Chapter 6

Development Among Mammals

ONLY a portion of the mammal species that existed a few million years ago have survived to this day. Yet the species that have survived are so numerous that any adequate history of their development would require several volumes. The various stages of progress of some kinds are as yet unknown; but there are a vast number which 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 modern mammals may be traced back unerringly through their genealogical chain to more primitive stock; link after link being revealed as new remains are uncovered, until the chain disappears in the primitive creatures of the Triassic period some 170 million years ago. Here, however, limitations of space will permit me to mention, and most briefly, the progress of only a few forms. And for that purpose I have selected a dozen species of mammals with which everyone is somewhat familiar, for they can be seen at any time on the farm or in the zoo: the dog, lion, elephant, horse, camel, ape, rhinoceros, porcupine, bear, pig, deer and bison.

It should be understood that only a few small and insignificant primitive mammals existed up to the commencement of the Cenozoic era about 55 million years ago. These minute creatures were the forerunners of modern marsupials. Their remains are found in the Triassic of North Carolina. These Allothera, as they are called, are also found in the Triassic of Europe and the Jurassic of South Africa.

That they must have had a terrible time trying to survive is indicated by the record that for 115 million years, more than twice as long as since their enemies, the dinosaurs, disappeared and gave them a chance really to progress, they remained little, sly creatures which were constantly on the dodge to keep from becoming food for the big lizards that dominated the world. But as soon as the dinosaurs disappeared they started rapid progress. And it may be assumed that the conditions under which they lived, with their lives in danger every moment, previous to this time had sharpened their wits and given them considerable intelligence. The dinosaurs, on the other hand, are noted for the minuteness of their brain in comparison to their brawn.

Even before the extinction of the dinosaurs, the little ancestors of modern mammals had made some progress, for in the Cretaceous period of about 90 million years ago there are found the fossils of numerous minute marsupials

which had developed from the older stock. And apparently contemporaneous with them, as indicated by their fossils, were also the first placental mammals, the undoubted ancestors of all modern forms. But all of both types, until the dinosaurs vanished, were constantly forced to hide, and given no opportunity to develop size.

The mammals of today all are of the placental type, with the exception of the opossums of both Americas, the Coenolestes of Ecuador and Colombia, and certain primitive types which live in Australia. In the Triassic of South Africa a group of reptiles has been found which very closely approaches the form of the most primitive mammals. Three such primitive mammals, which have made little progress above the mentioned advanced reptiles, survive in Australia even to the present time. They are the duckmole, the spiny anteater, and the proechidna, which is an anteater without a vernacular name.

These mammals have pouches in which, like the marsupials, they place their young. But as do the reptiles, and unlike the marsupials, they lay eggs. They have never reached the stage of caring for their young by retaining them in their body until they are mature enough to make the hazards of external life less dangerous. The eggs they lay are large and contain 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 anteater 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. They are known as Monotremes. They seem to represent the transition stage between lizards and placental mammals. It appears that the desire to protect their young from the rigors of difficult environment had stimulated extrasensory perception and psychokinesis, and that psychokinesis guided by extrasensory perception had actually taken a long step to attain this desire; for, unlike the young of reptiles, their young are provided nourishment, the forerunner of true milk, until they are husky enough to forage for themselves. But as yet they have not provided the fuller protection that the placental mammals have devised for their offsprings.

Neither have the marsupials, although they have made a decided advance in this respect over the monotremes. They no longer lay eggs, but give birth to their young. But unlike higher orders of mammals, the young are born prematurely, so helpless in fact that they cannot even suck. Thus the marsupials have only partially solved the problem. The mother takes the young one in her mouth and places it in the skin pouch and adjusts its mouth over the teat and then injects the milk down its gullet. A special arrangement of the glottis in the young enables it to breathe while milk is thus being pumped down it, without danger of strangling.

The kangaroo is the most familiar marsupial of today. With the exception of the dingo—a dog presumably reaching there through a human agency—all the mammals of Australia are monotremes or marsupials. This is due to the fact that Australia was cut off from the balance of the world before the placental mammals developed. In Australia there are marsupials that have solved most of the other problems solved by various species of more developed mammals. Some are similar to 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 re-

peatedly been connected by land since placental mammals came into existence, have forms of life with much more in common.

That marsupial mammals and placental mammals solved the problem of adaptation to similar environmental conditions along almost identical lines, even though the problem could have been solved in different ways, was probably as much due to extrasensory perception and the inner-plane weather favoring this particular solution, as to the outer-plane conditions.

The Placental Mammals

The placental mammals, to which group man belongs, made a distinct advance over the marsupials. Premature young are under a great handicap. The death rate due to enemies and climatic conditions is high. It is a decided advantage that the young shall have reached an advanced stage of growth at birth, and thus soon be able to endure severe weather and follow the mother about, or perhaps remain hidden by her without perishing.

This desire for greater protection for the young brought psychokinesis into play in the development of 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 functions in this long sleep of the unborn 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. Due to shrinkage of the earth, and to the impact of inner-plane weather, land areas rise and sink. There are periods in which portions of continents sink below the sea, islands and other land areas disappear, and land bridges that previously have connected 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 of the past. For instance, the shell fish and other marine forms 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 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 is found all along it and well down into California.

When this land bridge subsides, and instead of leaving a small shallow strait, as today, the Arctic Ocean is given free access to the North Pacific, these cold waters exterminate the Asiatic form of coast life that are suited to warm waters, and we find the fossils of the 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 taking the space to go into 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 the assertion upon sound and fully accepted scientific opinion.

In the Cretaceous period, something more than 55 million years ago, it is quite certain that all the continents of the world were connected by land; for dinosaurs, which were strictly land animals, have left their fossils in the non-marine Cretaceous rocks of every continent. Because there were both marsupial and placental mammals during this period, it is possible that the latter also found their way to all the continents, although no fossils of placental mammals belonging to this period have thus far been found in Australia or South America. South America was then connected with Australia by land across Antarctica, which then had a mild climate; and there is strong evidence that this connection, and a land connection between Brazil and West Africa, existed into Basal Eocene times.

Eocene Period

The first period of the Cenozoic era (meaning era of modern life) was the Eocene, which commenced about 55 million years ago. It 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 continued thus cut off well into the Cenozoic era, the Pacific and Atlantic being connected across what is now Central America. The Culebra Cut of Panama, through formation belonging to the Eocene period, reveals marine shells which would not have been present if it had then been a land area.

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 now. The Appalachian Mountains, older than the western ranges, were already worn down almost to a plain with a few peaks sticking up, as peaks thus stick up at present in large areas of Texas, the highest being in North Carolina. The Rocky Mountains and the Sierra were in existence, thought 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 Eocene rocks of northwestern New Mexico, and Upper 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 say 50 million years ago as large as a sheep ever having been found. 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 as a result of his studies of the fossils at Yale. From thence, as the then sub-tropical climate cooled, they were forced south into Europe and North America, where they displaced more primitive forms that were less adapted to environment than are those of today.

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 strait 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, where innumerable fossil mammals have been found. Before the close of the Eocene, as 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 having evolved. These creodonts were flesh eating mammals, with teeth very much like 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 40 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 Libyan 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 supplied 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 length of proboscis.

The horse, on the other hand, had its origin, and most of its development in America. Eohippus,-the dawn horse, is found in the very earliest Eocenes laid down about 55 million years ago, in Wyoming and New Mexico. It was a small graceful creature twelve inches high at the withers, with an arched back. It had 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 become stronger and better adapted to carrying the weight, and fortified against the impact of the ground; while the outer toes, not getting much use, fail to grow.

In Middle Eocene, about 10 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 front 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 35 million years, only migrating to the Old World in Pliocene times. Before the Upper Eocene the camel is not to be distinguished from other small primitive mammals. But in Upper Eocene distinguishing characteristics were far enough advanced that in Protylopus, a creature the size of a jack rabbit in 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 mammals of the Cretaceous period from which the carnivorous mammals developed. The descendants of this primitive Cretaceous insect eater diverged into two branches: those which were strictly flesh eating became the carnivorous mammals, and those which 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 America, and the transitional forms between the insect eaters and the Lemurs are found in North American Basal Eocene of about 50 million years ago. The first recognized Primate, such as Pelycodus, is found in the Wasatch formation of the Great Basin, some 45 million years old. In Upper Eocene formation of the Green River Valley, the Lemur, Northarctus, 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 45 million years ago. Most of the development of the tapir was accomplished in North America. It migrated into Europe during the Oligocene period, about 25 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 the Lower Eocene of North America, of about 50 million years ago, 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 developed, from the Wind River formation of the Eocene period, some 45 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 which have an even number of toes like the ox, deer and pig, are called artiodactyls. The oldest members of this group so far found 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, as do sheep, bison and cattle. 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.

Oligocene Period

The second period of the Cenozoic era is the Oligocene, commencing about

35 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 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 undoubtedly were the ancestors of modern lions, cats, leopards, etc.; but none of which had 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 sabre-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 the lower Oligocene formation is found Mesohippus, a horse which now had developed to the size of a coyote, and in somewhat later formation to the size of a sheep. It no longer had four toes in front, as did its Eocene ancestor, but had 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 35 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 15 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 still continue there. They also became extinct in Europe during the Oligocene period, continuing their development in Southern Asia and Africa. The transitional form between Northarctus of the Eocene and the man-like apes was discovered in the Oligocene of Egypt. It is Propliopithecus, which lived about 30 million years ago, and 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 had none, but they were larger than their Eocene ancestors, although not nearly so large as rhinoceroses at present. Tapirs also occur, larger and with longer proboscises 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.

Miocene Period

The third period of the Cenozoic era is the Miocene period, commencing about 19 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 them 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 formations in California being as much as from 5 thousand to 7 thousand feet thick. There was a good connection between America and Europe, but the bridge across Bering Sea was broken. Also, for the first time in the Cenozoic era, early in Miocene the principal elevation of the Coast Range took place, and the Sierra 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 of India. It was also a great period of mountain making in Europe.

This period is chiefly notable for the marked development 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 of mammals now on earth 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

the more primitive forms of the Oligocene period, but they were not so large as the lion and tiger of today. The sabre-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 have been 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 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, about 18 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 previously had fed upon the succulent browse of the trees, were compelled to turn to the 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 toe scarcely touched the ground, the middle toe bearing almost the whole weight, being much larger and a well formed hoof.

Merrychippus, a horse of the Middle Miocene, about 15 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 Merrychippus, is found Protohippus, still having three toes, but with teeth much more similar to those of the modern horse.

The camel of Lower Miocene times, Protomoryx, 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 15 million years old, while still an ape, has numerous man-like characteristics. From this common stock, about 18 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 15 million years ago. Instead of developing human characteristics, they developed other qualities, the Chimpanzee becoming less human than previously, and the Gorilla retaining its structure about such man-like characteris-

tics 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 of those followed by the 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 Wart-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 species, 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 numerous in Miocene times, but for some reason not clearly known, but which no doubt was influenced by inner-plane weather, the giant pigs, huge creatures as large as a horse, did not persist beyond the Miocene but, together with many other mammals, became extinct.

Pliocene Period

The fourth period of the Cenozoic era, the Pliocene period, commenced about 7 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 4 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 sabre-tooth group. Of the elephant group of this period, 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, that then roamed the hills about Los Angeles and had a very wide range, was larger than any present day species.

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 America and Asia 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 the 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 Pliocene 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 Kimberley, in South Africa, late in 1924, Dr. Raymond Dart, professor of anatomy at the University of Witwatersrand discovered in a limestone cliff which at the time was thought to date well back in the Pliocene, the remains of a man-like ape, which he called Australopithecus africanus (Southern man-like ape of Africa). Some even yet are inclined to place this find back as far as the beginning of the Pliocene, 7 million years ago, basing their opinion chiefly on geological evidence. But in the 24 years since he made this find Dr. Dart, and Dr. Broom, chief paleontologist of the Transvaal Museum were able to find fossils representing possibly 15 individuals. And chiefly because of their high intelligence, as they were using fire, Dr. Dart now wishes he had named these Transvaal pygmies, which are believed by some to be the ancestors of modern man, Homunculus (little man). And according to an article by him in the Autumn, 1948, issue of American Journal of Anthropology, he places them contemporaneous with the Men of Java, who lived at the commencement of the Pleistocene period, about one million years ago.

Pleistocene Period

The fifth period of the Cenozoic era is the Pleistocene period which commenced about one million years ago. Due to considerable elevation in land areas at the end of the Pliocene period, the climate of the entire Northern Hemisphere was greatly cooled, ushering in the glacial age. The Pleistocene is the age of ice during which the ice sheet came down from the north reaching as far south as 40° latitude, and over New York attaining a depth of 10,000 feet. During the 970,000 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 interglacial periods in which the climate usually grew even warmer than it is now.

At the commencement of the Pleistocene period had there been a primitive explorer roaming over America he would have found all the southern part of what is now the United States covered with such spruce and pine as at present grow in Canada. Had he gone north through this thick forest, he would have been stopped abruptly by such a wall of ice as is now to be seen when approaching Antarctica. It extended from what is now New York City to the State of Oregon, covering all of Canada and at least half of the United States.

In addition to the elevation of land areas, climatic changes are also influenced by the relation of the earth to the sun. Not only by the variation of the inclination of the earth's axis to the ecliptic, but also by the distance of the earth from the sun. The earth's orbit fluctuates considerably. It was elongated some 100,000 years ago, then was almost circular about 50,000 years ago, became elongated again in 20,000 B.C. and now is once more moving toward the circular. It will reach its nearest circular shape in about 20,000 years. Except as influenced by terrestrial conditions, the weather gets colder when the

orbit elongates, and warmer when it is more circular. Therefore, we are now moving toward a warmer climate which will be at its hottest about 20,000 years from now, when it is expected tropical vegetation will grow on the shores of the Arctic Ocean. But, according to George Gamow, professor of physics at George Washington University, large masses of ice will again start creeping down from the north, by about the year 50,000 A.D., as the fifth glacial advance, and will completely cover all the cities of Canada and northern United States.

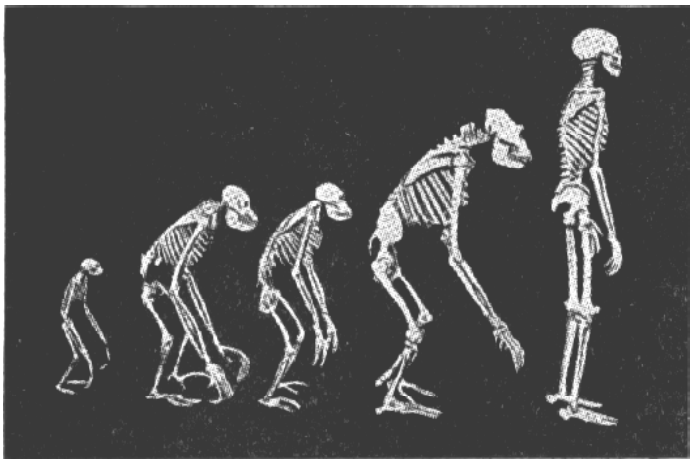
The animals of the Pleistocene period, though different in size and in other respects from those of the present, would readily be recognized as the general group to which they belong if seen today. The American Mastodon ranged the forests, and of the true elephants there were three species: the Mammoth, the Colombian Elephant, and the Imperial Elephant. There were giant wolves, and there were true cats, some of large size, as well as the Sabre-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 bison 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.

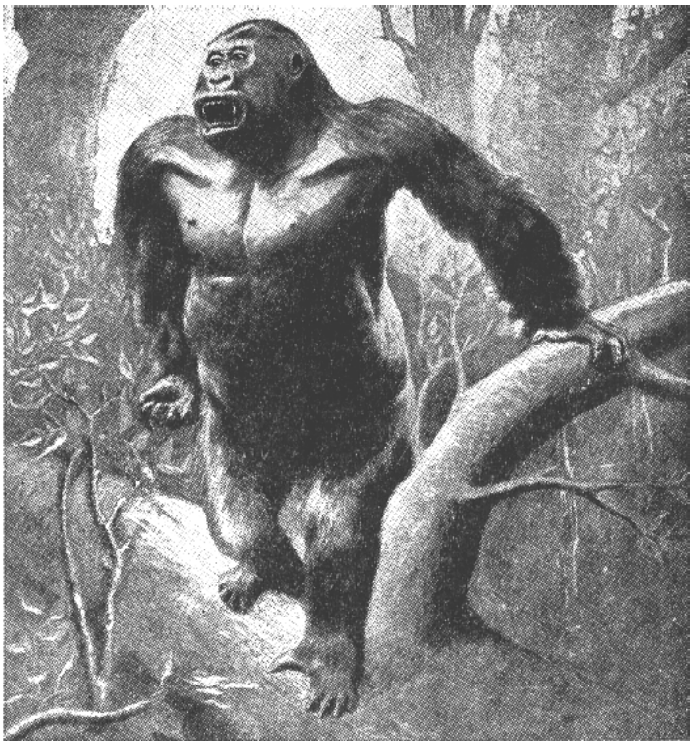
Such a brief survey of the development of mammals is not altogether satisfactory, yet at least I trust it shows conclusively that all existing forms have developed from more primitive preexisting mammals. In many cases complete series of fossils have been found showing the chief steps by which changes 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 members of a single species separated over a long period of time with an impassable 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.

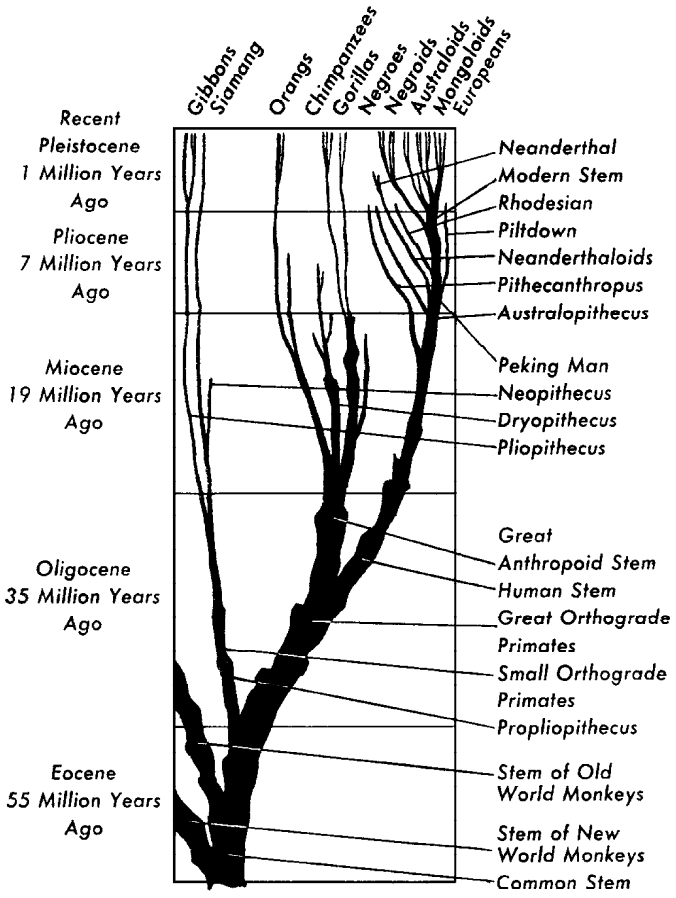
We have witnessed the creation of breeds by artificial selection; for all the tame pigeons—fantails, pouters, carriers, etc.—are known to be derived from the rock pigeon; and all domestic chickens are known to be descendants of the Jungle Fowl of India. There are instances, also, within the knowledge of man 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.



From left to right are the skeletons of the gibbon, orang, chimpanzee, gorilla, and man, showing transition to the upright posture.



The gorilla, man's nearest living kin.



Man's geneological tree.