

Natural Alchemy of Religious Opinion
Development Among Mammals
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Part VI. Development Among Mammals
by C.C. Zain

The mammals of today, are so numerous as to species-- and those of a few million years ago had species several times as numerous-- that any adequate history of their development would require several volumes. The various stages of progress of same kinds are as yet unknown, but there are a vast number that have left their bones at successive stages of development where they were covered by mud, sand, dust, or volcanic debris, to become fossils. These constitute an indelible record by which such mammals may be traced back unerringly along their genealogical tree to more and more primitive stock; link after link being added as new remains are uncovered; until all converge in the primitive creatures of the Triassic Period, some 80 million years ago. -Here, however, space will permit me to mention, and that most briefly, the progress of but a few forms; and for that purpose I have chosen something like a dozen species like the dog, lion, elephant, horse, camel, ape, rhinoceros, porcupine, bear, pig, deer, and bison, with which everyone is more or less familiar.

The Cenozoic Age, commencing, according to our time measure some 25 million years ago, is the age of mammals. And here, to prevent confusion I must mention that geologists up to a few years ago considered the Cenozoic Age lasted only 1/50 of geological time, but that investigators like Schuchert and Barren have found that it lasted 1/20 of geological time. Then, it should be borne in mind that earlier and more conservative estimates considered geological time less than half as long as the 500 million years here used; while more extreme geologists and biologists at present are calling for 1000 million years. Thus William Beebe, famous naturalist and explorer, writing in the Mentor for April 1925, speaks of the waters of the upper chalk (Upper Cretaceous) as perhaps 60 million years old, whereas we have assigned its age as but 30 million years. Our 500 million years is just about the average of present day opinion, and allows 25 million years for the Cenozoic Age, while the old figure, based on 1/50 of a shorter geological time gives the Cenozoic Age as but 5 million years. F.C. Loomis, Professor of Mineralogy and Geology at Amherst College, in 1923 using a time measure since the beginning of the Paleozoic of 100 million years, as being in accord with the old conservative estimate, instead of 225 million years as here given, states the five periods of the Cenozoic Period as follows-- Eocene 5 million, Oligocene 1 million, Miocene 1 million, Pliocene 1 million, Pleistocene 1 million; making a total of 9 million-years for the Cenozoic. Therefore, in his reading, if the student finds geological time stated according to such figures) he will know that they are based on a total geological duration of less than one half of the 500 million years pointed out by traditions as being the correct duration.

Now it should be understood that a very few little insignificant primitive mammals existed 50 million years before the Cenozoic Age. These were minute creatures, the forerunners of the modern marsupials. Their remains are found in the Triassic of North Carolina. These Allotheria, as they are called, are also found in the Triassic of Europe and the Jurassic of South Africa. In

the Cretaceous Period, something like 30 million years ago, numerous minute marsupials had developed from this older stock. And at this time, also, we find the first placental mammals, the undoubted ancestors of all modern forms.

In regard to placental mammals-- to which all mammals at present outside of Australia, with the exception of the opossums of both Americas and the Coenolestes of Ecuador and Colombia, belong-- I should explain briefly. In the first place there are found in the Triassic of South Africa a group of reptiles very closely approaching the form of the most primitive mammals. Three very primitive mammals survive in Australia even to the present time. They are the Duckmole, the Spiny Ant-eater, and the Proechidna, which is an ant-eater without a common name. These mammals have pouches in which, like the marsupials they place their young. But unlike the marsupials and like the reptiles, they lay eggs. These are large eggs containing much yolk. In the case of the Duckmole, after the eggs hatch, there are no teats for the young to suck, but the milk oozes out of numerous pores on the front of the mother's body and is licked off by the young. In the case of the Ant-eater the egg is placed in a temporarily developed pouch and when it hatches milk oozes out into the pouch. These mammals belong to the group lower than the marsupials that are called Monotremes.

The marsupials have made an advance over the monotremes. They no longer lay eggs, but give birth to their young. But unlike higher orders of mammals, the young are born very prematurely, so helpless in fact that they can not even suck. The mother takes the young one in her mouth and places it in the skin pouch and adjusts its mouth over a teat and then injects the milk down the gullet, a special arrangement of the glottis in the young enabling it to breathe while milk is being pumped down it, without danger of strangling. The kangaroo today is the most familiar marsupial. With the exception of the Dingo-- a dog probably reaching there through human agency-- all the mammals of Australia are monotremes or marsupials. This is due to the fact that Australia cut off from the balance of the world before the placental mammals had developed. In Australia there are marsupials that correspond to almost all of our mammalian orders; some being similar to our squirrels, some to our wolves, some to our hoofed animals, some to our burrowers, etc. Being isolated from the rest of the world, the development of mammals in Australia and the adjoining islands has been along independent lines. The other continents having been repeatedly connected by land since placental mammals came into existence have forms of life with much more in common.

The placental mammals, to which group man belongs, made a distinct advance over the marsupials. Prematurely born young are under a great handicap, and the death rate due to enemies and other causes is very heavy. It is a decided advantage that the young shall have reached an advanced stage of growth at birth, and thus soon be able to stand severe weather and follow the mother about, or perhaps remain hidden by her without perishing from climatic conditions. This desire for greater protection for the young developed the placenta; a tissue that links the unborn young and the mother in a prolonged partnership. By means of this tissue the blood vessels of the young are brought into close contact with the blood-vessels of the mother, and thus absorb from her dissolved nutritive matter, oxygen, water, and the necessary salts; also giving to her in return the dissolved waste products. One of the most important factors in this long sleep of the unborn young is that it enables it to be born with a well developed brain.

Even to glimpse the development of the various present day species of mammals from more ancient and primitive types it becomes necessary to know something of the interrelations of land areas throughout the world at the times when important mammalian modifications were made. I will, therefore, make brief mention of the changes in land areas that took place at different times. As Hermetic students believe, due to astrological forces, and at least due to some cause, there are periods in which land areas are elevated, new areas being formed, and existing continents connected by other land areas that form a bridge over which both plants and animals migrate from one continent to another. And there are periods in which portions of continents

sink below the sea, islands and other land areas disappear, and land bridges between continents subside leaving no way open for long lapses of time by which land creatures or plants from one continent can find their way to another.

There are various ways of accurately determining the existing land areas at any period in the past. For instance, the shell fish and other marine ferns that are able to migrate only along a coast line and never across deep bodies of water, are entirely different along the warm Asiatic coast near Japan from those occupying the coast along the Arctic Ocean. When the land, rises across Bering Strait, making a complete land bridge between Asia and America, the Arctic waters no longer flow southward along the west American Coast. Instead, the waters are warmed by the Japanese current, and the shore life from the Japanese region spreads along the continuous shore line following the land bridge, and are found all along it and well down into California. Then, when this land bridge subsides, and instead of leaving a small shallow straight, as today, the Arctic Ocean is given free access to the North Pacific, these cold waters exterminate the Asiatic forms of coast life that are suited to warm waters and we find the fossils of purely Arctic types. There is then no longer a route of migration open between Asia and North America, and the shell fish of the Arctic follow the cold waters well south along the western coast of North America. Thus, without explaining methods of determination in detail, it will be understood that when I speak of land connections between continents being made or broken, or of land areas being raised or lowered, I am not referring to tradition, but making such assertions upon sound and fully accepted scientific opinion.

Now in the Cretaceous Period, something like 30 million years ago, it is quite obvious that all the continents of the world were connected by land; for Dinosaurs that were strictly land animals have been found in the non-marine Cretaceous rocks of every continent. Because there were both marsupials and placental mammals during this period it is possible that the latter also found their way to all continents, although no fossils of placental mammals belonging to this period have been so far found in Australia or South America. South America was then undoubtedly connected by land across the Antarctic continent, which then had a mild climate, with Australia; and there is strong evidence that this connection, and a land connection between Brazil and West Africa, existed into Basal Eocene times.

The first period of the Cenozoic Age (meaning age of modern life), is the Eocene Period. It commenced about 25 million years ago, and is usually divided into two sections, the lower being called Basal Eocene, and the upper merely Eocene. In Basal Eocene times both Europe and Asia were well connected by land at the north with North America. South America was then cut off from North America and well into the Cenozoic Age; the Pacific and Atlantic being connected across Central America. The Isthmus of Panama, through formation belonging to the first periods of the Cenozoic, show marine shells which would not have been present if it had been a land area then.

The climate during the previous period, the Cretaceous, was very warm even into the Arctic regions; warm climate plants being found in Greenland. and Alaska. In Eocene times it was somewhat cooler, but still genial, as shown by the innumerable remains of great crocodiles and large palm trees in Wyoming and Idaho. North America in Basal Eocene extended further to the east than today, and Florida and the North Gulf Coast were submerged; but otherwise this continent was in shape very much as today. The Appalachian mountains, older than the western mountains, were already worn down almost to a plain with a few peaks sticking up, the highest being in North Carolina. The Rocky Mountains and the Sierras were in existence, though much lower than today, and the eastern coast and the interior were vast plains. The continent was largely forested; willows, poplars, sycamores, oaks, and other modern trees being mingled with conifers. England was temperate in climate.

Lower Basal Eocene rocks of northwestern New Mexico, and upper Basal Eocene rocks of

eastern Wyoming, South Dakota, and Montana, have yielded numerous fossil mammals; but for the most part they are types that later became extinct, leaving no descendants. All are small, no mammal of this, say 20 million years ago, ever having been found as large as a sheep. The ancestors of all modern mammals; then very small and primitive, had their origin probably in Cretaceous times on land well toward the North Pole, according to Wortman a result of his studies of the fossils at Yale. From thence, as then existing sub-tropical climate cooled, they were forced south into Europe and North America, where they displaced the more primitive forms that were less adapted to environment than they. .

In Eocene times proper, there was a submergence of the Atlantic Coast and Gulf Coast of North America, and the Gulf extended up the Mississippi Valley as a long arm of the sea. On the Pacific another long narrow arm of the sea extended up the great valley of California to Oregon and Washington. The Mediterranean covered most of southern Europe; the Pyrenees, Alps, and such great ranges not yet having been lifted. Europe was completely separated from Asia by a straight east of the Ural Mountains joining the Mediterranean with the Arctic Ocean. America and Europe were well joined by land; and the wave of mammal migration coming down into both continents from the north gave them mammals that were more nearly identical than at any time since. This is particularly true of the lowest formation of the Eocene proper, the Wasatch; extending over northern New Mexico, western Colorado, and eastern Utah, where innumerable fossil mammals have been found. Before the close of the Eocene-- shown by the Uinta formation in Green River Valley, northeastern Utah and northwestern Colorado-- the mammals had become totally different from those of Europe; for the land connecting these two continents had sunk below the sea.

In Basal Eocene the carnivorous mammals were represented by the creodonts, nothing similar to the dog family or the cat family yet being evolved. These creodonts were flesh eating mammals, with teeth very much like the cats, but with heavy tails and blunt claws. The first known member of the dog family in North America is a very small fox-like creature living about 15 million years ago, found in upper Eocene. It is believed to be a direct descendant from the primitive creodonts. It also appeared in Europe at about the same date. Furthermore-- about this period there is found in the Libian Desert of Egypt, an animal about three and one half feet high. It is the *Moeritherium*, which, although having no proboscis as yet, shows by the nasal openings the beginning of the development which finally supplies the elephant with a trunk. Fortunately the intermediate links between this short faced creature and the elephant of today, to which it is the ancestor, have been found; showing a gradual development in size and in the length of the proboscis.

The horses, on the other hand, had their origin, and most of their development, in America. *Eohippus*, the dawn horse, is found in very earliest Eocene, representing almost 25 million years ago, in Wyoming and New Mexico. It was a small graceful creature twelve inches high at the withers, with an arched hack. It has much the proportions of a fox terrier, except that the feet were already beginning to be modified from toes into hoofs. The hand had four complete toes, each with a hoof-like nail. The foot had three such toes, although a splint shows where its ancestor had another toe which had atrophied. Animals which require speed run on their toes, not flat footed. This lifts the outer toes on either side from the ground somewhat, tending to place the weight on the middle and longer toe. Thus the middle toes becomes stronger and better adapted to carrying the weight, and fortified against impact with the ground; while the outer toes, not getting much use, fail to grow. In middle Eocene, about 5 million years later, is found in Wyoming and New Mexico, *Orohippus*, the mountain horse. By that time this ancestral horse had developed in size to thirteen and one half inches tall. The splint remnant of the fourth toe had been entirely lost, the outer finger of the hand had been shortened, and the teeth had been modified. In upper Eocene, another 5 million years later, is found *Epihippus*, still larger than *Orohippus*, yet with three toes behind and four in front, but with the middle toe of each foot becoming quite dominant. From the vestigial structures of these early horses it is quite certain

that they descended, as did all present day mammals, from a five-toed ancestor. The five-toed Horse, however, while frequently mentioned, so far has not been found.

Strange as it may seem to some, North America is the original home of the camel, where he remained and developed for some ten million years, only migrating to the Old World in Pliocene times. Before upper Eocene times the camel is not to be distinguished from other small primitive mammals. But in upper Eocene distinguishing characteristics have been far enough developed that in *Protylopus*-- a creature the size of a jack-rabbit from the Uinta formation-- we can recognize the ancestor of modern camels, the intermediate steps being represented by a very complete series of fossils.

The Primate mammals, to which apes, monkeys, and man belong-- there is much evidence to show, developed from the same small insect eating mammal of the Cretaceous Period from which the carnivorous mammals developed. The descendants of this primitive Cretaceous insect eater diverged into two branches-- those that were strictly flesh eating became the carnivorous mammals, and those that adopted a strict diet of nuts and fruit, which took them into the trees, developed into the primates. The remains of these first primates are found in the lower Eocene of both Europe and North America, and the transitional forms between the insect eaters and the Lemurs are found in North American Basal Eocene of nearly 25 million years age. The first well recognized primates, such as *Pelycodus*, is found in the Wasatch formation of the Great Basin, some 20 million years old. In upper Eocene formation of the Green River Valley, the Lemur, *Notharctus*, is abundant. These Lemurs, so abundant in the northern hemisphere during the Eocene have since that time been found only in Madagascar, tropical Africa, and southern Asia, where very similar Lemurs still exist at present.

The earliest tapir is a mammal the size of a coyote, found in the Wasatch formation of the Eocene of the Great Basin of North America, of about 20 million years age. Most of the development of the tapir was accomplished in North America. It migrated into Europe during the Oligocene Period, about 10 million years ago, but only reached South America where alone it exists as a much larger animal today, in Pleistocene times, less than a million years ago.

Found in lower Eocene of North America, of about 20 million years age, is a small animal that in the course of several million years developed into a huge creature with two horns on its nose, resembling in many respects the rhinoceros. This creature, the *Titanotheres*, very numerous at one time, is not the ancestor of the rhinoceros; for it became extinct. Why it died out no one knows-- perhaps from disease, as there was no predatory animal at that time large enough to menace it. It is believed however, that the true rhinoceroses had their origin and much of their development in North America. The earliest form is a small fleet mammal without the characteristic horn yet developed, from the Wind River formation of the Eocene Periods some 18 million years old. From this developed a number of distinct forms, increasing in size as time rolled on, and finally becoming extinct in America in lower Pliocene, about three and one half million years ago.

Those animals that have an even number of toes, like the ox, deer, and pig, are called artiodactyls. The oldest member of this group yet found in the world are from the lower Eocene of the Great Basin. One of these little creatures the size of a rabbit is the ancestor of such mammals as chew the cud, like sheep, bison, etc. Another, somewhat larger, is the ancestor of the pig. Most of the development of the artiodactyls took place in the old world, to which they migrated very early.

The second period of the Cenozoic Age is the Oligocene commencing about 13 million years ago. It was marked by the rising of a land bridge between America and Europe across which mammals migrated both ways. This is shown by the close similarity of the mammals found in the White River deposits of the early half of this period in northeast Colorado, western

Nebraska, eastern Wyoming, and South Dakota, with those of Europe. The American climate was warmer than at present, although the gradual cooling that finally in the Pleistocene brought a glacial age set in during the second half of the period. In Europe the climate was sub-tropical, being even warmer than Eocene times, palms growing in Germany. The latter half of the Oligocene witnessed a great change; for the land bridge between Europe and America again subsided. As a consequence, the mammals of the two continents, as shown by the John Day deposits of eastern Oregon, being isolated from each other, and not able through interbreeding to disseminate to each other their developed characters, developed each along lines that were demanded by peculiarities of climate. Hence while early Oligocene deposits reveal mammals in America and Europe that are almost identical, by late Oligocene times the mammals of the two continents had so developed along divergent lines as to be quite dissimilar. Fortunately Oligocene formation, both early and late, yield vast quantities of fossils.

In North American Oligocene formation there have been found many different kinds of primitive cats, some of which were undoubtedly the ancestors to modern lions, cats, leopards, etc.; but none of which had yet developed into a near likeness of these. The claws, however, in some species had become well developed, and two broad groups were emerging, one with teeth gradually becoming more and more like those of present day species, and the other with the upper canine teeth greatly elongated. These became the saber-toothed group, the most terrible cats of all time, and the dominant beasts of prey down to less than a million years ago.

In Oligocene times the dog group had quite distinctly separated from the cat group although both certainly had a common ancestor in the creodonts of the previous period. The dog, represented by several species of *Daphaenus*, the largest dog of that time, was hardly larger than a coyote. The backbone greatly resembled that of the cats, and the claws were somewhat retractile, which is a cat feature. The teeth were small and had only partly developed the shearing edges characteristic of modern species, but the skull was dog-like, rather than like that of the cats.

In both Africa and India the descendants of the more primitive elephant of the preceding period had developed in size, in the height of the skull, and in the length of the proboscis. As found in Oligocene deposits its lower jaw had elongated and short tusks had developed both in the upper jaw and in the lower jaw. It, therefore had four tusks, instead of two as in modern species. This Oligocene ancestor of the modern elephant is called *Palaeomastodon*.

In North America, in lower Oligocene formation is found *Mesohippus*, a horse which had now developed to the size of a coyote, and in somewhat later formation to the size of a sheep. It no longer has four toes in front, as did its Eocene ancestor, but has three toes in front and three behind, the middle toe having developed to much greater strength and the missing toe being represented by a splint. In upper Oligocene, representing several million years later, is found *Miohippus*, which is very much like its ancestor, *Mesohippus*, except that it is much larger.

The camel of the lower Oligocene, about 13 million years ago, as shown by the White River deposits of North America, had developed to the size of a sheep, although more slender and fleet of foot. In the John Day deposits of eastern Oregon, representing upper Oligocene, some four million years later, the camels had developed into several branches-- the giraffe-camels, the gazelle-camels, and the two other groups which ultimately became the llamas and the true camels.

The primates-- monkeys, apes, etc.--became extinct in North America at the close of the Eocene period, although they existed in South America, and continue to do so. They also became extinct in Europe during the Oligocene Period, continuing their development in Southern Asia and Africa. The transitional form between *Notharctus* of the Eocene and the man-like apes was discovered by Dr. Schlosser in the Oligocene of Egypt. Another belonging to the same period,

say 11 million years ago, is *Propliopithecus*, which greatly resembles the gibbons of the present day.

There are a great many fossils of primitive rhinoceroses in the White River beds of North American Oligocene. There were three different groups, one of which was light and fleet of foot, another which was massive and slow, and still another which was the ancestor of modern species. Some of these had horns, and others not, but they were larger than their Eocene ancestors, although not nearly so large as rhinoceroses at present. Tapirs also occur, larger and with longer proboscides than previously.

In this John Day formation, belonging to the Oligocene Period, are also found primitive peccaries, and primitive giant pigs. There are found in this formation, likewise, innumerable small hoofed mammals that were developing into deer-like, ox-like, and sheep-like forms. The ox, nevertheless, mostly developed in Europe.

The third period of the Cenozoic Age is the Miocene Period commencing about 8 million years ago. The Atlantic Coast and Gulf region were again submerged, a cool current from the north driving out tropical forms along the eastern coast of America and replacing with northern forms. On the west coast the sea again extended up the California valley, leaving the tops of the Coast Range as small islands, Miocene deposits in California being as much as from 5 thousand to 7 thousand feet thick. There was a good land connection between America and Europe, but the bridge across Bering Sea was broken. Also, for the first time in the Cenozoic Age, early in Miocene times the bridge between North America and South America was formed. In late Miocene the principal elevation of the Coast Range took place, and the Sierras and plateaus of Arizona and Utah were elevated higher than previously. It was warmer than at present, although not warm enough for crocodiles to be found far north. It was even warmer in Europe, due to the continent being broken and intersected by warm arms of the sea, the climate being like that now of India. It was also a great period of mountain making in Europe.

This period is chiefly notable for the marked developments both in size and number of the mammals. Many kinds of mammals in the Miocene Period grew to much greater size than their present-day representatives; and there were far more genera and species than now. Practically all families on earth now are represented by more primitive Miocene forms, and many groups then prevalent have since become extinct. It was the period of greatest mammalian abundance, there being great numbers of hares, mice' pocket-gophers, squirrels, marmots and beavers, as well as numerous larger animals.

There were many kinds of dogs, some of which were as large as any existing bear-- truly formidable beasts. There were also true cats, developed from more primitive forms of the Oligocene Period, but not so large as the lion and tiger of the present day. The saber-tooth tigers were likewise present, having made notable advances, but not yet so large as the huge beasts that became extinct at the close of the ice age. The fossil remains of weasels; martins: otters, and raccoons are found; but these too are represented by more primitive animals than those bearing the same name today.

The elephants of the preceding period had continued to increase in size, and had developed along several different lines. One, the *Dinotherium*, found in Europe and India, had lost its upper tusks, and instead had a lower jaw that with its tusks bent abruptly downward. The four tusked mastodons increased in size and in tusk development, one genera, the *Trilophodon* found in France, not nearly so large as the Indian Elephant, had an enormously lengthened lower jaw. It represents an intermediate stage toward the development of the modern elephant. This was the first elephant to reach America, coming by way of Asia in early Miocene times, almost 8 million years ago. The members of the four tusked mastodon group are called *Tetrabelodons*.

The considerable elevation of land areas and the growing aridity of North America during Miocene times caused much of the forested regions to lose their trees and shrubbery and become broad plains covered with coarse grasses. Animals, such as the horses, that had previously fed from the succulent browse of the trees, were compelled to turn to harsher and harder food found on the plains. Also, due to the drying up of the rivers, it became necessary to travel immense distances for water. The result of this was a pronounced modification in the teeth and in the feet. There were a number of horses in Miocene times. They had increased in size to that of small ponies. Most of them were three toed, although the outer toes scarcely touched the ground, the middle toe bearing almost the whole weight, being much larger and with a well formed hoof. *Merychippus*, a horse of the middle Miocene, about 6 million years ago, is the intermediate link between the browsing type and the grazing type of horse. The milk teeth in this species are short crowned and have little cement, as in previous horses, but the permanent teeth are higher crowned and quite heavily cemented. In upper Miocene, developed from *Merychippus*, is found *Protohippus*, still having three toes, but with teeth much more similar to modern horses.

The camel of lower Miocene times, *Protomeryx*, had made a decided advance over the camel of the previous period. For one thing it is larger. All the teeth are present, which is not the case with modern camels; and the two toes instead of having cushions as at present are armed with sharp hoofs like those of a deer. The teeth also indicate a change to make them suitable for grazing rather than for browsing. The first tooth reduction is shown in *Procamelus*, a descendant belonging to the upper Miocene, showing changes in the shape of the foot and various other desert adaptations.

Descending from the ape-like creatures of the preceding period, *Sivapithecus*, found in India in middle Miocene deposits, some 6 million years old, while still an ape, has numerous man-like characteristics. From this common stock somewhat earlier in the Miocene, about 7 million years ago, the Orangutan branched off, and since that time has developed away from its human characteristics. The Chimpanzee and the Gorilla branched from the common stock in middle Miocene, some 6 million years ago. Instead of developing human characteristics, they developed other qualities, the Chimpanzee becoming less human than previously, and the Gorilla retaining in its structure about such man-like characteristics as were common to the original stock in middle Miocene times. Since middle Miocene times the living apes have mostly been developing along lines almost the opposite to those followed by the physical ancestors of man.

The bears are descended from the same ancestors as the dogs, the intermediate links having been found. Nothing that had developed far enough to be called a bear is present before late Miocene times. Its fossils are found in Europe/ and it did not reach America until the next period.

The history of the porcupines is also quite well known. They, however, underwent their development in South America, where today no less than 6 families and 29 genera are known. Some are no larger than a rat, some are large, in fact the largest living rodent, the Water-Hog, belongs to this group. Some live in trees, some in water and some in the ground, and some have long prehensile tails that they use as an extra. hand. It was not until Miocene times, when a land bridge was formed between North and South America, that porcupines are found in North America, and then only a single genus as now, represented by the present-day Short-tailed Porcupine.

The rhinoceroses of Miocene times were abundant both in North America and in Europe, and show considerable advance in size and structure over those of the preceding period. The ox and most of the deer underwent their development chiefly in the Old World, but the prong-horn antelope and the virginia deer have their ancestors well represented in American lower Miocene,- and can be traced accurately from that time to the present. Pigs were also numerous in Miocene times, but for some reason not clearly known-- chiefly astrological, no doubt-- the giant pigs, huge creatures as large as a horse, did not persist beyond the Miocene, but, together

with many other mammals, became extinct.

The fourth period of the Cenozoic Age, the Pliocene Period, commenced about 4 million years ago. It was cooler than the previous period, and a complete land connection existed between North America and Asia across what is now Bering Sea, giving a marine fauna on the Pacific Coast like that of Japan.

Early in the Pliocene the true wolves developed, some of immense size, and by middle Pliocene, about 2 1/2 million years ago, the modern genus of dogs had become established. Many cats are found in the formation, some of which are very large; both such cats as became lions and tigers, and those of the saber-tooth group. Of the elephant group of this era, now practically as large as modern genera, there was one, *Tetralophodon*, found in Nebraska, with four tusks, and a lower jaw six feet long. Another type, found over most of America, is *Dibelodon*, very much like a mastodon except that its teeth were not so developed. The mastodons, differing from the elephants in their teeth and in some other features, also were present in Pliocene times, and in America the Imperial elephant, much larger than any present-day elephant, had a very wide range.

The land bridge between America and Asia enabled horses and camels to migrate from America to Asia, and enabled elephants, now becoming somewhat similar to modern species, to migrate to America. The first of the modern horses is found both in Asia and America in upper Pliocene, about 2 million years old. The feet have one toe each, but the splints are also prominent enough to be 'dew claws' The camels of this time are somewhat more advanced in structure than those of the previous period, being represented by a mammal called *Pliauchenia*. Bears reached America during this period, and the native pigs, called *Platygonus*, were numerous and more highly developed in many respects than their modern American descendant, the peccary. There was a great abundance of rhinoceroses, four or five kinds native to America, and several others that migrated in Miocene times from the Old World. Several different kinds of ox and sheep are also present, and the prong horn antelope and virginia deer; but the moose, caribou, and wapiti, developed in Europe and did not reach America until the next period.

Nothing has been found of the primates in North America belonging to this period with the exception of a single tooth found in Nebraska of a man-like ape, or an ape-- like man called *Hesperopithecus*. In Bechuanaland, 80 miles north of Kimberly, in South Africa, however, late in 1924 there was discovered in a limestone cliff representing an age of about 4 million years, the remains of a man-like ape, called *Australopithecus Africanus*. As described it forms an intermediate link between the anthropoid apes of the Miocene and the ape-like men of the middle and late Pliocene.

The fifth period of the Cenozoic Age, the Pleistocene Period, commenced about 1,030,000 years ago. Due to a considerable elevation in land areas at the end of the Pliocene Period, the climate of the entire Northern Hemisphere was greatly cooled, ushering in a glacial age. The Pleistocene is the age of ice during which the ice sheet came down from the north reaching as far south as about 40 degrees latitude, and over New York attaining a depth of 10,000 feet. During the million years of the Pleistocene the ice came down no less than four distinct times, each time again receding. Between these intrusions of ice there were long warm interglacial periods in which the climate usually grew even warmer than it is now.

The animals of the Pleistocene Period, though different in size and in other respects from those of the present, would readily be recognized as to the general groups. to which they belong if seen today. The American Mastodon ranged the forests, and of the true elephants there were three species; the Mammoth, the Colombian Elephant, and the Imperial Elephant. There were giant wolves, and there were true cats, some of large size; as well as the Saber-tooth Tiger, which was more massive than any living tiger. There were camels that were considerably larger

than those of the present. There were also several species of true horses, with a single hoof on each foot, and there were bisons that were much larger than any existing species. Moose, Caribou and Wapiti had reached America from Europe, and there were huge cave bears in various parts of the world. Furthermore, there were huge ground sloths, and armored glyptodonts and a number of other mammals that have since become extinct. But in addition to these extinct forms there were those with which we are familiar such as the peccary, mink, weasel, martin, skunk, otter, badger, wolverine, raccoon, fox, coyote, puma, etc-- all present in America. And as there were rigorous climatic changes the competition between forms and the struggle to survive must have been exceedingly intense.

Such a brief survey of the development of mammals is not altogether satisfactory, yet at least I trust it will show conclusively that all existing forms have developed from more primitive preexisting mammals. In many cases complete series of fossils have been found showing the chief steps by which changes in structure were made, so that to doubt their genealogy is to doubt the evidence of one's eyes.

A study of these fossils indicates that whenever the members of a single species separated over a long period of time with an impassible barrier between, such as the destruction of a land bridge between two continents, or in some cases by a desert, or a broad river, or a mountain range; that the members of each region developed along different lines. No longer able to commingle and breed, and thus impart developing qualities each to the other; being in a different environment; they each develop qualities called for by that environment. Both in structure and in habit they become further and further apart, until they become distinct species. We have witnessed the creation of breeds by artificial selection; for all the tame pigeons-- fan-tails, pouters, carriers, etc-- are known to be derived from the rock pigeon; and all domestic chickens are known to be descendants of the Jungle Fowl of India. There are instances, also, within the knowledge of an of new species being the result of isolation. Rabbits, for instance, were turned loose by mariners on certain islands off the southwest coast of Europe several hundred years ago. These rabbits, although of the same stock as rabbits on the mainland, are today a totally different species; quite incapable of breeding with the rabbits of the mainland.

I believe, however/ that it is a great mistake to account for the progress of life-forms merely through their mechanical response to environment. In the first place, any small variation in a single individual would tend soon to be lost through breeding with individuals not so endowed. The lengthening of the elephant's trunk, I believe, was not due to the survival of those elephants that had a trunk an inch longer than their fellows, and those dying that had a trunk an inch shorter; but to astrological and psychological causes. There was need of a longer nose, and gradually this consciousness worked into the creature's subconscious mind. Then when the rays of planetary energy became propitious to stimulating such development this desire began to manifest itself as a long nose, not merely in isolated individuals, but in the whole group. The process once started, there was a continuous development of the trunk, even those not having it so long as others living to have offspring. A thorough discussion of this complex problem can not be here undertaken, but I feel sure that the development of one form into another will never be completely understood until the power of the astral consciousness to mould the form is acknowledged, and the power of astrological forces to stimulate waves of development in certain directions is known.

