those creatures that are somewhat better fitted to live in a certain environment survive, and those less fitted perish. Further, for the same reason, an organ or function that gives an individual an advantage, and therefore makes him more able to survive than his fellows who do not possess the organ or function, is preserved and passed on to his offspring. The offspring, then, by virtue of their superior adaptability, live and propagate, while less fortunate forms of life that compete with them for food and life, become extinct.

Due to the prolific tendencies of nearly all forms of life there is available space and food on earth for only a very small proportion of those that are born. As a consequence of the limited area and limited food supply, there is a bitter competition between the limitless forms for possession of this space and food. This competition takes three different directions. First there is the struggle between different species. Of two species deriving their food supply from the same sources or occupying the same territory, the one most suited to that particular environment will survive and leave offspring, and the other will perish. This principle is well exemplified in the struggle between sheep and cattle in the western United States. Cattle once throve in vast numbers on the broad western ranges. There was plenty of food, and they multiplied greatly. Then came the sheep. These could bite the grass clean to the roots, as well as live on brush and other unpalitable fare. They also left an odor where they passed that is disgusting to other herbivorous animals. Thus the cattle were forced out, for they can not live where sheep thrive. The owners of cattle and the owners of sheep then took up the struggle. The cattlemen, for a time, were greater in number and were skilled in the use of firearms. The realized that cattle could not compete with sheep, and made the issue in several sections of the West a war between cattlemen and sheep men. This struggle was carried to the courts, and finally to the legislature. Sometimes the victory is with one and sometimes with the other, but the struggle is due to the fact that sheep have developed more ability than cattle to survive when there is keen competition for food. Next, there is keen competition between individuals of a single species. This is inevitable, because the rapid rate of multiplication, if unchecked; soon fills all available space and becomes greater than the food supply. Our two worst pests-- because they carry deadly bacteria and deadly protozoa to the human race-- the housefly and the brown rat, for instance, multiply at an enormous rate. It has been calculated that the offspring of a single pair of houseflys, if they all lived and reproduced and these lived and reproduced, would in a season be so numerous that their mass would be larger than the whole earth. The offspring of a single pair of brown rats, if all reproduced and none died, in a single year would number one million. It will be seen that at such a rate of multiplication there soon would be no food left, even though flies and rats had no other competing species to reduce their food supply. We see this competition between members of the same species in the circle of our human acquaintance. There is a struggle for the dollars, for honors, and for special privileges. Some have millions of dollars and some have none, nor can find opportunity to earn their daily bread. We call ours a civilization, but surely it is not that so long as it deprives a single willing parson of the opportunity to work for enough food to live. War, too, a barbarous ancient institution is the direct result of this competition between individuals who have grouped together for mutual

advantage. But the problem of the individual's food supply and the problem of war can not be solved by any amount of sentimentality. They can only be solved by a discriminating use of carefully collected biological and sociological facts. The third form of competition is the struggle of both individuals and species with the forces of nature. Changes of temperature, in amount of moisture, storms, and changes in elevation and amount of land areas, all require fresh adjustments of organisms living in a region where such changes take place. The struggle to meet the conditions imposed by environment results in a constant shifting of living things, only those surviving that are peculiarly adapted to the conditions that obtain. Now in order that there shall be such progress as our study of the records of life in the past, and our everyday observations suggest, two things are necessary. The first is called variation. It means that in some degree the offspring may differ from the parents. The second is called heredity. It means that certain characteristics of the parents shall be presented to the offspring. Given sufficient variability, and the opportunity by which variations may become permanently established, together with heredity; and natural selection results. That is, those offspring that differ from their parents in such a way that they are better adapted to live, secure food and reproduce, will live and produce offspring similar to themselves, and those that differ from the parents in a way that endangers their survival will perish.

I cannot here enter into a discussion of Lamark's Law governing the inheritance of acquired characters. It must be apparent, however, that certain acquired character are not inheritable. Thus if a man loses a finger, or a lizard loses its tail, the offspring will not be thus mutilated. As to the method by which heredity is accomplished, the most widely heralded theory at present, although many naturalists admit it is insufficient, is Weismann's Germ-plasm Theory. According to this theory it is the chromatin of the cell-nucleus that contains the elements of inheritance. In each reproductive cell there is a given number of chromosomes. The substance of these minute spindles is called chromatin. According to Weismann's thory, in some mysterious manner, each organ and function of the body is represented by some kind of particle, or group of particles, in the chromatin. When the female egg is impregnated by the male sperm, each contribute chromosomes to the fertilized cell, As the fertilized cell subdivides and produces new cells, these likewise partake of the chromatin of the original cell, and thus the organs and functions of the parents, through this heredity-chromatin, are handed on to the offspring as minute mysterious bodies that ultimately grow into a replica of those possessed by the parents. Space will not permit a detailed analysis of the theory. It is evident, however, that plants that reproduce by cuttings, such as potatoes, and from these grow new plants that produce seeds that have chromatin, inherit the qualities of their parents other than through the chromatin-content; because chromatin occurs in the seed, and not in a potato tuber. According to the Hermetic view, that portion of the physical and mental makeup that is due to inheritance-- and undoubtedly heredity is an import ant factor-- is handed to the offspring as astral vibrations associated with whatever portion of the. parent develops into the offspring. The character of the parents resides as rates of motion in their astral bodies, which in reality are the molds of their physical bodies. This vibratory quality is associated with all the cell life of the parents, and when these cells, whether sex cells or somatic cells, develop into a new individual, they add this rate of vibration to the astral form of the new individual. This, very briefly is the Hermetic teaching. There are two other laws of heredity that deserve mention. One is Galton's Law, purporting to show that 1/2 the qualities of an individual are derived from its parents, 1/4 from its grandparents, 1/8 from its great grandparents, etc. The other is Mendel's Law, indicating how inherited characters are distributed, and that the fundamental cause of this distribution lies in the germ-plasm. This law was worked out by Mendel on peas, and later by others on rabbits, guinea-pigs, fowls, beetles, and silk-worms. It shows that inheritance is through unit-characters, and that while it can not be predicted what proportion of white and black will appear in succeeding generations from mating white and black individuals, yet once the proportion is known, it may be used with certainty as the basis of future production._ Thus if mating a white with a

black 1/4 of the offspring are found to be white and 3/4 black it may confidently be expected that in again mating black and white of the same species the same proportion of white and black will appear in the offspring. Now in order for a new species to be formed it ï¿½s necessary that some of the offspring show marked tendencies that neither of their parents had. The cause of the sudden appearance in the offspring of characters that neither parent had is held by biologists to be very obscure and mysterious. Such marked variations are called mutations, and De Vries and others have written long treatises covering their experiments and theories concerning them. It is enough here to mention that they do occur, and to give the Hermetic viewpoint concerning their cause. The very gradual changes in form and function that were once thought capable of explaining how all new species originated, are now known to be inadequate to account for some of them. The fact is that there are numerous structures and habits that have no value whatever in the preservation of the species until they are fully developed, for in the process of development they would have given the individual possessing them no advantage over other individuals not possessing them. They must have sprung into existence full formed as the result of a marked variation. Some offspring must have had them in a marked form, while their parents did not have them. In the Hermetic viewpoint there are two influences at work here. One is the intense desire of the parents to meet a certain condition. We have a case somewhat parallel to this in the phenomena of materialization. The medium does not understand the process, but there is the desire to produce phenomena of a certain type. An intelligent force occupying the astral plane, in response to this desire, dematerializes a portion of the flesh and blood of the medium and builds up a form of plastic ectoplasm outside the medium's body, and this form then becomes actual flesh and blood (See lesson #45). Here, in association with human intelligence, we see a desire for a given result, setting up subjective intelligent forces that actually bring about the result without the medium or others present knowing how it is brought about, In. the numerous examples of mental and spiritual healing at a distance we also witness the operation of a subjective form of intelligence that actually brings about physical changes in the form of a person at a distance. In the exceedingly numerous instances that may be verified by anyone willing to take the trouble, in which persons have demonstrated a certain condition or result by holding its image before the mind and desiring it, again we have instances in which a subjective form of intelligence brings about results without the objective intelligence being aware of the details regarding how the result is accomplished. This intelligent force is the mind which exists as definite rates of energy in astral substance. It has been organized by experience in various forms, and received certain of these experiences as astral vibrations through inheritance. Lower forms of life than man, also have minds, differing not in kind from man's subjective mind, but only in degree. The mind of a lower form of life, actuated by desire, is potent to effect physical results even as is man's subjective mind. Whatever power man possess, lower forms of life also possess in a more primitive and less developed degree And it is because these strong energies set up by desire change the astral form first, and because in the offspring the body is built up about this changed astral form and does not have to change a physical form already built, that marked variations occur more pronouncedly in the offspring. In addition to the physical environment, there is an astral environment that also exerts a constant pressure upon all organisms. Changes in a particular direction are stimulated and forced when the planetary vibrations exert a pressure in one way, and they are held back and prohibited when the planetary vibrations exert their pressure in another way. This is instantly comprehensible to the student of astrology; for he notes that inventions of a certain type spring into existence all over the world when the planets have a certain configuration. He notices that there is a crop of literary and intellectual celebrities that were all born at a certain period, such as the period about l809 when so may of the masters of American literature were born, as well as so many scientific man abroad. The energies, and desires, of species and races, as well as those of nations and individuals, are released by planetary configurations that modify the astral environment. Races of creatures come and go, even as the dinosaurs rose and then became extinct, not merely because of physical environment,

but because also of the pressure of the astral environment, shown by planetary .influence. There are cycles that govern human affairs, and cycles that govern evolution. This statement is too brief to be adequate, but it indicates the line of study open to those who wish to investigate fully. And to bring this lesson to a close it is but fitting that I should cite some instance of complex action based upon a creature's astral intelligence. Now in California there are many Yucca plants. There also is an insect, the Yucca Moth, that flies by night to a Yucca flower, collects the pollen from its stamens, and kneads this into a little ball which she tucks under her chin. She then flies to an older Yucca flower and lays her eggs in some of the ovules in its seed box. Finally she .applies the pollen from the little ball she carries to the tip of the pistil, thus insuring that the flower shall be fertilized and that the seeds, upon which her race depends, shall grow. She thus provided for the continuation of her race; for Yuccas do not bear seeds in regions where there are no Yucca Moths. (See The Outline of Science, by Prof. J. Arthur Thompson, page 76.)