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ORIGINS OF INDIANA'S MAMMALS

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The origins of Indiana's mammals are not essentially different from the origins of many other elements of the Indiana biota, the mammalian portion of which is small, even when the fossil forms, all of Pleistocene Age, are included. In many respects these fossil species are more interesting than the recent mammals, either now extant or recently exterminated within historical times. A study of them reveals much of the past geologic history and climate of the state. Careful search of the literature, correspondence with those interested in mammals, and fairly intensive collecting yield no more than a total of 82 indigenous species of mammals in Indiana, 14 of which occur only in the fossil condition and usually as mere fragments. Future lucky efforts in collecting or fortunate paleontological finds might raise the number to a scant 100 species, but it is doubtful if the actual number will ever much exceed 85 or 90 species.

The 68 living and 14 extinct species of mammals are distributed among 11 (three extinct in Indiana) of the currently recognized (Weber) 18 orders of mammals (two of which orders are extinct). Twenty-two (six extinct in Indiana) of the 217 currently recognized families of mammals occur in the state; nearly half, 103 of these families, are extinct. These figures are more clearly brought out in tabular form, and in comparison with the total figures for the mammals of the world show how poorly the group Mammalia is represented in Indiana.

NUMBER OF SPECIES OF MAMMALS

	In Indiana		In the World	
	Total	Extinct	Total	Extinct
Species	82	14	15,000 ±	2,500 ±
Families	22	6	217	103
Orders	11	3	18	2

The figures for the orders, families and species vary within wide limits according to the ideas of different authors. The figures for Indiana approximate correctness, but do not include a few commonly recognized subspecies. The species figures for the world are only gross estimates.

The reasons for the paucity of mammalian forms of life in Indiana are several. First, Indiana does not lie in a general region where mammals are abundant either as to numbers or species. Second, the state is of comparatively small size and is without marked physiographic features, such as high mountain ranges, deserts, etc. The highest point

in the state is in Randolph County, about 1,285 feet above sea level, and the lowest point is the mouth of the Wabash, 313 feet, less than 1,000 feet in extremes of elevation. Third, nearly the whole of the state lies within one zoogeographic life zone or area, due in large part to the uniformity of climate throughout the state.

No discussion of the origins of Indiana's mammals will be intelligible without some mention of the zoogeographic areas of the world. These geographic areas have been established because of the similarity or homogeneity of the animals inhabiting them. Several different arrangements of the zoogeographic areas of the world have been proposed, but in the main they all resemble one another closely. The one followed here is the Sclater-Huxley system so ably set forth in Lydekker's *Geographical History of Mammals*.

Three major divisions are recognized: 1. **ARCTOGAEC REALM** embracing most of the world except South America and Australia and adjacent islands. This large ancient realm is subdivided into several smaller regions, only two of which concern us in this discussion: *Holarctic*, comprising the northern portions of each hemisphere and Africa north of the Desert of Sahara; and the *Sonoran*, practically the entire United States with the adjacent parts of Canada and the tablelands of Mexico. Indiana is situated within the Sonoran Region, although in the northern part of the state several Holarctic mammals are found. As would be expected, the origins of Indiana's mammals are in the main the same as the origins of the Sonoran mammals. A glance at a map shows the Sonoran to be intermediate geographically between the Holarctic to the north and Neogaea to the South, so that its mammalian fauna is a mixed one, though it contains numerous forms quite characteristic of it alone. 2. **NOTOGAEC REALM** embracing Australia, and more or less remote islands. No mammals ever reached Indiana from this Realm. 3. **NEOGAEC REALM**, without outstanding subdivisions, frequently termed the *Neotropical Region*, embracing all of South America, Central America, the low costal regions of Mexico and the West Indies.

Each one of these vast Realms and Regions may be subdivided into smaller areas, which are characterized by being inhabited by certain very definite types of mammals and the absence of others. In fact so characteristic are the assemblages of mammals in any one area, even though that be a very small one, that a competent mammalogist placed anywhere on the earth would be able to tell almost exactly where he was by making note of the mammals in that place, perhaps not with the same mathematical precision that a geographer can tell where he is, but with a precision that would probably astonish most geographers. As an example of this, one would tell he was in Indiana if he had but two distinctive species of its mammals: Franklin's Ground Squirrel of the northern part of the state and the Pennsylvania Cave Rat of the southern part. No other state possesses this combination. To be sure, if one is on foot, it may not seem like a very exact location to say one is in Indiana, but taking the world as a whole and realizing that Indiana is but a small spot on its surface, it places one's location rather exactly.

Not only are mammals distributed in two dimensions over the surface of the earth, but they have a third dimensional distribution as

well, being found in the earth at various depths and various geologic ages. As these geologic ages will be referred to occasionally farther on, it will not be out of place to list those that concern us in their chronologic sequence:

The later geologic periods and their subdivisions:

Quaternary Period. (Age of Man.) 500,000 to 1,000,000 years or more in duration	} Recent. Pleistocene or Glacial.
Tertiary Period. (Age of Mammals.) Variously estimated 5,000,000 to about 20,- 000,000 years in duration.	
	} Pliocene. Miocene. Oligocene. Eocene. Paleocene.

It is scarcely necessary to state that the lowest formations are the oldest and contain the more primitive types of mammals. In general the more recent the remains, the more they bear a stronger resemblance to the mammals of today, so that in the case of the Pleistocene mammals many of them are identical or practically so with living mammals.

No mammals are known in Indiana earlier than the Pleistocene which in point of geologic time is very recent. However, throughout the Tertiary times mammals existed in great abundance in western North America, and probably were found throughout Indiana and the eastern half of the continent, but conditions were not favorable for the preservation of their remains in the east and relatively little is known of them.

Throughout the whole of the Tertiary and Quaternary Periods North America had essentially the same form that it has today. At times it was broadly connected with South America, and at other times the two continents were widely separated and for considerable periods. At times it was united to northeastern Asia by a Bering Isthmus instead of being separated as at present by Bering Strait. This isthmus may have been of considerable width and have exhibited a polar climate in its northern part and a temperate climate in its southern part, thus admitting animals of two different climates to pass from one continent to the other. This land bridge is most important from the standpoint of the distribution of the mammalian life of the northern hemisphere, and accounts for the fact that the northern half of North America and the northern half of Eurasia constitute but a single zoogeographic region, the Holarctic. The evidence that northeastern North America together with Greenland and Iceland were united with northwestern Europe is less convincing, at least from the standpoint of the distribution of mammals.

These two land bridges served double purposes in that they also permitted the North American fauna to migrate into Eurasia and into South America. Like human travellers living away from home, a few of them migrated back again as much changed animals. At first thought one might think that these intercontinental routes would admit only a few mammals. No doubt it was only a few that passed over, but once

in a new pasture it is surprising to see with what rapidity a few migrants may multiply. Witness, in mammals, the spread of the European Rabbit in Australia, the European Hare in South America, and the well nigh universal distribution of the House Mouse and House Rat transported by human agency. Even the slow breeding horse spread from an introduced colony near Buenos Aires to the Straits of Magellan, a distance of some 10 to 12 hundred miles, in not quite half a century.

Owing to differences in temperature between the two Americas, north and south migrations were more difficult than the east and west ones between Eurasia and North America. It is extremely improbable that any animal passed from a marked degree of latitude to another with ease or without undergoing considerable change in its structure, unless the climate was changing at the same time, as during an advance or recession of a glacier. However, it should be appreciated in this connection that high altitudes of mountains are boreal in their climate, and that otherwise impossible migrations have occurred along mountain ranges from north to south.

Another interesting but much less important feature of the Tertiary continent of North America was the Mississippi Embayment, a shallow sound that extended up what is now the Mississippi Valley from the Gulf of Mexico to southern Illinois, sometimes present and at others absent. When one realizes that the mouth of the Wabash is only 313 feet above sea level, it is easy to understand what a slight subsidence of the continent would be needed to bring about a return of this arm of the Gulf of Mexico.

Perhaps the greatest geologic feature that affected the mammalian life of Indiana as well as other parts of North America and the world at large were the great glaciers that swept down from the north only to retreat and to return again. Two well marked glaciations are known for Indiana. The older, the Illinoian glaciation, has its southern limit of drift extending along the Ohio River westward to Jeffersonville, thence north to Brown and Monroe counties and thence southwesterly to Posey County, thus leaving a small roughly triangular area in southern Indiana that was uncovered by the glacier. The other and much more recent, the Wisconsin glaciation, has the southern border of its drift distributed irregularly across the state from Franklin County westward to Vigo County with a southern dip in Bartholomew County and a northern recession in Parke County. Between these two glaciations was an interglacial period during which time the climate was comparatively mild so that rather warm climated forms of mammals were found at least in the southern part of the state, and one even reached as far north as Wabash County. During the advance of a glaciation, Boreal mammals were pushed far to the south, so that such northern animals as Muskoxen were common throughout all of Indiana. With the retreat of the ice such animals followed it northward and invaders from the south came in where the ice had once been.

One of the most obvious facts of Indiana's mammals is that probably none of them are autochthonous, that is, none of them had their actual evolution within the state, but like ourselves they came from elsewhere. It is barely possible that one or two species of bats might

have had their evolution in caverns of unglaciated Indiana, but there is nothing that points clearly to such an origin. Indeed, nothing is more difficult to say than that such and such an animal had its origin at any particular place. In the present imperfect state of knowledge all that can be said is that such and such a mammal probably had its origin or underwent its evolution in such and such a general region and at a certain approximate geologic time. On the other hand, it is easy enough to say that certain particular animals did not have certain particular origins, where they are abundantly found, but that they are obvious migrants from some other region.

From the point of view of their origins Indiana's mammals may be grouped as follows:

1. Wide ranging autochthonous North American forms, for the most part peculiar to the New World, 43 species in 35 genera or subgenera.

2. Wide ranging autochthonous North American forms, peculiar to the New World, but of probable original Eurasian extraction, 11 species in 9 genera or subgenera.

3. Holarctic forms, always specifically distinct, but more or less closely related to or resembling Eurasian forms, 19 species in 15 genera or subgenera.

4. Forms of certain, probable or possible South American origin, 9 species in 8 genera.

These four groups are in no sense sharply delimited, and it has been a difficult matter to determine in which group certain forms should be placed and no doubt many will think the selection was done by the mere flip of a coin. A brief account of the members of each of these groups follows:

WIDE RANGING NORTH AMERICAN GENERA, SUBGENERA AND SPECIES SO FAR AS KNOWN NOT HAVING AN ORIGIN OR ANY IMMEDIATE ANCESTORS OUTSIDE OF THIS CONTINENT. IT CONTAINS BY FAR THE LARGEST NUMBER OF INDIANA MAMMALS, GENERA OR SUBGENERA 35, SPECIES 43:

The Short-tailed Shrews *Cryptotis parva* and *Blarina brevicauda* are both widely distributed in North America, a few forms even reaching South America. Both occur throughout Indiana. They are closely allied to the genus *Sorex* of wide Holarctic distribution. Interestingly enough, both of the Short-tailed Shrews were first made known to science by that distinguished Indiana naturalist, Thomas Say, but not from Indiana specimens.

The twelve known Indiana species of bats are contained in seven genera. Four of the genera are quite peculiar to North America: *Lasiurus*, with two very distinct species, *Lasionycteris*, *Nycticeius*, *Corynorhinus*, each with but a single species. *Corynorhinus* is closely allied to the Old World genus *Plecotus*, but the other three are without close relatives anywhere. The other three genera of Indiana bats are: *Myotis*, with four characteristic North American species and one with obvious Eurasian affinities; *Pipistrellus* and *Eptesicus*, each with one species characteristically American. When and where Bats originated is unknown. They suddenly came to light in the Eocene and the earliest known

forms are fully developed bats. The Indiana species are all of a modern type. The Indiana species of *Myotis*, *Pipistrellus* and *Eptesicus*, probably evolved in North America, though they may have had a remote Eurasian ancestry. Two of the species of *Myotis*, *sodalis* and *griseescens*, have a center of distribution in the limestone caves of the Middle West, and may have had their origins in the same general region. They are probably the nearest approach to autochthonous species of mammals in Indiana.

The Raccoon, *Procyon lotor*, represents a family rather widely distributed in North and South America. Its only Old World member is the rare Panda of Asia. The family as a whole may have originated in Eurasia. It is well represented in the Recent Period of North and South America, and is found in the Pleistocene of each continent. The species is found throughout the state, probably entering from the south.

The Skunks seem to have originated in southern North America with one genus spreading into South America. At least southern North America is the seat of their distribution today. They do not seem to be known earlier than the North American Pleistocene. What appear to be rather distant relatives are found in the Ethiopian and Oriental Regions of the Old World. One species, the Eastern Skunk, *Mephitis nigra*, is common throughout Indiana, probably having entered the state from the east. The Prairie Skunk, *Mephitis mesomelas avia*, just enters the western border. The little Spotted Skunk, *Spilogale*, is much more southern in its habitat, and is found only in the extreme southwest corner of Indiana. Its admission to the state's fauna is open to question as no one as yet has procured a specimen.

The Badger, *Taxidea taxus*, is a genus peculiar to western and southwestern North America. It is rather closely allied to Eurasian forms, but is found fossil in the North American Pliocene and Pleistocene. It crosses the northern third or fourth of Indiana as an immediate invader from the west.

The Wolves, Foxes and allies constitute an old primitive group of carnivores; four genera with a total of five species occur or have occurred within Indiana, one as a probable Holarctic migrant. *Urocyon*, the Gray Foxes, is a wide spreading western and southern genus, probably entering Indiana from the south and west, and occurring at the present time throughout most of the state. The Prairie Wolf, *Canis latrans* (another species described by Thomas Say from material west of Indiana) has held its own against the march of civilization and is still found in fair numbers in the western and northern parts of the state, entering from the prairies of the west. The most interesting Canid of Indiana is the so-called Dire Wolf, *Aenocyon dirus*, known only from the Pleistocene of the Sonoran Region. The original specimen, a mere fragment of the upper jaw with a few posterior teeth, originally came from Pigeon Creek near Evansville, and was described as a new and very large species of extinct wolf by Joseph Leidy nearly 80 years ago. Subsequent explorations have found other remains, especially in the tar pits of Rancho LaBrea of southern California, and more recent studies have shown it to be not a true wolf, but to constitute a closely allied

genus. It probably was never found far north in Indiana, and evidently entered the state from the southwest.

The large group of Squirrels and allies has as a whole an uncertain origin. The group dates back to the Eocene of both northern hemispheres. With the exception of one genus, *Marmota*, the subgenera and species of Indiana's Sciuridae are most certainly all autochthonous in the Sonoran Region. The common Thirteen-striped Ground-squirrel, or so-called "gopher," *Citellus (Ictidomys) tridecemlineatus*, and the larger Gray or Franklin's Ground-squirrel, *Citellus (Ictidomys) franklinii*, had their development in the plains and prairies of the west and northwest and have entered Indiana from the northwest corner. The Striped Ground-squirrel has spread rapidly during historic times and has crossed the State of Indiana and gone about as far south as Indianapolis. Its larger gray cousin is spreading much less rapidly and is still confined to the northwest corner. The common Chipmunk, genus *Tamias*, probably originated in eastern or southeastern North America and appears to have entered the state from the eastern or southeastern border. It is found throughout Indiana. The three true or tree squirrels of Indiana are each placed in a separate subgenus and none so far as known have near relatives in other parts of the world, but are autochthonous in North America. They are: The Gray Squirrel, *Sciurus (Neosciurus) carolinensis*, in eastern or southeastern North America, formerly abundant in Indiana; the Fox Squirrel, *Sciurus (Guerlinguetus) niger rufiventris*, in southern United States, abundant throughout the whole of Indiana; the Red Squirrel or "Piney," *Sciurus (Tamiasciurus) hudsonicus*, in northern North America, occurring in only the northern third of the state. The Fox Squirrel may have been an inhabitant of shores of the old Mississippi Embayment. The Flying Squirrel, *Glaucomys volans*, is peculiar to the eastern United States, having a distribution reminding one of that of the Chipmunk, the Gray Squirrel and the Fox Squirrel. Like the true squirrels the Flying Squirrels probably had an ancient origin in the Northern Hemisphere. The genus *Glaucomys* is probably a recently modified derivative from Eurasia.

The Pocket Gopher, *Geomys illinoensis*, is the sole Indiana representative of a superfamilial group of rodents characterized among other things by the possession of external cheek pouches. The group contains mouse-like forms, leaping forms and digging forms, of which the Pocket Gopher is an example. The group has had its origin and evolution in the west and southwestern Sonoran Region and is peculiarly a North American development. The ancestors run back to the Eocene and Oligocene, while the genus *Geomys* ranges from the Miocene to the present day. The Pocket Gopher is found in only the extreme northwest portion of the state and obviously entered from the plains and prairies of the west.

One of the most interesting of Indiana's mammals is the extinct Giant Beaver, *Castoroides ohioensis*. It is among the largest of rodents known, equaling in size a Black Bear. It evidently had its origin in the Pleistocene somewhere to the south of Indiana and as the last glaciation receded it followed northward. Its maximum distribution is in Indiana and all the finds have been referred to a period after the retreat of

the Wisconsin ice sheet. It is supposed to have had habits similar to those of the modern Beaver. Curiously enough it is represented in collections by much better material than the living Beaver so far as Indiana is concerned. Probably the best specimen unearthed came from Indiana and is in the collection of Earlham University.

The following seven species distributed in six genera or subgenera belong to a large group of rodents constituting the subfamily Cricetinae. It is a rather ancient group and may have had its origin in the North American Oligocene. It has spread remarkably, occurs abundantly throughout the Sonoran Region and the Neotropical Realm with an occasional form in Eurasia. Two species of White-footed Mice, *Peromyscus maniculatus bairdii*, and *Peromyscus leucopus*, are found in Indiana, both of them wide ranging species, though the subspecies *bairdii* is a prairie form from the west and probably was originally found only in primitive prairie regions of the state. With the cutting down of timber its range has been much extended. *Leucopus* is another one of those wide ranging species that probably originally came from the east. The Pennsylvania Cave Rat, *Neotoma pennsylvanica*, represents a genus of varied habits and habitat found in the southern and western United States; so far as known the single Indiana representative is confined to the limestone cliffs of Harrison County, the species evidently entering the state from the south or southeast. *Neotoma* is not represented in the Old World, nor did it enter South America. It is known from the Pleistocene of Pennsylvania. The Microtine division of the Cricetine Rodents has an uncertain place of origin, is widely distributed in Eurasia and North America, dating back to the Miocene. The common Meadowmouse, *Microtus (Microtus) pennsylvanicus*, is a wide ranging eastern species probably originally entering Indiana from the east. It is found throughout the state. The Prairie Meadowmouse, *Microtus (Pedomys) ochrogaster*, is apparently autochthonous on the prairies of North America and has entered Indiana on the west where it probably was originally confined, but has since extended its range throughout much of the state. The Pine Mouse, *Pitymys pinetorum*, is found throughout Indiana. The genus has a curious distribution: eastern United States, parts of Mexico, and central and southern Europe. It is probably an old type that early acquired fossorial habits. A related genus is found in Post-Pliocene cave deposits in Pennsylvania. The Muskrat, genus *Ondatra*, is the largest known microtine. It is a distinctive genus peculiar to nearly the whole of North America, from Boreal to to Lower Sonoran. Its wide distribution may indicate a rather ancient origin somewhere in North America; but on the other hand it may be a young genus of great adaptability and virility. Its spread in central Europe where a few individuals were set free is a beautiful example of how rapidly an introduced mammal may radiate.

The common Cottontail, genus *Sylvilagus*, found in every county of Indiana, is a representative of a wide ranging genus in America, mostly in the Sonoran and a few forms in South America. It is unknown in the Old World. It was possibly autochthonous in southwestern North America, at least the species are more numerous in the West. The Indiana species, *floridanus mearnsi*, is a wide ranging form.

The Peccaries, family Tayassuidae, are represented in Indiana by four finds of Pleistocene age; *Tayassu lenis*, fragments from an old cave near Williams, Lawrence County; *Mylohyus nasutus*, Gibson County; *Platygonus vetus*, Lawrence County, mere fragments; *Platygonus compressus*, Laketon, Wabash County. All of this material is lost. The Gibson County specimen is interesting in that the original description was based upon it. Fortunately it was well illustrated by Leidy. *Platygonus compressus* was a wide ranging species, fragments having been found in New York, the Mississippi Valley and probably Mexico. The Peccaries are a group of rather specialized Pigs having their whole development in North America, dating from the Oligocene and Miocene. Probably in comparatively recent times they entered South America. They naturally entered Indiana from the south or southwest, and at a time when the climate of the state was warmer than at present, probably in an early Pleistocene warm interglacial period.

The Solid-horned Muskox, genus *Symbos*, so far as known is found only in the Pleistocene of North America; perhaps its evolution and extinction all occurred in that period. It differs chiefly from the Common Muskox in that its horns formed a solid mass across the forehead. Its remains are widely scattered in North America from Mississippi to Alaska, more frequently (about seven times, mostly in the northern part), in Indiana than in any other state. It probably evolved just south of the glaciation and followed the ice northward when its retreated.

Twice fragments of Pleistocene Horses, genus *Equus*, have been found in Indiana. In neither specimen is the species determinable. Horses had practically their entire evolution in North America, whence they spread to Eurasia and Africa where they exist wild today. For some unknown cause they became extinct in America during the Pleistocene, although the climate of both North and South America today is well suited to them as shown by their rapid spread after introduction by man.

WIDE RANGING AUTOCHTHONOUS NORTH AMERICAN FORMS FOR THE MOST PART PECULIAR TO THE NEW WORLD, BUT OF PROBABLE EURASIAN EXTRACTION: 11 SPECIES IN 9 GENERA OR SUBGENERA.

The Common Mole, genus *Scalopus*, of eastern United States is found throughout the whole of Indiana. It probably originated somewhere in the east and entered Indiana from that direction. It is a member of an old group dating back to the Miocene in North America. During the glaciation the Moles must have been pushed southward and then advanced on the retreat of the ice. The Star-nosed Mole, *Condylylura*, is one of the rare mammals of Indiana, less than half a dozen specimens having been taken and none of them extant. It seems more northern in its distribution in the state. Whether it has entered Indiana from the northeast in recent times or has gradually worked its way northward after the last glaciation can only be a matter of conjecture.

The Fisher, *Martes pennanti*, is an indigenous animal of the colder parts of North America. It has been reported three times for Indiana, many years ago, and was undoubtedly a wanderer from the north, and can scarcely be considered to have been a normal inhabitant of the state.

The common Weasel, *Mustela noveboracensis*, is a member of a group of species common and indigenous to North America, and it is probably of comparatively recent Eurasian origin. Species of *Mustela*, however, are known from the Miocene of both North American and Europe.

The Lemming Mouse, *Synaptomys cooperi*, is one of Indiana's interesting mammals. The genus is usually regarded as Boreal, but it is found as far south in Indiana as Franklin and Lawrence counties. It may have had an autochthonous evolution in North America without Eurasian ancestry. A. B. Howell, the latest reviser of the genus, thinks it had a North American origin, evolving late in the Tertiary and possibly even in the Quaternary. It may not have been so strictly Boreal as at present. It must have been pushed south by the glaciation and in addition to following the retreating ice north, many adapted themselves to the warmer climate and have persisted till today. In the early days of Indiana mammalogy, Quick and Butler of Brookville had more specimens of this rare mouse in their possession than were in collections in all the rest of the world. They generously deposited specimens in the chief museums of Europe and America.

The Jumping Mouse, *Zapus hudsonius*, occurs throughout Indiana. It is of Pleistocene or Recent age in North America and usually is considered a rather Boreal animal. A closely related and apparently more generalized genus, *Eozapus*, occurs in China; elsewhere in Eurasia still more generalized (*Sicista*) and again much more highly specialized genera (*Dipus et al.*), occur. *Zapus* is probably an invader of Indiana from the north.

Three species of Bison, or as they are more usually termed "Buffalo," have lived in Indiana. The most abundant, the plains Bison or Buffalo, *Bison bison bison*, occupying the western and southwestern part of the state in countless numbers a century and a half ago, and with possibly the Eastern Woods Bison, *Bison bison pennsylvanicus*, occupying the eastern and heavy timbered parts. A crude likeness of the Bison is on the great seal of the State of Indiana. No specimens from Indiana are known to be in collections. The other two species are extinct: *Bison antiquus*, represented by a fine skull from Knox County, in Earlham University, and *Bison latifrons* with no Indiana specimen. All three species had their evolution in America, but their ancestors undoubtedly came from Eurasia.

The Mastodon, *Mammot americanum*, because of its frequently found remains and large size, has been more often reported from Indiana than any other mammal. Fragmentary remains, mostly teeth, have been found from one end of the state to the other, and several almost perfect skeletons are known. It is an ancient type. Its remote ancestor was *Palaeomastodon* of the "Ur-Nile." Prof. Osborn estimates that to reach the forests of the Ohio and the Hudson it made a 10,000 mile journey via a northwest land connection, occupying in time 2,000,000 years. Remains of the Mastodon are not frequent in the Old World where the genus became extinct by the end of the Pliocene. Mastodons, however, were common in North America during the Pleistocene. That they persisted

until quite recent times is shown by an Indiana find, the grease from whose bones was used by workmen for oiling their shoes.

HOLOARCTIC FORMS ALWAYS SPECIFICALLY DISTINCT, BUT MORE OR LESS CLOSELY RELATED TO OR RESEMBLING EURASIAN FORMS; 19 SPECIES 15 GENERA OR SUBGENERA.

The true Shrews, *Sorex*, are represented in Indiana by two species. The genus is characteristically northern Holarctic and apparently had its origin in the Old World, crossing to North America comparatively recently, geologically speaking. *Sorex cinereus* is a northern form and entered the state from the north or followed up the last retreat of the glacier and still persists. *Sorex longirostris* is a species of the swamps of the southeastern United States and has probably entered Indiana from the south and east.

One bat, *Myotis lucifugus*, is the American counterpart of the Old World *Myotis daubentonii*, and undoubtedly developed in North America at a very recent date and has spread widely so that it is one of the commonest bats of the United States. Its antiquity in America is probably not much greater than that of the aboriginal Indians.

The Least Weasel, *Mustela vison*, the smallest carnivorous mammal in the world, is a member of a compact Holarctic group of the genus, usually northern in its distribution or living on high mountains. It has an almost continuous circumpolar or near-circumpolar distribution, and is probably found throughout the northern third of Indiana. The first of the three known Indiana specimens was taken only six years ago by our late lamented member, Bruce Williamson. That large aquatic weasel, the Mink, *Mustela vison*, has a close counterpart in Eurasia, *Mustela lutreola*, from which the American animal is probably a more or less remote derivative.

The Otter, *Lutra canadensis*, appears to be closely related to the Otter of Europe. According to Pohle, it crossed the land bridge between Eurasia and America in the Pliocene, retreating south during the glaciations and then re-establishing itself in the north. It is another of those wide ranging species which may have entered Indiana from any angle. The subspecies that used to occur throughout the state may possibly be *lataxina* of the southeast.

The circumpolar Wolverine was in America during the Pleistocene, probably a recent arrival from Eurasia. Its occurrence in Indiana, based on two scant records, can only be considered in the light of a straggler from the north.

The Black Bear, *Euarctos americanus*, is widely distributed in eastern North America with more or less close relatives in the western portion, and a closely allied species in Japan and eastern Asia. The Black Bear was a late Pleistocene or Pliocene arrival into America from Eurasia. Once across, it seems to have spread rapidly. Scarcely more than 100 years ago it was common throughout all of Indiana.

The Red Foxes, *Vulpes fulvus*, of America are probably recent Eurasian immigrants. The Red Fox of Indiana according to all observations entered the state within historic times from the east. There is some question as to whether this Fox of the eastern United States is

an indigenous mammal or one artificially imported by man for the sport of fox-hunting and allowed to escape. It is a curious fact that in the Pleistocene deposits of the eastern United States no remains of this fox have been found, while bones of the Gray Fox, *Urocyon*, are of not infrequent occurrence. The Red Foxes of the north and west are certainly not human importations. The True Wolf, *Canis nubilus*, another species described by Thomas Say, appears to be closely related to the Wolves of Eurasia, and was probably derived from comparatively recent migrants by way of Bering Isthmus. It was once common throughout Indiana. The only scientific detailed description of an Indiana Wolf is that by the Prince of Wied, and the only known specimen is a skull collected by him near New Harmony 100 years ago the past winter. This skull is now in the American Museum of Natural History, New York.

Two species of the genus *Lynx* are reported for Indiana in the days that have gone. The Bobcat, *Lynx rufus*, appears to have been common throughout the state and only recently became extinct. A wretched mounted and antique specimen of it is in a collection of "curios" in a pool room at Royal Center, Cass County. There are some in the audience who probably have seen the Bobcat in its wild state in Indiana. A detailed description of this species is given by the Prince of Wied. The occurrence of the Canada Lynx within Indiana is less certain. Authors refer to it as having been found in the northern part of the state. The genus *Lynx* is a segregate of the large old genus *Felis*. The original home of *Lynx* appears to be Eurasia, and it is probably a rather recent immigrant. The Bobcat is a rather southern species, while the Canada Lynx is Boreal.

Man is the most recent of the indigenous mammals to have entered Indiana. According to Hrdlicka and others, *Homo sapiens americanus* most certainly reached America by way of Bering Isthmus, or more probably by Bering Strait, passing over from Asia in good weather in seaworthy boats of skin. As to whether man was in America during the Pleistocene is an open controversy, some contending that he was here during the Ice Age, and others only after its disappearance, placing his arrival at no more than 10 to 15 thousand years ago. If the latter is the case, it is an excellent illustration of the rapid spread of a mammal throughout a vast expanse of territory and the rapid development of astonishing degrees of human culture in a short period of time. Man may have been coexistent in America with such disappearing animals as the Mastodon, but if so, it is curious that no reference to such a characteristic animal is made in any human documents comparable to the carvings found in Europe, or to the pictures inscribed on cavern walls by the men of the Stone Age.

The Woodchuck or Ground Hog, *Marmota monax*, is a member of a Holarctic genus ranging eastward from the Alps to the Atlantic seaboard of North America. It is a recent type, making its first appearance in both continents during the Pleistocene. Its geographic distribution reminds one of that of the species of Chipmunk and Flying Squirrel found in Indiana. Whether it originated in eastern North America or is a comparatively recent migrant from Asia is only a matter of con-

jecture. Subspecies of *Marmota monax* are found in Alaska and elsewhere in northwestern North America.

The Beaver, *Castor canadensis*, is a representative Holarctic genus of wide distribution in the northern portion of both hemispheres. Fossil related members of the family occur from the Oligocene in America and from the Miocene in Europe. The genus *Castor* dates from the European Pliocene and the American Pleistocene, so it may be a comparatively recent arrival from the Eurasian Holarctic. It was once found throughout the whole of Indiana.

The Elk, *Cervus canadensis*, is a late migrant from Eurasia across the Bering Isthmus. It is not found in North America prior to the Pleistocene. It was widely distributed in Indiana in historic times and is the "Stag" of the early explorers. A closely related species is found in Asia.

The true MuskoX, *Ovibos*, now confined in the living state to extreme northern North America and to Greenland, once had an extensive Pleistocene distribution in Europe, Asia and North America. It is not improbable that the genus may have had its origin in North America and thence spread westward. Its southern limit of distribution in North America closely corresponds with the southern border of the great ice sheets. As the glacier retreated, the MuskoX followed northward. Only a single find of *Ovibos* is known from Indiana, while its relative, the extinct genus *Symbos*, is represented by several excellent remains.

That true Elephants, *Elephas* (or very closely allied genera), ever inhabited Indiana and in no small numbers may surprise many. Two species are currently recognized, but authorities do not agree on the identification of the Indiana remains. Each of two particularly good Indiana specimens have been made the type of a new species and a new subspecies. One form was long identified as the Old World Mammoth, *Elephas primigenius*, an animal well known to the old Cave Men of Europe and figured on ivory or painted on the walls of their caverns. Whether the Mammoth was contemporaneous with Man in North America is unknown. Both species were most certainly coexistent with the Mastodon, but much less numerous than the latter animal. The Jeffersonian Mammoth, *Parelephas jeffersonii*, typified by a beautiful specimen in the American Museum of Natural History, found in Grant County, is considered by Osborn (1925) to be an inhabitant of temperature climates and to have entered North America during the middle period of the Age of Man. The Woolly Mammoth, *Mammonteus primigenius* of the Old World, an animal of colder climate, is typified in Indiana by an adult female skull from Rochester, Fulton County. This specimen, also in the American Museum of Natural History, is the type of the subspecies *compressus*. It entered North America during the period of the last great glaciation. In point of size the Imperial Mammoth of America (not found in Indiana) had a height of 13 feet, 6 inches; the African Elephant of today has a height of 11 feet, 4 inches; the Jeffersonian Mammoth of Indiana, 10 feet, 6 inches; the Indian Elephant, 10 feet; the American Mastodon, 9 feet, 6 inches; the Woolly Mammoth, 9 feet, 3 inches.

INDIANA MAMMALS OF A DISTINCTLY SOUTHERN ASPECT, SOME OF THEM AT LEAST CERTAINLY FROM SOUTH AMERICA; 9 SPECIES, 8 GENERA.

The common Virginia Opossum, *Didelphis virginiana*, is in many respects Indiana's most interesting mammal. It is the most primitive of our mammals, being a Marsupial and not a Placental, and is a living representative of bygone ages. It differs more from the other mammals of the state than any of them differ from each other. Related forms are found as far back as the Cretaceous of Wyoming. *Didelphis* itself dates from the Eocene of North America, and is found in Europe from the Upper Eocene to Lower Miocene. At the present time the Opossums are characteristically South American, and it is more than probable that the animal originally evolved in North America, spread to the continent to the south, and then came north again. Opossums seem to be slowly spreading northward and becoming more common; they appear to have been in northern Indiana from the earliest historical times.

The great Cat, *Felis* "*concolor*," variously called Cougar, Puma, Panther, Painter, Mountain Lion, has a range from Canada to Patagonia. The particular species formerly found throughout all of Indiana is designated technically as *Felis couguar*. Its past history is shrouded in mystery, as is that of most cats. The family Felidae is most abundant in the Old World and in the tropics. It is not unnatural therefore to think that the Puma may have had an origin in the warmer climates of the south and gradually to have spread in both directions into the south and north temperate zones. There is no evidence that it had an immediate origin in Eurasia, or in North America. *Felis* in the broad sense first dates from the Miocene of Europe.

The Rice Rat, *Oryzomys palustris*, recorded from Indiana on insufficient evidence, represents a cricetine genus with headquarters in the Neotropical Region. It occurs along the coastal regions of the southern and eastern United States and northward in the interior to Kansas and southern Illinois. It gives the impression of having been a recent invader from South America, but that continent originally received its cricetine rodents from North America in the distant past.

In the central United States the Canada Porcupine, *Erethizon dorsatum*, formerly ranged from the Ohio River northward into Canada, thus embracing the whole of Indiana. It was exterminated in the state within historic times and two examples from Laporte County are said to be in the State Museum. It is representative of a large group of peculiar Rodents, the Hystricoid, or Porcupine-like, found almost exclusively in South America. The group as a whole is of ancient lineage, rapidly disappeared elsewhere, but persisted in great variety and numbers in South America. The family Erethizontidae contains four extinct genera in addition to the living *Erethizon*, and extends from the Oligocene to the Recent in South America. The Canada Porcupine probably followed up the last glaciation and has now adapted itself to the colder parts of North America far removed from its original Neotropical origin.

The Swamp Rabbit, *Sylvilagus (Tapeti) aquaticus*, has the same general origin as the ordinary Cottontail already referred to, but is

probably more tropical, whether from South America or the coastal region of Mexico is only conjecture. It evidently followed up the Mississippi-Ohio-Wabash system, or perhaps even the older Mississippi Embayment and has reached just the southern end of Indiana.

Deer, of the genus *Odocoileus* and related genera, have long been inhabitants of America. The original home of their ancestors in all likelihood was Eurasia, and they early reached North America and gradually spread southward and evolved into the modern genera. Whether the White-tailed Deer, *Odocoileus virginianus*, had its origin in tropical America and later spread northward is only conjecture. Certainly it is in no sense a Holarctic form or Holarctic derivative, but is a characteristic Sonoran genus and species. Remains identical with the modern genus and species are found in Pleistocene deposits in Indiana and elsewhere in the United States. Another species of the genus *Odocoileus*, Cope's *dolichopsis*, is known by two fragments from the Pleistocene of Indiana. The latest student of this so-called species thinks it may not even be *Odocoileus*.

The Tapirs are represented in Indiana by a single tooth from the banks of Pigeon Creek near Evansville, identified as *Tapirus haysii*. The Tapirs are an ancient group. Fossil forms first appear in the Lower Eocene of Europe and North America, continue into the Pliocene, but in the Pleistocene are found only in eastern Asia and America, and in Recent times only in Malaya and South America. Whether *Tapirus haysii* underwent its development in the southern United States or is a comparatively recent invader from South America is only a matter of conjecture.

Jefferson's Ground-sloth, *Megalonyx jeffersonii*, is quite as interesting a mammal as the Virginia Opossum. It is another sole representative in Indiana of a peculiar and ancient order of mammals, the Xenarthra, an order occurring nowhere but in South America and the adjacent portions of North America where a few forms wandered in over the Central American land bridge, and, as in this instance, developed into independent genera and species. Most members of the order are extinct. Jefferson's Ground-sloth is represented in Indiana by but a single claw bone from Pigeon Creek near Evansville. The species as a whole is well known, the animal was of huge, clumsy proportions, perhaps about half the size of the Elephant. It was strictly vegetarian, pushing down trees by its great weight, or uprooting them with its strong claws. It was given the generic name *Megalonyx* by President Jefferson under the misapprehension that the huge claws came from a monstrous lion. The species was subsequently named for Jefferson himself by the French mammalogist, Desmarest.

Indiana's 82 species of living and extinct mammals have been shown to have had varied origins. Many had their evolution in the zoogeographic region of which Indiana is a part, many came from Eurasia by way of a Bering Isthmus, others came directly or indirectly from South America. None seems to have entered from western Europe or from Africa. They range from ancient primitive types, the opossum, existing today, to what is perhaps one of the latest evolved species

though of a generalized type, man himself, who has become the dominant figure in the world of mammals, and is rapidly exterminating the other mammals which are, zoologically at least, much more interesting. In size they vary from the small Shrew, less than one's little finger, to nearly the largest Elephants.

Arranging Indiana's mammals in a more or less modern geographic sense, about 30 per cent of them are northern forms, about 15 per cent are eastern or southeastern United States forms; about another 30 per cent are southern types or of general southern derivation, while about 15 per cent or slightly more are clearly of western origin, and 10 per cent are such wide ranging North American forms that nothing can be said with any degree of definiteness as to how they entered Indiana.

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