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The distribution of the Bulletin in signatures was discontinued with the close of Vol. VIII.

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BULLETIN
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Article I.—THE HUICHOL INDIANS OF MEXICO.

By CARL LUMHOLTZ.

PLATES I AND II.

My third and latest expedition to Mexico, where I was sent by the American Museum of Natural History, New York, in the spring of 1894, mainly to investigate the native tribes there, proved rich in scientific results, and lasted until the spring of 1897. During this period I spent about ten months among the Cora and the little-known Huichol Indians, by far the greater part of the time being devoted to the latter tribe. Before my departure for the field, the Governor of the State of Jalisco, Mexico, had told me of this interesting tribe. When I expressed to him my desire of finding primitive people in Mexico, he at once said, "You will find in a corner of this very State absolute savages, who wear their hair long, and refuse to pay taxes to the government. Once in a while they come in here to Guadalajara to see me, and sleep in the courtyard of the Palacio, which they seem to consider as their house."

The very name of this tribe is scarcely known outside of the State in which they live, and even within this extensive territory they are known only in parts not very remote from their homes. So great an authority as Manuel Orozco y Berra, in his 'Carta Etnográfica de México,' has nothing more to say about this tribe

than the following: "Theirs is a language of which we know very little. We remember having read that in a vague way it is made a dialect of the Mexican, and that it is thought that the Huichols are the remnants of the ancient Cuachichiles. We do not accept nor contradict this, because we have no dates. The Huichol language still remains to be classified by us. It is spoken in Santa Catarina, San Sebastian, San Andrés Coamiat, and Soledad y Tezompan, belonging to Colotlan."

This, in connection with the meagre information furnished by Don Francisco Pimentel, is virtually the only knowledge we have hitherto had concerning this tribe. I have heard that a small vocabulary has been published by one Mr. Landa in Pachuca; and a few rather unimportant facts may be found on page 321 of the first volume of Captain G. F. Lyon's 'Journal of a Residence and Tour in the Republic of Mexico in the Year 1826.'

It was with considerable interest, therefore, that I looked forward to meeting this almost wholly unknown tribe. After having spent two months among the Coras of the Sierra del Nayarit, I made an entrance into the country of the Huichols on the east, and, in spite of much opposition from these Indians, succeeded in conquering all obstacles in my way. In order to overcome their prejudice against me, on my arrival at the pueblo of San Andrés Coamiata I discharged all my men, who were Mexicans, and remained alone among the Indians. The Huichols look upon all strangers with much disfavor; and their feeling against me was so strong that the 'alcalde' of Santa Catarina, the capital, had even made threats on my life, should I ever go there. Gradually I learned the songs that the shaman was singing in the temple at the feast for making rain, thus breaking the hitherto insurmountable barrier between them and me; and by degrees I gained their confidence to such an extent that my stay in this tribe, although attended with many privations, was very fruitful in results. I purpose here to make some preliminary remarks concerning this interesting tribe, pending a detailed report to be issued later.

The name of the tribe is *Vī-rá-ri-ka*, in the western part of the country pronounced *Vī-sjá-li-ka*,¹ which means 'prophets' (Sp.

¹ The *tilde* over an *l* (*l̃*) indicates that the *l* is to be pronounced thick, almost approaching an *r* (pronounced with the tip of the tongue).

adivinos). The Mexicans call them 'los Huicholes,'—a corruption of the tribal name. Their number to-day is about four thousand, and they live in a mountainous country, difficult of access, in the northwestern part of the State of Jalisco, on a spur of the great Sierra Madre. This range runs in a northerly and southerly direction, parallel to Sierra del Nayarit, both Sierras forming the southern part of Sierra Madre del Norte, which ends at the Rio Alica (also called Rio Santiago, and by other names at different points on its course). The country is well watered, being traversed from north to south by a river, Rio Chapalagana, which runs at the bottom of a mighty, deep valley, a great many small affluents forming as many side valleys. While very narrow and steep at the bottom, the valley gradually broadens out, the sides rising to a height of from eight to nine thousand feet. The country thus consists of two parallel ridges and the valley between, the top of the ridges being covered with immense pine forests, the abode of numerous deer. Down in the little steep and mountainous side valleys, on the borders of the river, the climate is tropical, and sugarcane is raised on a small scale for home use. On the pine-clad heights the Indians are not generally found living; most of the ranches being situated at a moderate elevation above the sea, dispersed all over the district, in numerous small valleys.

The northern part of the country, around the pueblos of Tezompá and Soledad, is not so mountainous, and therefore has already been occupied by the Mexicans. The southern part, from the ranch Ratontita southwards, presents the same natural features as the northern; but the Huichols here still jealously keep the Mexicans out. It is probably only a matter of time, however, before this section too will become Mexicanized. Mexicans have also encroached on the outskirts of the Huichol country, towards the east and west, on both slopes of the Sierra.

All that is left, therefore, of the country owned solely by the Huichols, is mainly the central part. Here the population is fairly safe from advancing civilization, on account of the ruggedness of the country and its difficulty of access. It would hardly pay for white men to settle here, because of the small extent of country suitable for cultivation by the plough. I should estimate the present territory of the Huichols to be about forty miles long by

from twenty to twenty-five broad. This, however, gives no adequate idea of the length of time required to traverse this country of precipitous hillsides and mountain gorges.

The Indians raise corn, beans and squashes on a moderate scale. On account of the mountainous character of the land, ploughing is not resorted to, except in a few places; the old-fashioned Indian way of cutting down brush, burning it, and then tilling the ground, being in vogue. This way of cultivating, which is still used among several tribes in Mexico, is called in Spanish *coamilear*, and the field is called *coamil*.

There is generally an abundance of rain from July till November; but as so much of the corn is planted on the steep sides, where the water quickly dries up, the amount of water needed for cultivation is very great.

The Huichols have a tradition that they originated in the south, got lost underneath the earth, and came forward again in the east, in the country of the *hikuli* (Sp. *peyote*), which is the central mesa of Mexico, near San Luis Potosi. They, and their western neighbors the Coras, are related in regard to language, religion and customs. Many of their myths are similar. Nayarit, the great place of worship of the Coras, named Tonati by the chroniclers, is also the place of worship of the Huichols, and is called by them Sa-kai-mó-ka, this being the name of an idol of the setting sun, which stands at this high point of Sierra del Nayarit, "looking towards Mexico." In character the two tribes differ in that the Coras are unusually brave, while the Huichols are cowards, preferring assassination to open war. The Huichols do not like the Coras, because they are "serpents;" and the two tribes rarely have transactions with each other, although sometimes we find them intermarrying on the border.

It seems to be the accepted opinion that the country of the Huichols is included, with that of the Coras, under the term "Nayarit," and that the boundaries of Nayarit, or the "Province of Nuevo Toledo," as it was called, were Acaponeta in the west and Colotlan in the east. Thus the conquest of the Huichol country should have been accomplished at the same time as that of the Coras, namely in 1722. It seems hardly probable that the Huichols should not have been at least partly conquered before

that time by Spaniards coming from the east, more especially since they are not such warriors as are the Coras. This opinion is confirmed by a manuscript which I came across on my last expedition, according to which pueblos were formed in the eastern part of the Huichol country about the middle of the seventeenth century.

Franciscan missionaries converted them nominally to Christianity, founding the pueblos of Tezompa, Soledad, San Andrés Coamiata, Santa Catarina, and San Sebastian, all on the eastern side of the river except San Andrés Coamiata, which lies on a plain in the sierra on the west. The pueblo of Guadalupe y Ocotan is of later origin, the district surrounding it having previously belonged to San Andrés Coamiata. The two first-mentioned pueblos are possessed at present, as stated above, by the Mexicans. In the country of the Huichols there are to-day no priests, and there is probably no tribe in Mexico where the ancient beliefs have been so well maintained as there. Their exterior conditions have been somewhat altered by the introduction of cattle and sheep. Cattle are now the favorite animals for sacrifice at the feasts for making rain during the dry season.

The Huichols (see Plate I) are of medium height, or slightly over. At the pueblo of San Andrés, out of 43 men measured, 40 per cent. were below 1.63 metres, 30 per cent. above 1.68 metres, and 30 per cent. between these two figures, giving an average height of 1.65 metres. This corresponds, according to Dr. Hrdlička, with the heights of living Huichols, as calculated from measurements of the bones of Huichol skeletons. They are a healthy people, very emotional, being easily moved to laughter or to tears, and they are imaginative and excitable. Young people show affection in public, kissing or caressing each other. They are rather kind-hearted, and not inhospitable when having confidence in one; but they are avaricious, and the Mexican *peso* goes a long way in gaining their favor. As to regard for truth, they are absolutely wanting in that respect, and their word can never be depended upon. They are also very thievish, although they never stole anything from me.

On the western side of the river, as well as in the pueblo of Guadalupe y Ocotan, which is on the eastern side, towards the

south, the hair is worn long and flowing; but on the eastern side it is formed into a queue, interbraided, and tied around towards the end, with a colored ribbon. In all cases a narrow hair-ribbon is bound round the head.

The women weave blankets, tunics, girdles and hair-ribbons of ancient designs from wool. Cotton cloth, or *manta*, bought from Mexican stores, is gradually taking the place of woollen stuffs, as it is cheaper, and gives the women less trouble to make up. The women are clever at embroidery, with which they adorn both their own dress and that of the men.

The Huichols live mostly in circular houses (*i-kt'*) made from loose stones, or from stone and mud, and covered with thatched roofs. Their temples (*to-ki-pa*), which are devoted to various gods, are of similar shape, but much larger, having their entrance toward sunrise. Outside of the door is an open space surrounded by small god houses (*sjí-ñi-ki*), rectangular in shape, and covered with gabled and thatched roofs. The entrance to the *sjí-ñi-ki* faces the open place in front of the temple. Such small god houses may also frequently be found in the forests, and are sometimes circular in form. There are nineteen temples in the country, and although one may generally find ranches near them, still it is only at the time of the feasts that the population of the district congregates there, officials and their families camping in the small god houses. The principal temple of the country is at the pueblo of Santa Catarina, the ancient name of which is To-a-pú-ñi, a mountain in the neighborhood. It is devoted to the principal god, Ta Té-wa-ñi, the god of fire. Idols are never found in the temples, but are hidden away in remote caves, or in some special sacred small edifice made for the purpose, either round or rectangular.

There are a great many sacred caves devoted to various gods. These generally contain some little spring or pool which makes the cave sacred. Such pools or springs, which are called *ku-tsd-ña*, are also found in various parts of the country outside of caves; and the water is used for religious purposes, that from a few of them being thought beneficial to children, while a salutary influence upon human beings in general is attributed to that of most of them. The water is used both internally and externally. There is one cave near Santa Catarina where, once a year, every Huichol

must take a bath. The water from some *ku-tsa-la* is brought in gourds to the temple for the feasts, where people both drink a little of it and wash their heads with it.

The Huichol spends a great part of his life at ceremonies and feasts. From May to August, that is to say the dry and part of the wet season, there are frequent feasts for making rain. During the wet season, should it stop raining only for two or three days, the principal men gather in the temple and decide to sacrifice an ox or two, which means a 'feast,' or propitiation of the gods, lasting for two days. Then there is the feast of new squashes and that of the new corn, as well as that of toasted corn, connected with the cult of *hikuli* (Sp. *peyote*); but the greatest of all is the feast for eating corncakes, which are made from ground whole corn, and baked in an oven.

Very important in the religious life of the Huichol Indians is the use of *hikuli*, a small species of cactus (*Anhalonium lewinii*) which grows abundantly in the central mesa of Mexico. No doubt it is the same plant which in southwestern United States is called 'mescal buttons.' The same name, '*hikuli*,' is applied to this plant by the Tarahumares, who make journeys to the east to gather it, as do also the Huichols.

It appears that the gods, once upon a time, left the Huichol country, and went out to the country where *hikuli* is found to-day. A gigantic deer is the god of *hikuli*, and is called Ta-máts Pá-li-ke Ta-mo-jæ-ke, signifying "elder brother, walking at daybreak, everywhere," no doubt the dawn god. The plant is considered as the votive bowl of Ta Té-wa-li, the god of fire and the principal god of the Huichols, and has to be procured every year, or it will not rain.

In September parties from the various districts of the country start out to gather the plant, which is found near San Luis Potosi, in the State of the same name. They stop over night at the same camping places every year, going and coming, and have gods all the way along in the shape of mountains or springs. The time consumed in going is seventeen days. They remain at the place three full days, and are twenty-three days on the journey back. After the return of the *hikuli*-seekers to their own country they first spend many weeks in procuring a number of deer, so neces-

sary for the *hikuli* feast. The meat of the deer, having first of all been cooked between hot stones in earth mounds, is cut into small square pieces, and strung on strings and dried, and in that way kept for the feast. When the needed amount of deer-meat has been obtained, the *hikuli*-seekers must next cut down the brushwood and trees at a certain place, this being the first preparation for the communal field on which the new corn a few months hence will be sown. Immediately afterward the feast comes off, generally not before December or January. As indicated above, it forms an integral part of the feast for eating toasted corn, and is named accordingly *ra-ri-ki-ra* (*ra-ki* meaning 'toasted corn').

During all the months consumed in preparations for this feast, from the time of first starting out to gather the plant, until the feast is over,—a period of from four to five months,—entire abstinence from sexual intercourse, and from eating salt, is imposed; nor is it allowed to bathe or wash. Both men and women take part in the dance of this feast, which is afterwards, as is the case with most of their feasts, repeated at each ranch.

A peculiar feature in the *hikuli* ceremonies is the painting of the faces, in various designs, with a yellow root brought from the same country where the plant grows. These designs, which may also be found on the tobacco-gourds of the *hikuli*-seekers, are of different patterns, but are all signs of fire, in honor of which the whole feast is carried on. Both men and women partake of the drink made from the plant.

The effect of this plant on the nervous system is exhilarating, and it allays the feelings of hunger and thirst. Although, when fresh, it has a nauseating, slightly sour taste, it is wonderfully refreshing when one is taking exercise. So far from suffering fatigue in walking, one feels as if pushed along, as I can testify from my own experience. In this respect it resembles Peruvian coca; but, unlike that remedy, it leaves a certain depression, as well as a headache. Although one feels as if drunk after eating *hikuli*, and the trees dance before his eyes, still the balance of the body is very well maintained. It is also very important to note that a marked effect of the plant is to take away all sexual desire, this no doubt being the cause of the Indians imposing, by a curious aboriginal mode of reasoning, abstinence from sexual intercourse as a necessary part of the *hikuli* cult.

Professor A. Heffter, of Leipzig, writes me that, having made experiments with this plant upon himself, he had beautiful color visions. This he attributes to the new substance, which he calls 'mescalín,' discovered by him in the plant (see also the article 'Beiträge zur chemischen Kenntnis der Cactaceen,' in 'Apotheker-Zeitung,' 1896, No. 79).

During the months of preparation for the feast of *hikuli* the Indian is constantly seen eating slices of the fresh plant, cutting it lengthwise, and generally not consuming more than one slice, perhaps a quarter or a half of one plant, at a time. As a rule, a man does not eat more than four or five a day; but the number may reach as many as twenty. When taken in moderate quantities it has the effect of making him merry and good-tempered, and of putting him in a singing mood. His eyes assume a peculiar stare. His step and his movements become quicker than usual, although steady. He shows in his ecstasies, however, nothing similar to the effects of alcoholic drinks. In a few cases a man may consume so much that he is attacked with a fit of madness, rushing backward and forward, trying to kill people, and tearing his clothes to pieces. People then seize upon him, and tie him hand and foot, leaving him thus until he regains his senses. Such occurrences are thought to be due to infringements of the law of abstinence imposed upon them before and during the feast.

Hikuli is generally strung on long strings to dry, being in this state hung up in coils, like huge necklaces, in the temple or at the houses. When the feast comes on, the plant is dry, or nearly so, and, mixed with water, has invariably to be ground on the *metate*. A kind of thickish drink, rather brown in color, is produced from it, which is offered in small quantities, but at frequent intervals, to those present. It is never mixed with any other drink.

This plant is also used to a certain extent by the Cora Indians, who buy it from the Huichols. Both tribes cultivate the plant on a very small scale; liliputian gardens, or tiny patches of land, being enclosed with a stone wall for the purpose.

The plant is also considered to be medicinal, being rubbed on the body in cases of rheumatism. Rubbing it on the knees is said to insure strength in walking, and taken internally it is thought to give life.

The moving principle in the religion of the Huichols is the desire of producing rain, the deer and the *hikuli* being the chief factors in attaining this end. Once upon a time the all-important thing for the Huichols to eat—the deer—became god, and he is to them the symbol of life and of fertility. With his blood the grains of corn are sprinkled before being sown. The great god of *hikuli*, when he appeared the first time out in the country of the *hikuli*, showed himself as a deer, and every one of his tracks became a *hikuli*-plant—the plant of life; and the life is that of the deer.

Of very great interest in this tribe are their many symbolic objects—ceremonial arrows, 'faces,' shields, 'eyes,' votive bowls, etc.

Ceremonial arrows are inseparably connected with the life of the Huichol, the arrow representing the Indian himself in his prayers to the various gods. At all important events of his life, from his birth to his death, an arrow is made and sacrificed, and no feast can be imagined without the presence of arrows.

Very peculiar are the ceremonial 'faces' or 'appearances' (*ne-a-li-ka*) of the god supplicated. They are either hung to an arrow or placed separately in the small god houses or sacred caves. They are generally round in shape, looking like a diminutive shield made from split bamboo (*otate*) reeds, interwoven with cotton cord and crewel of various colors so as to represent mythological persons or events.

Other symbolic objects are the so-called 'shields' (*ndm-a*), rectangular in shape, looking like a diminutive matting, but made from splints of bamboo, interwoven with cotton cord and crewel of various colors so as to represent figures of mythological importance. These objects refer to ancient times, when the gods, or ancient people, covered their backs against the rays of the sun, or their fronts against the arrows or other missiles of their enemies.

Interesting, too, are the 'eyes' (*si-ku-li*), meaning the eyes of the gods. These are small crosses of wood, interwoven with cotton cord and crewel of various colors so as to form a square, which, however, is hung by one corner to an arrow. Sometimes one of the cross-pieces is made very long, so that the symbolic object is stuck in the ground in the same way as are arrows. In

this respect these symbolic objects are exactly like those found in the graves of Peru and among living tribes, for instance, the Tarahumares. Mr. Frank Hamilton Cushing has drawn my attention to the false head of a Peruvian mummy (from Ancon) actually having placed upon it, as eyes, such very objects. They are placed so that opposite angles come where the corners of the eyes would be.

Exceedingly important in their cult are votive bowls. These are ordinary gourds used as drinking vessels, the gourd being cut in two; and the bowl thus formed is painted inside with red ochre mixed with the ground kernels of a certain plant, called in Spanish *chia*, which is very oily, and gives it a kind of polish. These are the ordinary drinking vessels of the Huichol Indians; but when used for symbolic purposes they are adorned with glass beads, which are fastened to the inside or outside with beeswax, and arranged in various designs, being thus turned into drinking vessels of various gods.

All these symbolic objects are made on certain occasions, either for the tribe or for some private individual, and placed in god houses, sacred caves, or other consecrated localities of the gods, praying their silent prayers.

A Deluge legend is well established in the tribe, and with many particulars.

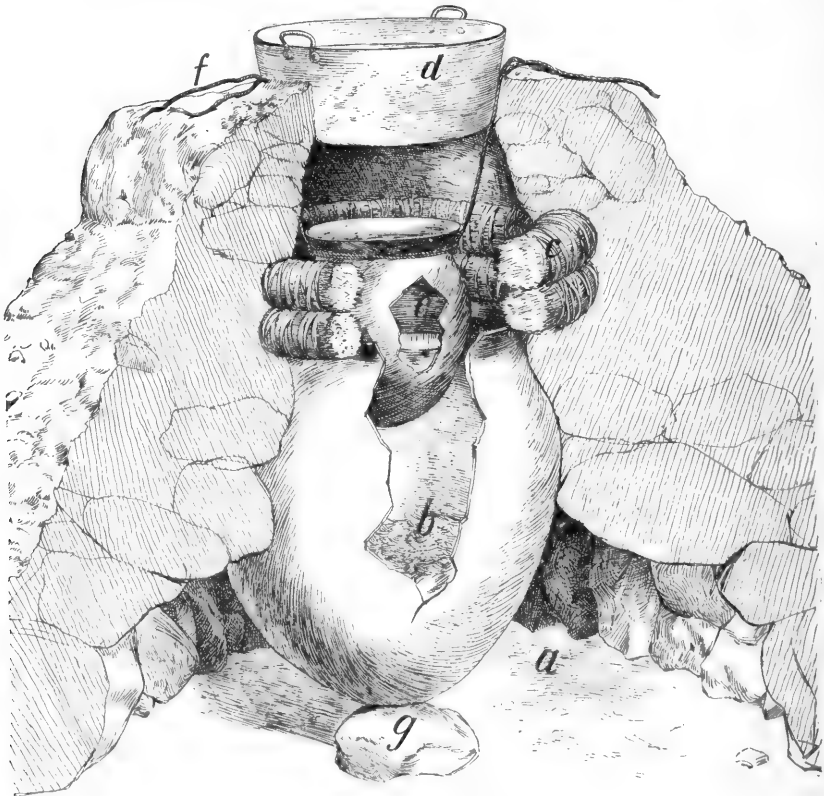
I cannot refrain from giving a detailed description of the way in which the Huichols manufacture one of their alcoholic drinks, called *tāatsj*. It is a very weak kind of brandy, produced from the stalks of a certain species of agave.

The Huichol name for a distillery is *sai-at-sá-mi* (Sp. *taberna*). The main part of it consists of a large jar (see cut, p. 12, *b*) in which the fermented stalks are cooked, and a smaller one (*e*) suspended inside of this to receive the condensed vapor. The jars, of course, vary somewhat in size in different distilleries, but the measurements given below are those of specimens which I brought back with me, and which well represent the ordinary type of the Huichol distillery.

The large jar measures 38 cm. in height, 1 cm. in thickness, and 33.5 cm. in diameter at the mouth; and it is made of rather coarse pottery-ware. The small jar measures 14 cm. in height

by 18.5 cm. in diameter of mouth, and is made of similar material.

On top of the large jar are placed two, and sometimes three, solid rings (*c*) of straw (*to-ni-ku-li*), one over the other, each 5.5 cm. thick, which fit exactly over the brim, forming, so to speak, an 'elongated neck' to it. Round this jar with its 'elongated neck'



Sectional View of Huichol Distillery.

is erected a mound-like structure of stone and mud, which holds the upper part of the jar firm, as well as the 'elongated neck,' but widens out toward the ground, forming a kind of oven (*a*) around the lower part of the jar. This oven has openings on either side to afford a draught for the fire. The jar does not rest on the ground, but on a medium-sized stone (*g*), thus increasing the draught, and

facilitating the heating of the jar. The earth and mud not only hold the 'elongated neck' in place, but also rise some eighteen or twenty centimetres or more above it, forming a kind of funnel. Into this funnel the cooling-vessel (*d*) fits snugly, the bottom of it remaining some ten to twelve centimetres above the straw rings.

The small jar (*wi-vi-á-le-a-mi*), or receptacle for the liquor, hangs down into the big one, suspended by two cords (*f*) of *ixtle* (yucca), which pass up along the sides of the cooler, and fall down outside over the mound. The cords are held in place solely by the pressure of the cooling-vessel against the sides of the mound.

Steam from the large jar condenses on the bottom of the cooler, which is kept filled with cold water, and falls in drops into the receiver below. That the steam may not escape round the cooling-vessel, the man in attendance plasters it round thickly with mud, and he now and then removes the cooler to see how the distillation is going on. When he finds that the receiver has become filled with liquor, he lifts it up, empties it into a large jar standing near, and then replaces it to receive more. He now puts the cooling-vessel in place again, plasters mud around it, and the distillation goes on as before.

The liquor produced in this way is very rarely distilled a second time. It is therefore very watery, but not unpleasant to the taste. Used in considerable quantities, it is intoxicating, still it does not seem to do much harm to the constitution of the Huichols. The liquor is never kept long, and has to be made to order for any approaching feast.

The Mexicans derive their famous *tequila*, or mescal, which is the strongest alcoholic drink produced in Mexico, from the maguey (*Agave americana*). One of the inferior kinds of brandy, *sotól*,¹ is produced from another plant of the same family, *sotól*; and this is the plant from which the Huichols extract their alcoholic drink. All the leaves are cut off from the bulb-shaped stalk, or 'heart' (Sp. *corazon*) of the plant, as the Mexicans call it. These 'hearts' are subsequently cooked by being placed between hot stones, and covered with earth, a layer of grass being put between.

¹ Sometimes in Mexico all native brandies, and there are several kinds, are comprised under the general term 'mescal.'

They afford a sweet article of food, very indigestible, but agreeable to most Indian tribes of Mexico.

This sweet stuff is crushed, mixed with water, and left to ferment for about a week in the open air, without any cover, in a cowhide, which is made to serve as a bag by suspending it between four poles. There is no other name for this bag, among the Huichols, than the Spanish *bóta* ; but the Mexicans have, besides, the name *el cuero*.

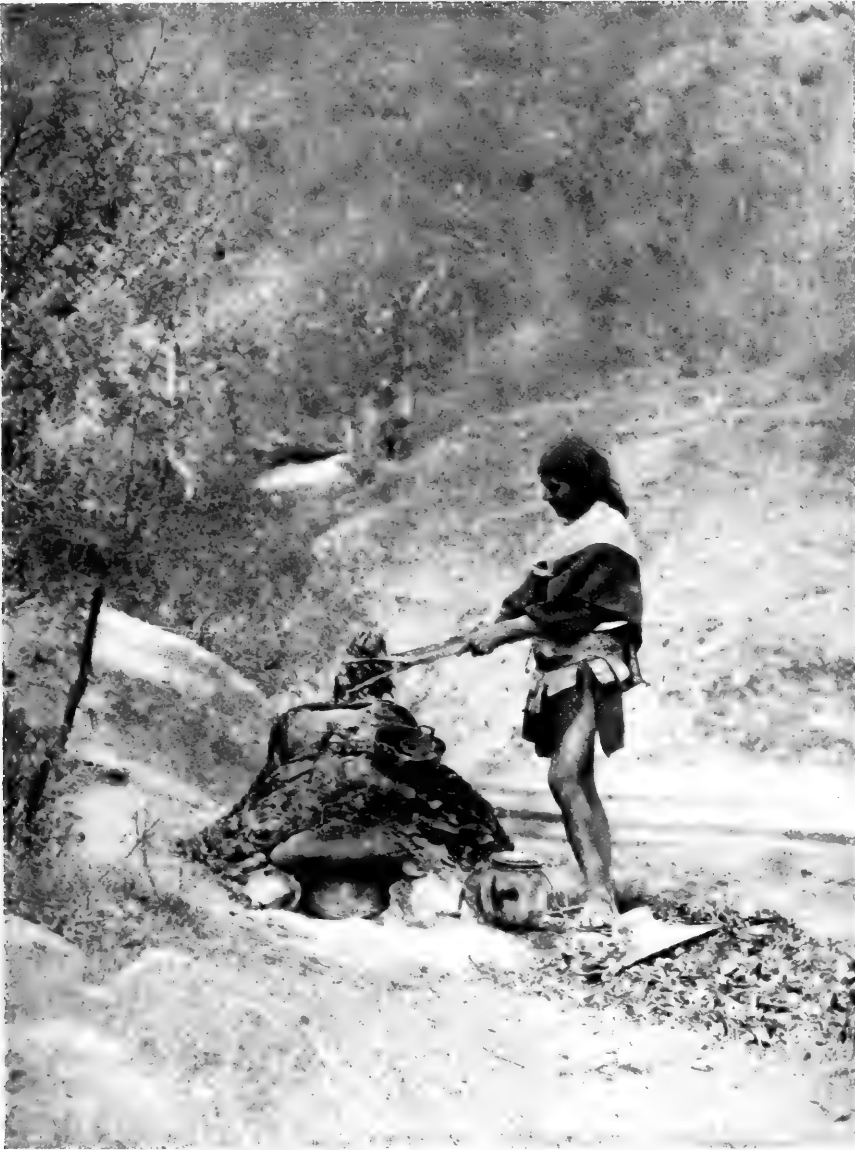
It will thus be seen that the only parts of the distillery that the Huichols have adopted from the Mexicans are the fermenting receptacle and the cooling-vessel. It was only to be expected that, with the introduction of cattle, a cowhide bag should take the place of a natural cavity in the rock, as a more convenient receptacle for the fermenting stuff. The cooling-vessel, which is at present bought in Mexican stores, and is of copper and round in shape, has the same name as that used by the Mexicans—*el caso*. Probably not longer ago than fifteen or twenty years wooden cooling-vessels of similar shape were used. I was anxious to secure one of these vessels ; but the only man capable of making one in the southeastern part of the country, where I was staying at the time, was absent, and thus neither time nor circumstances allowed me to procure a specimen.

The accompanying illustration (Plate II) shows the man in the act of renewing the fermented stuff in the boiler, or cooking-jar. He has taken out the receiver, which is standing in front of him ; and the cooler rests on the side of the mound. He is now engaged in emptying the boiler of the bits of stalk that have already been utilized. For this purpose he employs two fork-shaped sticks, the forked part being covered with a coarse network of *ixtle*, which form convenient implements for extricating the hot material. The refuse is thrown away in a heap to one side, as seen on the right of the picture.

The process of distillation among the Huichols is to my knowledge the most primitive found on the continent. A step higher in evolution is the method employed by their neighbors and relatives, the Cora Indians, which, although in detail more primitive than that of the Tarasco Indians, is practically identical with theirs, as described by the late John G. Bourke, in the 'American Anthropologist' for January, 1893, Vol. VI.



HUICHOL INDIAN IN HIS ORDINARY DRESS.



HUICHOL DISTILLERY.

Article II.—NOTES ON BIRDS OBSERVED AT JALAPA
AND LAS VIGAS, VERA CRUZ, MEXICO.

By FRANK M. CHAPMAN.

PLATE III.

Doubtless no other area of similar extent offers as many attractions to the naturalist as does that portion of the State of Vera Cruz lying between the parallels of 18° and 20° north latitude. Its surface includes lagoons, rivers and dashing streams; sandy beaches, marshes, and plains; valleys, cañons and mountain crests whose loftiest peak reaches an elevation of over 18,000 feet, and is crowned with perpetual snow. The temperature of the region is of course affected by its varying altitudes, and the climate is further influenced by extremes of aridity and humidity.

To these natural conditions should be added the accessibility of the region, and the fact that it is bisected by two lines of railway, which within a few hours take the traveller through three life-zones. Thus, leaving the city of Vera Cruz on the Mexican Railway, at 6 A. M., we pass through the arid coastal zone, or *tierra caliente seca*, and in two hours reach the lower border of the humid tropical zone, or *tierra caliente húmeda*, at an altitude of some 900 feet. We are now fairly in the mountains, and the ascent is more rapid, the lower border of the temperate zone, or *tierra templada*, at an altitude of about 2,700 feet, being reached at 9 A. M. We now journey through the elevated valleys of the *tierra templada*, and in two hours have reached the northern limit of this zone, and the southern limit of the humid alpine zone, or *tierra fria húmeda*, at an altitude of some 5,500 feet. The palms and heliconias of the humid tropical zone, the tree ferns and coffee groves of the *tierra templada*, are now replaced by forests of pines and oaks, which continue until, six hours after leaving Vera Cruz, we approach the arid alpine zone, or *tierra fria seca*, at an altitude of some 8,000 feet. The journey from this point to Mexico is on the great central plateau, a treeless region, over which comparatively uniform conditions prevail.

It is evident, then, that within this circumscribed area the student of the geographical distribution of life will find a field for work, where a minimum of effort will produce a maximum of result. A bio-geographic map of this region, based not only upon an exact knowledge of the distribution of its plants and animals, but also upon detailed information of its topography, soil, and climate, would be of surpassing interest, and it is as a contribution toward so desirable an end that this paper is presented.¹

The following notes are based upon observations and collections made between March 28 and April 27, 1897, at Jalapa, altitude 4,400 feet, and at Las Vigas, altitude 8,000 feet. During this period I employed as my assistant Señor Mateo Trujillo, of Jalapa, and his thorough knowledge of the ground, skill in collecting, and obliging disposition, were material factors in securing the 772 specimens (486 birds and 266 mammals²) which formed my collections. I desire also to express my thanks to Mr. J. F. Brooks, of Jalapa, for permission to camp and to collect upon his estate. As a matter of convenience I have arranged the species observed in the order given in the 'Biologia Centrali-Americana.'

I.—BIRDS OBSERVED AT JALAPA.

The names of few localities in Mexico are better known to ornithologists than that of Jalapa. One of the first faunal papers³ on Mexican birds was based upon collections made largely near this city, and as early as 1859 Dr. P. L. Sclater published a report⁴ on a collection of 850 birds' skins collected by Señor Raphael Montes de Oca in the vicinity of Jalapa, which, with an immediately succeeding paper on birds from Oaxaca,⁵ and one by the same author on Sallé's Collections,⁶ constituted the most important contributions to our knowledge of the distribution of Mexi-

¹ For an important paper on the distribution of the birds of Vera Cruz, by F. Sumichrast, see *Memoirs of the Boston Society of Natural History*, Vol. I, pt. iv, 1869.

² For a report on the Mammals, see this *Bulletin*, IX, 1897, pp. 197-208.

³ Cassin, *Catalogue of Birds collected by Wm. S. Pease during the march of the Army of the United States from Vera Cruz to the City of Mexico.* *Proc. Acad. Nat. Sci. Phila.*, 1848-49, pp. 87-91.

⁴ *P. Z. S.*, 1859, pp. 362-369.

⁵ *Ibid.*, pp. 369-393.

⁶ *Ibid.*, 1856, pp. 283-311.

can birds which had then appeared. Subsequently, de Oca became one of the best known of Mexican collectors. He continued his work in the vicinity of Jalapa for many years, and no general collection of Mexican birds was without 'skins' of his characteristic make.

In more recent years Señor Mateo Trujillo, of Jalapa, has proved a worthy successor of de Oca, and while acting for Messrs. Salvin and Godman, and for others, has procured large numbers of birds near his home.

It would seem, therefore, that so far as their occurrence is concerned, our knowledge of Jalapan birds is too complete to render worth publication notes made during a stay of only three weeks. I find, however, on examination of the papers mentioned, and upon reference to other recorded specimens of de Oca's collecting, that our published knowledge of Jalapan birds is not only indefinite, but in many instances is positively incorrect.

Jalapa, lying between two wholly distinct life-zones (the *tierra caliente* of the coast region and the *tierra fria* of the tableland), is so situated that within a few hours one may pass to a tropical, or to an almost boreal fauna. It would even make a material difference in the result of a day's collecting whether one should go to the south or to the north of the city. Consequently, the necessity for exactness in labelling is evident, a necessity, however, which de Oca, in common with many of the earlier collectors, did not realize. His specimens, if they were labelled at all, were marked simply "Jalapa," though, as Trujillo informs me, and as a study of Dr. Sclater's list shows, many of them were taken in an entirely different faunal region. Hence we find included in the paper referred to such species as *Certhia familiaris alticola*, *Sitta pygmaea*, *Parus meridionalis*, *Junco phaeonotus*, *Loxia curvirostra stricklandi*, *Dryobates stricklandi*, and others characteristic of the alpine zone, and which doubtless never occur, even as migrants, near Jalapa. Again, other birds mentioned in this same paper (e.g., *Dendrotyx barbatus*) do not occur nearer than the arid coastal belt of the *tierra caliente*, and this inexactness bears fruit to the present day in the form of requests which Trujillo receives for specimens of de Oca's species, which the former has not met with during many years' experience.

It is evident, therefore, that for the purposes of the student of geographical distribution, the locality 'Jalapa' on a de Ocan specimen is of little more service than would be a statement that the specimen came from the State of Vera Cruz, while to accept the locality 'Jalapa' as exact might prove extremely misleading.

Trujillo, appreciating the need of greater care, has labelled his birds with full data, but as his collections have never been reported on as a whole, the results of his labors remain inaccessible to the public. Thus the 'Jalapa' of ornithological literature and the Jalapa of maps are by no means the same place, and as a contribution to our knowledge of the manner of occurrence and habits of the birds of this region, I feel warranted in presenting the following notes.

Jalapa being, as has been before remarked, at an altitude of some 4,400 feet, is in the heart of the temperate life-zone, or *tierra templada*. This life-zone, unlike the ones below and above it, has no arid sub-division, the whole temperate belt receiving a never-failing supply of rain from the moisture-laden clouds which arise from the Gulf and are condensed on the mountain-sides. Jalapa is, in fact, celebrated for its fogs and drizzling rains, which, even in midwinter, or at the height of the so-called 'dry season,' give to its vegetation a perennial freshness.

Collections were made at Jalapa from March 28 to April 16, at a point one and one-half miles east of the city, where my camp was most advantageously situated. The surrounding country is a series of low, rounded hills with narrow, intervening valleys, and is largely under cultivation in corn and coffee. There are also grazing lands, tracts of scrubby bushes, young second-growths, and fairly large areas of fine old forests containing some first-growth timber. The region is well watered by small streams.

Birds were abundant. Three or four species were found to be laying, but dissections showed that the breeding season was only just begun. Most species were mating, or nest-building, and the song-season was therefore at its height.

1. *Catharus melpomene* (Cab.).—An abundant inhabitant of the denser undergrowth, preferably along the borders of woodland. Its dull colors, habit of sitting motionless when perching,

and the nature of its haunts, make it a difficult bird to observe. It is not shy, and one's presence often seems to stimulate its powers of song; nevertheless I succeeded in securing but seven specimens.

Both this bird's relationships and appearance would lead one to suppose that it possessed unusual vocal talent, but from the birds about Jalapa I heard only the most unattractive song. It was not unusual to hear four individuals singing at the same time their oft-repeated, unmusical, guttural, *cheerless-merelless*, with occasionally a few added notes.

2. *Catharus mexicanus* (Bon.).—Apparently rare, but two specimens, a male and a female, being taken. The former differs from the latter in having the black cap deeper and more clearly defined, the back, sides of the throat, the breast and flanks grayer, a difference which, as Salvin and Godman suggest,¹ is doubtless sexual.

3. *Merula tristis assimilis* (Cab.).—The most abundant species observed. Its calls resemble those of the Robin (*Merula migratoria*), but are apparently less varied; its song, however, is to my mind much richer and more musical than that of the Robin. Dozens of these birds could be heard singing early each morning, and in the afternoon we were again serenaded by this inspiring chorus of bird-song.

Comparison of two specimens of this Thrush, collected by Dr. G. A. Buller, at Tonila, Jalisco, with eight specimens from Jalapa, shows such marked differences in color that I have submitted my Jalapa material to Mr. E. W. Nelson for comparison with his large series of *Merula tristis* from the west coast region, including specimens from Huitzilac, Morelos, which is in the same district as Temascaltepec, the locality whence came Swainson's type. Mr. Nelson kindly writes me that the Jalapan birds differ from west coast examples in their darker coloration, the wings and tail being blackish brown, not grayish olive-brown, the brown on the flank being grayer and darker. West coast birds are somewhat the larger, as the following average measurements of representative

¹ Biol. Cent.-Am., Aves, I, 7.

series of males from Morelos and Jalisco and from Jalapa show: West coast birds: Wing, 5.12; tail, 4.06; culmen, .87; tarsus, 1.26. Jalapa birds: Wing, 4.98; tail, 3.94; culmen, .83; tarsus, 1.20.

It thus appears that the east coast bird is well entitled to subspecific rank, and I apply to it, therefore, the name *assimilis* of Cabanis based by him on Jalapa specimens.

4. ***Merula grayi* Bon.**—Much less common about my camp than the preceding species, but abundant in the gardens of the city of Jalapa, where *M. t. assimilis* was not observed. This peculiarity of distribution doubtless accounts for the name *Prima-vera corriente*, or Common Thrush, being applied to this species. The calls of *Merula grayi*, like those of *M. t. assimilis*, bear a strong resemblance to certain of those of our Robin (*Merula migratoria*), but it has also a wholly distinctive, nasal mewling note. Its song I consider one of the finest I have ever heard a bird sing. In its varied character, fluency and execution it suggests the songs of the Catbird (*Galeoscoptes carolinensis*), Thrasher *Harporhynchus rufus*, and Mocker (*Mimus polyglottos*), but it is sweeter in tone and less consciously sung; in spirituality I was reminded of the songs of both the Wood Thrush (*Turdus mustelinus*) and Hermit Thrush (*Turdus a. pallasii*). In short it is a flawless performance, and heard at nightfall, when the birds sing most freely, is one of the most satisfying bird's songs to which it has been my fortune to listen.

5. ***Galeoscoptes carolinensis* (Linn.)**.—A female, taken April 7, was the only one observed. This specimen shows no signs of molt in progress.

6. ***Melanotis cærulescens* (Swains.)**.—Abundant; resembling the Catbird in its fondness for dense shrubbery and in its general actions. Its notes could be heard at almost any hour of the day, and their loud tone and striking originality, in connection with the bird's numbers, combined to render it one of the most characteristic birds of the region. It would take a far longer experience than mine to enable one to fully describe the notes of this bird, if, indeed, they could ever be fully described.

So greatly do the songs of different birds vary from each other that I cannot say which is the true song of the species. I have heard three birds singing wholly unlike songs at the same time. They may utter a rambling, broken recitative or short, vigorous call of but three or four notes, and in addition to their own apparently limitless repertoire they imitate the notes of other birds in so perfect a manner that identification by means of notes alone was often extremely uncertain.

7. Harporhynchus longirostris (Lafr.).—Not common. In choice of haunts and in song it resembles *H. rufus*; its song, however, seemed to me to be richer than that of the Eastern bird.

8. Myiadestes obscurus (Lafr.).—The Jilguero, as this bird is called by the natives, was common in all the older woodlands, where it frequents the tops of the highest trees. Occasionally it may be seen darting ten to twenty feet upward into the air, apparently after insects, but were it not for its song the bird would rarely be noticed. This, however, is so remarkable that one would indeed be unobservant who could pass within one hundred yards of a singing Jilguero and not be attracted by its song. It is described in my journal as beginning "with several preliminary, metallic, bell-like calls separated by rapidly decreasing intervals, then bursting into a shower of sparkling notes, which, if you are near the singer, completely drowns the songs of all the other birds in your vicinity. There may be a dozen birds singing, but you hear only the Jilguero. In rapidity of utterance, spontaneity and absolute irrepressibility, the song reminds me of the Bobolink's, but *Myiadestes* sings more notes to the second than our 'mad singer.' The bird is secondary to the song; it takes entire possession of him. To use a rather unpleasant simile, it is like a fit; it is an explosion of music over which the bird has no control."

It is not to be wondered at, therefore, that the Jilguero is a favorite cage-bird among a people who are more than usually fond of pets. It is, as a rule, reared from the nest, and evidently thrives in captivity on a diet of plantains and boiled eggs.

There is a striking and very interesting difference in the songs of individuals of this species from different localities. Thus the voices of the birds about Jalapa are possessed of such strength that when heard at a distance of a few yards the sound is painfully loud, and I have often placed my fingers to my ears when passing near the cage of a singing bird. But the birds from the deep ravines or barrancas have much sweeter, less powerful voices, and under the name of "Jilguero de la Barranca" are highly prized.

In caged-birds I have noticed that the three to five notes which precede the song are in turn preceded by a nervous flitting or twitching of the first primary, the outward evidence of the emotion which culminates in the burst of music I have tried to describe.

The Clarin (*Myiadestes unicolor*) was reported by Trujillo as occurring on the wooded sides of a deep barranca several miles from, and at a lower elevation than, Jalapa. Its song, as I have heard it in captivity, is much superior to that of the Jilguero, being possessed of greater richness of tone, depth of expression, and variety of notes.

9. *Sialia sialis azurea* (*Baird*).—In a locality which strongly suggested an old apple orchard, Bluebirds were not uncommon, and I have observed seven individuals there in a morning. They were evidently preparing to breed, and their familiar song seemed, by association, wholly out of place in a region inhabited by Toucans, Trogons and Ant-birds.

10. *Regulus calendula* (*Linn.*).—Four individuals were observed, three of which were females showing, on dissection, no signs of an approaching breeding season.

11. *Heleodytes zonatus* (*Less.*).—Common in small companies of six or eight birds. They frequent the denser growth at the borders of woods, living both in the bushes and upper branches, but if found in the former situation at once mount upward, hopping from limb to limb. As they go they switch the tail violently from side to side, or sweep it about in a singular

way, but I have never seen them cock it forward as other Wrens do. At the same time they give utterance to a loud, scolding, cackling note, which is soon followed by a chorus sounding like *scratchertee-scratch-e-scratch*, three times repeated, and in such perfect unison that one can readily imagine it a concerted performance under the direction of a leader.

12. *Henicorhina mexicana* Nels.—This Wren was a not uncommon inhabitant of the denser undergrowth in damper parts of the forests where, owing to the nature of its haunts, its color and activity, it was as difficult to shoot as a Field Mouse. Its call is a low, chippering *kick*, but its song is possessed of surprising volume. It is thrush-like in quality, and suggests the song of the Robin, but it is delivered with the snap and energy which characterizes the song of the Whip-poor-will.

13. *Thryothorus maculipectus* Lafr.—Common. Its musical, rapid whistle does not appreciably differ from that of *Thryothorus rutilus*, and is so unlike the song of any other Wren with which I am familiar that it suggests a much closer relationship between these two birds than their appearance would lead one to suppose existed.

14. *Troglodytes aëdon* Vieill.—Two females, the only individuals of the species observed, show no signs of breeding. These specimens are obviously to be referred to *aëdon* rather than to *aztecus*.

15. *Cistothorus palustris plesius* Oberholser.—On the outskirts of Jalapa there is a small marsh grown with high grasses and reeds, in which there were about a dozen individuals of this bird, which has apparently not before been recorded from this part of Mexico. The three specimens secured are evidently to be referred to the interior form of Long-billed Marsh Wren recently distinguished by Mr. H. C. Oberholser¹ under the above name. They were females, and on dissection the ovaries showed no signs of enlargement.

¹ Auk, XIV, April, 1897, 188.

16. *Cistothorus polyglottos* (Vieill).—In the marsh inhabited by *Cistothorus p. plesius* there were several pairs of these Short-billed Marsh Wrens. A nearly completed nest of coarse grasses, open on top and placed near the ground, doubtless belonged to this species, and this evidence of their breeding was confirmed by the much enlarged testes of the three males taken.

Aside from their paler under parts, these birds are readily distinguished from any one of a representative series of *C. stellaris* by the broader white stripes of the back, and unbarred black inner webs of the basal two-thirds of the inner tail-feathers.

I have no specimens of this Wren from South America, and follow recent authors in referring the Mexican bird to *C. polyglottos*.

17. *Helminthophila pinus* (Linn).—A male, taken April 7, is acquiring new feathers in the interscapulars.

18. *Helminthophila rubricapilla* (Wils).—One of three specimens, a female taken April 7, is gaining new feathers on the breast.

19. *Helminthophila peregrina* (Wils).—A male taken April 18 shows no sign of molt in progress.

20. *Dendroica virens* (Gmel).—A female taken April 7 is acquiring new feathers on the crown.

21. *Seiurus aurocapillus* (Linn).—A male taken April 6 shows no signs of molt in progress.

22. *Geothlypis trichas* (Linn).—A female taken April 15 is growing new feathers on the crown.

23. *Icteria virens* (Linn).—A female taken April 10 shows no signs of molt in progress.

24. *Wilsonia pusilla* (Wils).—Three of the four specimens taken, one a female, are acquiring the black cap by a complete molt of the feathers of the crown, and are also gaining new feathers about the gular region.

25. **Basileuterus culicivorus** (*Licht.*).—Common, especially in young second-growth woods. It is a rather suspicious bird, and with drooped wings and slightly spread tail flits from branch to branch about the intruder, uttering a chirping call. Its song is simple and weak, but musical, and reminds one of the song of *Sylvania mitrata*, though by no means equal to it.

26. **Basileuterus rufifrons** (*Swains.*).—Much less common than *B. culicivorus*. It seemed to prefer bushy growths at the borders of woods, just such haunts as are selected by *Geothlypis trichas*.

27. **Vireo gilvus** (*Vieill.*).—A male, taken April 18, shows no signs of molt in progress.

28. **Vireo amauronotus** *Salv. & Godm.*.—It is a singular fact that in a region so well known as Jalapa this hitherto little known *Vireo* should prove to be a common bird. Five to seven individuals were heard daily, and their song so closely resembles that of *Vireo gilvus* that before examining specimens I entered the species in my notes under that name.

Comparison of seven examples of this bird with an equal number of *Vireo josephæ* and a large series of *V. gilvus* shows that its relationships were correctly defined by Messrs. Salvin and Godman in describing it from the then only known specimen.¹ In the plumage of the back it more nearly approaches *josephæ* in being brownish olive-green rather than grayish olive-green, while the crown is distinctly brownish, not grayish, as in *gilvus*. In the color of the under parts, however, it almost exactly resembles *gilvus*, being much less yellow than *josephæ*.

A female taken April 1 was about to lay, while one taken April 5 was laying.

29. **Vireo solitarius** (*Wils.*).—Two specimens, taken respectively March 29 and April 1, are acquiring numerous new feathers on the crown, back, throat, and breast.

¹ Biol. Cent.-Am., Aves, I, 193.

30. Neochloë brevipennis *Scl.*.—Three males of this rare Vireo were taken in scrubby undergrowth, two at the border of woods and one in the more bushy growth of an old field. Their song is short, and in character is sufficiently like the notes of *Vireo noveboracensis* to enable one to recognize the singer as a Vireo before seeing it. The iris is white.

31. Cyclorhis flaviventris (*Lafr.*).—Not uncommon, and resembling in notes and habits the same species as I have seen it in Yucatan.

32. Ampelis cedrorum (*Vicill.*).—Not uncommon in flocks of six to ten individuals. A female taken April 3 is acquiring a few new feathers on the crown, and is the only one of five specimens showing signs of a molt in progress.

It is surprising to learn that the relation between birds so apparently unlike as the present species and *Ptilogonys cinereus* should be recognized in the common name given to them both, *Ampelis* being known at Jalapa as *Filomena cola corta*, while to *Ptilogonys* the name *Filomena cola larga* is applied, or, respectively, the Short- and Long-tailed Filomena.

33. Ptilogonys cinereus *Swains.* — Tolerably common, haunting the tops of the tallest trees, where it usually selects a perch on a dead or leafless limb. Its position is upright, its manner alert, and with crest slightly erect it is ever ready to dart into the air for insects. It apparently catches several before re-lighting, and it may not return to the same perch. Its call is a loud, metallic *claiik*. Its flight is rather rapid and undulating, and when on the wing it utters a chuckling note.

A male having testes one-fourth of an inch in length, resembles the female in plumage except for the white tail band, which is as broad as in the fully-mature male.

34. Progne chalybea (*Gmel.*).—Not uncommon in the city of Jalapa, but not observed in the surrounding country. No specimens were obtained.

35. **Chelidon erythrogaster** (Bodd.).—Late each afternoon great numbers of Swallows were seen coursing low over the city of Jalapa. No specimens were obtained, but the present species and *Tachycineta bicolor* were positively identified, and there was also a species of *Petrochelidon*, whether *lunifrons* or *melanogaster* I cannot say. None of these birds were seen about my camp, distant less than two miles.

36. **Tachycineta bicolor** (Vieill.).—Seen in the late afternoon in large numbers feeding over the city of Jalapa.

37. **Stelgidopteryx serripennis** (Aud.).—Not common. Several were seen apparently prospecting for nesting sites in a sand-bank, and the testes of a male taken April 18 were considerably enlarged, evidence tending to show that this species breeds at Jalapa.

38. **Euphonia elegantissima** (Bonap.).—Not common.

39. **Tanagra abbas** Licht.—Not uncommon.

40. **Piranga rubra** (Linn.).—A female taken April 6 had slightly enlarged ovaries.

41. **Piranga leucoptera** Trudeau.—A fully plumaged male, taken April 3, was the only specimen observed.

42. **Piranga bidentata** Swains.—Common in the more heavily-wooded tracts, where it frequents the upper branches. Its song resembles that of *Piranga erythromelas*, but is more musical, and even more strongly suggests that of *Merula migratoria*. Its call-note is a characteristic *clit-tuck*, corresponding to the *chip-chirr* of *P. erythromelas* and *chicky-ticky-tuck* of *P. rubra*.

43. **Phœnicothraupis rubicoides** (Lafr.).—Three examples were taken, the only ones observed.

44. **Chlorospingus ophthalmicus** (Du Bus).—Common. A female taken April 1 was laying, another taken April 16 was sit-

ting, showing that the breeding season was at hand ; but I failed to hear, or, at least, to recognize either the song or call-notes of this species.

45. **Buarremon brunneinucha** (*Lafr.*).—Not uncommon ; living in the forests on or near the ground in the denser undergrowth. It is apparently a shy bird, and I failed to learn anything of its notes.

46. **Saltator atriceps** (*Less.*).—Not uncommon about the borders of woods. This is an active bird, seldom seen long in one place, and apparently it ranges over a wide extent of territory during the day. Its notes are loud and harsh, but I did not hear the unpleasant, steely alarm-note uttered so frequently by this species in Yucatan.

47. **Saltator grandis** (*Licht.*).—Less common than the preceding.

48. **Zamelodia ludoviciana** (*Linn.*).—Not observed about our camp, but apparently not uncommon in the trees of Trujillo's garden in Jalapa, to which it was doubtless attracted by their fruits. A male taken April 18 is evidently renewing its plumage by molt. The tail is but half grown, the wing-coverts and inner secondary are new, new feathers are appearing in numbers throughout the body where the change is nearly completed, but the wing quills, except as noted, are of the old brownish plumage. A second male, taken the same day, is in adult but apparently worn plumage, and shows no signs of molt in progress.

49. **Cardinalis cardinalis coccineus** (*Ridgw.*).—A single male was taken west of Jalapa, but the species was not observed near our camp.

50. **Guiraca cærulea eurhyncha** (*Coues*).—Not common. One was heard singing April 1, and the testes of a male taken April 13 measured about .15 inches in length.

51. *Sporophila moreletti sharpei* Lawr.—Flocks of fifteen to thirty were observed on two occasions.

52. *Volatinia jacarini splendens* (Vieill.).—Four individuals were observed, one of which was taken.

53. *Euetheia olivacea pusilla* (Swains.).—A flock, containing some thirty individuals, was observed April 15. The testes of two males taken on this date measure .15 inches in length, but the ovaries of two females show no signs of enlargement.

54. *Chondestes grammacus strigatus* (Swains.).—A single Lark Finch was seen, but not taken, west of the city of Jalapa.

55. *Spizella socialis arizonæ* (Coues).—Not uncommon in small companies. The three specimens taken are typical of this subspecies.

56. *Melospiza lincolni* (Aud.).—Abundant in the old weeds of uncultivated fields and in bushy growths.

57. *Aimophila rufescens* (Swains.).—Very common in bushy tracts and in the undergrowth bordering woodland, suggesting in choice of haunts as well as in actions the Song Sparrow (*Melospiza fasciata*). Its song is uttered frequently and with much energy, but is mechanical and unmelodious.

58. *Carpodacus mexicanus* (Müll.).—Observed only in the town of Jalapa, where it apparently was not common. Since leaving Jalapa Señor Trujillo has forwarded me two young females and an adult male of this bird taken in that city in May. When compared with specimens from the more arid tableland these Jalapa examples prove to be darker and more heavily streaked, and it is not improbable that further material will show them to be worthy of subspecific separation.

59. *Coccothraustes abeillæi* (*Less.*).—Not uncommon, a few individuals being seen almost daily. In the 'Biologia Centrali-Americana' (Birds, Vol. I, p. 427), this species is described as being "rather sluggish in its movements, frequenting the lower branches of the forest-trees," but I found it an alert, active bird, which perched in an exposed position on the topmost limbs of the tallest trees, where, after calling its loud, double-noted whistle, it left on an apparently extended flight for some distant haunt.

60. *Spinus notatus* (*Du Bus*).—Not uncommon. A female taken April 2 was laying.

61. *Spinus psaltria mexicanus* (*Swains.*).—Common in small flocks. Specimens of both sexes taken April 13 are apparently in full molt; the old wing-feathers are being replaced by new ones, but the old tail-feathers have not been shed.

62. *Icterus melanocephalus* (*Wagl.*).—Apparently not uncommon but irregular in its appearance, and evidently covering a wide range of territory in its daily wanderings. Its song, which is also uttered by the female, is a most singular performance, and always reminded me of a boy with no ear for music who whistles a series of unrelated notes, which he tries to improvise into a kind of rambling tune.

63. *Dives dives* (*Licht.*).—Seen on several occasions, but only in the parks of the city of Jalapa.

Near the railway station at Jalapa I had a brief distant view of flocks of birds which I provisionally identified as *Quiscalus macrourus* and *Molothrus*.

64. *Cyanolyca ornata* (*Less.*).—These birds occur only in the larger forests where, on April 7, I secured a male and female, the testes of the former being slightly enlarged.

65. *Xanthoura luxuosa* (*Less.*).—Very common in small companies about the borders of woods and in scrubby-growths. They are noisy birds, often reminding one in their notes of *Cyanocitta cristata*.

66. *Psilorhinus morio* (Wagl.). Observed and heard calling on two occasions, but no specimens were secured.

67. *Mionectes oleagineus assimilis* (Scl.).—Two specimens were secured of this well-marked race, which may be easily distinguished from Panama and South American examples by its grayish green throat and breast.

68. *Myiozetetes texensis* (Giraud).—Common in pairs about the borders of woodland. They are noisy, excitable birds, and their harsh chattering cries were among the most characteristic bird-notes. Several times, while one of these birds was pursuing its mate at full speed, I heard a whirring sound which was sufficiently loud to be startling in its effect at a distance of one hundred yards. It lasted only two or three seconds, and was apparently produced voluntarily, doubtless by the wings, though the primaries of this species show no unusual modification.

69. *Myiodynastes luteiventris* Bonap.—Six individuals were observed, of which three were taken.

70. *Mitrephanes phæocercus* Scl.—A rather uncommon inhabitant of the woods.

71. *Empidonax albigularis* Scl.—A male with enlarged testes, taken April 9, was the only one observed.

72. *Contopus pertinax* Cab.—Five individuals were observed, of which three were taken.

73. *Contopus borealis* (Swains.).—A male was taken April 13.

74. *Myiarchus lawrencei* (Giraud).—Very common, and evidently preparing to breed.

75. *Platypsaris aglaia* Lafr.—Common about the borders of woods. They were mated and nest-building as early as April 3, and were now noisy and active, their harsh, chattering notes,

as they chased one another about the tree-tops, often reminding one of the sudden outbreak of *Myiozetetes*.

Their nest, of which several were seen in course of construction and a completed one, without eggs, secured, is so unlike that described by Messrs. Salvin and Godman as belonging to this species, that I cannot but believe these authors were misled by a collector's error. They write of a nest, evidently resembling that of a Vireo, open at the top and about two inches deep. Whereas that built by *Platypsaris* at Jalapa, where both the bird (called 'Mosquero degollado') and its home are well known, is some fifteen inches long and about eight in width, with an entrance at one side near the middle. It is a remarkable structure, composed largely of coarse weed-stalks and grasses, in part covered with fresh green mosses, the walls of the cavity being lined with mud. These nests are attached to the end of a limb of one of the taller trees, and sometimes overhang a public road. (See Plate III.)

76. *Pachyrhamphus major* (Cab.).—Two specimens were taken and several others observed. The note heard was a low, sweet, questioning whistle.

77. *Automolus rubiginosus* (Scl.).—A male having much enlarged testes was secured April 3.

78. *Sclerurus mexicanus* Scl.—Four specimens were secured in dense woodland on or near the ground. Their note is a single high chirp of peculiar quality.

79. *Dendroornis flavigastra* (Swains.).—Not uncommon in the larger forests, where its loud whistled call was not infrequently heard.

80. *Picolaptes affinis* Lafr.—Three specimens were secured.

81. *Thamnophilus doliatus mexicanus* Allen.—Not uncommon in tracts of scrubby bushes. Its call is similar to that of the representatives of this species as I have heard them in Yucatan and Trinidad.

82. Chlorostilbon canivete (*Less.*).—A female taken on April 18.

83. Uranomitra cyanocephala (*Less.*).—Common. A nest found April 5 was placed in a small bush about five feet from the ground, and contained two partially incubated eggs.

84. Amazilia beryllina (*Licht.*).—A male taken April 10.

85. Sphenoproctus curvipennis (*Licht.*).—Not uncommon. This bird is locally known as 'Guiche (a name applied to all Hummers) Cantador del Monte,' or the Singing Hummer of the Woods, a distinction it well deserves. Upon first hearing this Hummer's song I supposed it to be uttered by a bird at least nine inches long, although the singer was some 75 feet from me, and the intervening space was thickly grown with bushes. A bird that I often watched regularly frequented certain perches. He was rarely quiet, but constantly turned his head from side to side as though looking for something, while his tail, which was above his drooped wings, was often nervously flitted. Frequently he uttered a long, high, twittering trill, which at intervals of several minutes was followed by his song. This truly remarkable performance is difficult of description, but if one can imagine the sound which would be produced by a violent, automatic jerking of a quart of water in a five-gallon demijohn some idea may be had of this bird's unique song. It lasted about ten seconds, and seemed to greatly excite the singer, and at its conclusion he quickly and repeatedly protruded his tongue for an inch or more, then, with a shrill twitter and a whirr he darted off in a direct line. He was gone only a few seconds when the twittering note and sometimes the song, uttered on the wing, told of his return to one of two or three perches, when the whole performance, twitter, song and sudden dart, were repeated.

So far as my observations went, the much-enlarged shafts of the outer primaries are functionless, as regards the production of any unusual sound. The shrill noise which often accompanied the bird's flight was undoubtedly vocal. It was frequently produced while the bird was at rest, and when I could distinctly see the movement of its mandibles.

86. *Trochilus colubris* Linn.—A female taken March 29 is gaining new feathers on the throat and back.

87. *Atthis heloisæ* (Less.).—A female taken April 12.

88. *Cypseloides niger borealis* (Kennerly).—A flock of from 50 to 100 of these birds was often observed passing over our camp early in the morning. They flew with great rapidity, and in a few seconds were lost to view. In the evening numbers were sometimes seen circling about at a great height.

A species of *Chatura* was observed in small numbers on several occasions, but no specimens were secured.

89. *Antrostomus vociferus* (Wils.).—Three specimens were taken, none of them having the sexual organs enlarged.

90. *Nyctidromus albicollis merrilli* Sennett.—Not uncommon, and heard calling each evening.

91. *Chordeiles acutipennis texensis* (Lawr.).—Night-hawks were seen in small numbers every evening flying at a great height. The only individual secured was of this form.

92. *Melanerpes formicivorus* (Swains.).—Several pairs of these birds were resident in certain tall dead trees at the border of a wood, the only locality in which they were observed.

93. *Sphyrapicus varius* (Linn.).—Three specimens were taken, two of which are gaining a few new feathers on the breast or crown.

94. *Eleopicus oleaginus* (Reich.).—Not uncommon. Its call resembles the sharp *peek* of *Dryobates pubescens*, but is uttered continuously for several seconds.

95. *Trogon puella* Gould.—Not common, and confined to the denser forests. A female taken March 30 was laying, and another taken April 8 had the ovaries much enlarged, indicating a comparatively early nesting season. The call of this species is a

softly whistled *coo*, several times repeated, agreeing in character with that of the three species of this genus I have heard in Trinidad.

96. *Crotophaga sulcirostris* Swains.—Several were observed, and one secured.

97. *Piaya cayana thermophila* (Scl.).—Not common. A female taken April 7 had much enlarged ovaries. The call of this bird is evidently uttered by both sexes; it is a loud, nasal *vee-à-ho*, reminding one in tone of a Peacock's scream, repeated several times and followed by a hyla-like piping whistle.

98. *Cathartes aura* (Linn.).—A few were observed daily.

99. *Catharista atrata* (Bartr.).—Less common than *C. aura*.

100. *Elanoides forficatus* (Linn.).—Two were seen March 29.

101. *Buteo latissimus* (Wils.).—Two specimens were secured.

April 5 and 16 flights of Hawks—I was unable to determine the species—were observed passing northward, exceeding in number any migration of these birds I have before seen. Unlike the well-known autumnal flights of Hawks when in straggling companies they may be seen for several hours, these birds were closely massed. Nor did they fly directly, but in circles, thousands being massed in whirling flocks, the number of birds being incalculable. They flew at an altitude of about 1000 feet, and although, as I have said, they soared in circles, they nevertheless progressed rapidly, those seen on the 5th being in sight only about 15 minutes, while those observed on the 16th were less than one hour in passing our camp.

102. *Polyborus cheriway* (Jacq.).—Two were seen.

103. *Leptotila fulviventris brachyptera* (Salvad.).—Common.

104. *Columbigallina passerina pallescens* Baird.—A male and female, taken respectively April 13 and 15, had the sexual organs much enlarged.

105. *Ortalis vetula maccalli* (Baird).—Occurred locally in small numbers.

106. *Rallus virginianus* Linn.—Four specimens were secured, two in the small marsh previously mentioned as the home of *Cistothorus elegans*, and two in a narrow strip of grassy marsh bordering a wood. Two were males with slightly enlarged testes and the basal half of the lower mandible coral-red; two were females with dull yellowish bills and unenlarged ovaries.

107. *Crypturus cinnamomeus* (Less.).—One or two of these birds were heard trilling their short, low whistle each morning and evening, but no specimens were secured.

II.—BIRDS OBSERVED AT LAS VIGAS.

Las Vigas, at an elevation of 8,000 feet, is on the border of the tableland, in the humid alpine zone, some forty miles in a direct line from Jalapa. After becoming partially familiar with the avifauna of Jalapa, a brief experience at Las Vigas proved a most impressive lesson in the effects of temperature on the distribution of life.

Two hours by rail after leaving Jalapa, with its semi-tropical vegetation, one is surrounded by magnificent pine-forests, which, almost wholly devoid of undergrowth, are apparently of boundless extent. The Trogons, Toucans, Tinamous, Ant-birds, Tanagers, Thrushes, Wrens, and other birds common in the region about Jalapa, have been left behind, and in their place one finds Juncos, Crossbills, Brown Creepers, Pine Finches, Evening Grosbeaks, and other species characteristic of the alpine zone. In short, an almost entire change in avifauna occurs. Of 108 resident birds observed at Jalapa and Las Vigas, only three (*Cathartes*

aura, *Catharista atrata*, and *Carpodacus mexicanus*) were found in both localities.

At Las Vigas we are still within reach of the moisture-laden Gulf clouds. The region is fertile, and humidity plays no part in this remarkable faunal change, which is evidently due to the influence of temperature alone. From the summit of the pine-clad hills one can look down on the dense forests of the temperate zone, distant only a few minutes as the bird flies, but between the two temperature has erected an invisible but potent barrier which few species cross.

At Jalapa the average temperature at 7 A. M. during my stay was 64°; at Las Vigas it was about 50°, and each morning we had a white frost.

Scarcely less interesting than this difference between the faunæ of Jalapa and Las Vigas is the much earlier nesting-season which, contrary to what would be expected, was found to exist at the last-named place. At Jalapa, as has been before remarked, only four species were discovered by dissection to be laying, and no young birds were seen. At Las Vigas the nesting-season was evidently more than half over. Full-fledged young were taken of the following species: *Merula migratoria propinqua*, *Sitta pygmæa*, *Certhia familiaris alticola*, *Dendroica olivacea*, *Junco cinereus*, *Loxia curvirostra stricklandi*, *Coccothraustes vespertinus montanus*, *Anrostomus vociferus macromystax*, and *Dryobates stricklandi*.

The following species were found on dissection either to be laying or incubating: *Sialia mexicana*, *Parus meridionalis*, *Ergaticus ruber*, *Vireo huttoni stephensi*, *Empidonax fulvifrons*. Fourteen species, or about forty per cent. of the resident birds noted were thus, even by my limited observations, found to be breeding or to have bred. Without a detailed knowledge of the climatic conditions prevailing at Las Vigas during the spring and summer months it would be useless to speculate on the manner in which this unexpectedly early breeding season has become established.

1. *Turdus ustulatus swainsoni* (Cab.).—The single specimen taken was too mutilated to permit of a satisfactory examination of the sexual organs.

2. *Turdus aonalaschkæ auduboni* (*Baird*).—Two specimens, representing both sexes, were secured. In neither of them were the sexual organs enlarged.

3. *Merula migratoria propinqua* *Ridgw.*—Common, and in full song. The breeding season was evidently at its height, and on April 25 a nest containing two nearly fledged young was found. It was placed on the lower limb of a pine toward the end, and in general construction resembles a typical Robin's nest. The usual number of young was said by the natives to be three.

4. *Sialia mexicana* *Swains.*—Apparently not common. Four specimens were taken, three males, having the testes much enlarged, and a female containing an egg ready for deposition. No songs were heard.

5. *Regulus calendula* (*Linn.*).—Not uncommon. Three females were taken, but in none of them did the ovaries show signs of enlargement.

6. *Parus meridionalis* *Scl.*—Common. The call of this Titmouse is a rapid, vigorous, double-noted whistle repeated three times, and not at all like the notes of *Parus atricapillus*. In its conversational 'juggling' notes there is, however, a marked similarity to the corresponding notes of that species. A female taken April 20 was laying.

7. *Psaltriparus melanotis* (*Hartl.*).—Not uncommon in small companies of three to five individuals. They seemed to prefer low, bushy growths, but were also seen high in the pines. Their note is a metallic twitter.

An incomplete nest found April 24 was suspended to the outer branch of a bush. It is composed of plant-down and grasses firmly interwoven, and externally is uniformly covered with bits of lichens. It is pensile, with the opening on one side at the top, and measures eight and one-half inches in length. The entire bottom is lacking, whether through an accident or because the

nest is incomplete is not apparent. The structure, however, is evidently of recent make.

8. *Sitta carolinensis mexicana* Nels. & Palm.—Tolerably common. A female differs from five males in having the abdomen and flanks browner, and also in having the crown wholly black, but not glossy.

9. *Sitta pygmæa* (Vigs.).—Tolerably common. They feed actively on the terminal buds of the pines, and often utter a rolling trill. April 25 one was seen feeding fully grown young.

Four males differ from Arizona examples in having the crown somewhat lighter.

10. *Certhia familiaris alticola* Berl.—Four specimens were taken, three adults and one fully grown young of the year. Apparently more than one brood is reared, for a female taken April 23 was collecting nesting material. The song of this Creeper is a rather loud but unmusical *squeak-squee-e-e-er*, evidently, therefore, unlike that of *Certhia familiaris americana* of Maine, as described by Mr. Brewster.

11. *Troglodytes aëdon* Vieill.—The two specimens taken agree with two from Jalapa in being clearly referable to *aëdon* rather than to *aztecus*.

12. *Troglodytes brunneicollis* Scf.—A shy and rather uncommon inhabitant of the rocky arroyos.

13. *Anthus pensilvanicus* (Lath.).—Two were observed April 22, and eight or ten on the 25th. No specimens were secured.

14. *Helminthophila rubricapilla* (Wils.).—A male, taken April 23, the only bird of this species observed, is gaining new feathers on the crown.

15. *Dendroica auduboni* (Townsend.).—A female in full plumage, taken April 23, was the only bird of this species observed.

16. *Dendroica virens* (Gmel.).—A fully plumaged male was taken April 24.

17. *Dendroica olivacea* (Giraud).—An abundant inhabitant of the pines. The only note heard was a loud rapid whistle so like the *peto* of *Parus bicolor* that I at first supposed it to be uttered by a Titmouse. Numerous young that had left the nest were seen being fed by the parents; my series of seventeen specimens includes three in first plumage.

18. *Seiurus noveboracensis* (Gmel.).—A typical female of this species was taken April 26.

19. *Geothlypis macgillivrayi* (Aud.).—Two males having unenlarged testes were collected.

20. *Ergaticus ruber* (Swains.).—A pair of these beautiful Warblers was taken April 24. The testes of the male were much enlarged, while the condition of the ovaries, oviduct, and abdomen in the female showed that she was incubating.

21. *Wilsonia pusilla* (Wils.).—A male was secured April 24.

22. *Setophaga miniata* (Swains.).—A male was taken April 25.

23. *Vireo solitarius plumbeus* (Coes.).—Not uncommon, frequenting the higher branches of the pines. Three males had much enlarged testes, and were in full song, indicating that the species breeds at Las Vigas.

24. *Vireo huttoni stephensi* Brewst. — Common. Six specimens were secured—five males with enlarged testes and one laying female. The call of this species consists of two unexpectedly loud whistled notes, often repeated.

25. *Piranga hepatica* (Swains.).—A female with slightly enlarged ovaries was taken April 23.

26. *Zamelodia melanocephala* (Swains.).—A singing male having much enlarged testes was taken April 24.

27. *Junco cinereus* (Swains.).—Abundant, especially about the borders of the pines, where it was much on the ground. Young in first plumage were common, and my series includes birds just from the nest, and others fully grown but in spotted plumage. The sharp chirp, twitter, and *chew-chew* notes of this species resemble those of *J. hyemalis*, but the song of seven notes suggests in a measure that of the Song Sparrow.

28. *Spizella socialis arizonæ* (Coues).—Common in flocks in the cleared fields. Specimens taken give no evidence of breeding.

29. *Melospiza lincolni* (Aud.).—Not uncommon along certain agave hedges bordering brooks.

30. *Aimophila superciliosa* (Swains.).—Common in hedge-rows and bushy growths bordering fields, roadsides, and arroyos. It is a bird of much character in pose, and when excited mounts to the top of a bush, partly erects its tail and chirps vigorously. The sexual organs in both sexes gave evidence of the near approach of the breeding season.

31. *Chamæospiza torquata* (Du Bus.).—A male with enlarged testes was shot in a growth of scrubby bushes.

32. *Pipilo fuscus* (Swains.).—Not uncommon in hedges of agaves. I heard no song, but the call-note was deceptively like that of the Song Sparrow. The testes of the males taken were much enlarged.

33. *Loxia curvirostra stricklandi* Ridgw.—Common in small flocks. They show the well-known fondness of this species for salt by frequenting, in numbers, the troughs on the mountain-tops where the goatherds were accustomed to call their flocks. Young in streaked first plumage, from individuals in which the

mandibles are as yet uncrossed to those in which the bill is fully developed, are included in my series of fifteen specimens.

34. *Coccothraustes vespertinus mexicanus* Chapm.

Coccothraustes vespertinus mexicanus CHAPM. Auk, XIV, 1897, 311.

Four specimens were taken, one of which, a young male but a few days from the nest, was being fed by an adult male.

35. *Spinus pinus macroptera* (Du Bus).

"*Carduelis macroptera* DU BUS, Esq. Orn. t. 23."
Spinus pinus macroptera CHAPM. Auk, XIV, 1897, p. 311.

Common and evidently preparing to breed. Males were observed singing on the wing after the manner of *Spinus tristis*, at which times the wings and tail are fully spread, displaying their yellow markings so effectively as to give the bird the appearance of being largely yellow.

36. *Scolecophagus cyanocephalus* (Wagl).—Several flocks were observed, and a pair of birds was secured.

37. *Corvus corax sinuatus* (Wagl).—Two or three individuals were observed daily about the town of Las Vigas.

38. *Aphelocoma sieberii* (Wagl).—Two males, one with much enlarged testes, taken April 21, were the only birds of this species observed.

39. *Empidonax fulvifrons* (Giraud).—Common. A nearly completed nest found April 26 was saddled on the limb of a small pine about fifteen feet from the ground, and was composed of dried lichens.

40. *Empidonax fulvipectus* Lawr.—Four specimens were secured, of which the sexual organs of two indicated that they were about to breed.

41. *Contopus borealis* (Swains.).—Four were observed, and a male with unenlarged testes was taken April 26.

42. *Contopus pertinax* Cab.—Common, and evidently preparing to breed. The males perched upon the topmost branches of the pines, and at short intervals gave utterance to their singularly musical song.

43. *Antrostomus vociferus macromystax* Wagl.—Evidently not uncommon. Several specimens were taken, and on April 25 two nearly fledged young were found. They were squatting side by side on a little shelf of earth, which served the purpose of a nest, on the grass-grown side of a deep arroyo. The female parent was perched on the ground about fifty feet away, and at intervals uttered a low, clucking note.

44. *Dryobates villosus jardinii* (Malh.).—Two were seen and one secured.

45. *Dryobates stricklandi* (Malh.).—An adult female, accompanied by a fully-grown young bird of the year, was taken.

46. *Colaptes cafer* (Gmel.).—Not common. Two males with much enlarged testes were secured.

47. *Cathartes aura* (Linn.).—A few were observed daily.

48. *Catharista atrata* (Bartr.).—One or two were observed daily.



NEST OF PLATYPSARIS AGLAIÆ *Lafr.*

About one-fourth natural size.

14

15

16

17

Article III.—NOTES UPON FISHES RECEIVED AT
THE NEW YORK AQUARIUM, WITH DESCRIPTION OF A NEW SPECIES OF SNAPPER FROM
BERMUDA.

By TARLETON H. BEAN.

In a paper upon New York Fishes, published in this Bulletin for 1897, pp. 327-375, the writer gave the name of the Unspotted Mascalonge as *Lucius lucius immaculatus* instead of *Lucius masquinongy immaculatus*; the Chautauqua Lake species is a true Mascalonge and not a Pike.

The present article treats of fishes received since the previous paper¹ went to press, and includes some species not belonging to the fauna of New York. Among them is the very beautiful Silk Snapper of Bermuda, which appears to have been erroneously identified heretofore with the Red Snapper of the Gulf of Mexico (*Neomænis blackfordi* Goode & Bean) or with the *Neomænis buccanella* C. & V., which is a member of the West Indian fauna. The species is believed to be undescribed and may receive the name :

***Neomænis hastingsi*, new species.**

This is, apparently, the Silk Snapper of the Bermuda fishermen, and, if we may judge from numerous individuals now living in the Aquarium, it does not much exceed one foot in length. The species is named for General Russell Hastings, of Soncy, Bermuda, through whose instrumentality the recent biological investigation of the islands by the New York University and the New York Aquarium was undertaken.

¹ As in the case of the former paper, a large part of the material here referred to has been presented by the Park Commissioners to the American Museum of Natural History.

Head, 3; depth, 3; least depth of caudal peduncle 9 in length of type to caudal base; D. X, 14; A. III, 8; V. I, 5; P. 16; scales, 8 or 9-65-17. Maxillary reaching scarcely past front of eye. 3 in head. Vomerine teeth in an arrow-shaped patch with a backward extension which is fully one-third as long as the eye. Canines in upper jaw very feeble; two or three posterior teeth of mandible are weak canines. Seven rows of scales on cheeks; nine rows on gill-covers. Least interorbital width equal to eye, which is $1\frac{1}{3}$ in snout and 4 in head. Gill-rakers, 7 + 9; the one in the angle conspicuously longest, $\frac{3}{8}$ inch long, or about one-half length of eye. First dorsal spine 7 in head; fifth and longest spine about three in head; last dorsal spine equal to eye in length. Longest ray of soft dorsal equal to maxilla, or 3 in head. First anal spine 8, the second and third about 4 in head, the second slightly longer than third. The anal base nearly $2\frac{1}{2}$ in head; third and longest anal ray about equal to anal base. The pectoral extends to the vent. The ventral does not reach the vent by a space one-half as long as the eye.

Colors in Life.—Ground color vermilion, the upper parts overlaid with coppery brown, lower parts vermilion. Four or five narrow golden stripes below lateral line. Caudal dark brown with a narrow black margin. Anal dusky, the spines and the membranes of last two rays pale. A narrow black blotch at pectoral base. Ventral pale, somewhat mingled with dusky. Membranes of spinous and soft dorsal uniformly dark. Snout copper color. Eye lemon yellow; pupil blue black. Many scales, especially on front of body, with a minute brown dot at base. Brownish spots on scales forming many oblique streaks above lateral line. Some living examples show a faint dark lateral blotch much like that of *N. synagris*, and similarly placed.

In spirits the body is pink with the upper parts brownish; the dusky color remains on the anal and the black blotch at base of pectoral. The black margin of caudal becomes merged with the general dark color of the fin.

MEASUREMENTS.

Length to tip of caudal.....	11 $\frac{1}{2}$ in.
Length to caudal base.....	9 $\frac{3}{8}$ in.
Least depth caudal peduncle.....	1 $\frac{1}{8}$ in.
Depth of body.....	3 $\frac{1}{8}$ in.
Head.....	3 $\frac{1}{2}$ in.
Eye.....	1 $\frac{1}{8}$ in.
Snout.....	1 $\frac{3}{8}$ in.
Maxilla.....	1 $\frac{1}{8}$ in.
Mandible.....	1 $\frac{1}{8}$ in.
Ventral.....	1 $\frac{1}{8}$ in.
Pectoral.....	2 $\frac{5}{8}$ in.
First dorsal spine.....	1 $\frac{1}{2}$ in.
Fifth " ".....	1 $\frac{1}{8}$ in.
Tenth " ".....	1 $\frac{1}{8}$ in.

Ninth soft dorsal ray	1 $\frac{1}{8}$ in.
First anal spine.....	$\frac{7}{16}$ in.
Second "	$\frac{1}{8}$ in.
Third "	$\frac{1}{2}$ in.
Third anal ray.....	1 $\frac{3}{8}$ in.
Anal base.....	1 $\frac{7}{16}$ in.

I am indebted to Mr. Barton A. Bean, of the U. S. National Museum, Washington, D. C., for the following comparative notes on *N. buccanella*, from alcoholic examples: In a specimen 12 inches long the depth of body is 3 $\frac{1}{2}$ inches; head, 3 $\frac{1}{2}$; eye, $\frac{7}{8}$; pectoral, 3 $\frac{1}{16}$; depth of caudal peduncle, 1 $\frac{1}{8}$. The pectoral extends almost to the anal origin. Scales, 6-53-16. He regards *N. hastingi* as nearer to *N. vivanus*, from which, however, it differs in several important particulars.

Numerous individuals of this new species were obtained early in July, 1897, at Hamilton, Bermuda, by the Biological Expedition of New York University, and all but the type are still living.

Neomænis synagris (Linnaeus).—SPOT SNAPPER.

This fine species was forwarded from Hamilton, Bermuda, in moderate numbers in July, 1897, by the New York University Expedition, and the example described below died on Nov. 4, 1897.

B. VII; D. X, 12; A. III, 8; V. I, 5; scales, 7-48-13. The vomerine teeth are in an arrow-shaped patch, with a very short and narrow backward extension. The second anal spine is shorter than the third, $\frac{3}{4}$ inch long. Third anal spine, $\frac{5}{8}$ inch. The first dorsal spine, $\frac{3}{8}$ inch; fourth, 1 $\frac{1}{8}$ inches; fifth soft dorsal ray, 1 $\frac{1}{4}$ inches.

The following are some additional measurements:

Length.....	11 in.
Depth of body.....	3 in.
Length of head.....	3 $\frac{1}{4}$ in.
Least depth of caudal peduncle.....	1 in.
Length of snout.....	1 $\frac{1}{8}$ in.
Length of eye.....	$\frac{9}{16}$ in.
Length of upper jaw.....	1 $\frac{1}{8}$ in.
Length of maxilla.....	1 in.
Length of mandible.....	1 $\frac{3}{8}$ in.

A black spot just above lateral line under beginning of soft dorsal, $\frac{7}{8}$ inch long. About 7 horizontal yellow stripes between lateral line and ventral margin. Several broken yellow stripes above lateral line. All these stripes continued more or less upon the head, three of them across the cheeks. A narrow vermilion margin to caudal fin. Entire dorsal with two stripes of yellow, the upper one at the margin of the membrane, the lower one not far above the base of the fin. A narrow black line at the tip of the membrane between first four or five rays of the soft dorsal. Ventrals and anal chiefly yellow. Maxilla with a streak of yellow along upper part. Two narrow yellow streaks on snout in front of eye.

Coregonus labradoricus *Richardson.*—LABRADOR WHITE-FISH.

Late in December, 1897, Mr. H. J. Beemer, of Montreal, Canada, sent to the Aquarium two Winnish and a Whitefish from Lake St. John in charge of Mr. R. E. Follett. The Winnish are still living, but the Whitefish died from injuries received in transportation. As this is the typical form of Labrador Whitefish, and has a different appearance from the species as found in the Adirondack lakes, it is well to give some additional notes. The single example is 16 inches long; it is a female with minute eggs. The lingual teeth are very evident to the touch. The fish resembles the Tullibee in shape. D. 11; A. 10; scales, 12-79-10; gill-rakers, 10 + 16.

MEASUREMENTS.

Length, including caudal.....	16	in.
Length of middle caudal rays (from end of scales).....	1	in.
Length of longest caudal ray.....	$2\frac{3}{4}$	in.
Depth of body at dorsal.....	$3\frac{3}{8}$	in.
Least depth of caudal peduncle.....	$1\frac{1}{4}$	in.
Length of head.....	3	in.
Length of snout.....	$\frac{3}{4}$	in.
Diameter of eye.....	$\frac{5}{8}$	in.
Length of maxilla.....	$1\frac{1}{8}$	in.
Length of mandible.....	$1\frac{1}{8}$	in.
Distance from snout to dorsal origin.....	$6\frac{1}{8}$	in.
Length of dorsal base.....	2	in.
Length of longest dorsal ray.....	$2\frac{7}{8}$	in.
Length of last dorsal ray.....	$\frac{5}{8}$	in.
Distance from snout to ventral origin.....	$7\frac{3}{8}$	in.
Length of ventral.....	$2\frac{3}{8}$	in.
Length of ventral appendage.....	$\frac{5}{8}$	in.
Distance from snout to anal origin.....	$11\frac{1}{8}$	in.
Length of anal base.....	$1\frac{1}{8}$	in.
Length of longest anal ray.....	$1\frac{3}{8}$	in.

Length of last anal ray.....	$\frac{9}{16}$ in.
Length of pectoral.....	$2\frac{1}{4}$ in.
Distance from snout to adipose fin.....	12 in.
Length of base of adipose fin.....	$\frac{15}{16}$ in.
Length of adipose fin.....	$\frac{5}{8}$ in.
Width of base of adipose fin.....	$\frac{1}{2}$ in.
Length of longest gill-raker.....	$\frac{1}{16}$ in.
Thickness of body.....	2 in.
Depth at vent.....	$2\frac{5}{8}$ in.

Mullus auratus *Jordan & Gilbert*.—RED MULLET; GOAT-FISH.

Three examples of a species of Red Mullet or Goatfish were seined at Sandy Hook, Oct. 8, 1897. Fishermen there reported it plentiful in September and October.

They died in the Aquarium, Dec. 6 and 7, when the salt water was at a temperature of $47\frac{1}{2}^{\circ}$ Fahr. They stopped feeding as soon as the water went below 50° . They were very fond of shrimp.

D. VII, I, 8; A. II, 5 or 6; V. I, 5; P. I, 15; scales, $2\frac{1}{2}$ to 3-34 to 35-7; gill-rakers, 6 + 13, the longest nearly $\frac{1}{2}$ eye, about as long as the pupil. Length, including caudal, $5\frac{1}{8}$ to $5\frac{3}{4}$ inches. Barbel, $1\frac{1}{8}$ in head.

MEASUREMENTS.

Length of largest example.....	$5\frac{3}{4}$ in.
Length to end of scales.....	$4\frac{3}{4}$ in.
Depth of body.....	$1\frac{1}{8}$ in.
Length of head.....	$1\frac{1}{16}$ in.
Length of barbel.....	$\frac{1}{16}$ in.
Least depth of caudal peduncle.....	$\frac{1}{2}$ in.
Snout to spinous dorsal.....	$1\frac{3}{4}$ in.
Spinous dorsal base.....	$\frac{5}{8}$ in.
Longest spine.....	$\frac{7}{8}$ in.
Upper jaw.....	$\frac{7}{8}$ in.
Snout (obliquely).....	$\frac{1}{2}$ in.
Eye.....	$\frac{3}{8}$ in.
Second dorsal from snout.....	$2\frac{7}{8}$ in.
Second dorsal base.....	$\frac{5}{8}$ in.
Longest ray second dorsal.....	$\frac{9}{8}$ in.
Last ray second dorsal.....	$\frac{3}{8}$ in.
Snout to anal.....	$2\frac{7}{8}$ in.
Anal base.....	$\frac{3}{2}$ in.
Longest anal ray.....	$1\frac{1}{8}$ in.
Last anal ray.....	$\frac{3}{8}$ in.
Snout to ventral.....	$1\frac{7}{8}$ in.
Length of ventral.....	1 in.
Length of pectoral.....	1 in.
Length of middle caudal rays from end of scales.....	$\frac{3}{8}$ in.
Length of external caudal rays from end of scales.....	1 in.

Color of body pale, with a pink tinge; sides with 5 or 6 irregular scarlet blotches in life, sometimes fading out almost entirely. About 5 longitudinal golden stripes on body. A dark red stripe half as wide as the eye is long, extending from head to tail a little above the median line. Eye scarlet. Spinous dorsal with a scarlet band near the tip and two golden bands lower down, the lowermost at the base of the fin. The spaces between the bands pearl color. Tip of spinous dorsal also pearl color. Four or five narrow red bands on the second dorsal, the spaces between them pearl. All the other fins are chiefly scarlet. In spirits the body fades out to a uniform purplish brown, with traces of scarlet on the gill-covers; the eye at this date, Jan. 20, 1898, is scarlet.

Article IV.—A COMPLETE SKELETON OF TELEOCERAS FOSSIGER. NOTES UPON THE GROWTH AND SEXUAL CHARACTERS OF THIS SPECIES.

By HENRY FAIRFIELD OSBORN.

PLATES IV AND IVA.

The remarkable series of Rhinoceros skulls in the Cope and American Museum Collections from the Upper Miocene or Loup Fork Beds of Kansas and Nebraska, has finally been prepared for exhibition and research purposes. Associated with them, and of very great value, is a complete skeleton representing an aged female of very large size, mounted from materials belonging to several individuals secured by our excavations in Phillips Co., Kansas, under the direction of Dr. Wortman in the months of September, October and November, 1894.

By the comparison of the 16 skulls and 13 jaws, representing both sexes and all stages of growth, we are enabled for the first time to positively define the animal long known as *Aphelops fossiger*, to distinguish it both from *Rhinoceros* and *Aceratherium*, and point out its important sexual and individual variations. The writer's attention was first drawn to the largely disregarded sexual and age characters of fossil Ungulates in studying the group of Titanotheres;¹ the extinct Rhinoceroses conform to the laws which were observed in that group, and which are familiar enough among living types, namely: males, of larger size with more robust and rugose skulls; horns, if present, more prominent; canines largely developed; incisors and anterior premolars disappearing in adults.

We owe to Hatcher² the valuable demonstration that *Aphelops fossiger* bore a terminal horn upon the nasals, although he assigned this character to a type which he supposed represented a new species, namely, *Teleoceras major*. Hatcher's type of *T.*

¹ 'The Cranial Evolution of Titanotherium,' Bull. Am. Mus. Nat. Hist., July 1, 1896, pp. 157-197.

² American Geologist, March, 1894, pp. 149-150.

major proves to be a middle-aged male of *A. fossiger*, and his distinction of *Teleoceras* as a genus supersedes *Aphelops* Cope,¹ because Cope² originally applied the term *Aphelops* to *A. megalodus*, defining it as an Aceratherium with only three premolar teeth in the lower jaw. This is true of the type species (*A. megalodus*), but this species should, so far as we know at present, be referred to the genus *Aceratherium*, in which the lower premolars vary from four to three in number according to age and individual variation, as in the living *Rhinoceros*.

Technically, however, Hatcher's definition did not clearly distinguish *Teleoceras* from *Rhinoceros*, as he himself stated (*op. cit.*, page 245). Our abundant material proves not only that *Teleoceras* is a *Rhinoceros* with a median horn on the tips of the nasals, but that it is fully distinguished from the genus *Rhinoceros* as follows :

	Horns.	Lower Premolars.	Digits.
Genus <i>Rhinoceros</i>	Upon anterior portion of nasals	4 in young, 3 in aged individuals	3-3
Genus <i>Teleoceras</i>	Upon tips of nasals	3 in young, 2 in aged individuals	3-3

The reduction of the lower grinders to 5 in *T. fossiger* (as compared with 6 in *Rhinoceros*) is a very important and distinctive character, as it absolutely excludes *Teleoceras fossiger* from the ancestry of any of the modern *Rhinoceroses*, and shows it to have represented a distinct side phylum, as Scott and Osborn had already determined from its skeletal characters.

EXCAVATION OF THE SKELETON.

The Phillips County Quarry,³ near Long Island, Kansas, was discovered in 1883 by Mr. Charles Sternberg, who collected for the University of Kansas and for the Harvard University Museum. From the latter collection Scott and Osborn procured materials

¹ American Naturalist, March, 1894, pp. 241-246.

² 'On Some New Extinct Mammalia from the Tertiary of the Plains.' *Palæon*, Bull. No. 14, Proc. Am. Phil. Society, July 25, 1873.

³ See Williston, 'Restoration of *Aceratherium fossiger* Cope,' *Kansas University Quarterly*, Vol. II, No. 4, April, 1894, pp. 289-290.

for the restoration which they published in 1890.¹ Subsequent collections were made by Sternberg and Hatcher for the United States Geological Survey, between 1884 and 1886. Later Professor Cragin collected here, and in 1891 Mr. E. P. West of the University of Kansas, aided by Mr. T. R. Overton, began the extensive collections which led to the preparation of the skeleton for the University under the direction of Professor Williston.² This skeleton, as mounted in the Kansas Museum and described by Williston, gives a much more accurate idea of this animal than the previous restoration by Scott and Osborn, in which the chest is represented far too shallow.

Its principal dimensions are as follows: Length, not including tail, 9 ft.; height, 4 ft.; greatest girth, 9 ft., 4 in.

The measurements of the American Museum skeleton as mounted are: Length, 10 ft. 2 in. to bend of tail; height at withers, 4 ft. 1 in.; greatest girth, 9 ft. 2 in.

From the above accounts, and especially from our own observations, it is seen that this quarry represents an old bone-bed, probably the deposit of some stream or small river along which the rhinoceroses herded in great numbers. The materials collected by the American Museum party are extremely numerous, especially in the skeletal parts, the figures running somewhat as follows: Skulls, 4; scapulæ, 7; vertebræ, 159; humeri, 13; radii, 20; ulnæ, 10; carpals, 90; metacarpals, 38; pelves, 5; femora, 8; tibiæ, 20; astragali, 22; calcanea, 18.

In this typical bone-bed are mingled individuals of both sexes and of all sizes, and the proximity of one specimen to another is not a certain guide. There are certain spots, however, where considerable portions of individual skeletons have drifted together. We associate the skull and pelvis in our mounted specimens, for they are of similar age and were found within about six feet of each other, the skull being that of a fully adult female, and the pelvis indicating a corresponding age, because the ilia are united above the sacrum; with the pelvis moreover was found a part of the jaw belonging to the skull; also with this pelvis

¹ 'Preliminary Account of the Fossil Mammals from the White River Formation contained in the Museum of Comparative Zoölogy.' Bull. Mus. Comp. Zoöl., Vol. XIII, No. 5, p. 92, 1890.

² *Op. cit.*

belong a femur, tibia and fibula, astragalus, calcaneum and cuboid of one side, several metacarpals and metatarsals and two cervical vertebræ. The selection of the other limb and foot-bones was made from these as a guide.

Similarly about 300 feet distant were found the principal ribs which have been selected for this mount, characterized by the very rugose appearance and oblique lines for the insertion of the abdominal muscles (*sacro-lumbalis, longissimus dorsi*). Near these ribs were large jaw and limb-bones corresponding in size with those placed in the mounted skeleton. Apart from these probable associations, the main principle of selection adopted throughout has been that of the age and size standard, after a careful comparison of all the elements. In each region the largest and oldest bones were chosen. Upon this principle the ribs are shown to be of very great length; the chest girth exceeds that indicated in the Scott-Osborn restoration, and equals that in the mount in the Kansas Museum, which has heretofore appeared extreme. In additional support of this correlation of material belonging to different individuals, this bone-bed gives evidence of the existence of only one species of *Rhinoceros*, namely, *T. fossiger*. All the differences observed are due to growth, individual and sexual variations, as set forth below.

The following description is supplementary to the very full statements of the skeletal characters of *T. fossiger* made by Osborn in 1890.

DESCRIPTION OF MOUNTED SKELETON.

(Museum Catalogue Number, 2604.)

Mounting.—The composite skeleton shown in the accompanying plate (Plate IV) has been mounted with remarkable skill by Mr. Adam Hermann, preparator. All the bones are traversed by small steel rods, rendering them firm and solid and the limbs self-supporting. As shown in the photograph, the only visible parts of the metal framework are the two uprights for the shoulder and skull, and pelvis. The bones are in a beautiful state of preserva-

tion, and except in the case of the artificial elongation of a few of the ribs and completion of the upper border of the scapulæ (from complete scapulæ of smaller size) no plaster was necessary.

Skull.—Nasals smooth, expanding into a laterally-compressed beak anteriorly, probably characteristic of adult females, with sharp sides and a lateral notch. Temporal ridges forming a sessile sagittal crest; premaxillaries with triple infraorbital foramina; lachrymals with well-defined, knoblike projection; zygomata very deep, with extensive attachment for masseter muscle inserted on a well-defined ridge on angle of jaw. Occiput broad and low. Jaw with a single mental foramen below the second or third premolar, and a marked median depression between the canines upon front surface of the chin.

Dentition.—Formula: I_{1}^{2} , C_{1}^{0} , P_{2}^{3} , M_{3}^{3} . Lower and median upper incisors vestigial; lower canines worn, enamel measuring 40 mm. ($1\frac{1}{2}$ inches). Adult condition indicated by very slight wear of crown of third superior molar. Upon outer surfaces of upper grinders parastyle nearly obsolete. First upper molar with enamel crown of same length as that of premolars. Second upper molar with sudden elongation or hypsodontism, with enamel crown measuring 70 mm. Thus m_{2}^{2} and m_{3}^{3} elongate or hypsodont, and of great service as reserve teeth for old age. Molars with secondary folds characteristic of the species.

Vertebrae.—Atlas much narrower than in *R. indicus*, with vertebrarterial canal directly traversing the transverse process; axis with a very low spine; cervicals 1-3, with transverse process restored; characters of inferior lamellæ somewhat conjectural.

Supposed Vertebral Formula: C.7, D.19, L.3, S.5.

The above formula is purely conjectural. It is made to conform to that of the living *R. unicornis* and *R. sumatrensis*.¹ Seventeen of the ribs are provided with both capitular and tubercular facets. The ribs are extremely long and powerful, not very widely arched; lower line of chest nearly reaching the ground, as in

¹ The definitely ascertained formula of the Oligocene *A. tridactylum* is D, 19; L, 5; S, 3. This animal gives us no clue to *A. fossiger*, because it belongs to the Diceratheres series.

the Hippopotamus ; girth (9' 2") exceeding that of *R. unicornis* (8' 9") ; chest section deep and heavy, rather than rounded as in *R. unicornis*.

Scapula very characteristic, triangular in contour, with pointed upper border ; narrow supraspinatus and very broad, triangular infraspinatus fossa ; acromion placed midway on spine, reflected backwards, so that attachment of deltoid and trapezius muscles is elevated. Coracoid process forming a prominent rugosity for short head of biceps ; bicipital tendons passing through a double osseous groove upon front of humerus (as in *R. unicornis*, *R. bicornis* and *R. simus*)^{1,2} and inserted distally in a prominent rugosity upon front of radius. Humerus exhibiting prominent rugosity for subscapularis muscle interior to inner tendon of biceps ; greater tuberosity consisting of a large incurved hook for supraspinatus muscle, and a separate and distinct knob for infraspinatus muscle ; powerful deltoid ridge, everted but not hooked ; distally a large external condyle for extensor muscles, which exhibit rugose insertion areas in the proximal ends of metapodials.

Pelvis with ilia arching over and coalescing above the five sacral vertebral spines, affording a stout area of origin for *latissimus dorsi*, *erector spinæ* and *gluteus maximus* muscles, correlated with support and propulsion of the enormous abdomen ; a foramen piercing the posterior superior border of the ilium. Femur with rugose but not very prominent greater trochanter ; lesser trochanter for insertion of *gluteus maximus* muscle, much less prominent than in *R. unicornis*, and not hooked ; third trochanter not prominent. Pubis and ischium more slender than in *R. unicornis*. Tibia with a characteristic fissure in the cnemial crest dividing it into two distinct tuberosities for patellar tendons (unlike single crest of *R. unicornis* and *A. malacorhinus*). Fibula fused with tibia in aged individuals.

¹ Busk 'On the Ancient or Quaternary Fauna of Gibraltar,' *Trans. Zool. Soc.*, 1877, p. 97.

² De Blainville, 'Ostéographie,' *Atlas 3, Gen. Rhinoceros*, Pl. iv.

COMPARATIVE MEASUREMENTS.

	<i>Teleoceras fossiger.</i>		<i>Rhinoceros indicus.</i>	
	Feet.	Meters.	Feet.	Meters.
Total length to bend of tail.....	10. 2	3.10	10.8	3.05
Height, skull.....	4. 1	1.23		
" withers.....	3.11½	1.21	5.6½	1.69
Breadth, across pelvis.....	2.10	0.87	2.8	0.82
" " ribs.....	2.11	0.89		
Skull, length condyles to pmx.....	1.11½	0.59	2.1½	0.65
" width across arches, dental series.....	1. 3	0.38		
Vert. column, total excluding caudals*.....	7. 9	2.36	8.2	2.48
Cervicals, including intervert. spaces.....	1. 6½	0.47		
Dorsals, " " ".....	4. 6½	1.39		
Lumbar, " " ".....		0.24		
Sacral.....		0.21		
Rib (? 5th)—length (around the curve).....		0.80		
(? 10th) ".....	3. 3½	1.01		
Girth of chest at 11th rib (estimated).....	9. 2	2.80	2.9	2.66
Fore limb, total flexed (ball of hum. vert. to ground).....	2. 4½	0.72	3.5	1.04
Scapula.....		0.38		
Humerus.....		0.31	1.4	0.40
Radius.....		0.24	1.3	0.38
Ulna.....		0.34		
Mc. iii.....		0.105	.8	0.20
Hind limb, total flexed (ball of femur vent. to ground).....	2. 7½	0.80	3.8½	1.13
Femur.....		0.41	1.8	0.52
Tibia.....		0.23	1.2½	0.36
Mt. iii.....		0.100	7. ½	0.19
Lower jaw, total length, condyle to tip of canine.....		0.51		
Dentition, to tip of canine.....		0.35		
Grinding series.....		0.26		
*Length caudals (along curve).....		0.81		

From the above measurements it appears that from head to tail *T. fossiger* is only six inches shorter than *R. unicornis*, while the back is eighteen inches (.580 mm.) nearer the ground. This remarkable lowering of the trunk is chiefly caused by the great reduction of the fore arm, fore leg and metapodials. The humerus and femur are respectively only 90 and 110 mm. shorter than in *R. unicornis*, while the radius and tibia (typically shorter elements) are respectively 140 and 130 mm. shorter, and the metacarpals and metatarsals are respectively 90 and 950 mm. shorter. This limb reduction is very striking. At the same time the abdom-

inal girth exceeds that of *R. unicornis*, justifying Cope's conclusion that this animal had rather the proportions of the Hippopotamus than of the Rhinoceros. It will be recalled¹ that *R. unicornis* has a lower abdominal line than *R. sondaicus* or *R. sumatrensis*, or than either of the African Rhinoceroses. *T. fossiger*, therefore, had a totally different external appearance from any existing form.

JUVENILE, SENILE AND SEXUAL CHARACTERS.

There are conspicuous differences in the dentition of different specimens, all of which may be explained as due to influences of growth or sex.

In the young calf jaw (No. 2608) the milk cutting teeth are as follows: di_2 , dc_1 , dp_3 . In the young *R. sondaicus* (*R. javanicus*), according to de Blainville, we similarly observe two milk incisors. A somewhat older calf of *T. fossiger* shows di_1 , dc_1 , dp_3 .

Even in older jaws there is evidence in one case (No. 8391) of two lower incisors upon one side, the formula being: i_{2-1} , c_1 , p_3 , m_3 , as indicated by the incisor alveoli. The outer incisors (i_3) in the lower jaw tend to drop out at an early age, leaving only the alveoli; but the vestigial upper incisors (i_2) are remarkably tenacious, although entirely useless.

The canines vary strikingly in the sexes. In the females (Nos. 2604-6, 2610-11, 2623), as shown in the photographs, they are of moderate size. In certain males (Phillips Co., Kansas, No. 2612; Republican River, Nebraska, Nos. 8391-2) they exceed in size any that have been recorded in other Rhinoceroses living or extinct, as shown in Pl. IVA.

No jaw shows any vestige of p_1 . p_3 is present in young jaws, and invariably absent in very aged jaws. Its dehiscence is correlated with the coming into use of m_3 . The upper molars, especially the second and third, are extremely hypsodont, the unworn enamel of the crown measuring, respectively: $m_2 = m_3 =$. They are reserved for middle and old age.

The size of the skull differs considerably in the two sexes, the female skulls (Phillips Co., Kansas, Nos. 2604, 2607, 2622-3; Decatur Co., Kansas, No. 8388; Republican River, Nebraska, No.

¹ See Sclater 'On the Rhinoceroses now or lately living in the Society's Menagerie,' *Trans. Zool. Soc.*, 1875, pp. 645-651.

8393) being smaller and less rugose, with less prominent sagittal crests, and decidedly smaller nasals, as shown in Pl. IV A. In old females the nasals acquire a slightly rugose surface, and probably bore a small horn. In the males (Decatur Co., Kansas, Nos. 8385, 8396; Republican River, Nebraska, No. 8420) the nasals become greatly thickened at the extremities (Pl. IV A), forming a vertically compressed plate, which undoubtedly bore a considerable horn. Differences in size are observed in skulls from various localities, those from Decatur Co., Kansas, and from Nebraska, being larger than those from the Phillips Co. quarry, which are probably due to differences of geological level, the species running into a larger and more robust type before its extermination.

Growth-changes in the limbs are especially observed in the close fusion of the fibula with the tibia, and of the remarkable arching over of the sacrum by the superior borders of the ilium; this whole area above the sacrum forming a solid plate.

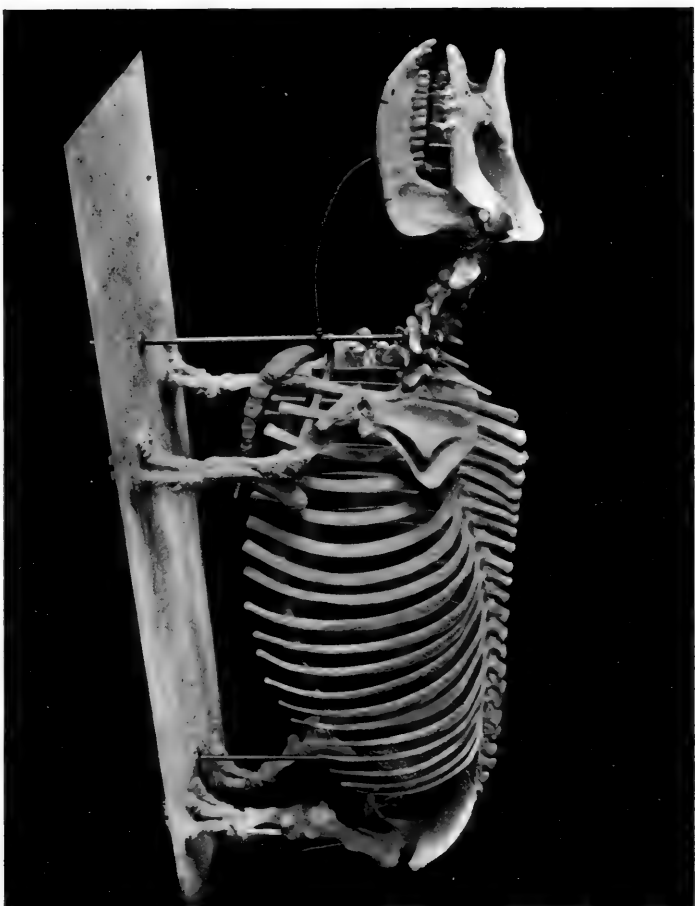
CONCLUSIONS.

T. fossiger may be briefly characterized as a brachycephalic, extremely short-limbed Rhinoceros, partly aquatic in its habits, with a very large brain and no diploë of the skull.¹ It parallels the African Rhinoceroses *R. simus* and *R. bicornis*, in the form of the humerus, femur and atlas, and in the terminal position of the nasal horn. The occiput, however, is widely different from that of the African Rhinoceroses, as well as of *R. sumatrensis*, resembling rather that of *R. unicornis*, although less pitched forward. The limbs are much shorter than in any living type, and, as pointed out by Pavlow,² at once recall those of *R. brachypus* and *R. aurelianensis*. A further comparison of *T. fossiger* strengthens the resemblance to the latter form. The proportions of the skull, limbs and metapodials are very similar. In both the cnemial crest of the tibia is double; the secondary folds of the superior molars are similar, as well as the general form of the skull. Further details will be given in the writer's forthcoming Memoir on the Extinct Rhinoceroses.

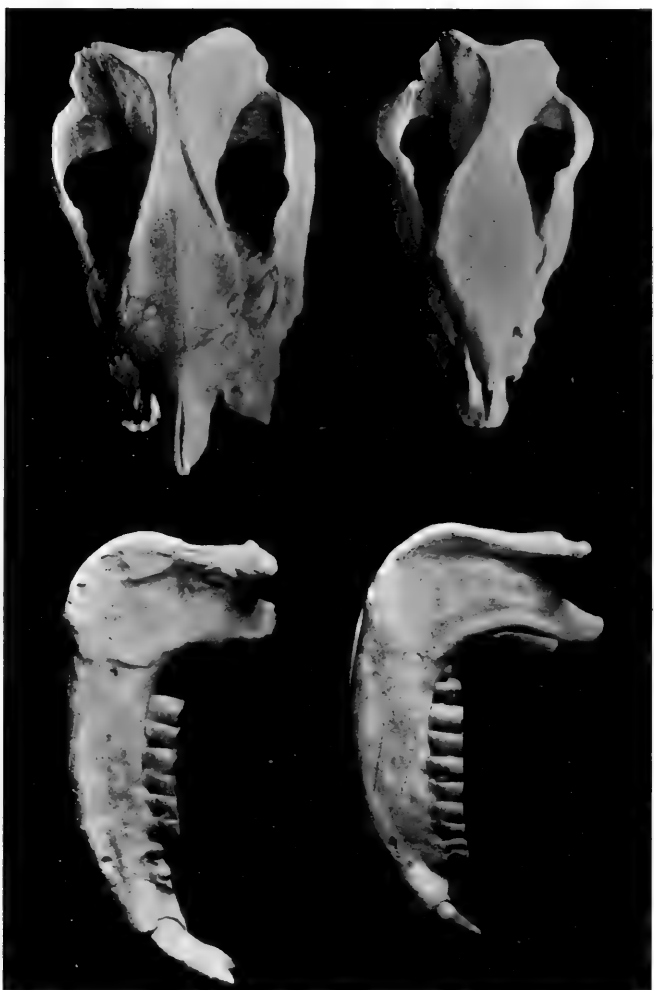
¹ See Scott and Osborn, *op. cit.*, 1890, p. 93.

² Les Rhinocérider de la Russie et le développement des Rhinocérider en général, Bull. d. la Soc. d. Nat. d. Moscou, 1892.





MOUNTED SKELETON OF *Teleoceras fossiger*.
One-twentieth natural size.



Teloceras fossiger.

FEMALE SKULL (No. 8393) AND JAW (No. 2606).

MALE SKULL (No. 8396) AND JAW (No. 2612).

Article V.—MARKED HUMAN BONES FROM A PRE-HISTORIC TARASCO INDIAN BURIAL PLACE IN THE STATE OF MICHOACAN, MEXICO.

By CARL LUMHOLTZ and ALEŠ HRDLÍČKA.

PLATES V-IX.

I.

By CARL LUMHOLTZ.

In the latter part of October, 1896, during my last expedition (1894-97) into Mexico, where I was sent by the American Museum of Natural History of New York, I arrived at the pueblo of Zacápu, in the State of Michoacan. In the vicinity of this pueblo are many stone mounds, or *yácatas*, as they are called in that State. Most of these mounds are on or near the edge of an old flow of lava, which stretches from Zacápu in a northerly direction for many miles. On one occasion I followed for sixteen miles this edge of lava, which rises as high as five or six hundred feet, and found that stone mounds, and fortifications consisting simply of walls built of rough stone without plastering, were of frequent occurrence. Houses could also be seen, but on account of the roughness of the country they could only be sighted at a distance. They seemed to be made of stone, or rather small lava blocks, and plastered with mud. This kind of country extended for miles, and I have heard that such monuments of antiquity are to be found for a stretch of thirty or forty miles from Zacápu northward.

Directly above the village of Zacápu, on top of a ridge of this lava formation, stands a large stone fortress, called by the Mexicans 'El Palacio,' it being erroneously believed that King Calzontzín, of Tzintzúntzan, as they call him, had here one of his temporary country residences. One of the fabulous stories about him is, that food was carried to him directly from Tzintzúntzan—

nearly forty miles off—by runners. Every monument of antiquity in that part of the country is attributed to Calzontzín, as is every one in the country north of Michoacan to Montezuma.

The fortress is easy of access, and presents a level tract on the top, partly covered with bushes. It might have accommodated five or six hundred people. Only on one side of the fortress, the eastern and lowest, are there traces of walls on the edge. In the vicinity of this fortress are a great number of *yácatas*, generally rectangular in form.

Zacápu itself used to be one of the more important pueblos of the Tarasco Indians. There is still a very large contingent of natives of pure breed in its population, which numbers perhaps three thousand, over half of which are Indians. The latter are here, however, all 'civilized,' and no longer speak their native tongue, but they retain some of their superstitious customs. The place, until lately, has been noted as the abode of many robbers.

Circumstances did not allow me to make any other excavations than those for skeletons. Through the kind services of the principal man of the place, I secured a guide thoroughly familiar with the surroundings, who might be able to tell me of some locality where *muertos* could be found. At the recommendation of this guide, a small level place about twenty-five yards square, situated amidst rocks and ridges of lava, just at the foot and to the north-east of 'El Palacio,' was selected for excavation. The same day I was able to put men at work, and we immediately unearthed several skeletons. For five days, with the help of many men, I continued excavations here with great success; and before my departure I had thoroughly exhausted the place, which yielded over a hundred skulls of at least two distinct types, possibly three. The majority of them were apparently pure Tarasco; but there were also eight skulls of another type, having a shape which is very strange and unique in Mexico. All these specimens have been examined by Dr. A. Hrdlička, my collaborator, and a description of them will appear in time. The skeletons were found huddled together without any order whatever, and lying two or three deep. The topmost ones were encountered at a depth of about three feet.

Remarkably few objects were found with these skeletons, the principal consisting of about a dozen small copper bells and a few beads.

One interesting object was a dish containing a human skull (Fig. 1). The dish is dark in color, and is made of rather inferior earthenware. It measures 23 cm. in diameter from edge to edge of the rim, and 9 cm. in height. The skull was found resting on ashes. In this dish was also a small head rather rudely carved in light volcanic rock (Figs. 2, 3). The features are distinct, however; but the head is flat at the back, being 10 cm. long, and 4.5 cm. thick. At the top of it is a hole, which suggests that it was once used as a pendant. According to Dr. N. Leon, of Mexico, this method of burial of a detached skull has not hitherto been found in the State of Michoacan, but cases are known from the State of Oaxaca. When ashes are found, it is generally the result of the burning of the bones and the food. Mixed with the ashes were a few fragments of other, apparently equally simple, earthenware vessels, every piece differing in color and thickness.

We were also lucky enough to meet with a burial-jar (Plate V) standing upright among the skeletons towards the eastern part of the cemetery, nearer to the edge than to the centre. This is a large jar of clay, oval in form, of graceful shape, with flaring, curved rim. It measures 74 cm. in depth, the diameter of the opening being 49.6 cm. The maximum circumference of the jar is 225 cm., and is found to be much nearer to the rim than to the base of the jar. The ware, which is comparatively thin, is of a very good quality, with a smooth surface, particularly on the inside. The average thickness of the rim is 12 mm., and its width is about 6 cm.; it is polished inside, and red in color. Below this rim the body of the jar is 8 mm. thick, increasing in thickness gradually and uniformly downwards. It has a convex cover, also of clay. This cover, the rim of which was broken when found, looks like an inverted bowl. It is of inferior material, and may not have been made for the purpose. With cover on, the jar measures 91 cm. in height. The jar contained only the charred remains of a skeleton.

Such burial-jars are not altogether rare in the Tarasco region, although it is only accidentally that one comes across them, and to look for one may often prove a laborious and fruitless task.



Fig. 1. Pottery Dish with Human Skull and Sculptured Stone.



Fig. 2. Head cut from Volcanic Rock.
Front view. (One-half natural size.)



Fig. 3. Head cut from Volcanic Rock.
Side view. (One-half natural size.)

I am informed by Dr. N. Leon that two kinds of Tarasco burial-jars are found in Michoacan,—large ones, 1.50 by 0.80 m., which contain the skeleton with clothing and utensils (this kind belongs to a very ancient epoch); and small ones, measuring 0.50 m. by 0.20 to 0.25 m., containing the body burnt or half burnt. The greater number is of the former class. He has not found either kind with covers in Zacápu. At present, jars resembling the large kind are manufactured in Comanja, near Zacápu. Burial-jars, according to the same informant, have never before been found associated with burials, as in this case.

The most curious objects discovered, however, while we were excavating near 'El Palacio,' were some marked human bones (Plates VI, VII, VIII, IX), which excited the interest of even the Mexicans working there. We unearthed, all together, 26 marked human bones dispersed among the skeletons. There were 11 femurs, 3 humeri, 11 tibiæ, and 1 fibula. Most of these were in an imperfect condition, 1 humerus and 3 tibiæ being the only perfect specimens in the lot. It was impossible to ascertain, with any degree of certainty, to which bodies they belonged, on account of the evident unsystematic, almost haphazard mode of burial, contrasting strangely with the apparent care shown in the markings on the bones. For a detailed description of these bones I refer the reader to the second part of this paper, prepared by my friend, Dr. A. Hrdlička.

Let us first consider the circumstances under which they were found. As has been said, there were possibly three types of people interred at this remarkable ancient burial-place, the majority of them being Tarasco. There is circumstantial as well as somatologic evidence that this was the case.

Mixed with them were the remains of a peculiar type of people. Their heads had been artificially flattened in a singular manner. I have seen a few specimens of this kind of skull at the residence of Dr. Perez at Uruapan, State of Michoacan, who thought, however, that the extraordinary flattening of the front, and the bulging out at the back and sides, were the natural growth of the skulls. This, however, cannot be the case, as they show undoubted marks of artificial deformation. The skulls in possession of Dr. Perez had been brought to him from some caves to the south-

west of the pueblo of Periban, and thus in the ancient territory of the Tarasco Indians.

The flatheads excavated at Zacápu, among which there are four females, differ from the Tarasco skulls in having a smaller cranial capacity, as well as in other respects of a more secondary character. They are, as Dr. Hrdlička thinks, akin to the Maya skulls, or to Quiché.

The skull found in the pottery dish is apparently Tarasco, but the skeleton found inside of the large burial-jar presents some features distinct from those of that tribe. It belongs to a tall individual, and all its components are large and massive. Dr. Hrdlička, though very doubtful of its being Tarasco, does not think it absolutely impossible that such may be the case. If it be Tarasco, then the physical types of people found would be reduced to only two.

Respecting the mode of burial, the greatest number of the bodies seem to have been carelessly interred, as if in a hurry; the deformed heads being found in the centre of the cemetery, and rather below the others. It is curious to note that the large Tarasco burial-jar should have been found here in such an unusual way. It is also remarkable that a detached skull should have been found in the clay dish,—the first time, so far as I know, that this has been met with among the Tarasco Indians. Lucian Biart mentions having found somewhat similar dishes elsewhere in Mexico (L. Biart, 'Aztecs,' p. 210, Chicago, 1877). It should also be observed how few objects were found at this burial-place, as if the people had been poor, or as if they had been slaves, or buried in great haste.

It would be difficult to make any positive assertions in regard to the mode of burial and its meaning. But as to the marked human bones, so prominent a feature of the burial-place, I will offer an explanation.

We may take it for granted that the markings on these bones are all of a post-mortem character. Further, any one familiar with Indian thought would, I think, naturally assert that they have a magical or shamanistic purpose. According to my experience with Indians, the idea of the trophy is not consistent with aboriginal American thought. Such things as these marked

bones, scalps of fallen enemies, etc., have a deeper significance to the Indian than that of mere trophies.

Nor should the fact that human bones are found with one end open, the marrow having been taken out, or the bones, maybe, even split, always be interpreted as indicative of cannibalism, particularly when only certain of the bones found in an ossuary are thus treated, and when some of them, as is sometimes the case, give evidence besides of death by disease.

There are two ways open for an explanation of the marking and cutting of these human bones. The first is, that it may have been an operation undertaken for the purpose of despatching the dead. Among the present tribes of Mexico known to me personally, there is a universal belief that the dead are troublesome to the survivors for at least one year; and certain ceremonies and feasts in regard to them have to be observed in order to prevent them from doing harm, and to drive them away. The Tarahumares never neglect, when making beer, to put into the large jars in which the beer is kept a certain strong-smelling plant, called in Spanish *estafiate*, in order to keep the dead from spoiling the beer by urinating in it. The Cora Indians and others always take care, at their feasts for making rain, to have a special altar with food for the dead on it, since they would do harm if this were omitted. It is customary among most of the tribes in northern Mexico for a person, when drinking native brandy, to sacrifice a little to the dead, before drinking, by dipping the forefinger into it and throwing a few drops over his shoulder.

Another consideration here is the relation which, as the Indians hold, exists between disease and pain and the bones of the deceased person. Their ideas on this point can be no better expressed than in Cushing's 'A Case of Primitive Surgery' ('Science,' New York, Vol. V, No. 130): "Such a sore [as the one described in the article], if malignant and deep, causes pain as of the bones. Its seed, then, must be deep-seated, or in the bones themselves: this seed must be removed, else it will grow and cause death." In a general way, the Indians classify diseases as of two kinds,—those seated in the bones, and those seated in the flesh. There were not many diseases among aboriginal tribes. The most prevalent complaint was probably rheumatism in one

form or another, as it is to-day among tribes which have not come much in contact with the whites. For this reason disease would, in most cases, be considered as located in the bones, particularly in those of the limbs.

As, however, the contents of the bones, or the marrow, is the principal part of them, the Indians believe that the pain of the disease is in the marrow, the 'brain' of the bones. When the Indians have pain in the head, they naturally think that it is in the brain; and when they have pain in the bones, as they call it, they naturally locate the pain in the inside of the bones, or in the marrow.

If a disease has been so obstinate as to yield in no wise to the shaman's efforts, and to cause death, the Indians think that the pain of the disease will continue after death, and vex the ghost, making him malignant and troublesome. Therefore the pain has to be conquered, and driven away from the bones and the marrow.

These considerations of aboriginal thought in regard to disease and death would lead one to believe that these bones were marked principally in order to sever all connection between the spirit and his former earthly surroundings, and from the disease which caused his death. At the same time, the operation would ease the minds of the survivors in relation to the harm that the dead one might do to them if such 'after-curing' were not performed.

The bones of dead bodies, in such case, might then have been cut off, scraped free of flesh, cleaned and 'cured,' and the marrow taken out of them and probably also 'cured' or 'killed' by burning,—a femur, or a tibia, or a humerus, etc., as the case might be,—and again buried with the dead.

Bodies of persons who have died from diseases in the 'flesh' most likely would not be treated in such a way, or it may be that such an operation gradually became conventionalized for all cases of very painful disease.

Against this interpretation, however, as applied to the present case, is the circumstance that three of the bones show unmistakable signs of having been handled repeatedly, and for a period of time, and bones thus treated would most likely have been buried when the body of the one to whom they belonged was interred.

Besides, it is not absolutely certain that the marked bones are those of Tarasco Indians, notwithstanding the fact that by far the greater number of those buried in the cemetery belong to that tribe. The deformed skulls, the burial-jar, and the detached skull would, in any case, also be matters of conjecture only.

Although the objections raised against this theory may in part be overcome, there is another explanation which seems to be even more plausible, namely, that the bones were taken from slain enemies for other uses than as mere trophies. This idea is borne out, according to a competent authority, by the finding of the detached skull before mentioned in a bed of ashes, because ashes clog the trails, and blind the power, of ghosts.

It is not necessary for our present purpose to discuss the many singular customs in regard to the disposition of the dead prevalent among other races of the globe. We remember how certain Australian people clean the flesh from the bones of their dead immediately after death, and how some of the bones (or even those of the whole body) are carried round for stated periods by the nearest of kin, etc. A discussion of primitive notions of the dead and of the causes of death, and of operations performed on the dead, would carry us too far.

The conception by primitive people of personal possessions being, so to speak, imbued with one principle or more of the spirit of their possessor, even after his death, is probably widespread, and is one of the reasons why so many races bury with the dead their personal possessions, or even destroy them.

In order that a sorcerer may do a man harm, it is generally deemed necessary that he shall possess some of his belongings, especially some part of his person, as, for instance, the hair. At least among the natives of this continent, so far as I know, such a sorcerer or an enemy might even injure the dead man's spirit by coming into possession of some of his personal property, and worry him or make him uncomfortable, or even deter him from doing harm.

Still more important is the power which is supposed to be latent in the bones of the dead.

I think we have a solution of the pending question in the admirable passage from Cushing's 'Zuñi Creation Myths,' p. 328,

where he speaks of the Zuñis killing the first two missionaries sent among them, taking their scalps, as was their custom, and cutting off the hand of one of them: "There the ceremonial of the scalp dances of initiation were performed over the scalps of the two friars, an observance designed both as a commemoration of victory and to lay the ghosts of the slain by completing the count of their unfinished days and making them members by adoption of the ghostly tribe of Zuñi." From this it may be inferred that the scalp or other portion of a slain enemy is not, I repeat, a trophy, but a *ghost-fetish*, an amulet by which the victor at once propitiates the shade of his victim, and ceaselessly wields power over him. The paint or the marks placed on the scalp are significant of this. They are designed to furnish the count of days, and to renew the life (in color of blood) of the slain enemy, who is now considered as adopted, as a ghostly slave, so to say, of the victor.

I am furthermore indebted to my friend Mr. Cushing for having in this connection drawn my attention to a practice, that existed among the Southern Indians of the United States, similar to that which I suppose to underlie the marking of the bones in question. See picture in Le Moyne's Drawings, reproduced by De Bry: 'Brevis Narratio,' II, Frankfort-on-the-Main, 1591. On p. xv is an illustration showing warriors in the act of cutting off limbs of fallen enemies.

From these statements I believe that the marked bones of this Tarasco burial-place were the bones of enemies, kept as amulets or fetishes, and buried with the dead warrior who procured them. Their possession meant to the conqueror the strength of the subdued man, as a sign of which he placed the transverse marks on them, symbolic, perhaps, of the count of the dead man's days. The extraction of the marrow would further help to make the fallen enemy a prisoner of the victor by eviscerating the bones and robbing the ghost of his last independent mortal power.

Judging from the importance which Indian tribes put upon their arms and legs, it is only natural that we should find the marked bones in this burial-place to be almost exclusively those of the limbs. An Indian who loses an arm or a leg might just as well die, in his own opinion, therefore he always takes special

care of those members. The Zuñi name for a sturdy, stalwart man, for example, is *óm-thla-na* ('big thigh'); and for a graceful, well-formed woman, *óm-kók-shi* ('good or fine thigh').

The haphazard mode of burial may be explained in the possible fact that the people had to retire before an enemy. There was no time for burying much of their personal property, but their fetishes would be sure to follow them.

Such bones would be considered a powerful 'medicine,' and the frequent occurrence of illustrations of human bones in the Codices, especially of the femur, might be explained in the light of the conclusions here reached. The Codex of the Borgian Museum is especially illustrative on this point. In the Codices, femurs are frequently pictured as tied to the head-dress of a priest; and sometimes a plume or a flower may be shown, stuck into a hole in the end of them; and a bone is often adorned with cross-bands of red and white. Compare also the cross-bones and the god of death with bones in conventionalized form, etc.

II.

By ALEŠ HRDLIČKA.

The bones in question present on one side transverse markings running parallel to each other. They have generally been produced by filing, although the idea that in some cases they were also cut cannot be discarded. It is impossible to find any uniformity in the arrangement of these markings, which vary not only in character and in number, but also in depth and location.

Another peculiarity that at once presents itself to the eye is that in six cases the largest end of the bones has been perforated, so as to make a communication with the medullary canal. In several instances the shaft has been broken or the epiphysis cut off, no doubt also in order to reach the medullary canal. There is one case in which an ornamental design immediately adjoins the transverse lines; this design consists of transverse zigzag markings between two parallel lines. (See Plate VIII.)

The following is a detailed description of these bones :

A.—ENTIRE BONES.

[The fractional numbers refer to the Museum numbers of the specimens.]

I HUMERUS

($\frac{30}{2115}$). Adult bone, left (Fig. 4). Flattened considerably from side to side, the edge pointing towards front. Olecranon fossa communicates, by means of a large opening, with the canal of the bone.



Fig. 4. Section of Middle.

Length	30.7 cm.
Circumference in middle ¹	6.7 "
Diam. antero-post. "	2.4 "
Diam. lateral "	1.53 "

Markings occupy the middle two-fifths of the bone; they are 13 in number, and from one to two millimetres deep, irregularly arranged. No rubbing over the markings apparent on the bone.

3 TIBIÆ.

	$\frac{80}{2104}$ (LEFT).	$\frac{80}{2127}$ (RIGHT).	$\frac{80}{2129}$ (RIGHT).
Length	32.9 (styloid want.)	35.5	36.0
Circumf. at middle ¹	6.3	7.9	9.3
Diam. ant.-post.			
at middle.	3.1	2.9	3.5
" later. "	1.8	1.9	2.1
Shape	Platycnæmic.	Platycnæmic.	Platycnæmic.
Remarks	Middle third of bone occupied by markings, which are 13 in number, regularly arranged at about 9 mm. one from the other, deep about 1.5 mm. No use of the bone apparent.	About the middle third; 23 markings, regular; separation, av'ge 5 mm.; depth ab't 2 mm.; bone somewhat smoother on the side of markings.	About middle fifth; 7 markings, irregular; separation, 11-21 mm.; depth ab't 1 mm.; no use apparent.
Situation of markings.	Internal surface.	Internal surface. Knee surface perforated, communicates with shaft.	Internal surface.

¹ The exact middle of the bone is taken.

B.—IMPERFECT BONES.

2 HUMERI.

	8108	8109	8110	8111	8112	8113	8114
Circumference at about middle.....	6.3	7.3	9.0	7.3	9.0	7.3	8.6
Diameter ant. post.	2.1	2.55	3.5	2.7	3.5	2.7	2.9
" lateral.....	1.52	1.9	2.1	1.9	2.1	1.9	2.4
Remarks.....	The shaft is quite angular. Communication of shaft-cavity with olecran. fossa. Markings occupy about the 2d fourth of the post. ext. surface from above; ten in number, irregu- lar; about 2 mm. deep. Bone smooth ¹ over two lower markings, no use ap- parent above.	Bet. upp. and mid. third.	Bet. 1st and mid. third.	Below upper third.	Below upper third.	Below upper fifth.	At upper third.

8 TIBIÆ.

	8115	8116	8117	8118	8119	8120	8121
Circumf. at about middle.....	8.2	14	14	14	14	14	14
Diam. ant. post.	3.1	1.4	1.6	1.6	1.7	1.7	1.7
" lateral.....	2.2	1.5	1.5	1.5	1.5	1.5	1.5
Marks begin.....	Mid. third.	Mid. third.	Bet. upp. and mid. third.	Bet. upp. and mid. third.	Bet. 1st and mid. third.	Below upper third.	At upper third.
Marks occupy.....	Mid. third.	Mid. third.	Bet. upp. and mid. third.	Bet. upp. and mid. third.	Bet. 1st and mid. third.	Below upper third.	At upper third.
Whole number.....	14	14	16	17	17	17	17
Number remaining.....	14	14	16	17	17	17	17
Regularity.....	Some.	Some.	Some.	Yes.	Yes.	Yes.	Yes.
Average separation (in mm.).....	6-10	6-11	8	9	9	7	6
Least and greatest sep. (mm.).....	6-10	6-11	8	9	9	7	6
Depth (in mm.) about.....	1.5	1.5	2	2	2	1.5	1.5
Use apparent?.....	—	—	Smoothed.	Smoothed.	Smoothed.	Surface smoothed.	—
Peculiarities of bones:	Yes.	Some, yes.	Some, yes.	Some, yes.	Much, yes.	Some.	—
Platycnæmic?.....	Knee art. sur- face perforated and communi- cates with the hollow of the shaft.	Knee epiphy- sis appears to have been re- moved, lower ant. surface in- fact.	Ext. surface <i>en pilastre</i> .	Ext. surface <i>en pilastre</i> .	Ext. surface <i>en pilastre</i> .	Ext. surface <i>en pilastre</i> .	Ext. surface <i>en pilastre</i> .
Site of markings.....	Interior surface.	Posterior surface.	Interior surface.	Interior surface.	Interior surface.	Interior surface.	Interior surface.

¹ The smoothing of the surfaces, wherever it occurs, is but slight, and usually attended with smooth aspect of the other surfaces of the bone.

I FRAGMENT OF FIBULA.

($\frac{30}{21\frac{3}{8}}$). Fibula of a young subject, about the lower third; ten markings left; distances 3-10 mm.; depth about 1.5 mm. No use apparent.

In regard to the significance of the markings on the bones, there is nothing about the notches which would lead directly to any definite conclusion; nevertheless there are certain characters in common which may aid considerably in the solution of the mystery.

In the first place the markings are not accidental; they have been made artificially, after a certain basal design, or habit, and with care, at the expense, no doubt, of much patience; and all this implies that they had their serious purpose.

The markings were not made by one individual, nor by one and the same instrument; their execution and characters show great variety; it almost seems as if each bone had had its own worker—which fact signifies that the phenomenon concerned directly many individuals, and that renders the markings an event of social nature.

The bones used were all human, and this fact indicates that whatever the object of the markings may have been, it bore a close relation to human beings themselves.

The longest bones of the body were chosen, and the thick bones of the lower extremity had a further preference; these facts would show that the size and hence the durability, and the length and hence the space available, were factors in the selection of the bones. The nice surfaces for marking, and the ease of handling, may have been two more of such factors. Outside of all these, there is no reason to believe that to any particular one of the human bones used was attributed any specific importance.

The numerous artificially made communications with the medullary canal of the bones, all made without any further signs of injury to the bone, indicate that such communications of the medullary canal with the outside had their importance. Attempts to cleanse the inside of the bones would account for such openings, and this would in turn signify that the bones selected for this particular use were still fresh (fallen enemies? dead relatives?). Can-

nibalism is never mentioned as having existed in Michoacan. The marrow may have been utilized for some special purpose.

The situation of the grooves on the bones gives no clew as to the meaning of these. In most cases the markings occupied the middle third of the bone, but in a few others the grooves extended considerably nearer to the epiphyses; and the only thing that may be inferred from the situation, and also from the arrangement of the markings, is that a certain amount of imitation entered as an element into their production.

The number of grooves on the different bones are entirely irregular, and range from seven to thirty-six, only two or three of the bones bearing the same number. This shows that numbers played no specific *rôle* in the production of the grooves. (The numbers are not divisible by any common numeral.)

The arrangement of the grooves is similar on most of the bones, as has been already remarked, but the interval between the grooves varies on the different bones; it varies occasionally even on the same bone; and the same is true of the depth of the markings.

An attempt at decoration appears in only a single case, and in this case the simplicity of what appears to be a decoration suggests that those marks might have served some much more practical, probably a hieroglyphic, purpose.

As to the identity of the bones, this cannot be authentically determined, on account of the fragmentary condition of the majority of the marked bones, and because we are in possession of but few other known bones of ancient Tarascan people. The thickness and size of most of the marked specimens would point out that they were masculine bones, yet some may have been feminine members. The question of identity of the bones being very important, I append here a few measurements for comparison:

FEMURS.

	Circumference at Middle.			Diameter (ant. post.)		
	Aver. mm.	Max. mm.	Min. mm.	Aver. mm.	Max. mm.	Min. mm.
Tarascan (4)...	84.5	86	83	29.2	33.0	27.0
Marked (11 frag'ts)...	83.4	88	75	27.9	30.0	24.0

FEMURS.—Continued.

	Diameter (later.) at the Middle.			Angle of the Neck with the Shaft.		
	Aver. mm.	Max. mm.	Min. mm.	Aver.	Max.	Min.
Tarascan (4)	23.8	25.5	22	125.3°	128°	123°
Marked (11 frag'ts) . .	23.4	27.0	20	125.5°	128°	123°

TABLÆ.

	Circumf. at Middle.			Diameter ant. post at Middle.			Diameter (later.) at the Middle.		
	Aver. mm.	Max. mm.	Min. mm.	Aver. mm.	Max. mm.	Min. mm.	Aver. mm.	Max. mm.	Min. mm.
Taras. (1), smwh't def.	95.0	—	—	33.5	—	—	25.0	—	—
Marked (9).	81.9	98	63	30.4	35.0	25.5	20.8	24.5	18.0

The Tarascan bones, it will be noticed from the preceding, appear somewhat stronger; but the number is not large enough for definite conclusions.

Finally, we have to take notice of the fact that the marked bones were found promiscuously buried with the Tarascans, which may mean that each of the bones had its owner, with whom it was buried.

The above seem to be all the facts of importance we possess about the marked bones. No such custom of marking bones exists among the Tarasco people to-day. Are any inductions possible on the basis of such a knowledge?

In our endeavor to arrive at the proper explanation of the marked bones, naturally the first thing which it would be important to consider would be the nature of the burial-place where the notched bones were found. (Description in the first part of the paper.) In looking through the literature for a description of the funeral rites of the Tarasco, I find that Bancroft, in his 'Native Races of the Pacific States (II, pp. 619 *et seq.*), gives a good *résumé* of such descriptions from several old and reliable writers.¹

¹ Gomara, *Conq. Mex.*, fol. 310, 311, 312; Torquemada, *Monarqu. Ind.*, tome II, 524, *et seq.*; Beaumont, *Crón. Michoacan, MS.*, pp. 55, *et seq.*; Brasseur, de Bourbourg, *Hist. Nat. Civ.*, III, pp. 82, *et seq.*; Payne, in *Soc. Mex. Geog., Boletin*, 2d a Época, I, pp. 717, *et seq.*

Mr. Bancroft says that in Michoacan the funeral rites were of a very exact character, especially when a high personage was concerned. When a king died and his body was ready for the burial rites, the new king proceeded to select those among the servitors who, according to the inviolable law of the country, were doomed to follow the dead prince. Seven of these were noble women, to whom various duties were assigned. Among the male victims, who seem to have been slaves for the most part, every trade and profession was represented, and also clowns, and some of the physicians who had failed to save the life of the monarch. At midnight the litter was carried on the shoulders of the chief men to the temple, followed by vassals, warriors and courtiers, and while the flames of the pyre shot up, and the funeral chants fell from the lips of the mourners, the victims were stupefied with drinks and clubbed; the bodies were thrown into holes behind the temple, by threes or fours, together with the ornaments and other belongings of the deceased. The ashes and valuables were gathered from the smoking pyre, and made into a figure, which was dressed in royal habiliments, with a mask for its face, a golden shield on its back, bows and arrows by its side; this was set upon a throne facing the east, the whole being placed in a large urn, which was deposited upon a bed of golden shields and silver articles in a grave with stone walls, lined with mats, about twelve feet square, and equally deep, situated at the foot of the temple. The urn was covered with a number of valuable mantles, and around it were placed various implements, food, drink, and boxes filled with feather-work and ornaments; the grave was finally bridged with varnished beams and boards, and covered with a coating of earth and clay.

“The obsequies of the people bore a general resemblance to the above, the ceremonies being regulated by the rank and means of the deceased. The graves were usually situated in the fields or on the slope of a hill.”

It seems to me this description throws some light on the question of the burial-place of El Palacio, Zacápu. The body in the urn may not have been that of a Tarasco king; it may have been simply that of a great statesman, shaman, or soldier. We have almost everything in this case to support the conception of this

having been a burial of some Tarasco noble—we have the haphazard buried bodies, a thing most uncommon otherwise with the Indians; the small number of women, most of whom were young adults; the nature of the burying-ground, and the urn. Of the large number of male bodies found in the grave, a certain number were presumably slaves. These were, almost beyond a doubt, the individuals with the flattened skulls. The significance of the large number of other people, apparently Tarasco themselves, is uncertain. They may represent the victims of more burials than one, or may include soldiers fallen in battle.

So much for the burial-place. Granted that we have learned its real nature, the information obtained as to the marked bones remains still only that of a collateral order.

On the basis of all the preceding facts the following theories are proffered :

The bones were trophies from fallen enemies, and the grooves signified the number slain by the owner of the bone. The mention of a similar custom with 'Chichimecs' by Herbert Spencer ('Sociologie,' 1896, II, 38), and Bancroft ('American Races,' I, 629) seems to support the theory.

Or the grooves may have served the rôle of simple records of age, of great feasts, or of other events. The recording on bones of various occurrences is not an uncommon phenomenon with the Indians, though, so far as I can find, only animal bones were used for such a purpose.

Or, finally, the bones may have served some as yet undetermined religious or ceremonial purpose.

In conclusion, then, the authors present here, as a contribution to the ethnology of the ancient people of Mexico, the unique phenomenon of marking human bones. They also give their individual opinions in regard to the significance of that custom. In this, however, they agree: that there is one characteristic which prevails throughout the marking, namely, the similarity of execution of the grooves. This shows that the whole proceeding must have been conducted on a certain method, which again demonstrates that their significance was of a uniform character.





TARASCO BURIAL-JAR.



MARKED HUMERI AND FIBULA.





MARKED TIBIÆ.



VARIETIES OF MARKING.



ARTIFICIAL PERFORATIONS TO THE MEDULLA OF THE BONES.

Article VI.—A COMPLETE SKELETON OF CORYPHODON RADIANS. NOTES UPON THE LOCOMOTION OF THIS ANIMAL.

By HENRY FAIRFIELD OSBORN.

PLATE X.

The chief object of the writer in planning the American Museum Expedition of 1896 was to complete materials for the investigation of the evolution of the Amblypoda, and extend our knowledge of *Coryphodon*. The observations of Cope, Marsh, Osborn, Wortman and Earle have been principally upon scattered and imperfect material, and it seemed of the utmost importance to secure materials sufficient to determine the relations of this animal to its ancestral form, *Pantolambda*, and to its successive form, *Uintatherium*; also the proportions of the body, the positions of its limbs and the number of its vertebræ. Accordingly our party, led by Dr. Wortman, aided by Mr. Granger of the Museum, and Messrs. Brown and Riggs of the University of Kansas, spent the months of April and May in northwestern New Mexico, revisiting the locality where Cope's most complete *Coryphodon*, *C. elephantopus*, had been found. The search here in the 'Coryphodon' or 'Wasatch Beds' was entirely unsuccessful, but fortunately the underlying 'Torrejon Beds' yielded a remarkably complete series of *Pantolambda*. The party moved to the north in June, and devoted July and August to a most energetic exploration of the Big Horn Basin, especially of the exposures on the south side of the Gray Bull River from Brown's Ranch towards the Big Horn River below Otto.

The party soon discovered two skulls, both in the sandstone. The first (No. 2867), upon level A, with four vertebræ and some fragments of limb bones associated with it, the teeth being badly

weathered, has been mounted in our skeleton. The second (No. 2963) was found upon level B, 40 feet higher; it exhibits the form of the top and back of the skull, together with the complete teeth and palate. Shortly afterwards, upon the same level A as No. 2867, the skeleton (No. 2865) was discovered with fifteen ribs and vertebræ, the humerus, ulna, radius and two or three of the sternal bones. This was followed by the discovery on level A of the hind limb (No. 2869), several pairs of jaws, and finally, upon level B, the part of a crushed skeleton (No. 2829), including the skull, jaws, all the ribs and vertebræ in position. This, as Dr. Wortman wrote, made the party absolutely certain of a mount. The four skulls, Nos. 2827, 2867, 2963, 2865, with the associated skeletons, were thus found substantially upon the same geological level, they are in the same stage of evolution, and are found to belong to the classic species *C. (Bathmodon) radians* Cope, the first known in America.

The party then moved to the overlying Wind River Beds, and discovered a unique skull (No. 2977) of a distinct species, which reverses the natural order of evolution, since the sagittal crest is a little broader than one's finger. This exhibits the desired transition between *Pantolambda* and *Coryphodon*, and represents, in all probability, a persistent primitive type.

Altogether parts of 18 individuals were found in the Wasatch Beds (supplementing the 30 individuals found by Dr. Wortman in 1891), and 7 individuals in the Wind River Beds. The selection of nine individuals for mounting was done with great care as follows: The mounted skull, No. 2867, agrees exactly in size, and is specifically identical with the skull and jaws of No. 5829. The latter (No. 2829), while laterally crushed, had associated with it the right scapula and complete fore-limb, left scapula and parts of left limb which were used in mounting; also all the vertebræ as far back as the pelvis; these vertebræ, while too much crushed to mount, enabled us to determine the formula and select, from series Nos. 2865 and 2863, vertebræ which exhibit the same characters. The latter individual (No. 2863) included the pelvis and hind-limb, thus determining *positively the correct proportions of the entire animal*. The mounting was done with great skill and care by Mr. Hermann.

DESCRIPTION OF SKELETON.

Composite of nine individuals, all from the Big Horn Beds, as follows: No. 2867; skull, left humerus, left mtc. I and ectocuneiform; caudals 1-3, 10-11. No. 2867, lower jaw. No. 2829; right scapula and fore-limb complete; left scapula, magnum, trapezium, trapezoid, metacarpals I-V and phalanges. No. 2865; all cervical vertebræ, dorsals and ribs 1-9 complete, 3 phalanges of right pes. No. 2963; dorsals 10-15 and ribs complete, lumbar 1-5 complete, pelvis, left pes (excepting mts. I, III-V, and ectocuneiform). No. 2869; right hind-limb complete (excepting mts. IV-V and 3 phalanges. No. 4329, left ulna, femur and tibia. No. 258; caudals 4, 5, 8. Sternals complete from No. 2825. *Restored*: left radius, left fibula, right mts. IV-V, left mts. III-V, caudals, 6, 7, 9, and 12-22.

In general one is struck by the very large size of the head, formidable front teeth, the shortness of the ribs, the heavy character of the girdles, the heavy limbs, and the semiplantigrade or subdigitigrade condition of the feet. It is probable, as already shown by the writer, that in the hind foot the calcaneum nearly touched the ground in the forward step.

The *skull* presents a very peculiar appearance with its powerful and spreading upper and lower canines, and widely spaced incisors, slender zygomatic arch and broad, flattened cranium. The following characters distinguish this specific type: Premaxillaries short, not reaching nasals; free portion of nasals short; nasals projecting between maxillaries, and then spreading upon inner side of frontal tuberosities; naso-frontal suture disappearing posteriorly; maxillaries occupying a broad area and bulging out opposite the canine alveoli and concave behind; lacrymals not clearly defined; frontals above the orbits supporting two prominent knobs or convexities, confluent with parietals posteriorly; parietals expanding above middle portion of temporal fossa, and lateral parietal crest thickening, as indicative of a rudimentary parietal horn; mid-parietal region depressed and extremely rugose for muscular attachment (*occipito-frontalis*); malars extending to the front of orbit, exhibiting a downward masseteric process slightly behind the orbit, expanding widely but slender in section; postglenoid processes for squamosal rather slender; external auditory meatus widely open, and paroccipital and posttympanic region compressed into a narrow ridge; occiput

low and broad; lower jaws with condyle facing upwards and backwards; prominent depression posteriorly; a mental foramen below first premolar, a second mental foramen below lower canine.

Dentition.—The superior teeth, wanting in this specimen, are perfectly preserved in No. 2829, and agree with the fragmentary type specimen of *Coryphodon (B.) radians* Cope.

Vertebral formula: C.7, D.15, L.5, S.4.

This remarkably low vertebral formula is ascertained from No. 2829, in which all the dorsals and lumbar are retained in a single block and can be counted with considerable certainty. The formula is very low, but not more so than in *Titanotherium*, in which D. L.=20. The chief characteristic of the vertebral column is the series of low, undifferentiated neural spines, which are ill correlated with the heavy skull.

Cervicals.—Atlas moderately broad with a slightly expanded transverse process, perforated slightly above the base by the vertebrarterial canal. The spine of the axis extends equally forwards and backwards. The remaining cervicals exhibit a gradual development of the inferior lamella, which is well marked in C.6, but lacks the strength exhibited in the larger *Perissodactyla*. The cervical centra are very short, and the vertebral centra gradually increase in length and depth toward the lumbar region.

The most striking feature of the *dorsal* vertebræ, which is shared by *Phenacodus*, is the great prominence of the transverse process supporting the tubercle of the ribs. This projects widely out from the side of the vertebra in D.1, and gradually recedes to D.11, which is apparently the last vertebra in which the rib tubercle articulates. In all the dorsals the head is placed directly between the adjacent vertebræ from D.1 to D.15. The low spines characteristic of the cervical region extend back as a feature of the dorsals, the vertebræ exhibiting terminal tuberosities for the fascia of the ligamentum nuchæ. The dorsal vertebral spines gradually thicken in antero-posterior diameter; as they pass backwards they decrease in height. In the lumbar region they are cleft on the dorsal line. The lumbar terminate inferiorly in compressed keels.

MEASUREMENTS OF SKELETON.

	FEET AND INCHES.	METERS.		
Length incisors to perpendicular of tail.....	7' 9½"	2.38		
Height at withers.....	3 4½"	1.03		
Fore Limb :				
Scapula.....	1' 5"	.43		
Humerus.....	1' 3½"	.39	} 2' 8½"	
Radius.....	10"	.25		or
Manus, total.....	7"	.17		.82
Hind Limb :				
Pelvis, transverse.....	2' 4"	.71		
Femur.....	1' 6½"	.47	} 2' 11½"	
Tibia.....	11"	.28		or
Pes, total.....	6"	.15		.90

These measurements show that the tibia is only an inch longer than the radius, while the femur is three inches longer than the humerus.

The anterior pair of ribs is extremely short, the succeeding ribs increase in length and decrease in diameter, passing from a flattened into a trihedral form in D.6 and 7, and finally into an oval form in D.10-15. A characteristic feature of the ribs of D. 6-11 is a pit upon the upper surface just external to the tubercle.

The zygapophyses have horizontal faces as far back as D.15. In D.14 and 15 they turn obliquely upwards, the faces being vertically flattened. In L.1 to L.5 the zygapophyses are sharply concave and nearly vertical in position. The characters of the caudals are not certainly known, the few centra being restored from a number of different specimens. We have not ventured to give the tail the remarkably flattened character already described in a specimen found in 1892.

Fore Limb.—The scapula is vertically elongate, terminating in a point superiorly, and distinguished from that of *Uintatherium* by nearly subequal supraspinatus and infraspinatus fossæ. It is partly restored in the mount, but perfectly preserved in No. 2873. The spine rises near the superior border, is slightly thickened and reflected, and passes down into the acromion process, which turns sharply forwards and overhangs the great tuberosity of the

humerus. The humerus is distinguished by the prominent greater tuberosity, which enters inferiorly the prominent and recurved deltoid ridge, extending far down upon the anterior surface, two-thirds the length of the shaft. The characters of this bone are best seen in No. 2780, an animal of the same size.

The entepicondyle is a rugose tuberosity, the ectepicondyle is more elevated on the shaft, and is marked by an anteverted ridge. The forearm is perfectly preserved upon the right side. The radius covers the front face of the humerus, and the distal faces of the ulna and radius are placed obliquely to the transverse axis of the body, facing upwards and throwing the fore feet and toes outwards rather than forwards. In this specimen the cuneiform does not articulate with the fifth metapodial, as observed in certain other specimens. The manus, as above described, is subdigitigrade, the lower surfaces of the proximal ends of the metapodials being slightly raised above the ground. The position of the metapodials in the forward step is, however, much more oblique than in the manus of the Elephant, the lower surfaces being nearer the ground.

The *pelvis* is partly restored in this mount. Its characters are better shown in No. 258. The ilia expand widely, but the antero-inferior border is not extended very far down. The ischia and pubes are strongly developed, and enclose a wide obturator notch.

A very characteristic feature of the skeleton is the long and rather slender form of the femur and the disproportion between the femur and the tibia, which is much greater than that which exists between the humerus and the radius. The great trochanter does not rise to the level of the head. The third trochanter is a long rather low crest, much less strongly marked than in *Pantolambda*, placed on the upper third of the inner side of the shaft. The lesser trochanter is very prominent, and lies slightly below the middle of the shaft. The patella is a very characteristic bone, but there is some doubt as to its position; it appears probable that the slender pointed spine of the patella faces upwards, as the long patella facet is thus made to correspond with the long facet on the inner side of the front face of the trochlea of the femur. The tibia is a very stout bone with a rather low

cnemial crest, and rests by a slightly concave distal face upon the broad flat astragalus. The position of the pes is probably fairly represented in the left right foot, and although it is possible for the astragalus to be brought still nearer to the ground in the long forward step, it appears that in this type plantigradism is not so marked as has been stated by Osborn; probably the different species varied in this respect. As in the fore feet, the median digit faces outward. The astragalus has a well-marked astragalar foramen.

GENERAL APPEARANCE OF CORYPHODON.

The most accurate forecast of the appearance of the animal was that made by Cope¹ in 1874 :

“The general appearance of the Coryphodons, as determined by the skeleton, probably resembled the Bears more than any living animals, with the important exceptions that in their feet they were much like the Elephant. To the general proportions of the Bears must be added a tail of medium length. Whether they were covered with hair or not is, of course, uncertain; of their nearest living allies, the Elephants, some were hairy and others naked. The top of the head was doubtless naked posteriorly, and in old animals may have been only covered by a thin epidermis, as in the Crocodiles, thus presenting a rough, impenetrable front to antagonists.

“The movements of the Coryphodons, doubtless, resembled those of the Elephant in its shuffling and ambling gait, and may have been even more awkward, from the inflexibility of the ankle. But, in compensation for the probable lack of speed, these animals were most formidably armed with tusks. These weapons, particularly those of the upper jaw, are more robust than those of the Carnivora, and generally more elongate, and attrition preserved rather than diminished their acuteness. The size of the species varied from that of a Tapir to that of an Ox.”

Osborn² in 1892 wrote as follows :

“The fact is, the position of the fore and hind feet of Coryphodon is absolutely different. The *fore foot was digitigrade*, like that of the Elephant, the *hind foot was plantigrade*, like that of the Bear. In other words, the carpus was entirely raised from the ground and the manus rested upon the distal ends of the metacarpals and upon the spreading phalanges, while the calcaneum

¹ Vertebrate Palæontology, Vol. IV, Wheeler Survey, p. 203.

² Fossil Mammals, of the Wasatch and Wind River Beds, Collection of 1891, Osborn and Wortman, Bull. Am. Mus. Nat. Hist., Sept., 1892, p. 121.

and tarsus rested directly on the ground together with the entire plantar surface of the foot. This substantial difference between the advanced state of evolution of the fore foot and retarded evolution of the hind foot, is of great interest. It is clearly shown in the accompanying figures."

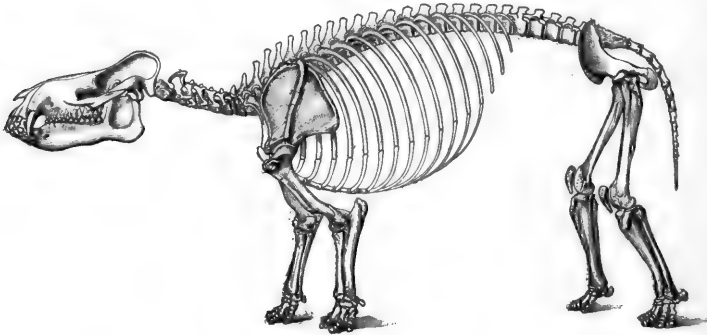


Fig. 1. *Coryphodon hamatus*, as restored by Marsh, 1893. One-twentieth natural size.

In 1893, Marsh,¹ in his description and restoration, presented quite a different conception of the animal as *unguligrade*. In regard to these matters he makes the following statement :

"This restoration is given one-twelfth natural size. The position shown was chosen after careful consideration, and is believed to represent fairly one naturally assumed by the animal in life when standing at rest. The figure represents a fully adult individual, and one of the largest species of the genus which, when alive, was nearly six feet in length and about three feet in height. The basis of this restoration is the type specimen of *Coryphodon hamatus*. This was supplemented by other remains, which appeared to be superficially identical. A large number of such specimens were available, some of them in excellent preservation. For parts of the skeleton where such remains were wanting specimens from nearly allied forms were used, but no serious error can thus result. . . . The fore feet presented in the present restoration are constructed mainly from the same specimen (that first figured and described by the writer), and the position given in the original figure has been essentially retained. . . . The position first given to the figure is retained in the restoration after a careful investigation of the whole posterior limbs in a number of well-preserved specimens. In *Dinoceras* the terminal

¹ 'Restoration of *Coryphodon*,' Amer. Journ. Science, Oct., 1893, p. 324.

phalanges are much larger than in the Elephant, so that they thus bore a greater weight, the digit being undoubtedly free, although a pad may have helped to support the feet. In *Coryphodon* the digits were still more elongate and the terminal phalanges proportionately larger and broader, indicating that they

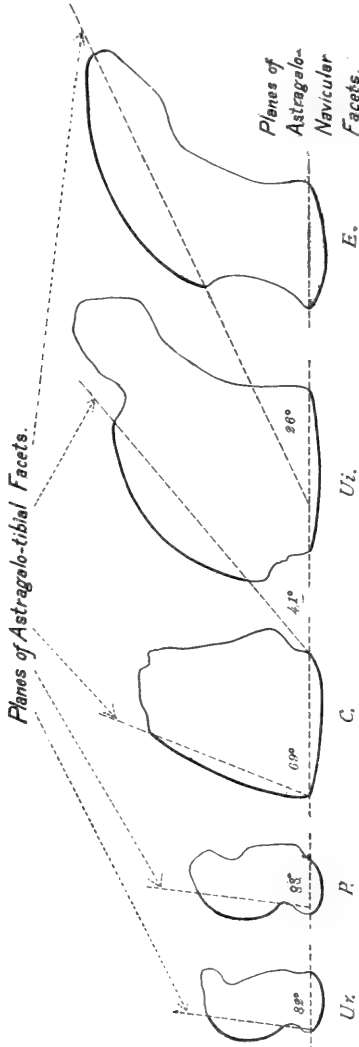


Fig. 2. Diagrams showing the *Angles* between the *Astragalo-tibial* and *Astragalo-navicular* facets, obtained by vertical sections of the Astragalus. *Ux.*, *UNUS*, plantigrade; angle, 82°. *P.*, *PANTOLAMBDA*, plantigrade; angle, 83°. *C.*, *CORYPHODON*, transitional; angle, 69°. *Ui.*, *UINTATHERIUM*, subdigitigrade; angle, 41°. *E.*, *ELEPHAS*, digitigrade; angle, 26°.

were covered with hoofs that supported the feet. This would agree with the position given them in the restoration, which coincides with the anatomical structure of the entire hind limb."

This clear statement of Professor Marsh's as to the position of these limbs is consistent with his restoration, in which not only the metapodials but the phalanges are raised from the ground, and the animal is represented as walking upon the tips of its toes, or terminal phalanges, the latter being supported by hoofs. The morphological importance of this restoration is very great. If correct it places *Coryphodon* among the Unguligrada, widely removed from the unquestionably plantigrade *Pantolambda*. Contrary evidence that *Coryphodon*, so far from being unguligrade, was transitional between complete *plantigradism* and *digitigradism*, is given below. Many other important morphological characters are involved in Marsh's restoration, and are now found to be incorrect. The scapula is given a trihedral form, with a very broad angular infraspinus fossa; the pelvis is extraordinarily reduced; the limbs are elongate and, together with the above-mentioned unguligrade action of the digits, elevated the body very much from the ground. In proportion to the scapula, the humerus, the ulna and the radius are of very great length, and similarly the tibia is only slightly shorter than the femur. The most important character, however, is that assigned to the vertebral column, there being 19 dorsals and, as far as can be determined from the drawing, 6 lumbar, or D. L.=25, a formula exceeding that of the Rhinoceros. The net result of these observations is to give the animal the general appearance and characters of a modern Perissodactyl,¹ with the single important exception of the five digits preserved in the fore and hind feet.

It appears from our more complete material that the difference between the feet was exaggerated by Osborn, as already observed by Marsh. There is no doubt, however, that as seen in the mounted specimen, in the forward step the calcaneum rested very near the ground, being separated merely by a thick plantar pad. The digits of the fore and hind feet have nearly the same relations to the ground. *Both feet are in a somewhat similar stage of tran-*

¹ The Perissodactyl affinities of the animal were dwelt upon in Professor Marsh's earlier papers (Am. Jour. Sc., 1876, page 428; *op. cit.*, 1877, page 84), but were abandoned subsequently ('Dinocerata,' 1884, page 177), in which *Coryphodon* was correctly associated with *Uintatherium* in the Amblydactyla (Amblypoda).

sition between *plantigradism* and *digitigradism*. *Pantolambda* has a long tuber-calcis and pes like that of the Bear. *Uintatherium* has a very short tuber-calcis and bore the pes slightly more plantigrade than the Elephant. *Coryphodon* has a tuber-calcis intermediate in length; in the astragalus the upper facet for the tibia and lower facet for the navicular presents an oblique angle, the astragalus thinning out to a sharp edge in front (whereas in *Uintatherium* these facets are more nearly parallel, and the astragalus is truncate in front). The angles between the tibial and navicular facets of the astragalus, as shown in sections in Fig. 2, afford the most decisive evidence that the pes of *Coryphodon* was intermediate between the nearly plantigrade *Pantolambda* and the sub-digitigrade *Uintatherium*.

Coryphodon had a very short back and short, spreading limbs, with a very clumsy, shuffling gait.

The rudimentary horn observed for the first time in the parietals is prophetic of the great parietal horn of *Uintatherium*. Many other characters of the skull and skeleton are also prophetic, but there is little tendency displayed to reduce the upper incisors or lower canines into the *Uintathere* type.



MOUNTED SKELETON OF *Coryphodon radians*.
Slightly exceeding one-fifteenth natural size.

Article VII.—THE EXTINCT CAMELIDÆ OF NORTH AMERICA AND SOME ASSOCIATED FORMS.

By J. L. WORTMAN, M.D.

PLATE XI, AND TWENTY-THREE TEXT CUTS.

Among the living selenodont Artiodactyla the Camels and Llamas of the Old and New World represent a very aberrant group. Even if one were not familiar with the wonderful record of their past history as revealed in the Tertiary deposits of this country he would be quite justified, from the number of anatomical peculiarities which they exhibit, in placing their origin far back in the Tertiary, at a time when the primitive divergence of the various lines of the Selenodonts was taking place.

The evidence is not yet sufficiently complete to trace the phylum with absolute certainty below the upper Eocene or Uinta stage, but from this point on to the present time there is very little to be desired, in the way of intermediate species, to form a compact and closely connected series, reaching to the modern types.

More or less elaborate studies of this group have been made by Cope¹ and Scott,² to whom we are especially indebted for much knowledge concerning the extinct forms, and while it would be difficult to add anything to their statements from the specimens known to them, yet the acquisition of a large amount of new material bearing upon this subject by the various Museum expeditions within the past few years has rendered it especially desirable to review the whole subject, with a view to defining, if possible, the exact limits of the various genera and species of the extinct North American representatives. The object of the present paper, therefore, is: (1) A review of the genera and species of the North American Tylopoda, with descriptions of

¹ 'Phylogeny of the Camelidæ,' Amer. Nat., 1886, p. 611.

² 'On the Osteology of *Poebrotherium*,' Journ. of Morph., 1891. 'The Mammalia of the Uinta Formation,' Trans. Amer. Phil. Soc., Aug. 20, 1889.

additional materials of known types, as well as of new allied forms ; (2) a careful consideration of the various steps in their evolution ; and (3) a study of certain osteological characters of the higher selenodont Artiodactyla in its direct bearing upon the transmission of acquired characters.

The oldest members of Tylopoda which we can determine with certainty are found in the Upper Eocene deposits of the Uinta Basin, which strata, it may be noted, contain the first remains of true selenodont Artiodactyla in this country, a fact originally pointed out by Marsh, who was the first to explore this region for fossil remains. In the preceding deposits of the Bridger Basin the remains of Artiodactyla are found, but are very rare, no truly selenodont types being known. It is true that in several genera, such as *Homacodon* and *Helohyus* of Marsh, we have a distinct foreshadowing of the selenodont molar, yet it is not until the Uinta is reached that the true Selenodonts appear.

Mr. O. A. Peterson, to whom we are largely indebted for the beautiful collection now in the Museum from this horizon, divides these beds into three stages,¹ which he designates as the lower, middle, and upper Uinta Beds, or, to use his own field designation, Horizons *A*, *B*, and *C*. A large part, if not the entire lot, of these remains were obtained from the lower part of Horizon *C*, or the upper part of Horizon *B*, so that their stratigraphical position would be correctly stated to be at least 300 to 400 feet below the top, and at least 800 feet from the bottom of the Uinta formation. No fossils are known from the upper levels of Horizon *C*, nor do we know any Artiodactyla from the Brown Sandstones, 800 feet in thickness, constituting Horizon *A*. If, therefore, close connections between these Uinta forms and the preceding Bridger species, on the one hand, and the succeeding White River, Oligocene species, upon the other, are not shown to exist, the fact is, in all probability, due to our lack of knowledge of the species which lived during the time of deposit of these intermediate strata.

The identification of these Uinta Cameloids is attended with more or less difficulty, owing in part to the fragmentary condition

¹ See Osborn's 'Fossil Mammalia of the Uinta Basin,' Bull. Am. Mus. Nat. Hist., Vol. VII, p. 74.

of some of the material, and in part to other lines which resemble them in certain points of skull and limb structure. These resemblances are, no doubt, due to the close proximity to the point at which the respective phyla began to diverge.

For the purpose of bringing into stronger relief the characters of the Cameloids of this horizon, it is necessary to compare them accurately with the cotemporary Selenodonts, and, since several of them apparently represent new genera, they are herewith described.

Leptoreodon marshi,¹ gen. et sp. nov.

This genus and species is represented in the collection by an almost perfect skull in good state of preservation, a number of vertebræ, and a few fragments of the limbs (No. 2064), which I use as the type. There are several other specimens of a more fragmentary character which are probably to be referred to the same

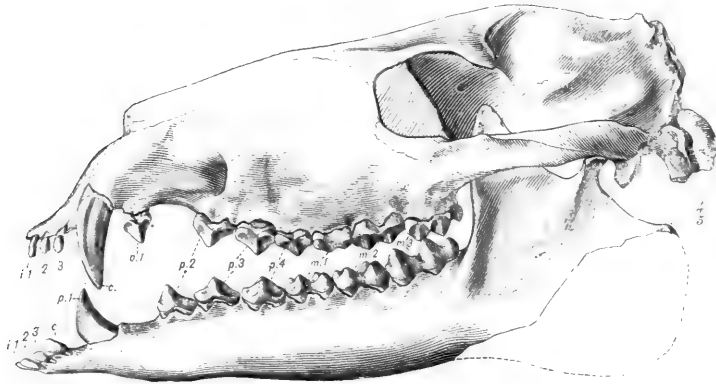


Fig. 1. Side view of skull of *Leptoreodon marshi*.

genus and species, but they contribute little additional information to the knowledge of the skeleton. The genus differs from all the Oreodonts hitherto described in the possession of a short diastema in front of, and a longer diastema behind, the first superior premolar, together with a considerable diastema between the first and second premolar in the lower jaw. The incisors are

¹ This species is dedicated to Prof. O. C. Marsh, in recognition of his numerous contributions to American palæontology.

present in full in both jaws; the inferior canine is small and incisiform; the superior canine is large, with the characteristic D-pattern of the Oreodonts on cross section, and the first inferior premolar is enlarged and caniniform as in the Oreodonts. The first superior premolar is two-rooted with a high, compressed cutting crown, the second is similar but somewhat larger, the third has a principal broad, lunate external cusp and a faint internal cingular ledge. The fourth premolar crown is composed of a single external and internal cusp, much as in the Oreodonts.

The superior molars closely resemble those of *Protoreodon* (*Eomeryx*) in the composition of the crown, so far as can be determined in their advanced stage of wear in the type specimen. It is impossible to say whether or not there were anterior intermediate cusps present, but judging from certain appearances in this region of the crown, I am inclined to think that less worn teeth would show them. The mesostyle consists of a vertical pillar as in the Oreodonts generally, and not of a wide open loup as in *Agriochærus*.

In the lower jaw the incisors and canines are of the typical oreodont pattern, but they are unusually procumbent in position. The first premolar is enlarged and caniniform, the second simple, the third with a small internal cusp and posterior heel, and the fourth similar in pattern, except that the internal cusp is smaller and the heel more pronounced. The lower molars are almost identical in structure with those of the early Oreodonts.

The whole skull differs from that of the Oreodonts in its more slender proportions. This is particularly noticeable in the lower jaws, which are relatively long and shallow, especially in the region of the symphysis, in marked contrast with the deep and abrupt chin of the Oreodonts in general. There does not appear to have been a preorbital pit present, and the orbit was not enclosed by bone posteriorly. The present genus may be distinguished from its contemporaries in the following dental characters, viz.: from *Protoreodon* (*Eomeryx*) in the possession of diastema in both jaws and the full number of incisors in the upper jaw.¹

¹ In all of our material I have not yet seen a specimen among the Oreodonts other than *Leptoreodon* that has a full set of incisors in the upper jaw. Marsh figures the type of *Eomeryx pumilis* with but two superior incisors, and if *Protoreodon* has the full complement, as believed by Scott, then the two genera are certainly distinct. In two specimens in the Museum collection which correspond closely with *Protoreodon parvus*, as described by Scott, there is but a single incisor on each side above, and the premaxillæ are widely separated from each other in the median line.

From *Hyomeryx* it is readily distinguished by the full number of superior incisors and by the diastema, although it resembles this latter genus, which is described by Marsh¹ as having more slender jaws than *Protoreodon* (*Eomeryx*). From the cameloid, *Leptotragulus*, it is easily separated by the numerous oreodont characters which the skull exhibits, although the symphyseal region is strikingly similar in the two genera.

Of the hind foot, the cuboid, navicular and the head of the third metatarsal are sufficiently preserved to afford characters for identification. These bones indicate an animal with far more slender limbs and feet than any of the Oreodonts with which I am familiar. The navicular has an inconspicuous posterior hook unlike that of the Oreodonts, and, judging from the much reduced facet on the cuboid, the fifth digit was considerably diminished in size if not entirely rudimental. The limb-bones are not well enough preserved to confirm or negative this conclusion of the slender and delicate proportions of the animal, but, upon the whole, I think it may be safely concluded, from the evidence at hand, that *Leptoreodon* held the same position with reference to the American Oreodontidæ that *Xiphodon* did to the European Anoplotheriidæ.

The second genus to be described in this connection contains species somewhat smaller in size and less perfectly selenodont.

Bunomeryx montanus, gen. et sp. nov.

There are two specimens in the collection which I classify under this head, viz. : an anterior portion of a cranium somewhat crushed, containing the maxillary dentition complete upon one side, together with the greater part of the left mandibular ramus of the left side having all the true molars and the last premolar in good preservation (No. 2071). The second specimen consists of a portion of a lower jaw with a few teeth, the posterior part of the cranium, a nearly complete fore foot, portions of the hind limbs and other parts of the skeleton (No. 2070). The first of these specimens may be taken as the type, but there can be very

¹ 'Descriptions of Tertiary Artiodactyles,' Amer. Jour. Sci., Vol. XLVIII, Sept., 1894, p. 268.

little doubt that the second specimen is identical with the first and can be regarded as a collateral type.

This genus most nearly resembles *Homacodon* Marsh, from the Bridger Beds, although it presents some dental characters similar to *Dichobune* of the European Eocene. The more important generic characters may be stated as follows :

Dentition, $I_{\frac{1}{5}}^1$, $C_{\frac{1}{1}}^1$, $Pm_{\frac{4}{3}}^4$, $M_{\frac{3}{3}}^3$. Superior molars, having well-defined crescentic outer cusps and a distinct mesostyle and parastyle ; first molar provided with two conic internal cusps (protocone and hypocone), with anterior and posterior subcrescentic intermediates ; second molar having anterior subcrescentic intermediate, subconic protocone, a posterior subcrescentic intermediate and no hypocone ; third molar similar to second. The superior premolars are present in full number ; the two anterior have simple cutting crowns, while the crowns of the third and fourth are made up of single external and internal conic cusps well developed. In the lower jaw the structure of the molars is intermediate between the bunodont and selenodont pattern ; there are only three premolars, the anterior two of which have simple compressed crowns, while the last or fourth of which is provided, in addition to the principal cusp, with anterior and internal cusps, together with a well-defined heel.

As compared with *Homacodon*, *Bunomeryx* is readily distinguished (1) by the possession of three premolars in the lower jaw ; (2) by the crescentic character of the external cusps of the superior molars ; (3) by the presence of a well-developed parastyle and mesostyle ; (4) by the absence of the hypocone on the second superior molar, and (5) by the subcrescentic character of the intermediates. (6) The internal cusp of the third superior premolar is, moreover, better developed in *Bunomeryx* than in *Homacodon*, and (7) the fourth inferior premolar is much more advanced in structure. The structure of the inferior molars is much more selenodont in *Bunomeryx* than in *Homacodon*.

From *Dichobune* the present genus is readily distinguished by the absence of all traces of the anterior cusp of the trigon in the lower molars as well as the more crescentic character of the outer cusps of the superior molars, and the possession of well-defined mesostyle and parastyle. The complete adult dentition of *Dichobune* is apparently not known, but there can be but little doubt that it had the full number, forty-four teeth, in which case *Bunomeryx* would be sharply distinguished by the inferior premolar formula. I cannot at present say in what manner *Bunomeryx*

differs from the European *Deilotherium*, *Spaniotherium*, *Metricotherium*, *Mouillacitherium* and *Oxacron* of Filhol, which are placed by Zittel in the subfamily Dichobuninæ. On account of the very imperfect knowledge we have of these forms, no comparisons are at present possible.

In specimen No. 2071, the upper and posterior portion of the cranium is sufficiently preserved to indicate a relatively high overhanging occipital and a strong sagittal crest, the latter dividing into two well-marked lateral postorbital branches. In advance of the point of division of these two branches a strong ridge is continued forward upon the frontals in the median line as in many of the lower forms of the Selenodonts. The postorbital process is well developed, but it does not join the molar, so that the orbit is not enclosed by bone posteriorly. There is no evidence of the presence of any long horn-cores.

Of the fore limb, the distal ends of the ulna and radius are preserved, but they are considerably crushed. There is apparently little or no tendency to coössification of the bones, although the shafts are closely applied to each other in the lower third of their extent. The articular end of the radius shows distinct facets for scaphoid and lunar, but does not touch the cuneiform. The distal end of the ulna articulates solely with the cuneiform.

The carpus is of the typical artiodactyl pattern, and especially resembles that of the earlier Selenodonts. In the proximal row the cuneiform rests exclusively upon the unciform, the lunar about equally upon magnum and unciform, while the scaphoid is supported below by magnum, trapezoid and trapezium. In the distal row the unciform articulates distally with Mt. III, and to a slight extent with Mt. II. In the modern Suillines, the Cameloids and the later Oreodonts, the second metacarpal has lost all connection with the magnum, but in the early Oreodonts Mt. II still retains a contact between these two bones. In *Protoceras* of the Oligocene a very minute contact is observable.

The trapezoid is free, and shows no tendency to unite with the magnum as in *Leptomeryx*, the later Tragulines and Pecora. The trapezium is not preserved in the specimen, but judging from the well-marked facets upon the scaphoid, trapezoid and Mt. II, it is quite certain that it was not only present and of good size, but

that it supported a very considerable vestige of the first digit. It would not indeed be a matter of surprise to find this digit complete in more perfect specimens very much as in *Oreodon*.

There are four metacarpals preserved of which the median ones, Mt. III and IV, are the largest and subequal in size. Mt. II is slightly larger and longer than Mt. V, and in all of them the distal keels are confined to the palmar surfaces, as in all primitive Ungulates. The phalanges of the fore feet are not known.

Of the hind limb the materials are not so complete as of the fore limb, but enough is preserved to make out its more important characters. The fibula was much reduced, and probably incomplete in the middle part of the shaft. The distal end of the tibia displays no usual form of the more generalized Selenodonts, as do the tarsal bones. The cuboid and navicular were not coössified, and there is evidence of four complete metapodials, the lateral ones, however, being unusually slender and delicate. The first two phalanges resemble those of the early Cameloids, *Protoceros* and *Leptomeryx* in their form, as do likewise the unguals in being relatively high-pointed and flattened upon their opposed surfaces.

Bunomeryx elegans, sp. nov.

A second species of this genus is indicated in the collection by a portion of a cranium containing the last three premolars and the molars, in excellent preservation, together with both mandibular

rami bearing all of the teeth with the exception of the incisors and canines.

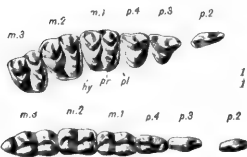


Fig. 2. Crown view of upper and lower teeth of *Bunomeryx elegans*. *hy.*, hypocone; *pr.*, protocone; *pl.*, protoconule.

The most important difference between the two species is seen in the presence of a short diastema between premolars two and three of the lower jaw in *B. elegans*. In *B. montanus* this diastema is absent, and the teeth of the lower jaw were apparently in

a continuous series or closed row. *B. elegans* is smaller and more delicate than *B. montanus*, a fact that is not only indicated by all the teeth but particularly emphasized by the fourth inferior pre-

molar, which is considerably narrower and has a less development of the internal cusp. Another important distinction between the two species is found in the greater development of the vestigial hypocone of the second superior molar of *B. elegans*. In *B. montanus* this cusp has almost entirely disappeared, the only evidence of its presence being indicated by a cingulum in this portion of the crown.

One fact of great interest in connection with this genus is the probable light which it throws upon the homologies of certain cusps of the molar crown in the higher selenodont Artiodactyla. It is here that we witness the actual passage from the bunodont to the selenodont type of molar in this important group. If we can trust the evidence before us, *Bunomeryx* is a direct lineal descendant of the Bridger *Homacodon*, and it is a matter of the utmost moment to note that in the latter genus there are six fully-developed cusps upon the crowns of the first and second superior true molars; in the third there are only five cusps present. In *Bunomeryx*, as already indicated, the full six cusps are found on the first superior molar only, while in the second molar there is but a vestige of the postero-internal cusp or hypocone. The evidence appears to be conclusive, therefore, that the true homological hypocone is in process of retrogressive disappearance, and in proportion as this cusp is reduced, the posterior intermediate is pushed out to take its place. As a further evidence of the truth of this proposition it may be stated that the true hypocone of both the first and second molars of *Homacodon*, as well as the first molar of *Bunomeryx*, exhibits no tendency whatever to develop a selenodont structure, while the posterior intermediates especially in *Bunomeryx*, exhibit very decided advances in this direction. The very position of this cusp, moreover, precludes any possibility of its entering into the formation of the single posterior internal crescent of the more perfectly developed selenodont molar of the higher types.

I believe therefore that the history of the formation of the four crescents of the superior molar crowns of the Selenodonts has been as follows, tracing it from the five-cusped *Pantolestes*¹ of the

¹ From this genus I exclude the type of *Pantolestes etsagicus* Cope as belonging to a distinct genus ancestral to and leading directly up to the bunodont Artiodactyla. It is very probably synonymous with *Eohyus distans* of Marsh, who properly placed it among the Bunodonts.

Wasatch. The primitive condition of this oldest type of the Artiodactyla was two buniform external cusps, two buniform intermediates, together with one large more or less lunate internal cusp, flanked by a rudimental postero-internal cusp which is clearly shown to be an outgrowth from the cingulum. There is no evidence that this postero-internal cusp was ever developed on the last molar, because in all the forms from *Pantolestes* to *Bunomeryx* it is persistently absent. The next step consisted in the reduction of the large lunate internal cusp and the full development of a well-marked postero-internal cusp, or hypocone, on the first and second molars. This condition is seen in, and is characteristic of, *Homacodon*. The third step consisted in the disappearance of the true hypocone and the gradual usurpation of its place and function by the posterior intermediate in the crown of the second true molar, a condition seen in *Bunomeryx*. As a fourth step in this development one can readily imagine this process extended to the first true molar, when it would be complete.

This hypothesis may be objected to on the ground that *Bunomeryx* cannot stand as the direct ancestor of any of the Selenodonts at present known, on account of its reduced premolar dentition in the lower jaw, but if we are to regard the type of superior molar exhibited by either *Homacodon*, *Dichobune* or *Helohyus* as the one which preceded, and from which was derived the tetraselenodont or four-crescented crown, then this hypothesis must be accepted as true.

The only case so far known wherein the true hypocone has been preserved and has become crescentic, is in *Cænotherium* and *Plesiomeryx*, and here we have three well-developed crescents upon the posterior moiety of the crown, of which the inner one represents the hypocone and the middle one the posterior intermediate. It is possible that the cusps of the two anterior superior molars of *Xiphodon* are to be interpreted in the same way, and that the posterior inner crescent is composed solely of the posterior intermediate, the true hypocone having come to occupy a more anterior and median position. In this case the anterior internal crescent would be made up of protocone and the anterior intermediate. Future discovery will no doubt reveal considerable variety in the formation of the internal crescents in the various

phyla of the Selenodonts, but it appears to me certain that the hypothesis herein advanced is the correct one for the formation of the tetraselenodont superior molars of the Cameloids, Pecora, Tragulines, and probably the Oreodonts and Anthracotheres.

Parameryx (Leptotragulus) proavus *S. & O.*

This genus was first described by Marsh¹ and later by Scott and Osborn,² who considered that it belongs to the Traguline division of the order. Later Scott gave a fuller account of it³ and placed it in the Tylopoda⁴ immediately ancestral to *Poebrotherium* of the White River Oligocene. The materials in the Museum Collection do not add very materially to the knowledge of this form; however, there are some important points to be made out from it. There are four specimens which I refer to this species, the most important of which are a fragmentary skeleton containing a fairly good hind foot, together with the posterior part of the last lower molar (No. 2509). The other specimens pertain exclusively to the lower jaw (Nos. 1803, 1805 and 1808).

In the lower jaw there is one diagnostic character by means of which the last lower molar can be recognized, and that is the presence of an extra cusp upon the inner border of the heel near its point of junction with the postero-internal cusp. It is by means of this character alone that I associate the fragmentary skeleton with this species. The lower molars are of the typical selenodont pattern, and the cusps more elongated than in any of the cotemporary Selenodonts.

The inferior premolars are three in number, the fourth being provided with a well-developed internal cusp and heel. The second and third are simple and without accessory tubercles. In advance of the second premolar there is a considerable diastema, in front of which is the large procumbent alveolus for the canine. The incisors are not preserved, and this region of the jaw is so much broken as not to reveal their alveoli.

¹ 'Introduction and Succession of Vertebrate Life in America,' 1877.

² 'Preliminary Report on the Vertebrate Fossils of the Uinta Formation,' Proc. Am. Philos. Soc., 1877, pp. 255, 264.

³ 'Mammalia of the Uinta Formation,' Trans. Am. Philos. Soc., N. S., Vol. XVI, Part iii, Aug. 20, 1896, pp. 479-486.

⁴ Marsh had, however, clearly recognized the affinities of this genus with the Tylopoda ten years previously, since we find in the address above quoted the following statement: "A most interesting line, that leading to the Camels and Llamas, separates from the primitive selenodont branch in the Eocene, probably through the genus *Parameryx*."

Of the bones of the hind foot, the entire tarsus is preserved with the exception of the cuneiform. These parts of the skeleton present a most striking resemblance to those of *Poëbrotherium* in all the details of their structure, the only difference discoverable being that of size. The third metatarsal is present but unfortunately a small part of the shaft is missing so as not to exhibit its full length; there is enough, however, to indicate that it was unusually long and slender, much flattened upon the surface which it offered to the second metatarsal, and that the form of the shaft, moreover, had that peculiar squarish outline upon cross section, a feature so highly characteristic of the Oligocene Cameloids. Another distinctive cameloid feature is seen in the increased size of the medullary cavity. The lateral or fifth metapodial was reduced to a mere splint, as is indicated by the much-reduced facet upon the cuboid; this facet is relatively as small as it is in the cuboid of *Poëbrotherium*. The phalanges have about the same proportions and shape as the corresponding bones of the White River species.

That *Parameryx* (*Leptotragulus*) was a member of the Tylopoda, as has already been pointed out by Marsh and Scott, there can be very little doubt, but at the same time the evidence is equally conclusive that it does not stand in direct ancestral line with the succeeding Poëbrotheres. The evidence against such a conclusion is to be found in the fact that *Parameryx* (*Leptotragulus*) has only three premolars in the lower jaw, an enlarged caniniform canine and relatively short, thick inferior premolars, the last of which, or fourth, has a considerable development of the internal cusp. It may therefore be looked upon as a precociously specialized side branch which died out at the close of the Eocene and left no modified descendants.

***Protylopus petersoni*,¹ gen. et spec. nov.**

This genus and species is primarily founded upon the anterior portion of a skull from which the left ramus is missing. The specimen is broken obliquely in such a manner as to show upon the right side all of the facial portion, including the orbit and the

¹ This species is named in honor of Mr. O. A. Peterson, whose explorations of the Uinta Beds have been attended with such marked success.

anterior root of the zygomatic arch, while upon the left side the greater part of the orbit is missing. Fortunately the skull contains the dentition nearly complete. In association with it were found the greater part of an ulna and radius of the same individual. A second specimen which I refer to this genus and species includes a large part of both hind legs, together with a large number of vertebræ, ribs and other parts of the skeleton. A

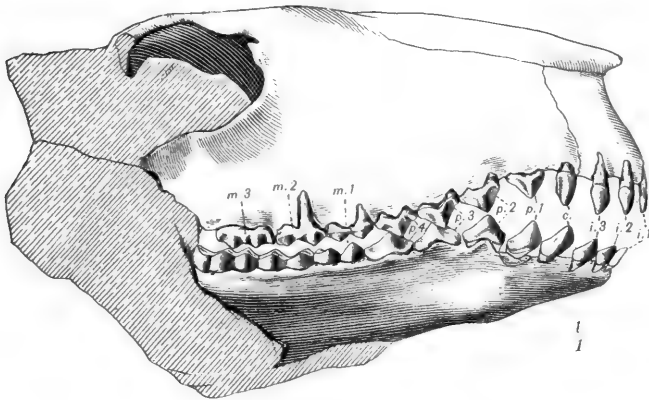


Fig. 3. Side view of skull of *Protylepus petersoni*.

third specimen contains hind limbs and vertebræ, while a fourth includes the greater part of a hind foot.

The more important generic characters may be stated as follows :

Molars tetraselenodont without intermediate cusps. Teeth of the typical number, forty-four, arranged in a continuous series. Canines of both upper and lower jaws small and incisiform, the first inferior premolar not caniniform. The first three superior premolars elongated from before backwards, secant and without accessory cusps, the fourth with single external and internal crescentic cusps. The inferior premolars elongated and cutting, the fourth without internal cusps. Hind feet provided with but two functional digits, the outer ones, second and fifth, reduced to mere vestiges. Lumbar vertebral formula 7. Ulna and radius, at least in old individuals, coössified in the middle part of their shafts but free at their proximal ends.

The skull is crushed laterally so as not to reveal the exact form of the face, but it can be safely stated that the muzzle had

moderate length, with slightly overhanging nasals, much as in *Poebrotherium wilsoni*. The premaxillæ are relatively broad and extend upwards and backwards to articulate with the nasals. The orbit is not enclosed by bone posteriorly, but exhibits a marked tendency towards that peculiar roofing so highly characteristic of *Poebrotherium* and the later Tylopoda. In advance of this bony shelf is seen a faint though distinct indication of the supraorbital notch, so constant a feature of the cameloid skull. The lower jaws may be described as long and slender, with a considerably elongated symphysis.

The superior incisors are relatively small, of a more or less conical form, and directed downwards. The premaxillæ were apparently not in contact in the median line. The superior canine is but little larger than the outer incisor, of a more or less hook-shaped appearance, and provided with a distinct sulcus upon the outer portion of the crown as in *Poebrotherium wilsoni*. The first premolar follows after a very short interval and, like the second, is a simple two-rooted cutting tooth. The third premolar has a faint internal cingular ledge, while the fourth, as already mentioned, is provided with single external and internal crescents. The molars are much worn, and do not show clearly whether or not intermediate tubercles were present, but I think it may be safely assumed, from the general appearance of the crown, that they were absent. In the second and third molars, between the internal crescents, is to be seen a small styliform cingular cusp which is entirely absent, so far as I can determine, in *Poebrotherium*.

In the lower jaw the incisors are of a more spatulate form and more procumbent in position. As in the upper jaw, the canine is slightly larger than the outer incisor, but of a very marked incisiform pattern. After a very short interval or diastema, is placed the first premolar,

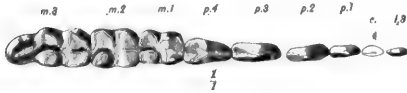


Fig. 4. Crown view of lower teeth of *Protylopus petersoni*.

a two-rooted tooth whose crown closely resembles that of the canine, the two teeth being about equal in size. The second and third premolars have elongated secant crowns like the Tragulines.

The fourth has a well-marked heel and anterior basal cusp, but there is apparently no internal cusp present. The molars are so much worn that their structure is not very apparent. There can be very little doubt however that they had the usual structure. In the heel of the last molar a prominent accessory cusp is seen upon the border of the inner side near the point where it joins the lower posterior internal cusp. In *Poëbrotherium* this cusp is clearly present, but it has fused with the postero-internal, producing a prominent angle at this portion of the crown. In perfectly unworn teeth of *Poëbrotherium wilsoni*, it can be readily demonstrated to be an independent cuspule.

Of the vertebræ, unfortunately, no cervicals are known, consequently it is impossible to say whether they exhibit the peculiar features of the more typical Camelidæ or not. The dorsals are well represented in specimen No. 2564, the whole series being present, with the exception of the first three or four, together with all the lumbar locked in position. The vertebræ resemble those of the modern Llamas closely in their general proportions. The bodies of the anterior dorsals are but moderately keeled, and towards the posterior end of the series strongly keeled; they increase gradually in size from before backward. The neural spine of the fifth is long and recurved, those of the succeeding dorsals decreasing in length posteriorly. The neural spines of the last two are considerably shorter and broader, having an almost vertical direction. The rib facets in the anterior region have their usual relations and positions, the ribs articulating with the vertebræ by two



Fig. 5. Vertebræ of *Protylopus petersoni* (?).

distinct facets, but in the last two the capitular and tubercular facets appear to be fused together as in these dorsals of the Llama. The lumbar are seven in number, the constant formula for the Tylopoda; they resemble closely the corresponding bones of *Poebrotherium* and the later Cameloids. The sacrum is composed of only four vertebræ, but it is highly probable that another one or two was added from the caudal region as age advanced, just as in *Poebrotherium* and the modern Llamas. The three anterior vertebræ of the sacrum have very reduced neural spines, while in the fourth the spine is well developed. The ribs do not display any characters of especial importance.

The pelvis is in a very fragmentary condition, but it may be stated that the ilium is well expanded, and, so far as one can judge, the whole bone would correspond closely with that of *Poebrotherium*. The femur is present in its entire length with both ends in a good state of preservation, although the shaft is somewhat crushed. The proximal end has practically the same relations and arrangement of the different parts as that of *Poebrotherium* and other members of the group. The distal end thus early gives slight though conclusive evidence of the peculiar and characteristic appearances which this part of the bone assumes in the later Camelidæ. This is especially seen in the great extension of the condyles backwards behind the median line of the shaft as well as the forward projection of the borders of the rotular groove, which serve to increase the antero-posterior diameter of this part of the bone. Although not clearly indicated on account of crushing, yet there seem to be distinct traces of the beginning of that peculiar depression at the proximal end of the rotular groove so highly characteristic of the later Tylopoda. In a like manner the patella has begun to assume the distinctively cameloid form by the great elongation of its lower border into a long, pointed process.

The tibia, which about equals the femur in length, shows a great resemblance to that of *Poebrotherium*. The cnemial crest is unusually well developed, and extends quite one-third of the way down the shaft. The fibula is much reduced, and although the specimen does not show whether or not the shaft was complete, the probabilities are that it consisted of a distal portion

only. That part of the shaft which is preserved is very slender and closely applied to the shaft of the tibia. In the hind foot the tarsal bones have nearly the same relations as in *Poëbrotherium*. The tuber of the calcaneum is somewhat shorter proportionately than in the White River genus, but otherwise both the calcaneum and astragalus are strikingly alike in the two genera. The cuboid of *Protylopus* is slightly narrower in proportion to its height than the corresponding bone in *Poëbrotherium*, and the navicular is provided with a much better developed posterior hook. As in *Poëbrotherium*, there are two cuneiforms present, the inner of which is a vestigial nodule of bone only.

There are but two functional metapodials, the third and fourth, the second and fifth being reduced to mere vestiges. Upon one side the vestige of the second metapodial is preserved in place, and it is seen to articulate by a peculiar ledge-like facet upon the principal cuneiform. Upon its posterior surface is a distinct facet

by which it articulates with the small cuneiform. The remnant of the fifth is not preserved, but the facet by which it articulates with the cuboid is very small, and there can be no doubt that it was as much reduced as the second.

The functional metapodials are relatively much shorter than in *Poëbrotherium*, and of a considerably more primitive form. They are well flattened upon their opposed surfaces in the upper half of the extent of their shafts. Below this the inner surfaces of the two bones are well rounded. Unlike the metapodials of *Poëbrotherium*, they lack that characteristic four-sided appear-

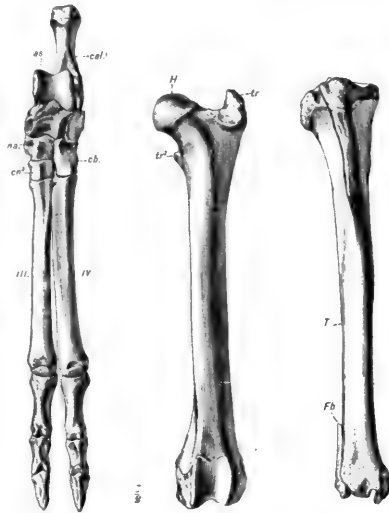


Fig. 6. Left hind foot, femur, tibia and fibula of *Protolytus petersoni* (?). *cal.*, calcaneum; *as.*, astragalus; *cb.*, cuboid; *na.*, navicular; *cu¹*, external cuneiform; *h.*, head of femur; *tr.*, greater trochanter; *tr²*, lesser trochanter; *t.*, tibia; *fb.*, fibula.

ance of the later Camels, but on the contrary, are more or less triangular upon cross section, especially in the proximal half of their shafts. The metapodials as well as the long bones show their cameloid affinities in the unusually large size of the medullary cavities. The phalanges exhibit comparatively few differences from those of *Poebrotherium*, the unguals being flattened upon their opposed surfaces. The fore foot is entirely unknown, but it is highly probable that it will be found to possess four complete functional toes.

It may transpire that the association of this skeleton with the above-described skull is incorrect, and that these bones belong to separate and distinct species; however, they agree so well in the matter of proportionate sizes of the different parts, and both are so distinctly cameloid, that I am persuaded to believe that they refer to one and the same species. It may be noted here, however, that in one of the specimens referred to above (No. 2067), there is evidence that at least one of the lateral metapodials of the hind foot was complete though very slender, and should probably be referred to another species on this account. The bones are, moreover, somewhat more slender and delicate than the one here described. At all events, whatever form of skull belongs with these skeletal parts it is nevertheless certain that the skull of *Protylopus*, above described, is just such a type as is required to satisfy all the necessary conditions in order to occupy a position in direct ancestral relation with *Poebrotherium*. The true Tylopod phylum is therefore traceable directly to it. Beyond this, there is at present no satisfactory evidence to establish, with any degree of certainty, the identity of the true Camel pedigree.

Poebrotherium *Leidy.*

With a consideration of this genus we pass from the Eocene to the Oligocene representatives of the group. It was established by Leidy as early as 1847 upon an imperfect skull presented to the Philadelphia Academy by Mr. Alexander Culbertson of Chambersburg, Pa., who was at the time engaged in the western fur trade. It was among the first of the mammalian fossils from the remarkable Bad Lands of the Cheyenne River

region, whose treasures were destined in later years to play such an important part in the development of American palæontology. Leidy at first¹ regarded the skull as pertaining to a genus nearly allied to the Musk Deer, but later² pointed out its true position among the Camelidæ.

The generic differences between *Poebrotherium* and *Protylopus* are not great, and indeed it would appear at first sight that they are insignificant. It is more than probable, however, as stated

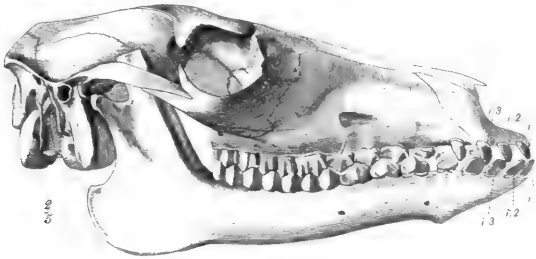


Fig. 7. Side view of skull of *Poebrotherium wilsoni*.

above, that *Protylopus* will be found to have four complete and functional digits in the fore limb. So far as our knowledge extends at the present, the chief distinctions are as follows: In *Poebrotherium* the molars are much more selenoid and the crowns more lengthened than in *Protylopus*; the third superior incisor is larger than the superior canine; the ulna and radius are firmly coössified, even before the epiphyses of the bones are joined to the shaft and the shaft of the fibula has completely disappeared.

Poebrotherium wilsoni Leidy.

This species, although very abundant in the White River Beds of the Cheyenne River region, has not been very fully described. All of the specimens in the Museum collection have been found in the Lower Oreodon level, and it is doubtful if the vertical range of the species extends much above this point. It differs very markedly from its successor, *P. labiatum*, in the practical

¹ 'Ancient Fauna of Nebraska,' Dec., 1852, p. 10.

² 'Extinct Mammalian Fauna of Dakota and Nebraska,' 1860, p. 141.

absence of diastemata in the lower jaw. The canines of this series are, moreover, broad and incisiform, being separated from the first premolars by very short diastemata. In the same manner the second premolars follow after a very short interval. In

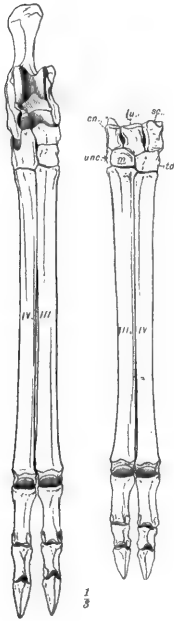


Fig. 8.



Fig. 9.

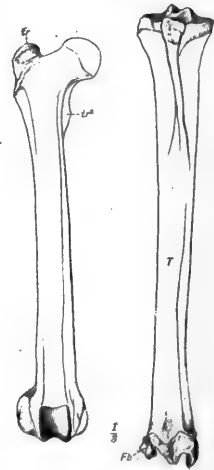


Fig. 10.

Fig. 8. Fore and hind foot of *Poebrotherium wilsoni*.

Fig. 9. Ulna and radius and humerus of *Poebrotherium wilsoni*.

Fig. 10. Femur and tibia of *Poebrotherium wilsoni*.

P. labiatum, on the other hand, the lower canines and outer incisors are almost in contact, the canines are subcaniniform in shape, and there is a short diastema in front of, and a long diastema behind, the first inferior premolar. The bones of the limbs and other parts of the skeleton are, as far as can be determined, very much alike in the two species. As in *P. labiatum*, there is a considerable range in size in the various specimens referred to this species.

Poebrotherium labiatum Cope.

The type of this species consists of the larger part of a skeleton of a single individual from the White River Beds of north-eastern Colorado (No. 6520). Associated with this specimen are two almost complete lower jaws from the same locality (Nos. 6517, 6518) showing the characteristic diastemata of *P. labiatum*, but considerably smaller. These specimens were erroneously referred by Cope to *P. wilsoni*. I have not been able to correlate with certainty the level from which these specimens were taken, with that in which similar remains in the Cheyenne River region occur, but judging from Cope's unpublished sketch of the section of the bed, there can be little doubt that it corresponds closely with the upper part of the Oreodon horizon. This surmise is strengthened by the fact that there is one specimen in the collection (No. 638), from the extreme upper part of the Oreodon Bed, which agrees in every way with the type of *P. labiatum*, except that it is a little larger. Another specimen from the Cheyenne River Bad Lands includes a lower jaw and a good part of the skeleton. The lower jaw exhibits the characteristic diastemata of *P. labiatum*, but is much smaller than the type, and of the same size as the two jaws mentioned above. Unfortunately the exact level of this specimen is not known, but it has every appearance of having come from the upper part of the Oreodon stratum.

Whether or not these smaller specimens are to be referred to a species distinct from *P. labiatum* is a matter which requires a greater amount of material than we at present possess in order to decide correctly. So far as one can determine at present, the only distinction between the two is one of size, and this is not great. I have thought best to regard them as belonging to the same species until other differences are shown to exist. Taken as a whole, *P. labiatum*, as exemplified by the larger individuals, was considerably larger than *P. wilsoni*, and in the possession of diastemata in the lower jaw, as well as the more caniniform shape of the lower canines, makes a distinctive approach to the species from the John Day Beds. In this connection it is proper to observe that no remains of Camels are known from the Protoceras level of the White River Beds. When such are found they

[April, 1898.]

will probably establish a complete transition between *P. labiatum* and the John Day species.

Gomphotherium *Cope.*

It is especially to Cope that we are indebted for the discovery of Camels in the John Day Beds. The first remains secured by him from this horizon were referred to *Poebrotherium*, but later he established the genus *Gomphotherium*¹ for their reception,

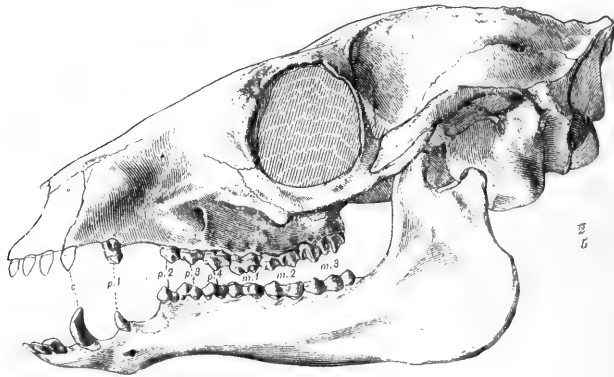


Fig. 11. Side view of skull of *Gomphotherium sternbergi*.

which he distinguished from *Poebrotherium* by the more simplified character of the crown, and the one-rooted condition of the first superior premolar. As this distinction was founded largely upon error, I am now able to give the more important and true characters which serve to separate the two genera in a satisfactory manner.

In *Poebrotherium* the inferior canine is either in contact with the outer incisor, or is separated from it by a very short diastema, and the form of the canine is either like that of an incisor or very imperfectly caniniform. In *Gomphotherium*, on the other hand, the inferior canine is either separated from the outer incisor by a very distinct diastema or the diastema is absent, and the shape of the canine is strongly pointed and recurved, as

¹ 'The Phylogeny of the Camelidæ,' *Amer. Nat.*, 1886, p. 618.

in many of the later Camelidæ. In *Poebrotherium* again, the orbit is not inclosed by bone posteriorly, whereas in *Gomphotherium* the posterior boundary of the orbit is complete. Another important distinction is seen in the character of the articular facets of the third and fourth metapodials of the fore foot. In *Poebrotherium* these bones give evidence of having been more widely separated in the living animal, and capable of considerable independent movement, the facets being relatively large and the opposed surfaces comparatively smooth. In *Gomphotherium* these facets are much reduced, the metapodials closely applied to each other and their contiguous surfaces much roughened, clearly foreshadowing the coössification of these elements into a cannon bone.

***Gomphotherium sternbergi* Cope.**

The type of this species consists of the greater part of the skeleton of a single individual in good preservation from the lower beds of the John Day Valley, Oregon. Other specimens from the same horizon include more or less perfect foot-bones, fragments of jaws, and other parts of the skeleton. The form of the skull presents a striking resemblance to that of the modern Camels in its general make up. The nasal bones are, however, proportionately longer, the bony roof of the orbits not so broad, and the muzzle apparently more laterally constricted in front of the infraorbital foramen. As compared with *Poebrotherium* and the Llama the face is less bent down on the basicranial axis, in this respect resembling more the skull of the Camel. The vertical depth of the face immediately in front of the orbit is relatively greater than in *Poebrotherium*, and the opening of the posterior nares has a more forward position.

A very interesting transition from the relatively low, much-swollen otic bullæ of *Poebrotherium*, to the high, little-swollen condition of these parts in the living species, is observable. The otic bullæ of all the Camels are highly characteristic; they consist of an inner, longitudinally-directed swollen part, together with an outer vertical buttress, which joins the inner part at an angle, and at the upper limit of which is placed the external

auditory meatus. Immediately behind the point of junction of these two parts is seen the deep recess where the hyoid arch is articulated to the skull. In *Poebrotherium* the inner portion of the bulla is much the larger, and the recess for the tympanohyal is inconsiderable. In *Gomphotherium* the two parts are about equal in size, and the tympanohyal recess much more pronounced. In the living genera, *Camelus* and *Auchenia*, the inner

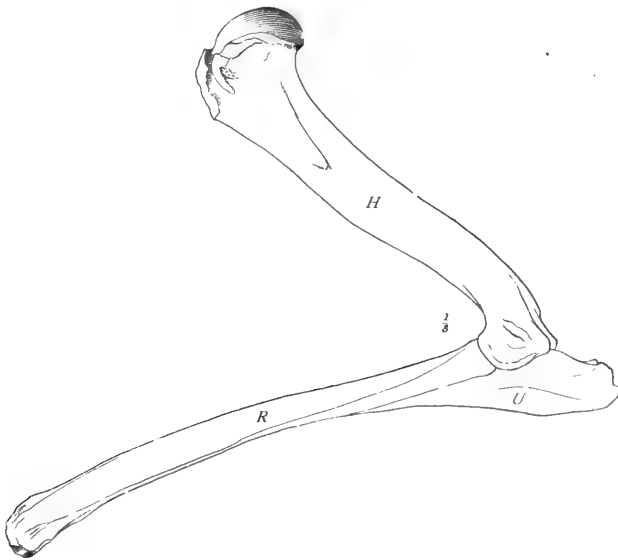


Fig. 12. Humerus, ulna and radius of *Gomphotherium sternbergi*.

part of the bulla is much reduced and the tympanohyal recess is converted into a deep circular pit surrounded by bone.

In the skeleton of the limbs the lower end of the femur is peculiar in the unusual size and development of the areas of attachment of the outer and inner heads of the gastrocnemius. This same peculiarity is seen in the femora of old individuals of both *Poebrotherium labiatum* and *Procamelus occidentalis*, although to a somewhat less extent, and is doubtless a result of age. The head of the humerus shows the first distinctive change leading to the development of the double bicipital groove, a feature so char-

acteristic of the later Camelidæ. In no individual in the collection is there evidence, even in those of the most advanced age, of any traces of bony union of the metapodials. In size *G. sternbergi* exceeded *P. labiatum* by at least one-third.

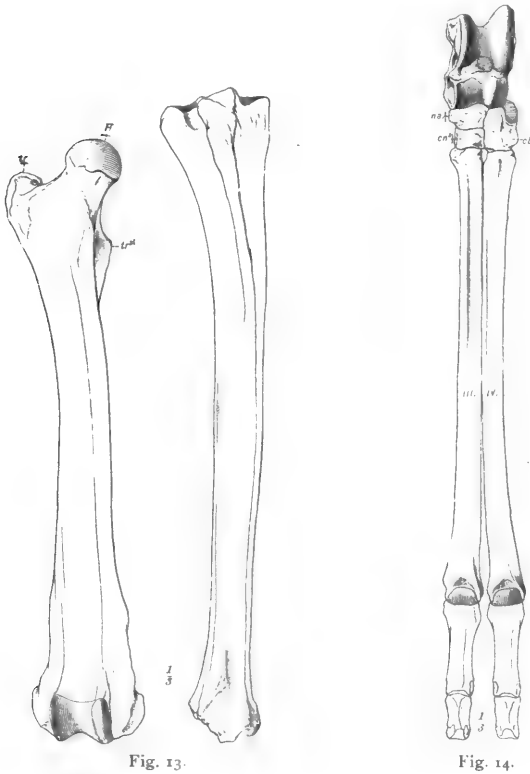


Fig. 13. Femur, tibia and fibula of *Gomphotherium sternbergi*.
 Fig. 14. Hind foot of *Gomphotherium sternbergi*.

***Gomphotherium cameloides*, sp. nov.**

This species is represented in the collection by an almost complete mandibular ramus from the uppermost levels of the John Day deposits (No. 8179). To this same species I also refer an upper dentition (No. 7915), an almost complete fore limb (No. 7912), as well as several other fragments. The chief distinctions

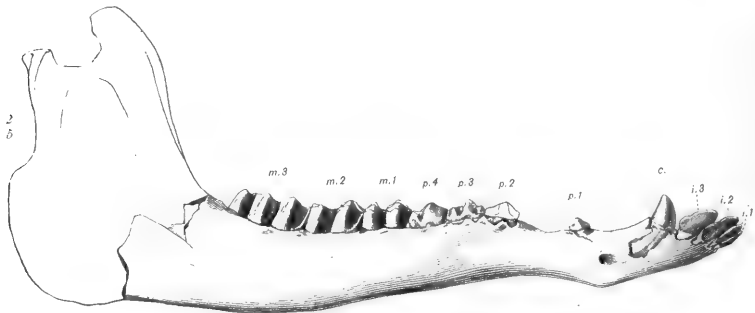


Fig. 15. Lower jaw of *Gomphotherium cameloides*.

between this species and the older *G. sternbergi* are seen in the increased size and the absence of a diastema between the lower canine and the outer incisor in *G. cameloides*. The comparative measurements display these differences in size at a glance; they are as follows:

	<i>G. sternbergi.</i>	<i>G. cameloides.</i>
	MM.	MM.
Length of sup. ms. and three posterior pms...	60	83
“ “ inf. ms. and three posterior pms...	65	97
“ “ entire inferior dentition.	110	170
“ “ anterior metapodials.	180	228

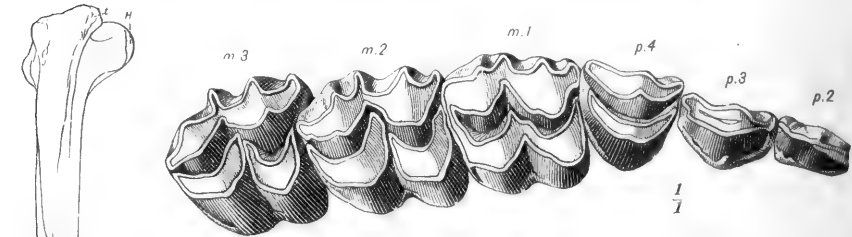


Fig. 16. Upper teeth of *Gomphotherium cameloides*.

It will therefore be seen that *G. cameloides* shows the same increase in size over *G. sternbergi* as *G. sternbergi* does over *Poebrotherium labiatum*. Of the bones of the anterior limb, no differences are observable between them and the corresponding parts of *G. sternbergi*, except in the matter of size already noted above.



Fig. 17. Humerus of *Gomphotherium cameloides*.

The exact stratigraphical position of this species is several hundred feet above that of *G. sternbergi*, and there can be no doubt whatever that *G. cameloïdes* is not only the direct lineal descendant of the older species, but is, at the same time, the progenitor of the succeeding Loup Fork species. This conclusion is somewhat at variance with the view expressed by Scott,¹ in which he says: "The Camels of the John Day formation do not

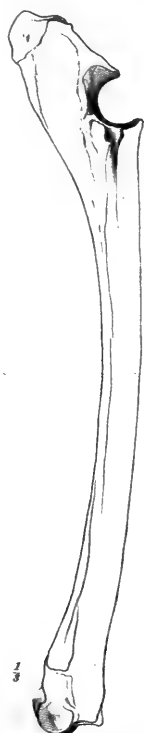


Fig. 18. Ulna and radius of *Gomphotherium cameloïdes*.

present any important modifications of the dentition; in some of them the first upper premolar has but a single fang, and others are decidedly reduced in size; the former Cope has erected into a separate genus, *Gomphotherium*. It seems probable that these forms are not in the direct line of the cameline descent." A careful examination of Cope's type of *Gomphotherium sternbergi*, the only species, by the way, with the exception of the one above named, which has so far been described from these beds, reveals the fact that the first superior premolar, instead of being a single-rooted tooth, is *strongly two-rooted*; and that the succeeding premolars exhibit a most interesting and instructive transitional stage between *Poebrotherium* and *Protolabis*, not only as regards their form but their degree of reduction as well. I have been unable, after the most exhaustive study, to find any evidence whatever tending to show that



Fig. 19. Fore foot of *Gomphotherium cameloïdes*.

¹ 'The Osteology of *Poebrotherium*,' 1891, p. 49.

these John Day species are not in the direct line of the tylopoodean ancestry.¹

Protolabis Cope.

The next step in the line of cameline ancestry is furnished by the genus *Protolabis*, originally established upon the greater portion of both premaxillæ and maxillæ, together with the front of the lower jaw upon one side. This specimen was found near Pawnee Buttes, Colorado, and is from the typical Loup Fork horizon.² Another specimen was found by the writer in the so-called Loup Fork Beds of the upper John Day Valley of central Oregon, which was described by Cope as a new species of the same genus. It consists of the anterior portion of the cranium bearing the complete upper dentition in good preservation.

As regards the type specimen upon which the genus was originally founded, it is necessary to remark that the only distinction between it and *Procamelus robustus* is to be found in the possession of alveoli for the first and second incisors above, which would indicate a complete superior incisor dentition. In *Procamelus*, of the adult stage at least, these incisors are wanting. A careful examination of the specimen shows that the part of the premaxilla in front of the third incisor, upon the right side, is much shorter than that upon the left side, and instead of two alveoli there are in reality three, which would make altogether four incisors in the premaxilla upon this side. The corresponding part of the premaxilla upon the opposite side is much longer, and contains the two alveoli for the first and second incisors. In every other detail the specimen agrees perfectly with *Procamelus robustus*. Indeed, Cope has pointed out that these first and second incisors of this series, in all the species of *Procamelus*, were

¹ In this connection it is proper to call attention to the fact that there are important faunal differences between the upper and lower beds of the John Day deposits. These distinctions are so marked as to entitle them to be regarded as separate and distinct divisions of the North American Miocene. Besides the species of cameloids above described, this upper division contains two species of *Merycocherus* among the Oreodonts. *Mesohippus prastans* among the Horses, and *Elotherium humerosum* of the Elotheres, which have not been found thus far in the lower division of the beds. There can be little doubt that other important faunal distinctions will be discovered when careful collections are made with this particular object in view. For the lower series the name Diceratherium Beds may be retained, but for the upper series I herewith propose the name *Merycocherus* Beds.

² Proc. Philad. Acad., 1876, p. 145.

retained in the jaw for a longer or shorter period, and in some instances until the animal was almost if not quite adult. In view of these facts I am disposed to interpret this specimen as a case of abnormal retention of the incisors of the rather abundant species *P. robustus*. If this conclusion is correct, then the species *Protolabis heterodontus* becomes a synonym of *Procamelus robustus*. The second species regarded as belonging to this genus from the Nebraska Loup Fork, *Protolabis prehensilis* Cope, was founded upon the anterior portion of a lower jaw without teeth, and as there is no indication whatever what the upper dentition was like, the reference at most is mere guesswork. In fact, I doubt very much if it even is specifically distinct from *Procamelus robustus*.

With the elimination of these forms from the Nebraska Loup Fork, we have left the single species *Protolabis transmontanus*, represented by the Oregon specimen above referred to. In this specimen we have a genuine case of normal retention of the superior incisors, a fact which separates it at once from *Procamelus*, but the distinctions between it and its predecessor, *Gomphotherium*, are less clear. Cope assumed that it differed from this latter genus, in the coössification of the metapodials into a cannon bone, but of this there are no specimens at present known to demonstrate the truth or falsity of such an assumption. It is true that Camel remains have been found in the Deep River Beds of Smith's Valley, Montana, which deposits have been generally looked upon as older than the Loup Fork of both Oregon and Nebraska. These fossils have been uniformly referred to the genus *Protolabis* by Cope and Scott, but it does not appear, from any materials with which I am acquainted, whether these remains have been correctly determined or not. Neither skulls, jaws, nor even teeth, are known from this horizon which would enable one to say definitely whether the dentition was that of *Protolabis* or *Procamelus*. The metapodials of both fore and hind feet are united into a cannon bone, and the size almost, if not quite, equals that of *Procamelus robustus*, a circumstance which would seem to indicate that if they belong to the genus *Protolabis* they must represent a different and later species, since *Protolabis transmontanus* is much smaller, scarcely exceeding *Gomphotherium*

cameloides in size. The only valid distinction between *P. transmontanus* and *G. cameloides* is seen in the marked reduction of the second superior premolar in the former, and as this is in the direct line of modification leading to the Loup Fork *Procamelus*, I have thought best to regard it as of generic rank, especially until the question of the coössification of the metapodials is definitely settled.

Protolabis transmontanus *Cope.*

This species was somewhat smaller than the modern Llama, and so far as one can judge from the imperfect remains, exhibits very similar proportions in its general form. The crowns of the molars are notably shorter and have a more quadrate outline than those of either the modern genus or *Procamelus*. This, however, may be due in a measure to wear. The superior canine is smaller than the third incisor; the first premolar is two-rooted, and the second is much reduced in size, as in *Procamelus*. The first and second incisors are of goodly size, implanted by strong roots and with obliquely-directed, more or less spatula-shaped crowns. The nasals are relatively longer than in the Llama, and the muzzle is moderately compressed laterally.

Procamelus *Leidy.*

In the widespread Loup Fork deposits of the plains region remains of Camels are very numerous; next to the Horses, they are perhaps the most abundant fossils to be found in these beds. A number of genera and species of these Camels have been described, but, as has too frequently happened in the history of the science in this country, unfortunately, misplaced zeal in the finding and describing of new forms has been allowed to run riot, and much of this work is apparently characterized by an utter lack of the most ordinary display of judgment and discrimination. No less than four or five genera have been proposed, of which not more than two are entitled to recognition. Of these *Procamelus* is the more abundant, and is represented by three well-marked and easily-distinguished species. The most distinctive features of the genus are the possession of a full complement

of premolars in both jaws, the loss of the first and second pairs of incisors in the upper jaw in the adult stage, and the at least partial coössification of the metapodials of both fore and hind feet into cannon bones.

Procamelus robustus *Leidy.*

I place as synonyms of the above those proposed by Cope, *Protolabis heterodontus* and *Protolabis prehensilis*. The type specimen, as figured by Leidy, consists of a lower jaw bearing all the premolars and molars with the exception of the second, together with the second and third molars of the upper jaw. The jaw is broken just in advance of the first premolar so as not to show the characters of the incisors, canine and chin. In Cope's type of *P. heterodontus* the lower jaw is preserved as far back as the root of the last premolar, and this is associated with the almost complete superior dentition. The type of *P. prehensilis* is represented by the front of both rami of the lower jaw, associated with a last lower molar. A careful comparison of these specimens reveals a remarkable agreement in all details, and I do not think there can be any question of their belonging to one and the same species. The only difference worthy of note is seen in the jaw fragment which constitutes the type of *P. prehensilis*; in this specimen the chin is not so abrupt nor deep, and the lower border of the symphysis is more nearly in line with the long axis of the jaw. The size is practically the same in all. I distinguish the species by the following characters: Size, large; lower molars with much greater transverse diameter than in other species; symphysis not coössified; chin abrupt and deep. In one specimen only is the upper incisor dentition known, and in this the first and second incisors are retained. It may transpire that this is not an abnormal case as expressed above; but that it is a further character of the species. No other parts of the skeleton are known with certainty.

Procamelus occidentalis *Leidy.*

This species is by far the most abundant of the Camels in the Loup Fork Beds. I regard the name proposed by Leidy, *Homo-*

camelus caninus, as synonymous with the above, together with *Procamelus angustidens* given by Cope to various remains. It is somewhat smaller than *P. robustus*, and is altogether intermediate in size between this latter species and *P. gracilis*. It can be readily distinguished from *P. robustus* by the coössification of the two rami of the lower jaw at the mandibular symphysis, and especially by the narrow lower molars. The first and second incisors disappear early in life and no traces of their alveoli are seen in the adult skull. A large part of the skeleton is known, and this is surprisingly like the modern genera. The two main metapodials are firmly united into a cannon bone, and the vestigial representatives of the two lateral metapodials are coössified with them. No unguis phalanges, however, are known, and it is a matter of uncertainty whether they were relatively high and compressed like the early Camels, or whether they were broad and depressed like those of the living *camelus*. It is probable that when found they will show the intermediate conditions between these two extremes. Most of the skeleton has been described and figured by Cope,¹ and need not be repeated here.

Procamelus gracilis Leidy.

The species, described by Cope under the name of *P. fissidens*, agrees in every particular, so far as the measurements are concerned, with the above, and I therefore regard them as synonymous. *P. gracilis* is the smallest species of the genus, and its remains are not uncommon in the Loup Fork Beds of Colorado and Nebraska. It about equals the modern Llama in size, and is considerably smaller than *P. occidentalis*. Of the materials in the collection referable to this species, there are three lower jaws. One of these has the posterior part of the symphysis preserved, and this agrees with *P. robustus* and differs from *P. occidentalis* in the lack of coössification of the rami, although the well-worn teeth indicate an old animal. The lower molars are of the narrow type, in this respect agreeing with *P. occidentalis* rather than *P. robustus*. In two of the specimens the second premolar is well developed and two-rooted, but in the third specimen this tooth is much reduced and single-rooted, thus indicating a ten-

¹ Surv. W. 100th M., p. 329.

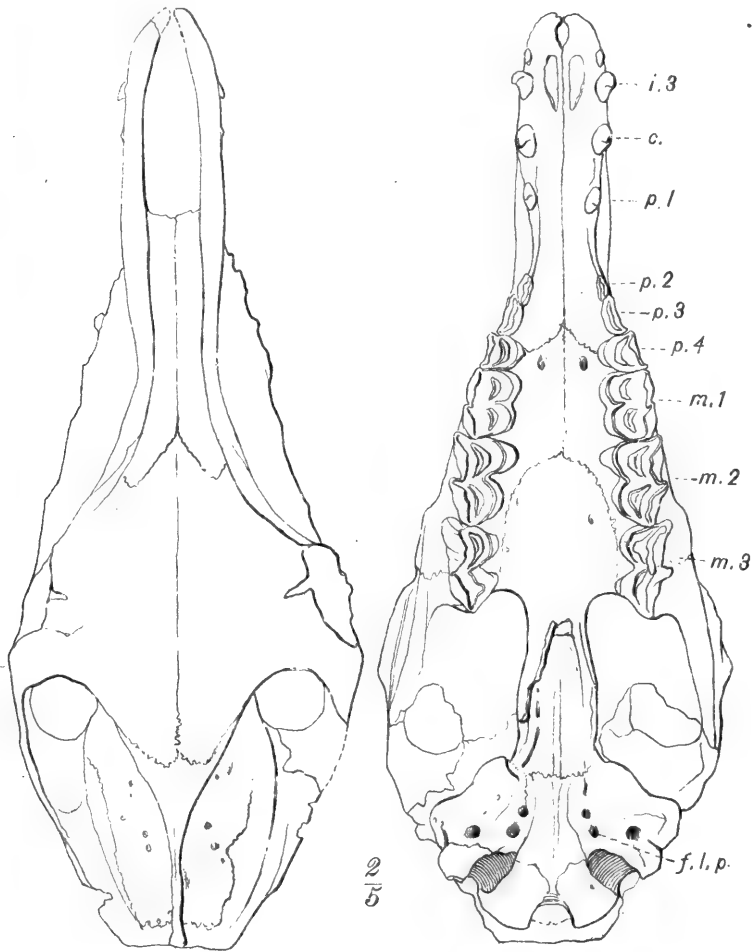


Fig. 20. Top and under view of skull of *Procamelus gracilis*, after Cope.

dency to disappear. This, it may be said, constitutes a decided advance in the direction of the next genus, *Pliauchenia*, in which this tooth is permanently absent. I give herewith some comparative measurements of the three known species in order that the differences in size may be more readily understood :

	<i>P. robustus.</i> MM.	<i>P. occidentalis.</i> MM.	<i>P. gracilis.</i> MM.
Length of last three pms. and ms.	152	126 133 126 135	111
Length of last three pms. and } first two ms. }	106	90 85 88 92	77 76 76

Two incomplete metapodials in the collection, which are of suitable size for those of this species, show lack of bony union, notwithstanding the fact that the epiphyses are completely joined to the shaft. It is not certain, but there is evidence, that these metapodials belong to the fore foot, in which event it will not be surprising to find in more complete and perfect specimens that these bones are not coössified in this species, except in old individuals. In the hind foot the metapodials are completely united, as is shown by several specimens. In one specimen, which corresponds in size with *P. occidentalis*, the proximal part of the cannon bone shows lack of bony union for a distance of nearly two inches down the shaft.

Pliauchenia *Cope.*

The only character so far known in which this genus differs from *Procamelus* is found in the absence of the second lower premolar, and as this constitutes an important step in the dental evolution of the Camels, the species displaying it are entitled to rank as a separate and distinct genus. The exact stratigraphic position of the group is not known, owing to the imperfect collecting that has been done in the Loup Fork Beds. It is generally stated that *Pliauchenia* was contemporaneous with *Procamelus* in the Loup Fork, and comes from the same horizon, but of this one cannot be certain. It must be remembered that this deposit is several hundred feet in thickness in places, and it would not be a matter for surprise if it is found, upon more careful investigation, that *Procamelus* comes from the lower levels and *Pliauchenia* from the upper strata of the same bed.

Three species have been described by Cope, of which two are from the Loup Fork of New Mexico and one from the later

Blanco Beds of Texas. One of these species, *P. vulcanorum*, was founded upon a superior maxillary bone with most of the teeth in place, but as the diagnosis of the genus rests exclusively upon the number of premolars in the lower jaw, I do not see how this species can be admitted until the lower dentition is determined. It is therefore discarded.

***Pliauchenia humphresiana* Cope.**

The type of this species consists of the anterior portion of two lower jaws from the Loup Fork of New Mexico. A second specimen which I refer to this species is from the Loup Fork Beds of Long Island, Phillips County, Kansas, collected by the Museum party during their explorations there. The specimen consists of the greater part of a lower jaw broken just in advance of the first premolar and bearing all the molars and premolars with the exception of the first and third. In size the specimen about equals the smaller individuals of *Procamelus occidentalis*, which it otherwise closely resembles in the structure of the teeth. The molars are of the narrow and elongated type, and the premolars have the same structure as that seen in the various species of *Procamelus*.

***Pliauchenia minima*, sp. nov.**

The smallest species of Cameloid yet known from the Loup Fork deposits is represented in the collection by the greater part of a lower jaw, from Decatur County, Kansas, which I provisionally refer to the above genus. The specimen is broken posterior to the symphysis and does not display the incisors, canine nor first premolar, if indeed this latter tooth were present. The diastema in front of the third premolar is unusually long and the ramus in this region remarkably slender; more so, in fact, than in any known species of the Camelidæ. The third and fourth premolars are present but considerably reduced in size. The molars are of the usual pattern. Some fragmentary remains of a hind foot from this same region are probably to be referred to this species. The phalanges and distal ends of the metapodials are extremely cameloid, but unusually slender and delicate. The

metapodials are firmly coössified. The size of the species is about equal to that of *Poëbrotherium labiatum* of the White River. The reference of this species to *Pliauchenia* is of course only provisional, and until the entire dentition is known the reference is uncertain. If it should transpire that the first premolar is absent it could not be placed in *Pliauchenia*, but would occupy a position between this genus and *Auchenia*.

Pliauchenia spatula Cope.

This species is founded upon an unusually complete lower jaw from the Blanco beds of Texas. According to Cope it is one of the largest Camels yet found, and considerably exceeds the modern Dromedary in size. A comparison of the measurements of the three known species will exhibit the striking difference in size; they are as follows:

	<i>P. spatula.</i>	<i>P. humphresiana.</i>	<i>P. minima.</i>
	MM.	MM.	MM.
Length of last two pms. and ms. . . .	188	110	70

Camelops Leidy.¹

Camel remains in the Pleistocene, Equus Beds, are very numerous; they have been found in nearly every State and Territory west of the Mississippi River, and are, in places, exceedingly abundant. Unfortunately, however, in most instances the fossils are so fragmentary that it is impossible to determine the genus or species to which any given specimen is to be referred. This fact has been taken advantage of, it appears to me, to inordinately multiply the genera and species, upon no better ground, frequently, than mere guesswork. These remains have been grouped at different times in no less than five distinct genera and ten species. The first of these genera, *Camelops*, was proposed by Leidy (Proc. Acad. Nat. Sci. Phila., 1854, p. 172), upon the fragment of an upper jaw of a large Camel from the gravel drifts of Kansas. The second genus, *Megalomeryx*, was also proposed by Leidy (Proc. Acad. Nat. Sci. Phila., 1858, p. 24), for the reception of some large teeth supposed to belong to an extinct Camel, from the Pleistocene of Nebraska. In 1872

¹ Proc. Acad. Nat. Sci. Phila., 1854. p. 172.

Dr. Leidy again described some large Camel remains from California, which he referred to the living genus *Auchenia*.¹ Following this Cope² described two new genera, *Holomeniscus* and *Eschatius*, which he based upon fragmentary materials from Oregon, Mexico and elsewhere. He distinguished these genera from *Pliiauchenia*, *Auchenia* and *Camelus* by the possession of a single superior premolar, the fourth, and separated *Eschatius* from *Holomeniscus* by the extreme reduction of this tooth to a simple cone. The evidence upon which a knowledge of the superior premolar dentition of these forms rests is furnished, so far at least as I have been able to learn, by (1) a fragment of an upper jaw of *H. vitikerianus*, containing the first and second molars, together with the roots and alveoli of the premolar or premolars immediately in advance, as well as a portion of the free border of the jaw; (2) a much damaged fragment of a superior maxilla of *H. hesternus*, in which no knowledge of the premolar dentition is possible, since neither the teeth nor their alveoli are preserved; and (3) a portion of a superior maxilla of *Eschatius conidens* without teeth but having nearly all the alveoli preserved.

It appears from a careful examination of this material that the number of superior premolars in all these Pleistocene cameloids, with the exception of *Eschatius conidens*, is uncertain. In the only specimen in which it can be possibly made out, there are undoubted traces of an alveolus for a third premolar. If there were two premolars above, then the dental formula is the same as in the living genus *Auchenia*, and is indistinguishable from it, so far, at least, as the number of teeth is concerned. The third superior premolar is very small in *Auchenia*, and it will not be surprising to find, when a larger number of suitable specimens of these North American Pleistocene species are known, that in some cases a vestige of this tooth remained in the jaw for a longer or shorter time during the life of the animal; at least this seems to be the rule in many cases wherein a tooth is about to disappear from the series.

I therefore reject the definition given by Cope, but retain the genus as distinct from *Auchenia*, upon an entirely different

¹ Report U. S. Geolog. Surv. Territories, 1873, p. 225.

² Proc. Amer. Philos. Soc., 1884, p. 16.

ground. In the lower molars of *Auchenia* there is a very prominent buttress, amounting almost to a lamina, developed at the outer extremity of the antero-external crescent, especially in the second and third molars. This structure is not present in the lower molars of any of the North American species which I have seen, although there are faint traces of it to be found in some of them.

As regards the generic name to be applied to these North American species, I revive the one originally given by Leidy, *Camelops*, notwithstanding the fact that no attempt was made by him to give a generic definition. The extreme reduction of the fourth premolar, together with the small size of the inferior canine, satisfactorily distinguishes *Eschatius*, which is undoubtedly a distinct genus and is here regarded as such.

In the description of the numerous remaining species which have been proposed, apparently very little latitude has been allowed for individual and sexual variations, and because of the very fragmentary condition of the material so far known any accurate understanding of their limits is quite impossible. On this account it is very difficult to determine what species are valid and entitled to recognition. Until a larger number of specimens in a less fragmentary state are obtained, I cannot distinguish more than two, or at the utmost three species, and these determinations rest solely upon size.

Camelops kansanus *Leidy.*

This species is by far the most abundant of all the North American Pleistocene Cameloids, and of the widest geographical distribution. I regard as synonymous of the above the following specific names: *Megalomeryx niobrarensis* Leidy,¹ *Auchenia hesterna* Leidy,² *Holomeniscus hesternus*³ Cope, *Auchenia huerfanensis* Craigin,⁴ and *Holomeniscus sulcatus* Cope.⁵ Leidy's type of *Camelops kansanus* consists of a fragment of the anterior portion only of the upper jaw, bearing the root of the incisor and a portion of the alveolus of the canine, and does not reveal the

¹ Proc. Acad. Nat. Sci. Phila., 1858, p. 24.

² Rep. U. S. Geolog. Surv. Territories, 1873, p. 225.

³ Proc. Amer. Philos. Soc., 1884, p. 16.

⁴ Amer. Geologist, 1892, p. 257.

⁵ Rep. Geol. Surv. Texas, 1893, p. 84.

number of premolars nor the character of the lower molars. It agrees so well in size and character, however, with the corresponding parts of other specimens from different localities in which the dentition can be accurately determined, that there can be very little doubt that they belong to one and the same species. The type of *Megalomeryx niobrarensis* consists of lower molars from the sand hill region of Nebraska; and since they do not present any characters which will serve to distinguish them from the corresponding teeth of *C. kansanus* they may be safely regarded as belonging to the same species. In the same way the teeth described by Leidy from California under the name of *Auchenia hesterna* present no differences, either in size or structure, that would lead one to consider them as belonging to a distinct species. *Auchenia huerfanensis* of Craigin comes apparently in the same category and does not differ, so far as can be made out from the description, from *C. kansanus*. Neither can one detect any characters in the type of *Holomeniscus sulcatus* of Cope from the Pleistocene of Texas that separate it from the above species. Cope described a sulcus upon the inner face of the lower molars, which he thought distinguishes this species. Upon careful comparison I find this sulcus is quite as well developed in many other specimens, the reference of which to *C. kansanus* there can be no reasonable doubt. I find it to be a character which not only varies with the state of wear of the tooth but is subject to a considerable degree of individual variation.

The dentition of the species thus considered is as follows: $I\frac{1}{3}$, $C\frac{1}{1}$, $Pm\frac{1}{1}^2$, $M\frac{3}{3}$. In size the majority of the specimens about equal the corresponding parts of the Dromedary, although some are notably more robust, while others are decidedly more slender. In fact, there appears to be a very great range, as far as size is concerned, in certain bones, especially those of the feet. The length does not seem to vary so much as the degree of robustness, and this probably is due to differences in sex and age. I give here with the measurements of some of the principal limb bones of this species from the Pleistocene sand beds near Hay Springs, Nebraska, collected by the Museum expedition during last summer. These bones, it is proper to remark, pertain to many

individuals, and were found hopelessly mixed together. I also give measurements of the corresponding bones of the Dromedary for comparison :

	<i>C. kansanus.</i>	<i>Dromedary.</i>
	MM.	MM.
Length of posterior cannon bone.....	345	325
	360	
	365	
Length of anterior cannon bone.....	330	325
	370	
Length of ulna and radius.....	555	580
Length of humerus.....	375	420
Length of scapula.....	415	460
Length of phalanges, proximal row.....	98	102
	to	
	124	

A specimen from an anterior cannon bone from the Silver Lake locality in Oregon is considerably more robust than either the Dromedary or those of *C. kansanus* from Hay Springs; it measures 385 mm. There is yet another specimen in the collection consisting of a complete posterior cannon bone from the Pleistocene of Hitchcock County, Nebraska, which greatly exceeds in length that of any known Camel. It is notably more slender than the cannon bone of the Dromedary, has less distal spread of the metapodials, but is nearly double the length; its exact measurement is 555 mm. It is highly probable that this represents a distinct species, but I refrain from creating another specific name until we know more of the skeleton.

***Camelops vitikerianus* Cope.**

A fragment of an upper jaw containing the first and second molars, together with the roots and alveoli of the two superior premolars, is the only specimen of this species so far known with certainty. A complete lower jaw was described by Cope from the Pleistocene of Texas under the name of *Holomeniscus macrocephalus*,¹ which I strongly suspect belongs to this species. It agrees, so far as one can judge, in size, but no exact comparison is possible, since the inferior condition of *C. vitikerianus* is unknown. Cope remarks in his description: "I observe here that it is not certain that the species now described is not an *Auchenia*, as the superior dentition is not known." The lower molars, as figured, are

¹ Rep. Geolog. Surv. Texas, 1893, p. 85.

certainly not those of any *Auchenia* with which I am familiar, since they entirely lack the antero-external buttress of this genus and agree with those of *Camelops*. I cannot see any reason whatever to regard this jaw as belonging to a species different from that represented by the upper molars above noticed. The size of the species is near that of the living *Auchenia*, and is hence much smaller than *C. kansanus*, the only character to my knowledge by which it can be distinguished.

Camelus americanus, sp. nov.

From the Pleistocene Beds of the Hay Springs locality were obtained by the Museum expedition last year several specimens of a Cameloid apparently different from anything hitherto described from this country. One specimen consists of the greater part of

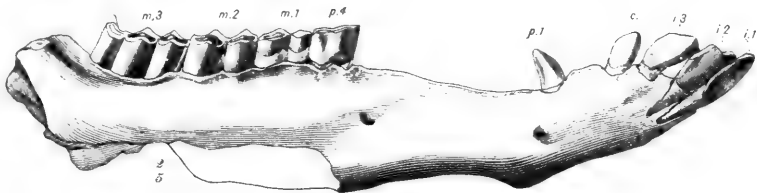


Fig. 21. Lower jaw of *Camelus americanus*, side view.

both rami of the mandibles of a fully adult individual, in excellent state of preservation, but broken in such a manner as to display but little of the jaw posterior to the last molar. The second specimen consists also of a mandibular ramus, but the individual was young, in which the milk molars had not yet been shed.

The inferior dental formula of the adult specimen is as follows: I_3, C_1, Pm_2, M_3 . This it will be noticed is the dentition of the genus *Camelus*, from which I cannot distinguish it generically at present. If this is a true *Camelus*, as I suspect, it is the first time that it has been found in the western hemisphere.

The incisors display the usual spatulate cameloid pattern, and are very procumbent in position. Almost immediately behind the third incisor follows a rather weak incisiform canine. At the posterior termination of a comparatively short diastema is placed

the first premolar, a moderately well developed tooth, with a compressed, internally grooved, pointed, recurved crown, very similar to the lower canine of *Auchenia*. After a relatively long interval follows the fourth premolar, which with the molars makes a continuous series. The fourth premolar is relatively more robust than that of the Llama or Dromedary, and gives evidence by this fact of a less reduced condition. Its form is the same as in these two genera. The molars display the same structure as those of the later Cameloids in general, except the second and especially the third show the first indication of the external buttress so characteristic of *Auchenia*. The two rami are firmly coössified at the symphysis. I distinguish the species from *Camelus dromedarius* by the relatively small incisiform canine, as well as by the less reduced fourth premolar and much smaller size. A comparison of the measurements of this species with *C. dromedarius* and *A. lama* are herewith given :

	<i>A. lama.</i> MM.	<i>C. americanus.</i> MM.	<i>C. dromedarius.</i> MM.
Length from incisive border to end of last molar.....	165	205	265
Length of molars and fourth premolar.....	80	92	132
Length from incisive border to fourth premolar.....	85	114	233

Eschatius condens Cope.

The last of the American Cameloids to be considered is this species which, so far as we are now aware, was the most specialized of the Camelidæ. As already noted, the characters which

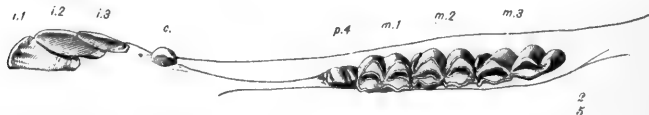


Fig. 22. Crown view of lower teeth of *Auchenia lama*.

distinguish this group from all others is found in the extreme reduction of the fourth superior premolar to a simple cone, as originally pointed out by Cope ; this is associated with a marked reduction in size of the lower canine. The specimens from which

the genus and species is known are, unfortunately, very fragmentary, so that it is impossible to say much concerning it. It was first found at the Silver Lake locality in southeastern Oregon, but subsequently Cope identified remains referable to it from certain localities in Mexico, showing that it was most widely distributed. Two species have been described by Cope, *E. coindens* and *E. longirostris*, but it is very doubtful indeed whether the material at



Fig. 23. Crown view of upper teeth of *Auchenia lama*.

present known warrants the recognition of more than a single species. There are some trifling differences in the length of the diastema of the lower jaw, it is true, but this is probably due to individual variation. The size of the species about equals that of the Dromedary.

THE EVOLUTION OF THE CAMELIDÆ.

We come next to consider the evolution of the Camelidæ, and although the principal facts of their development have been quite fully set forth in the foregoing pages, yet it seems proper to summarize them here. The earliest forms in which one can detect true tylopodean peculiarities, as already pointed out, are found in the upper Eocene or Uinta stage; at the same time it is quite certain that the phylum was detached from the main stem of the Artiodactyla at a much earlier date. Both Cope and Scott have expressed the opinion that the ancestry of the group is traceable directly to the Wasatch genus *Pantolestes*, and Scott believes that the connection is established by the Bridger genus *Homacodon*. Whether or not these opinions will bear the test of future discovery time alone will reveal. At present I am of the opinion that the osteology of these genera is too imperfectly

known to speak with any degree of confidence as to its correctness.

The principal changes of structure in the evolution of the group relate largely to the limbs and skull, although, as is well known, the cervical vertebræ are highly characteristic in the whole family. Unfortunately the cervicals are entirely unknown in the earliest representative, *Protylopus*, but in the succeeding genus, *Poebrotherium*, they had already assumed the typical cameloid peculiarities. If one is permitted to judge by analogy, it is more than likely that *Protylopus* possessed the peculiar cameloid cervicals, and it seems highly probable that one of the crucial tests of tylopoidean affinity, in any genus older than this, will be found in the incipient changes leading to this modification.

The changes in the limbs consisted mainly in (1) their gradual elongation, (2) coössification of certain bones, (3) modification of the patella and loss of the greater part of the tibia, and (4) the subtraction of digits, the change in the character of the feet and modification of the phalanges, together with the coössification of the podial elements into a cannon bone. In this connection should also be mentioned the development of a double bicipital groove upon the humerus and the modification of the carpal and tarsal elements.

The question of the elongation of the limbs is closely associated with the general increase in size, in which there is as complete a gradation, from the little *Protylopus*, scarcely larger than a good-sized Jack Rabbit, to the more modern species, larger than the Dromedary, as the most hypercritical opponent of the Evolution Theory could possibly demand. In the matter of the coössification of certain bones, the ulna and radius were the first to be affected by this process. As we have already seen, it had taken place in *Protylopus* in a very old individual, and then only in the middle of the shaft, leaving the proximal ends entirely ununited. In *Poebrotherium* the complete coössification of these elements was accomplished in young individuals before the milk dentition had been completely shed, and before the epiphyses had united to the shafts of the long bones, as is demonstrated by many specimens in the Museum collection. In all the later types these bones are firmly united.

The patella of the later Camels is peculiar in that it is narrow and of great vertical depth. The first evidence of this modification is seen in the development of a long pointed process upon the inferior border of the bone in *Protylopus*; this is continued in *Poëbrotherium* and *Gomphotherium*, until in *Procamelus* the modern condition is reached. The shaft of the fibula in all the modern types has completely disappeared, and the bone is represented by a distal nodular element which lies under the end of the tibia. In *Protylopus* a considerable part of the shaft of the bone was present, but it was probably not complete. In *Poëbrotherium* the shaft is reduced to a very short bony spicule, and the distal part is partially pushed under the end of the tibia; in *Gomphotherium* the shaft has completely disappeared, and in *Procamelus* the modern arrangement is attained.

In the matter of the loss of digits I cannot speak with any very great degree of confidence, especially as regards the older types. Our materials fail to reveal the number of toes in the fore feet of *Protylopus*, but there is very little doubt that there were four. In one specimen which I have referred to this genus, the lateral toes of the hind feet are reduced to mere nodular splints, while in another specimen in the collection there is evidence that the lateral toes of the hind feet were complete but very slender. In *Poëbrotherium* the lateral toes are reduced to vestiges in both fore and hind feet, while in the later forms even these vestiges disappear.

The modifications in the character of the feet refer to what may be properly termed a retrograde change, if we regard the subject from the standpoint of the podial evolution of the Ungulates generally. *Protylopus*, as well as *Poëbrotherium* and *Gomphotherium*, had apparently a fully developed unguligrade gait. The ungual phalanges are relatively high, keeled upon their dorsal surfaces, and more or less flattened upon their opposed sides. The distal ends of the proximal phalanges do not have their articular surfaces extended upon the dorsal side, while the distal phalanges of the second row have this surface well extended upon the dorsal portion of the bone. This arrangement is highly characteristic of all the higher Artiodactyla, and is the strongest possible evidence that can be adduced from the skeleton of the unguligrade gait.

In *Procamelus*, on the other hand, the distal ends of the proximal phalanges, as well as those of the second row, have the articular surfaces reaching well back upon the dorsal aspect, just as in the modern Camel and Llama, and this we know to be accompanied by the digitigrade gait and the peculiar cushioned foot. There is likewise a marked change in the character of the ungual phalanges, which are much reduced and flattened vertically especially in *Camelus*.

The conclusion is obvious, therefore, that this peculiar tylopod character is secondary, and was developed from the unguigrade condition. Just what led to it is impossible to say. Zittell's explanation that it resulted as a consequence of the coössification of the metapodials can hardly be the correct one, since the same thing occurred in all of the Pecora in which the unguigrade gait was retained.

The coössification of the metapodials and the consequent formation of a cannon bone took place comparatively late in the history of the phylum, much later in fact than the union of the ulna and radius. In *Protylopus* and *Poebrotherium* the metapodials were not only free but capable of considerable independent movement, as indicated by the facets. The opposed surfaces of these bones, moreover, are relatively smooth and less flattened than in the succeeding *Gomphotherium*. In this latter genus the bones are more closely applied to each other, the surfaces roughened, and the articular facets, by which they join one another, much reduced. The feet of *Protolabis* are wholly unknown. In one species of *Procamelus* (*P. gracilis*), there is evidence that the metapodials of the fore feet were not united until late in life, if at all, while those of the hind foot were fully coössified into a cannon bone. *Procamelus occidentalis* had the posterior metapodials fully united and those of the fore foot only partially coössified, being free at their proximal ends for some distance.

In the Pleistocene species the metapodials were fully united into a cannon bone early in life, and in the modern Camelidæ bony union of these elements takes place before birth, almost as soon in fact as bony tissue is thrown down in the shafts.

It will thus be seen that the coössification of the metapodials, as well as that of the ulna and radius, was a gradual process, and

is always found first in the old individuals ; its further advance has consisted in reducing the time of its appearance to such an extent that it is now altogether intra uterine. I leave for a future paper the discussion of these important facts in their relation to the question of the transmission of acquired characters. I may state here, however, that they furnish very strong presumptive, if not conclusive, evidence of the transmission of a pathological change.

The modifications of the skull include some minor changes in the position of the orbit, its inclosure by a complete bony rim, a broadening of the frontal region and a shortening of the nasal bones. There have also occurred some modifications of the tympanic bullæ and a change in the position of the posterior nares. The most important of all the modifications connected with the skull, however, are found in the dentition, and here the changes are quite as profound as have occurred in any other group of mammals within the same length of time. In *Protylopus* the structure of the molars is, to a large extent, intermediate between the bunodont and selenodont pattern. This is especially seen in the lower molars, the internal cusps of which are rather more conical than crescentic ; the outer cusps are not perfectly crescentic, and the crowns of all the molars are very short. The lower canines are small and incisiform, the inferior incisors are sub-erect, and there is evidence of the fact that these teeth had a more or less effective bite against the upper ones.

In *Poebrotherium* the crowns of the molars are much more elongated and the crescents fully developed. The lower canine is yet incisiform in the older species, *P. wilsoni*, but has begun to assume the caniniform shape in the later *P. labiatum*. The lower incisors have a very procumbent position, but while yet opposing the superior incisors, the effectiveness of the bite is considerably diminished on this account. The only important change in the teeth of the John Day species is seen in the reduction in size of the first upper premolar and the assumption of the caniniform shape of the lower canine. The inferior dentition of *Protolabis* is not known, but an important change has taken place in the second superior premolar, in that it is much reduced in size.

If the specimen which I have referred to *Procamelus robustus* is normal, it offers the first evidence of the diminution in size,

leading to the final loss of the first and second pair of superior incisors. In *Procamelus occidentalis* these teeth have completely disappeared in the adult, but vestiges of them have been found in the young, a fact which was demonstrated by Cope.

Plianchenia furnishes us with the next step in which the second premolar has disappeared from the lower jaw, leaving the first, third and fourth of this series. The superior premolar dentition of this genus has not yet been found, but it is highly probable that some of the species will show a loss of the corresponding tooth in the upper jaw. It is highly probable that at this stage, or the one preceding, three diverging lines took origin, of which one continued into *Auchenia*, another into *Camelus*, and a third into *Camelops* and *Eschatius*.

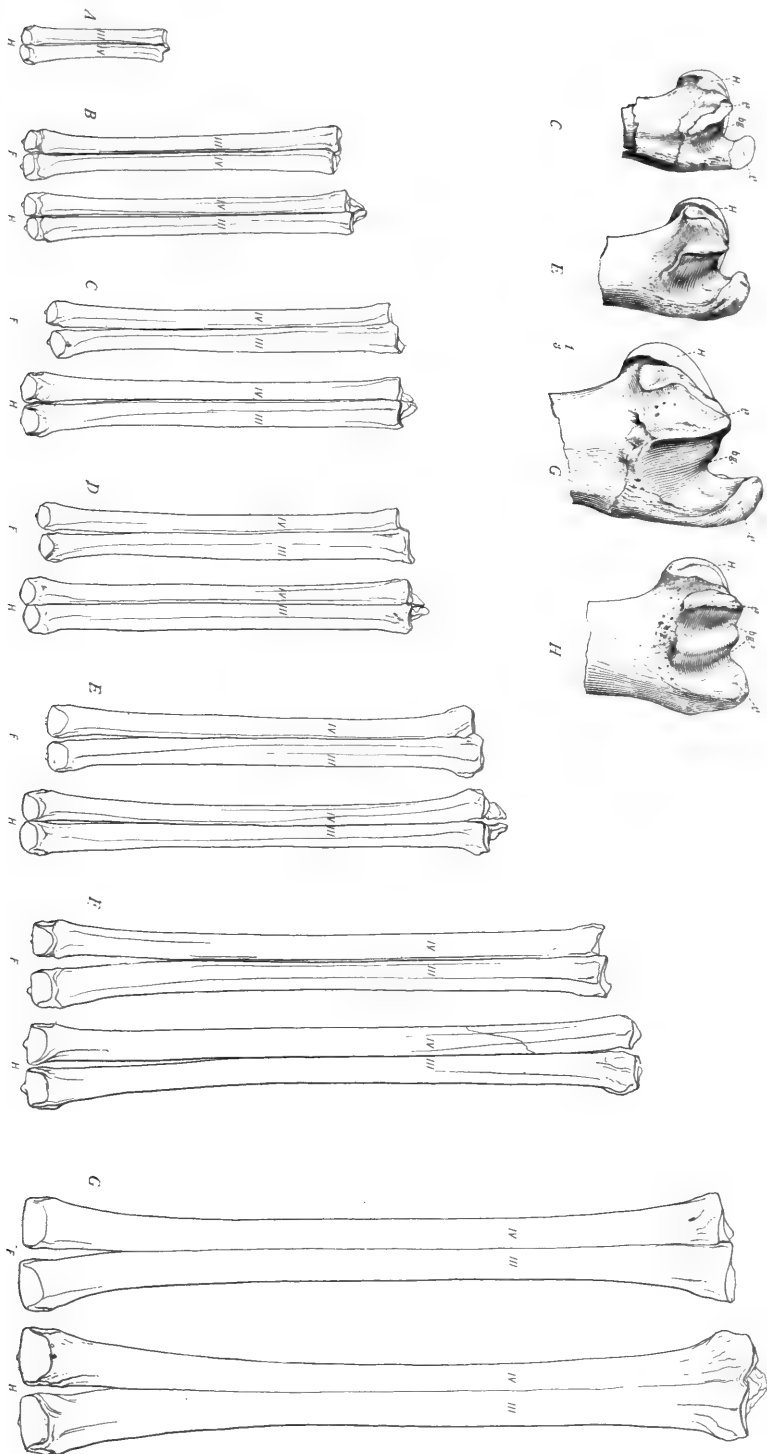
From *Plianchenia* the transition is easy to *Camelus*, in which there are three premolars in the upper and two in the lower jaw. In *Auchenia* the premolars are still further reduced, there being two above and only one below. The first evidence of the peculiar buttress found in the lower molars of this genus is seen in *Procamelus gracilis*, and on this account I am of the opinion that this species is the ancestor of the Llamas. It is highly probable that the species migrated to South America at the close of the Miocene, and that the intermediate links between it and the living genus will be found in that country. *Camelops* could have easily been derived from *Plianchenia spatula*, requiring the loss of only two premolars in the lower jaw and probably one above; in a like manner *Eschatius* follows *Camelops* and carries dental reduction to the extreme limit reached in the Camel group.

In this attempt to indicate the more exact specific evolution of the group one is necessarily handicapped by want of knowledge of the osteology of many species which are at present represented by fragmentary remains only. I doubt not that it will be materially altered when we come to have a more perfect understanding of these forms. I give herewith a table of distribution in time, of the Cameloids treated of in the foregoing pages.

PERIODS.	FORMATIONS.	THICKNESS.	FAUNAL DIVISIONS.	EVOLUTION OF SPECIES.
Recent.	Recent.			<p><i>Camelus.</i> <i>Auchenia.</i></p> <p><i>Eschatus</i> <i>Camelus americanus.</i></p> <p><i>Camelops kansanus.</i> <i>Camelops vitikertanus.</i></p>
	Equus.	150	Equus.	
Pleistocene.	Blanco.	100	<i>Plianchenia.</i> <i>Hippidium.</i>	<p><i>Plianchenia spotula.</i></p> <p><i>Plianchenia hamphersiana.</i> <i>P. minima.</i></p> <p><i>Procamelus occidentalis.</i> <i>P. gracilis.</i></p> <p><i>Procamelus robustus.</i></p>
	Loup Fork.	400	<i>Procamelus.</i>	
Miocene.	Deep River.	200	<i>Cyclopidius.</i> OF MIGRATION.	<p><i>Protolabis.</i></p> <p><i>Gomphotherium cameloides.</i></p>
	John Day.	1000	<i>Merycochoerus.</i> <i>Diceratherium.</i> <i>Protoceras.</i>	
Oligocene.	White River.	800	<i>Oreodon.</i> <i>Titanotherium.</i>	<p><i>Poebrotherium labiatum.</i></p> <p><i>Poebrotherium wilsoni.</i></p>
	Uinta.	800	<i>Diplacodon.</i> <i>Telmatotherium.</i>	
Eocene.	Bridger.	2000	<i>Uintatherium.</i>	<p><i>Parameryx.</i></p> <p><i>? Homacodon.</i></p> <p><i>? Pantolestes.</i></p>
	Wind River.	800	<i>Bathyopsis.</i>	
	Wasatch.	2000	<i>Coryphodon.</i>	
	Torreon.	300	<i>Pantlambda.</i>	
	Puerco.	500	<i>Polymastodon.</i>	

EXPLANATION OF PLATE XI.

A, hind metapodials of *Protylopus petersoni*; *B*, fore and hind metapodials of *Poëbrotherium wilsoni*; *C*, fore and hind metapodials and head of humerus of *Poëbrotherium labiatum*; *D*, same species from higher level; *E*, fore and hind metapodials and head of humerus of *Gomphotherium sternbergi*; *F*, fore and hind metapodials of *Gomphotherium cameloides*; *G*, fore and hind metapodials and head of humerus of *Procamelus occidentalis*; *H*, head of humerus of *Auchenia lama*.



METAPODIALS OF EXTINCT CAMELOIDS.

Article VIII.—DESCRIPTIONS OF NEW MAMMALS
FROM WESTERN MEXICO AND LOWER CALI-
FORNIA.

By J. A. ALLEN.

For an important part of the material forming the basis of the present paper I am indebted to Mr. Oldfield Thomas, curator of mammals at the British Museum, who, in sending specimens of small mammals from the State of Sinaloa, Mexico, and the Cape region of Lower California for comparison with material in the American Museum of Natural History, has kindly given me permission to describe such as seemed to be new. Of the 14 species sent, 7 appear not to have been before described. The Museum is also indebted to Mr. Thomas for permission to retain a set of the duplicates of the species represented, including the types of the new species.

The rest of the material here reported upon was received a few months since from Mr. A. W. Anthony, being the results of his mammal collecting at numerous islands off the west coast of Lower California during 1897. This collection contains 103 specimens, representing about 18 species, of which 9 are here described as new. The others are as follows, with their localities:

Dorcelaphus hemionus eremicus Mearns, 2 ♀♀ ad.—Turtle Bay, June 26, and Playa Maria Bay, July 3.

Zalophus californianus (Lesson), ♂ ad., and additional female skull, Guadalupe Island, March 26.

Tamias leucurus peninsulae Allen, 4 specimens, all adults; two from San José del Cabo, April 24, and two from San Juanico Bay, June 12.

Four specimens of *Peromyscus* are left undetermined, some of which, in all probability, represent undescribed forms, but the material is too limited to warrant such an assumption.

***Marmosa sinaloæ*, sp. nov.**

Similar in general coloration to *M. canescens* Allen from the Isthmus of Tehuantepec, but much smaller and more slender. Skull 31 x 16.5 as compared with 35 x 20 in *M. canescens*. Teeth proportionately smaller and weaker.

*Measurements.*¹—Type, ♂ ad., total length, 242; tail, 130; hind foot, 16; ear, 22. Another male, total length, 215; tail, 122; hind foot, 18; ear, 25. A female, total length, 205; tail, 115; hind foot, 16; ear, 22.

Skull.—Total length, 31; basal length, 29; greatest zygomatic breadth, 16.5; breadth across postorbital processes, 6.2; width of brain-case, 11.2; length of nasals, 13.7; tip of premaxillaries to posterior border of palatal floor, 17; length of lower jaw (alveolar border to condyle), 22; height at condyle, 3; height at coronoid process, 7.

Type.—No. 448 (collector's number), ♂ ad., Tatemales, State of Sinaloa, Mexico, May 14, 1897; collected by P. O. Simons.

This is a miniature of *M. canescens*, and one of the most diminutive of Opossums. In coloration its general resemblance to *M. canescens* is striking, being, however, a little browner above, and a little more strongly tinted with pale yellow below. The type and one other specimen (collector's No. 441) are from Tatemales, and a third is from Rosario, Sinaloa, Mex., the latter taken April 23, and the two former May 13 and 14, 1897. The specimens are adult, but not old, and have been compared with specimens of *M. canescens* of corresponding ages.

***Lepus peninsularis* Thomas, MS., sp. nov.**

Similar in general features to *L. cinerascens* Allen, but much paler in coloration and rather smaller.

Above pale grayish brown, grizzled with black; darker and browner on dorsal region, grayer and much paler on sides; top of head like back; ventral surface white; upper surface of hind feet white, lower surface of same strongly yellowish grizzled brown; upper surface of fore feet brownish white, lower surface brownish yellow.

Measurements.—Type ♀ ad. (collector's No. 438); total length, 324; tail vertebræ, 20; hind foot, 73; ear, 61. Another specimen, ♂ ad. (collector's No. 439), total length, 319; tail vertebræ, 18; hind foot, 76; ear, 65.

Skull.—Total length, 61.5; basal length, 52; greatest zygomatic breadth, 30; breadth at postorbital constriction, 9.5; length of nasals, 26; width, posteriorly, 11, anteriorly, 7; length of molar series at alveolar border, 11.5; width of palatal floor at middle, 9; length of lower jaw, incisive border to angle, 43; height at condyle, 25.

¹ All measurements are in millimetres, and, when not otherwise stated, are, in the case of skins, the collector's measurements from the fresh specimens.

Type.—No. 438 (collector's number), ♀ ad., Santa Anita, Lower California, July 17, 1896; collected by D. Coolidge. Another specimen (collector's No. 439), ♂ ad., same date and place.

This species belongs to the *Lepus trowbridgei-cinerascens* group, of which it will doubtless prove only a subspecies. It differs little in size or proportions from *L. cinerascens*, but is markedly different in color, even when examples taken at the same season (July) are compared. The dark ashy gray cast of the upper parts seen in *cinerascens* is replaced in *peninsularis* by a paler buffy or brownish suffusion much like that of *L. arizonæ*; the feet are whiter above and much lighter below, and the grayish white of the ventral surface is replaced by clear white, which occupies a much larger extent of the apical portion of the hairs. In the two skulls of *peninsularis* the nasals are broader than in any skull of a large series of *cinerascens*, but in other respects the cranial characters are much the same in both species.

***Lepus cerrosensis*, sp. nov.**

Above very pale fulvous brown, copiously grizzled with black-tipped hairs; sides pale fulvous gray; below white, the plumbeous underfur showing through the surface, owing probably to the worn condition of the coat; pectoral band pale yellowish brown; upper surface of fore feet pale fawn color; of hind feet, white tinged with pale yellowish; soles pale grayish brown with a fulvous tinge; tail dark gray above, white below; ears dull grayish brown.

Total length, 310; tail vertebræ, 25; hind foot (in skin), 54; ear (from notch), 46.

Skull.—Total length, 58; basal length, 49; greatest zygomatic breadth, 28.5; breadth at postorbital constriction, 10; breadth of nasals posteriorly, 9; length of nasals, 12.

Type, and only specimen, No. $\frac{438561}{11910}$, ♀ ad., Cerros Island, Lower California, April 17, 1897; collected by A. W. Anthony.

This species is represented by a single specimen from Cerros Island, collected April 17, 1897, by Mr. Anthony. It is in poor condition, being in the midst of the spring molt, but the new hair is sufficiently advanced to render description not difficult. It is apparently a young adult, but fully grown, as the size is quite equal to that of the other members of the *Lepus trowbridgei* group, of which this is an apparently well-marked insular form.

[*May, 1898.*]

***Lepus arizonæ confinis*, subsp. nov.**

Coloration above much like that of *Lepus peninsularis*, the brownish suffusion of the upper parts being very much darker than in *L. arizonæ*, the sides of the body and cheeks especially darker, as are also the feet and the pectoral band, and the white of ventral surface is less pure—more of a grayish white—and less extensive.

Length, in comparison with *L. arizonæ*, 310 as against 375; hind foot, 61 as against 76; ear (from notch), 65 as against 70.

Skull (in comparison with *L. arizonæ*).—Total length, 60.5 as against 65; basal length, 53 as against 56; greatest zygomatic breadth, 29 as against 32; interorbital breadth (behind postorbital processes), 9.5 as against 11.5; breadth of nasals posteriorly, 10.5 as against 12.3; length of nasals, 24.5 as against 28.

Type, and only specimen, No. $\frac{18562}{11011}$, ♀ ad., Playa Maria, Lower California, July 8, 1897; collected by A. W. Anthony.

This is a small dark form of the *L. arizonæ* group, strikingly different in coloration from either *L. arizonæ* proper or *L. a. major* Mearns.

***Thomomys fulvus anitæ*, subsp. nov.**

Similar in coloration to *T. fulvus*, but with the rostral portions of the skull, particularly the nasals, much modified.

Coloration above strong yellowish brown, slightly darker along the median line; below buff, nearly to the base of the hairs. Region about the mouth and entrance to cheek pouches and ear patch blackish.

Measurements.—Male adult, total length, 250; tail vertebrae, 83; hind foot, 34; ear, 9. Female adult, total length, 222; tail vertebrae, 62; hind foot, 35; ear, 8.5.

Skull, ♂ ad.—Total length, 42; basal length, 38.7; greatest zygomatic breadth, 26.5; mastoid breadth, 21; least interorbital breadth, 8; length of nasals, 14.6; width of nasals posteriorly, 2.5, anteriorly, 4; extent of intermaxillaries beyond nasals, 2; interparietal, 3 × 4, ending anteriorly in an obtuse angle. The nasals broaden uniformly from the posterior border to the front—not abruptly from the beginning of the apical third anteriorly, as in *T. fulvus*.

Type.—Male adult, No. 129 (collector's number), Santa Anita, Lower California, May 29, 1896; collected by D. Coolidge.

In coloration *T. fulvus anitæ* is not different from average examples of *T. fulvus*, except that on the ventral surface the buffy tint is deeper and extends nearly to the base of the hairs,

the usual plumbeous basal zone being nearly obsolete in the three specimens examined. The chief difference between this form and true *T. fulvus* consists in the even, straight lateral outline of the nasals. It is, however, rather larger than topotypes of *T. fulvus* of corresponding age. Based on two specimens (♂ ad. and ♀ ad.) from Santa Anita, and an additional adult from San José del Cabo, Lower California.

***Thomomys fulvus martirensis*, subsp. nov.**

Size larger than typical *T. fulvus*, and coloration much less fulvous, being of a pronounced grayish cast, especially in old adults.

Above dull grayish brown, varied with blackish, especially along the median line, with a suffusion of pale fulvous, chiefly on the sides. Below grayish white, the hairs extensively plumbeous at base; sometimes the tips of the hairs with a faint yellowish tinge. Ear patch blackish, and the parts surrounding the mouth and openings to the cheek pouches dusky. Tail and feet dull grayish white.

Younger individuals are more suffused with fulvous, both above and below.

Measurements.—Adult male, total length, 248; tail vertebræ, 67; hind foot (in skin), 31. Adult female (average of 8 specimens), 230; tail vertebræ, 70.

Skull, adult male, total length, 44.5; basal length, 41; greatest zygomatic breadth, 25; mastoid breadth, 21; least interorbital breadth, 9; length of nasals, 16; width of nasals posteriorly, 2.5, anteriorly, 5. In females and young males the interparietal is subquadrate and of the usual size and form seen in *T. fulvus*; in old males it becomes much smaller, and in the type is quite obliterated, being overgrown by the lateral ridges for muscular attachment.

Type.—No. $\frac{6870}{004}$, ♂ ad., San Pedro Martir Mountains (alt. 8200 feet), Lower California.

T. fulvus martirensis is based on a series of 14 specimens collected in the San Pedro Martir Mountains, Lower California, at varying altitudes from 7000 to 8200 feet, by Messrs. A. W. Anthony and E. C. Thurber, in May, 1893, and previously referred (Bull. Am. Mus. Nat. Hist., V, 1893, p. 183), with much hesitation, to *T. fulvus*. They are easily separated, however, by their large size and grayish coloration, only the younger individuals showing a very marked suffusion of fulvous. In cranial characters the two forms present no very marked difference, the nasals being of the usual type seen in *T. fulvus*, and thus very different from the nasals in *T. f. anita*.

Thomomys atrovarius, sp. nov.

Size medium, hind foot (from dry skin), 28. Nasals narrow, only slightly expanded apically; interparietal very small, triangular, the apex forming the anterior border; upper incisors with very slight curvature.

Plumbeous Phase.—Above plumbeous, slightly tinged with brown through a slight brownish tipping of the hairs; below plumbeous, the hairs very slightly grayish tipped; feet very thinly covered with whitish hairs; tail nearly naked, the hairs mixed plumbeous and gray, most abundant towards the base. (Two specimens.) A third specimen is slate black, the sides with the hairs faintly tipped with fulvous brown, most conspicuous posteriorly near the hips.

Measurements.—Young adult male (collector's number 452), total length, 210; tail vertebræ, 65; hind foot (from skin), 28; ear, 7. Adult female, total length, 200; tail vertebræ, 62; hind foot (from skin), 28; ear, 7. Another specimen, a very old male, without collector's measurements, is larger, measuring, in skin, total length, 240; tail, 76; hind foot, 29.

Skull, ♂ ad. (very old), total length, 40; basal length, ? (base of skull broken); greatest zygomatic breadth, 24.5; mastoid breadth, 19.5; interorbital breadth, 7; length of nasals, 9; width of nasals posteriorly, 2.4, anteriorly, 3.7; interparietal wholly concealed. Female (very old), total length, 37; basal length, 36; greatest zygomatic breadth, 25; mastoid breadth, 19; interorbital breadth, 7; length of nasals, 8; width of nasals, posteriorly, 2.2, anteriorly, 4; interparietal, triangular, 4.8 x 3. Nasals widening evenly from posterior border anteriorly, without the usual sudden expansion towards the apical border. The young male skull is of the same size as that of the old female, but has still narrower nasals and a smaller interparietal ($3 \times 2\frac{1}{2}$).

Type.—No. 452 (collector's number), young adult ♂, Tatemales, State of Sinaloa, Mexico, May 15, 1897; collected by P. O. Simons.

This species is based on three adult specimens, two males (of different ages, as noted above) and a female, the latter from Rozario, the two males from the nearby locality of Tatemales, State of Sinaloa, Mexico, collected by P. O. Simons, respectively April 3 and May 15 and 17, 1897.

It apparently most resembles *T. orizaba* Merriam, from Mt. Orizaba (alt. 9500 ft.), State of Puebla, Mexico, but as the localities are far apart, and the physical conditions very different, they are not likely to prove the same.

Perognathus pernix, sp. nov.

In coloration similar to *P. fallax*, but one-third smaller, with the tail relatively much shorter, and without conspicuous thigh bristles. General color above yellowish brown profusely lined with blackish, paler on the sides, with a broad fulvous lateral line; below white to the base of the hairs; upper surface of fore leg pale fulvous to elbow; outer surface of hind leg strong fulvous to tarsus. Tail bicolor,—brown above and whitish below,—sparsely haired except towards the end, where it becomes moderately crested and penicillate at the tip.

Measurements.—Male adult (type), total length, 165; tail vertebræ, 90; hind foot, 22; ear, 9. Female adult, total length, 165; tail vertebræ, 88; hind foot, 22; ear, 10.

Skull.—Total length, 25; basal length, 19.6; greatest breadth (mastoid), 12; interorbital breadth, 6; length of nasals, 8.5.

Type.—No. 139 (collector's number), ♂ ad., Rosario, State of Sinaloa, Mexico, Feb. 22, 1897; collected by P. O. Simons.

This species is based on three specimens, two from Rosario, and one from Mazatlan, State of Sinaloa, Mexico. It resembles *Perognathus fallax* in coloration, but is less dark than average examples of that species. The tail is relatively shorter and much less crested, and appears to lack the bristles on the rump and thighs so characteristic of *P. fallax*. That the small size is not due to immaturity is shown by the very worn condition of the teeth in each of the three specimens.

A large series of *P. fallax* averages about 200 mm. in total length, as against 165 mm. in the three examples of *P. pernix*; the tail in *P. fallax* ranges from 92 to 130, averaging about 110, as against 89 in *P. pernix*.

Neotoma sinaloæ, sp. nov.

Size medium, ears rather small, with small auditory bullæ; molar series short and broad; strong sulcus on antero-interior border of m^1 ; palatal opening broad, considerably expanded anteriorly; rostral portion of skull rather broad.

Above (♀ adult, collector's No. 446), deep fulvous brown, sparingly varied with black-tipped hairs; top of head grayer, less fulvous; beneath white, the fur plumbeous basally; feet white; tail well haired, bicolor, blackish brown

above, much lighter below. Two other specimens (younger) are much less fulvous, and one of them is strongly varied with black-tipped hairs, especially over the posterior half of the dorsal area.

Measurements.—Two females measure respectively: total length, 332, 315; tail vertebræ, 160, 155; hind foot (in skin), 32, 31; ear, 27, 25. A male (somewhat younger) measures the same as the smaller female.

Skull (♀ ad., collector's No. 446). Total length, 41.5; basal length, 37; greatest zygomatic breadth, 21.5; mastoid breadth, 15.2; least interorbital breadth, 4.8; length of nasals, 15.4; greatest breadth of nasals anteriorly, 4.3; width of rostrum at base, 4; inner base of incisors to posterior border of palate, 17; length of upper tooth row, 7.

Type.—♀ ad. (collector's No. 446), Tatameles, State of Sinaloa, Mexico, May 14, 1897; collected by P. O. Simons. Two other specimens, sub-adult, same locality and collector, May 6 and 14.

This form greatly resembles *N. mexicana* in coloration, but has a rather longer tail, heavier dentition and a much deeper sulcus on the antero-interior border of m^1 , and very much smaller bullæ, the bullæ being about half as large as in *M. mexicana*.

***Neotoma arenacea*, sp. nov.**

Above grayish brown, sparingly lined with black-tipped hairs, and with a faint suffusion of dull fulvous brown, much lighter and grayer on the head; feet wholly white; underparts white, the fur grayish plumbeous for the basal half; tail very scantily haired, pale brown, indistinctly bicolor, the upper surface being but little darker than the dull grayish lower surface; ears large, pale brown, nearly naked.

Measurements.—Adult males, two specimens, respectively: total length, 351 and 349; tail vertebræ, 164 and 167; hind foot, 36 and 35; ear, 30 and 31. Adult female, total length, 330; tail vertebræ, 160; hind foot, 36.5; ear, 32.

Skull.—Rostral portion narrow, slender; ascending branches of intermaxillaries extending much (3 mm.) beyond the nasals; lateral border of frontals forming a sharp ridge or bead, extending from posterior termination of intermaxillaries to parietals and forming straight evenly diverging lines; anterior opening of infraorbital foramina narrow, the outer wall narrow and evenly rounded off on the upper anterior border; molar series narrowing posteriorly, m^3 being about one-third narrower than m^1 ; sulcus on antero-interior face of m^1 obsolete; palatal opening considerably broader anteriorly than between pterygoids; bullæ of medium size. Total length (♂ ad., collector's No. 611), 46.2; basal length, 41; greatest zygomatic breadth, 23.5; mastoid breadth, 17.2;

least interorbital breadth, 5.3; length of nasals, 18.2; breadth of rostrum at base, 4.3; greatest breadth of nasals anteriorly, 5; inner base of incisors to posterior border of palate, 15; length of upper molar series (crown surface), 7. Female adult (collector's No. 509), total length, 44; basal length, 38.5; greatest zygomatic breadth, 22; mastoid breadth, 16.6; least interorbital breadth, 5.3; length of nasals, 16.8.

Type.—♂ ad. (collector's No. 611), San José del Cabo, Lower California, Aug. 6, 1896; collected by D. Coolidge.

This species is represented by three fine specimens, two of which are from San José del Cabo, July 28 and Aug. 6, and one from Sierra Laguna, L. Cal., June 16, 1896. All are adult, with the teeth moderately worn.

Neotoma arenacea is apparently related most nearly to *N. fuscipes macrotus*, but is rather smaller and very much paler in coloration, with less hairy and much lighter colored tail, and differs besides notably in the greater posterior extension of the intermaxillaries beyond the nasals, and the very different configuration of the frontals, especially in the sharp, heavy and straight supra-orbital bead. The dentition is lighter (the molars narrower); the anteorbital opening is narrower, but the palatal opening is similar in the two forms. It is evidently a member of the *N. fuscipes* group, differing from true *fuscipes* in the direction of *N. f. macrotis*, but with the distinctive features of the latter exaggerated, with other differentiations added.

***Neotoma anthonyi*, sp. nov.**

Size small, general coloration dark gray; posterior surface of hind legs conspicuously blackish; feet wholly white; front border of nasals strongly rounded.

Above grayish brown, moderately varied with blackish-tipped hairs, and faintly suffused with a very pale tint of brownish fulvous, rather stronger on the sides; top of head scarcely different from back; feet pure white; upper surface of fore arm and outer surface of hind leg blackish, in strong contrast not only with the white feet, but with the general coloration; below white, the under fur plumbeous, except along a narrow median band, where the white extends to the base of the hairs; tail bicolor, blackish brown above, grayish white below, fairly well clothed with short hairs.

Measurements.—Four adult males: total length, 329 (330–345); tail vertebræ, 139 (132–146); hind foot (from skin), 35 (34–36); ear (from skin), 24 (23–25). Adult female, total length, 324; tail vertebræ, 149.

Skull.—♂ ad. (No. $\frac{188564}{11918}$), total length, 46; basal length, 42; greatest zygomatic breadth, 25; mastoid breadth, 18.2; least interorbital breadth, 4.8; breadth of rostrum at base, 4.6; length of nasals, 18; greatest breadth of nasals anteriorly, 5; inner base of incisors to end of palate, 18; length of upper molar series, 8. The nasals are strongly rounded in front; palatal opening of moderate width, not expanding anteriorly; m^1 with sulcus on antero-interior border, supraorbital bead weakly developed.

This species is based on five adult specimens (3♂♂, 1♀), collected on Todos Santos Island, Lower California, May 1-12, 1887, by Mr. A. W. Anthony, in whose honor the species is named, in recognition of his important zoological work in Lower California and its outlying islands.

Type.—♂ ad. (No. $\frac{188664}{11918}$), Todos Santos Island, Lower California, May 11, 1897; collected by A. W. Anthony.

Neotoma anthonyi is too distinct, both in coloration and cranial details, to require comparison with any of its congeners.

***Neotoma bryanti* Merriam.**

Neotoma bryanti Merriam was described (Am. Nat., XXI, Feb., 1887, pp. 191-193) from a single specimen, in very bad condition, from Cerros Island, Lower California. A fine series of topotypes, numbering 18 specimens¹, all in good condition and representing various ages, renders it desirable to give some further account of this peculiar rat. The type specimen was driven from its nest by fire, and thus became badly singed. "This unfortunate circumstance," says Dr. Merriam, "together with the fact that the skin was preserved in brine, explains the very poor condition in which it reached me. Enough remains, however, to show that the species differs remarkably from all known representatives of the genus in possessing a very dark belly, which, in this individual at least, is absolutely concolor with the back and sides. It may be added that the dark color of the underparts is in no way due to the scorching above mentioned" (l. c., p. 191).

The fact remains, however, that not one of my 18 topotypes has the underparts as above described, they being white, the fur long, full and soft, with the usual plumbeous under fur seen in most

¹ Collected by Mr. A. W. Anthony, April 1-3 and July 4, 1897.

members of the genus. Owing to the imperfection of the original description (the only previous notice of the species) the species may be redescribed as follows :

Adult.—Above pale fulvous brown, moderately varied with black-tipped hairs; top of head and face grayer; sides paler grayish fulvous, with less black; below white, in some specimens with a faint tinge of buff; the middle portion of ventral surface, from the upper part of breast to tail, forming a broad band, with the white extending to the base of the hairs; sides of the ventral area with fur more or less plumbeous at base; feet wholly white; tail very light grayish brown above, lighter below, scantily haired.

Young Adult.—Grayish brown, strongly varied with black and slightly suffused with a pale tinge of fulvous, giving a faint olivaceous effect; below with the pure white median band narrower and sometimes interrupted by the intrusion of plumbeous under fur from the sides of the ventral area; feet and tail as in the adults.

Nursing Young.—Similar in general coloration to the young adults.

Measurements.—Six adult males: total length, 372 (352–387); tail vertebrae, 165 (153–177). Three adult females: total length, 352 (350–352); tail vertebrae, 154 (152–155). Hind foot, measured from the dry skin, 38–40; ear, 26–29.

Skull.—♂ ad., total length, 48; basal length, 44; greatest zygomatic breadth, 25; mastoid breadth, 20; least interorbital breadth, 5; breadth of rostrum at base, 4.7; length of nasals, 17.5; greatest breadth of nasals anteriorly, 5; inner base of incisors to posterior border of palate, 21; length of upper molar series (crown surface), 8.

Female ad., total length, 45; basal length, 42; greatest zygomatic breadth, 23; mastoid breadth, 19; least interorbital breadth, 5. The anterior molar (m^1) has a well-defined sulcus on the antero-interior border, palatal region rather narrow, including palatal opening, which is very slightly broadened anteriorly; the supraorbital border of frontal strongly beaded, leaving the surface of frontals deeply hollowed.

This species bears a much nearer relationship to *N. arenarius* than to the *N. fuscipes* group, especially as represented by *N. f. macrotis*. It is very much smaller than the latter, with a more naked and relatively shorter tail, much smaller ears, and very much paler coloration. It also differs very much from the latter in many cranial details.

The unusual coloration ascribed to the type of *N. bryanti* must have been due to the singed and otherwise bad condition of the specimen.

Peromyscus eremicus propinquus, subsp. nov.

Similar to *P. eremicus fraterculus*, but less fulvous and much more strongly varied with black.

Above prevailing color blackish brown suffused with pale grayish fulvous, stronger on the sides, where it passes into a deep fulvous lateral line; below white, the under fur dusky plumbeous; feet white, lower part of tibia dusky; ears very large, naked; tail brownish above, a little lighter below, nearly naked except toward the tip.

Measurements.—Male adult (type), total length, 190; tail vertebræ, 100; hind foot (from skin), 18.5; ear (from skin), 19. Average of three specimens (1 ♂, 2 ♀♀), total length, 189; tail vertebræ, 100.

Type.—♂ ad., No. $\frac{18579}{11928}$, San Pablo Point (San Pablo Bay), Lower California, June 22, 1897; collected by A. W. Anthony.

This form is based on 4 specimens, from San Pablo Point, Pacific coast of Lower California, collected June 22, 1897, by Mr. Anthony. It is a dark form of the *P. eremicus* group, holding apparently the same relation to *P. eremicus fraterculus* that *P. texanus thurberi* holds to *P. texanus gambeli*, with the same relative distribution. Aside from coloration, however, *P. texanus propinquus* differs notably from *P. texanus fraterculus* in its conspicuously larger ears.

Peromyscus cedrosensis, sp. nov.

Above brown, suffused with fulvous, and varied with blackish, passing on the sides into a broad ochraceous lateral line; below white, the under fur plumbeous, with a conspicuous longitudinal streak of fulvous on the breast, extending in some specimens to the abdomen; feet white, lower part of hind leg dusky; soles naked; ears large, pale brown, naked; tail pale brown, almost naked, nearly unicolor.

Measurements.—Adult male (type), total length, 194; tail vertebræ, 107; hind foot (from skin), 20; ear (from skin), 15. Three adults (1 ♂, 2 ♀♀), total length, 197 (194–204); tail vertebræ, 108 (106–117).

Skull.—♀ ad., total length, 26; basal length, 21; zygomatic breadth, anteriorly, 10, posteriorly, 13; mastoid breadth, 10.5; interorbital breadth, 3.5; length of nasals, 9.6.

Type.—♂ ad., No. $\frac{18588}{11933}$, Cerros Island, Lower California, April 1, 1897; collected by A. W. Anthony.

Peromyscus cedrosensis is based on 4 adult specimens (1 ♂, 3 ♀) from Cerros (or Cedros) Island, Lower California, of which 3 were taken April 1 and 2, and 1 July 4, 1897, by Mr. Anthony. They are practically identical in coloration, except that the fulvous pectoral streak is indistinct in the July specimen, which is in rather worn pelage.

This species is nearest *P. eremicus fraterculus* Miller in coloration, but is much darker, with the lateral line much brighter, and the pectoral streak stronger and apparently much more constant.

***Peromyscus cineritius*, sp. nov.**

Size large, coloration light ashy gray.

Above light ashy gray, sparingly varied with blackish-tipped hairs, with a very slight suffusion of pale fulvous; beneath white nearly to the base of the fur; feet white, thinly haired; tail bicolor, dorsal third dusky brown, the sides and below whitish, moderately haired, and with a slight pencil at the tip.

Measurements.—Adult male, type, total length, 191; tail vertebræ, 83; hind foot (measured from skin), 21; ear (from skin), 15. Four adults (3 ♂♂, 1 ♀), total length, 184 (171–191); tail vertebræ, 78 (75–83).

Skull (type).—Total length, 27.5; basal length, 23; mastoid breadth, 11; interorbital breadth, 3.3; length of nasals, 9.5.

Type.—♂ ad., No. $\frac{18589}{11938}$, San Roque Island, Lower California, June 21, 1897; collected by A. W. Anthony.

Peromyscus cineritius is based on 9 specimens, from San Roque Island, Lower California, taken by Mr. A. W. Anthony, 8 of them on June 21 and 1 on April 16, 1897. Four of them are fully adult, three others are nearly so; one is quite young and the other is an unweaned young. Seven of the nine specimens are practically identical in coloration; the two young ones are darker gray, more varied with black, and entirely without the slight buffy suffusion of the adults.

This species is a member of the *texanus* group, but differs strikingly from all other members of it in its large size and pale ashy-brown coloration.

***Peromyscus geronimensis*, sp. nov.**

Similar in general coloration to *P. texanus*; size large for a member of this group.

Above rather pale fulvous brown, varied with black, which in young adults forms an indistinct, rather broad dorsal band; sides clearer pale fulvous; below clear white, the fur plumbeous at extreme base; tail bicolor, the dorsal third dusky, the sides and lower surface whitish, thinly haired.

Measurements.—Male adult (type), total length, 175; tail vertebræ, 83; hind foot (from skin), 20; ear (from skin), 14. Eighteen adult males, total length, 170 (164–182); tail vertebræ, 75 (70–83). Six adult females, total length, 176 (170–184); tail vertebræ, 78 (71–86).

Skull.—Male adult (type), total length, 25; basal length, 21; mastoid breadth, 11; interorbital breadth, 3.8; length of nasals, 8.

Type.—♂ ad., No. $\frac{13616}{11960}$, San Geronimo Island, Lower California, March 17, 1897; collected by A. W. Anthony.

This very distinct species of the *P. texanus* group is based on 24 specimens (18 ♂♂, 16 ♀♀), all adult, taken by Mr. A. W. Anthony, March 15 and 17, 1897, on San Geronimo Island, Lower California. Four or five have a more or less distinct median blackish dorsal band, and are doubtless 'young adults'; the smallest specimen of the series is in perfectly adult pelage. The 6 females average slightly larger than the 18 males.

Peromyscus geronimensis is very distinct from its geographically nearest mainland ally, *P. t. thurberi*, through its much larger size and very much paler coloration. It differs still more, and in a similar way, from *P. clementis* Mearns, from San Clemente Island, as shown by a series of 17 topotypes, received also from Mr. Anthony.

There are four other specimens of *Peromyscus* in Mr. Anthony's Lower California collection, made in 1897, from as many scattered localities, that greatly resemble the present species in size and coloration. Some of them may represent distinct insular forms, but the present material does not seem to warrant their separation. They are the following: Ascension Island, April 18, 1897, ♂ ad.; Natividad Island, April 19, ♂ ad.; San

Juanico Bay, June 13, ♂ ad. ; Turtle Bay, April 13, ♂ ad. The San Juanico Bay specimen is pale grayish brown with very little fulvous suffusion ; the Turtle Bay specimen is clear pale fulvous.

Peromyscus exiguus, sp. nov.

Similar in coloration to *P. clementis*, but smaller, with a relatively much shorter tail.

Measurements.—Male adult (type), total length, 154; tail vertebræ, 62; hind foot (from skin), 20; ear (from skin), 16. Five adult males, total length, 159 (154-168); tail vertebræ, 66 (62-72). The corresponding measurements, made by the same collector, of 6 adult males of *P. clementis*, are 164 and 82.

Skull.—♂ ad. (type), total length, 26.5; basal length, 22; mastoid breadth, 11.5; interorbital breadth, 3.5; nasals, 10.

Type.—♂ ad., No. $\frac{13574}{11933}$, San Martin Island, Lower California, March 14, 1897; collected by A. W. Anthony.

This form is represented by 6 adult males, collected on San Martin Island, Lower California, on March 14, 1897, by Mr. Anthony. As said above, in coloration it closely resembles topotypes of corresponding age of *P. clementis* Mearns, from San Clemente Island, off southern California (about three degrees north of San Martin Island), from which it differs mainly in smaller size and disproportionately shorter tail.

Peromyscus dubius, sp. nov.

Above very dark brown—a grayish fulvous brown much varied with black, more suffused with fulvous and with less black on the sides, and a narrow brownish fulvous lateral line; beneath white, the fur plumbeous at base; feet soiled white; tail sharply bicolor, the dorsal third blackish brown, the sides and lower surface soiled white.

Total length, ♂ ad. (type and only specimen), 175; tail vertebræ, 82; hind foot (from skin), 18; ear (from skin), 15.

Skull.—Total length, 26; basal length, 21.5; zygomatic breadth (anteriorly), 12; mastoid breadth, 11; interorbital breadth, 3.5; length of nasals, 9.5.

Type.—♂ ad., No. $\frac{18586}{11532}$, Todos Santos Island, Lower California, March 11, 1897; collected by A. W. Anthony.

As represented by the single specimen above described, this is a very dark form, the skull showing full maturity. The *Neotoma* (*N. anthonyi*) from this island proves to be so distinct from all its congeners that it lends probability to the view that the *Peromyscus* found there is also a well-marked insular form of the *P. texanus* group.

Article IX.—REMOUNTED SKELETON OF PHENACODUS PRIMÆVUS. COMPARISON WITH EUPROTOGONIA.

By HENRY FAIRFIELD OSBORN.

PLATE XII AND FOUR TEXT FIGURES.

This unique skeleton was transferred to the American Museum with the remainder of the Cope Collection in 1893. It had been mounted¹ as found (Fig. 1), laterally crushed, a large portion of the vertebræ and ribs concealed so that their number could not

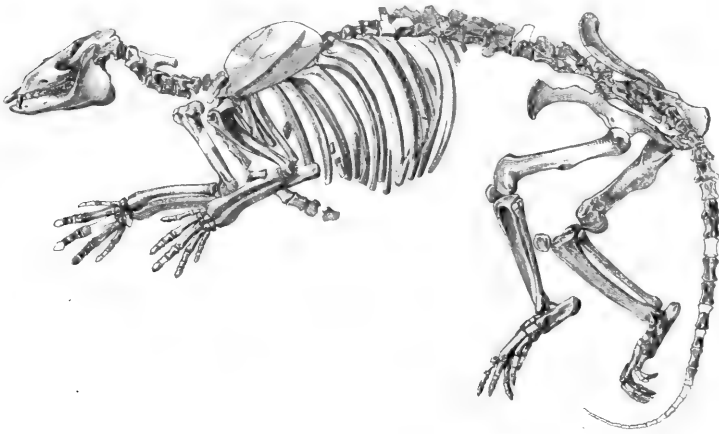


Fig. 1. Skeleton of *Phenacodus primævus* as originally mounted and cast under the direction of Professor Cope.

be definitely ascertained, and in such position as to convey a false impression both of the proportions and mode of location of this remarkably primitive Ungulate.

After very careful deliberation we decided to remove the skeleton entirely from the matrix, and remount it as nearly as possible in the natural position. This removal cost many months of labor

¹ See Cope, 'Tertiary Vertebrata,' Plate LVII E.

and two months more were occupied by Mr. Hermann, Preparator, in mounting the animal as represented in Plate XII. This mount is now a model of its kind, since it not only displays the real characters of the animal, but every bone upon one side of the body or the other can be removed for purposes of detailed study. Moreover, in course of removal of the stone and plaster matrix, the two missing cervical vertebræ were found inserted in the tail, and the number of ribs was definitely ascertained to be fifteen on each side, thus positively determining the dorsal vertebral formula, a matter of very great importance. These results alone justify the labor involved.

As photographed in Plate XII, *Phenacodus primævus* strikes us as a rather slenderly built, straight-limbed animal, digitigrade like the Tapir, five-toed, but almost exclusively supported on three toes both upon the fore and hind feet, with the median toe considerably enlarged, well hoofed, and extended beyond the others; therefore functionally of the tridactyl type. Flower's restoration, in his volume upon the Horse, is very nearly correct. The upwardly-arched back, powerful lumbar vertebræ, the long hind-quarters (measuring 635 mm.), the long powerful tail, when contrasted with the much shorter fore-quarters (measuring 460 mm.), the rather low withers and small head, are reminiscent of Creodont ancestry.

Phenacodus was, in fact, a swift-footed, cursorial, small-brained, microcephalic type (in distinction from *Coryphodon*). It was largely propelled by its powerful hind limbs. The skeleton is, however, straight limbed at the elbow in contrast with the early Amblypods, such as *Pantolambda* and *Coryphodon*.¹ In this respect it approaches that of the Perissodactyla. The terminal phalanges of the three median toes are broad and spreading, while the lateral phalanges have rather the narrow compressed type seen in *Euprotogonia*.

The most striking features of the skull are the small size and separation of the basicranial foramina, the simple primitive structure of the whole region around the ear at the base of the skull (the auditory meatus being bounded posteriorly by the mastoid),

¹ See Osborn, 'A Complete Skeleton of *Coryphodon*,' Bull. Am. Mus. Nat. Hist., Vol. X, April 5, 1898, pp. 81-91.

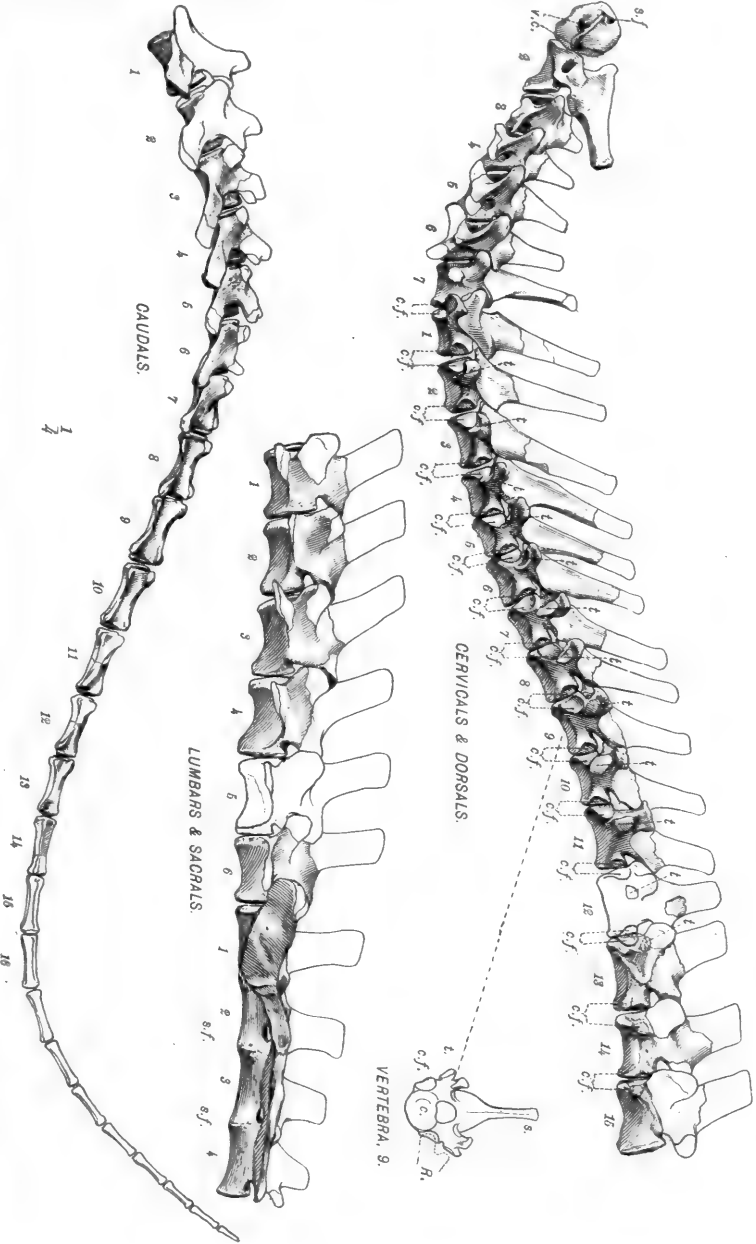


Fig. 2. Vertebral Column of *Phenacodus primævus*: s. f., spinous foramen; v. c. vertebrarterial canal; c. f., capicular facets; t. tubercular facets. Spines, fifth lumbar vertebra and posterior caudal vertebrae restored. One-fourth natural size.

[May, 1898.]

and the longitudinal grooves upon the superior intranareal surfaces of the maxillaries (also observed in *Coryphodon*). The proportions and characters of the skull (exclusive of the teeth) are identical with those in the ancient Amblypoda, such as *Peripitychus* and *Pantolambda*.

The distinctive feature of the vertebral column is the small number of dorsal vertebræ, namely 15, exactly as in *Coryphodon* and *Titanotherium*, giving a dorso-lumbar formula of 20-21. In

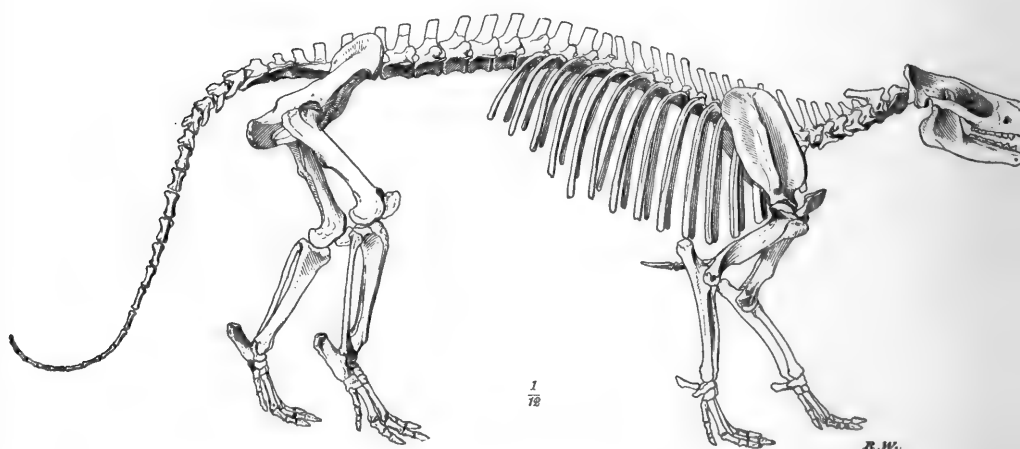


Fig. 3. Skeleton of *Phenacodus primævus* placed in the standing position to show elevation of the withers. One-twelfth natural size.

the writer's opinion this number is characteristic of the primitive Condylarthra or Protungulata. Marsh,¹ on the other hand, has assigned to the Holodactyla (Condylarthra) 23 dorso-lumbars, and to the Protungulata 30 dorso-lumbars or more. The second distinctive feature is found in the splitting of the transverse processes on the posterior dorsals for articulation with the tubercles of the ribs and for the support of the zygapophyses respectively, as shown in Fig. 2, these processes being sharply separate.

¹ 'Dinocerata,' pp. 171, 172.

TABLE OF MEASUREMENTS.

	<i>Phenacodus.</i>		<i>Euprotogonia.</i>	
	Feet.	In.	Metres.	Metres.
Length, chin to perpendicular line of tail.	4	4 $\frac{3}{4}$	1.340	
Length, chin to ischiac symphysis			1.220	.590
Length skull, condyles to symphysis of premaxillæ . . . . .			.235	
Height, dorsal spines at withers. . . . .			.550	.270
Height, dorsal spines at hips. . . . .			.585	.280
Limbs, total length of hind-limb, outside measurement.	2	1	.635	.310
Limbs, total length of fore-limb, outside measurement.	1	6	.460	

Euprotogonia puercensis thus appears to be about one-half the size of *Phenacodus primævus* in all its measurements. As shown in Fig. 4, the lateral digits are considerably longer, reaching the ground.



Fig. 4. Skeleton of *Euprotogonia puercensis* as now mounted, with missing parts restored in outline from *Phenacodus*. One-twelfth natural size. Same scale as *P. primævus*.

COMPARISON WITH EUPROTOGONIA.

Euprotogonia.

[TORREJON.]

- (1) Caudals 18 preserved, neural arches complete in C 1-8. D. L. formula unknown.
- (2) Fore-limb. Posterior face of ulna convex. (C.)
- (3) Ectepicondylar ridge prominent. (C.)
- (4) Magnum very small. (C.)
- (5) ? Os centrale. (C.)
- (6) Trapezoid very short. (C.)
- (7) Terminal phalanges laterally compressed, intermediate between hoofs and claws.
- (8) Hind-limb. Femur with sharp and prominent patellar trochlea.

Phenacodus.

[WASATCH.]

- Caudal formula indeterminate. Neural arches complete anteriorly. D. L. = 20-21.
- The same, concave.
- The same.
- Magnum somewhat enlarged.
- The same wanting.
- The same somewhat enlarged.
- Hoofs fully formed in *P. primævus*.
More compressed in *P. (Trispseudylus) wortmani*.
- The same.

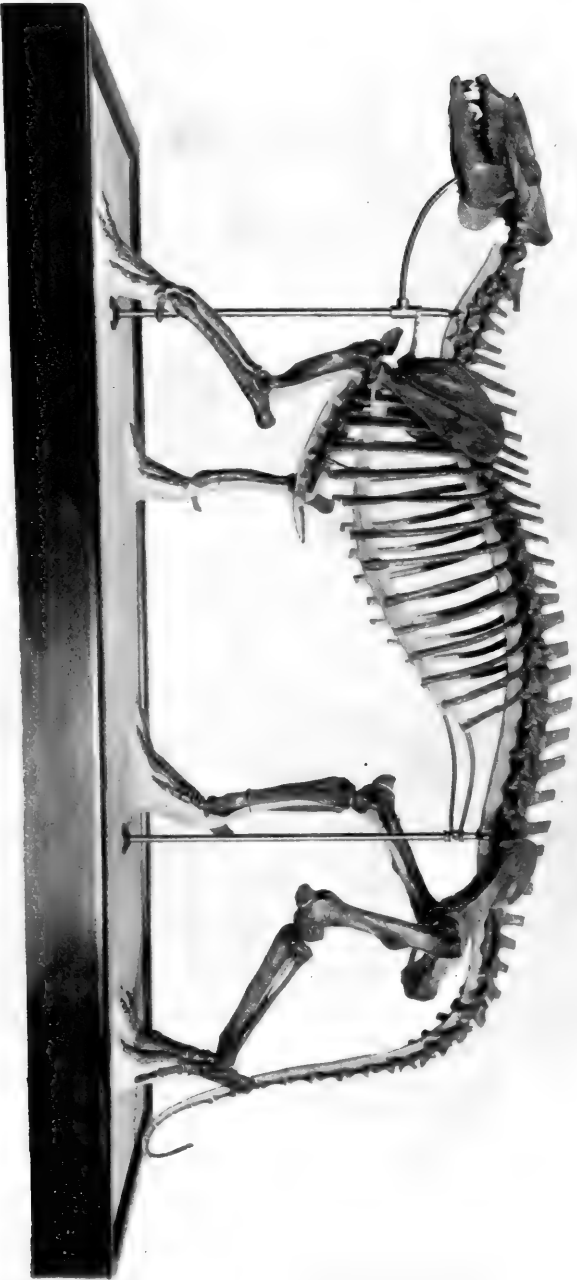
COMPARISON WITH EUPROTOGONIA.—Continued.

<i>Euprotopogonia.</i> [TORREJON.]	<i>Phenacodus.</i> [WASATCH.]
(9) Tibial spines sharp and prominent ; cnemial crest very prominent and elongate. (C.)	The same. Cnemial crest less prominent, and shorter.
(10) No fibulo-calcaneal facet.	The same.
(11) Astragalo-cuboidal facet depressed.	The same.
(12) An astragalar foramen ; tibial trochlea in front of foramen, <i>i.e.</i> , sub-digitigrade. (C.)	No astragalar foramen. Tibial trochlea extended further back, <i>i.e.</i> , fully digitigrade.
(13) Meso-cuneiform very short. (C.)	The same.
(14) Lateral digital reduction advanced : ratio of Mts.V : Mts.III : 23 mm. 37 mm., or as 2 : 3.	Lateral digital reduction still more advanced : ratio of Mts.V : Mts. III : 35 mm. : 73 mm., or as 1 : 2.
(15) Metatarsals and phalanges slightly curved. (C.)	The same nearly straight.

This strengthens the observation of Matthew,¹ in his recent comparison of these types, that the features in which *Phenacodus* differs from *Euprotopogonia* are progressions from the Creodont type, as indicated in the above column by the letter C.

A far larger proportion of Creodont characters are, however, found in the Amblypod contemporary of *Euprotopogonia*, namely, *Pantolambda*, which will be fully described by the writer in a forthcoming paper.

¹ 'Revision of the Puercu Fauna,' Bull. Am. Mus. Nat. Hist., Vol. IX, 1897, pp. 305-308.



Mounted skeleton of *Phomocodus primaeus*.

(One-twelfth natural size.)

Article X.—NOTES ON MEXICAN FISHES OBTAINED
BY DR. CARL LUMHOLTZ.¹

By TARLETON H. BEAN.

Ptychocheilus lucius Girard.

Head, $4\frac{1}{3}$; depth, $4\frac{1}{2}$; eye, $6\frac{1}{2}$ in head. D. 9; A. 9; V. 9; P. 15; scales, 26-90-13; teeth, 2, 4-5, 2. Least depth of caudal peduncle, $3\frac{7}{8}$ in head. Maxillary reaching slightly past front of eye. Eye 2 in snout, which is 3 in head. Nape slightly elevated. Lateral line strongly decurved. Intestines robust; eggs numerous. Example from locality 45 (N. Sonora, F. Robinette), with *Catostomus bernardini*. Length of specimen, $12\frac{1}{2}$ inches; head, $2\frac{7}{8}$; depth, $2\frac{3}{4}$; snout, $\frac{1}{8}$; eye, $\frac{7}{16}$.

A smaller individual, $8\frac{3}{4}$ inches long, from N. Sonora, F. Robinette, with two examples of a *Catostomus*, shows the following:

MEASUREMENTS.

Length (tail imperfect).....	$8\frac{3}{4}$ in.
Head.....	2 in.
Depth.....	$1\frac{3}{4}$ in.
Least depth of caudal peduncle.....	$\frac{5}{8}$ in.
Snout.....	$\frac{1}{2}$ in.
Upper jaw.....	$\frac{3}{4}$ in.
Eye.....	$\frac{3}{8}$ in.
Postorbital part of head.....	1 in.
Distance from snout to dorsal.....	4 in.
Length of dorsal base.....	1 in.
Length of longest dorsal ray.....	$1\frac{5}{16}$ in.
Length of last dorsal ray.....	$\frac{5}{8}$ in.
Distance from snout to ventral.....	$3\frac{7}{8}$ in.
Length of ventral.....	$1\frac{1}{8}$ in.
Distance from snout to anal.....	$5\frac{1}{2}$ in.
Length of anal base.....	$\frac{7}{8}$ in.
Length of longest anal ray.....	$1\frac{1}{8}$ in.
Length of last anal ray.....	$\frac{9}{16}$ in.

D. iii, 8; A. ii, 9; V. i, 8; P. i, 16; scales, 24-87-12; maxillary not quite reaching front of eye.

¹ For a report on the Mammals and Birds of the Lumholtz Collection, see this Bulletin, Vol. V, 1893, pp. 27-42.—ED.

Leuciscus niger (Cope).

Head, $3\frac{5}{8}$; depth, 4; eye, $5\frac{1}{3}$ in head. D. ii, 8; A. ii, 7; V. i, 8; P. i, 15; scales, 17-83-11, about 41 rows from occiput to origin of dorsal; teeth, 2, 5-4, 1, the first three hooked, all with grinding surface, last two on left side worn off at the point; the right side appears to have dropped one tooth of inner row and one of outer. Gill-membranes broadly attached to isthmus. Upper jaw equal to snout and to interorbital width. Eye, $5\frac{1}{3}$ in head, $1\frac{1}{8}$ in snout. Intestine shorter than body. The ventral extends almost to vent. The example is a female; with three smaller ones it was taken at San Diego, Chihuahua, in the summer of 1891, by Dr. Lumholtz.

MEASUREMENTS.

Length to base of middle caudal rays.....	$7\frac{1}{4}$ in.
Depth of body.....	$1\frac{3}{4}$ in.
Least depth of caudal peduncle.....	$\frac{3}{4}$ in.
Length of head.....	2 in.
Length of upper jaw.....	$\frac{5}{8}$ in.
Length of snout.....	$\frac{5}{8}$ in.
Diameter of eye.....	$\frac{3}{8}$ in.
Distance between eyes.....	$\frac{5}{8}$ in.
Distance from snout to dorsal.....	4 in.
Length of dorsal base.....	$1\frac{5}{8}$ in.
Length of longest dorsal ray.....	$1\frac{1}{8}$ in.
Length of last dorsal ray.....	$\frac{5}{8}$ in.
Distance from snout to ventral.....	$3\frac{7}{8}$ in.
Length of ventral.....	$1\frac{1}{8}$ in.
Distance from snout to anal.....	$5\frac{5}{8}$ in.
Length of anal base.....	$\frac{3}{4}$ in.

The smaller examples measure from $4\frac{1}{2}$ to 6 inches to the end of the scales.

Catostomus bernardini Girard.

Mouth inferior, but well advanced, the lips well developed, profusely and minutely papillose, the papillæ in about five rows. The individual is a female with numerous, very small eggs. The lateral line continuous and extending almost to the end of the scales.

Head, equal to depth, 4; least depth of caudal peduncle, 12; postorbital part of head, 10; eye, $2\frac{1}{2}$ in snout, $5\frac{3}{4}$ in head; width of isthmus, $3\frac{3}{8}$ in head. D. i, 11 to 12; A. i, 7; V. i, 9; P. 15; scales, 11 to 12-70 to 72-12; margin of lips cordate.

MEASUREMENTS.

	♀ N. Sonora, F. Robinette.	
Extreme length.....	$13\frac{3}{4}$ in.	$13\frac{1}{2}$ in.
Length of caudal fin.....	$2\frac{1}{4}$ in.	2 in.
Length of head.....	$2\frac{7}{8}$ in.	3 in.
Depth of body.....	$2\frac{5}{8}$ in.	$2\frac{5}{8}$ in.

Least depth of caudal peduncle	1 in.	1 in.
Length of snout	$1\frac{1}{4}$ in.	$1\frac{3}{8}$ in.
Diameter of eye	$\frac{1}{2}$ in.	$\frac{7}{16}$ in.
Distance between the eyes	$1\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
Length of postorbital part of head	$1\frac{1}{16}$ in.	—
Distance from snout to dorsal origin	$5\frac{5}{8}$ in.	$5\frac{7}{8}$ in.
Length of dorsal base	$1\frac{7}{8}$ in.	$1\frac{13}{16}$ in.
Length of longest dorsal ray	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.
Length of last dorsal ray	$\frac{7}{8}$ in.	$\frac{13}{16}$ in.
Distance from ventral origin to vent.	$2\frac{1}{2}$ in.	—
Distance from snout to ventral origin	—	$6\frac{1}{4}$ in.
Length of anal base	$\frac{7}{8}$ in.	$\frac{7}{8}$ in.
Length of longest anal ray	$2\frac{1}{4}$ in.	2 in.
Length of last anal ray	—	$1\frac{1}{8}$ in.
Distance from end of anal to caudal base	$1\frac{5}{8}$ in.	—
Length of pectoral	$2\frac{1}{8}$ in.	—
Length of ventral	$1\frac{3}{4}$ in.	$1\frac{3}{4}$ in.

The ventral originates under the middle of the dorsal base. The female was taken in company with a *Ptychocheilus lucius*, $12\frac{1}{2}$ inches long, at locality 45, N. Sonora, F. Robinette. The second, of which measurements are given, was collected with a *Ptychocheilus lucius*, $8\frac{3}{4}$ inches long, in N. Sonora, by F. Robinette. A smaller individual, $8\frac{1}{2}$ inches long, is evidently of the same species.

Pantosteus plebeius (B. & G.).

Head, $4\frac{1}{2}$; depth, 4% ; eye, $5\frac{1}{2}$ in head. Ventrals reaching to vent. Dorsal inserted midway between snout and upper caudal rays. Caudal moderately emarginate. Color, in spirits, dark brown above; belly and under surface of head pale; anal and ventrals paler than body. D. 9-10; A. 7; V. 9; scales, 84 to 90-28 to 30.

Three examples, varying in length from $6\frac{3}{8}$ to $6\frac{1}{2}$ inches, were taken associated with four individuals of *Leuciscus niger* at San Diego, Chihuahua, in the summer of 1891, by Dr. Lumholtz. Two of them have numerous small tubercles developed on the anal, caudal and caudal peduncle, especially upon the lower caudal lobe, and the third has a few tubercles on the anal and the lower portion of the caudal peduncle.

A specimen of *Pantosteus plebeius*, No. 168, U. S. Nat. Mus., from Rio Mimbres, J. H. Clark, $4\frac{3}{4}$ inches long, has D. 10; A. 7; scales 27-90. Ventral not quite reaching vent; head, 4; depth, 5; eye, 4 in head.

***Ameiurus dugesi* Bean.**

A single individual, $8\frac{7}{8}$ inches long, agreeing with the description of the above species, was taken at camp No. 25, Feb. 23, 1892, in the Rio Verde. It was killed with dynamite, and is not in good condition for study.

***Cyprinodon eximius* Girard.**

Two examples of this species, the larger $1\frac{7}{8}$ inches long, are from locality No. 39, San Diego, Chihuahua, F. Robinette. D. 11; A. 10; scales, 11-28.

Article XI. — EVOLUTION OF THE AMBLYPODA.
PART I. TALIGRADA AND PANTODONTA.

By HENRY FAIRFIELD OSBORN.

TWENTY-NINE TEXT FIGURES.

The Amblypoda constitute a sharply distinguished order of Ungulates which probably sprang from the Creodonta during the Cretaceous period and extended through the Eocene period in three great stages of evolution known as the suborders Taligrada, Pantodonta and Dinocerata, the latter entirely confined to North America.

They are arrested or persistently archaic in structure throughout, but especially in the brain, the triangular teeth, and the pentadactyl feet. The morphological problems involved in the skeleton and teeth, and the phylogenetic problems involved in the succession and extinction of the main and collateral lines, form the main subjects of this essay.

The American Museum has sent out a series of expeditions after remains of the Amblypoda: First, into the Wasatch of Wyoming, 1891; second, into the Bridger and Washakie Basins, 1893 and 1895; third, into the Torrejon, 1892 and 1896; fourth, into the Wasatch of New Mexico, and Big Horn Mountains of Wyoming, 1896. We have thus succeeded in bringing together invaluable material for the history of this remarkable group from the time it issued in the Creodont-like *Pantolambda*, of the Torrejon Beds until it became extinct in the largest Uintatheres of the Upper Washakie and Middle Uinta Beds.

Several very important results are obtained:

First.—The evidence can be clearly stated as to the succession of the known types of *Pantolambdidae*, *Coryphodontidae* and *Uintatheridae*. Many prophetic or ordinal characters are now observed in the earliest types; certain species of *Coryphodon* are found to show the rudimentary parietal horns and the incisiform

lower canines of the Uintatheres, but no known species leads directly into *Uintatherium*.

Second.—It is now demonstrable that the Periptychidæ belong in this group as a *bunodont division*, which probably arose and diverged in the Cretaceous period.

Third.—The nearly complete skeleton of *Pantolambda bathmodon*, the most archaic type of Ungulate known, places almost upon the firm basis of fact Cope's hypothesis, that the Ungulates sprang from the Creodont division of the Unguiculates.

Fourth.—A fairly complete systematic revision of the entire group is rendered possible.

The writer desires to express at the outset his indebtedness to Dr. J. L. Wortman for his energetic and intelligent supervision in the field of these various expeditions, assisted by Mr. Walter Granger, Mr. Barnum Brown and others; to Dr. W. D. Matthew for the skill and care with which the very fragmentary skeletons of *Pantolambda* have been put together, and for critical assistance in the diagnosis of specific types. Also to the various preparators and draughtsmen of the department.

I.—ORIGIN OF THE AMBLYPODA.

A. THE CRETACEOUS TRITUBERCULATE MOLAR.

Hypothetical Upper Cretaceous Ancestors.—In describing the Laramie mammals in 1893 the writer¹ directed attention to the resemblance which certain isolated upper and lower molars bore to the teeth of the Periptychidæ, especially to *Ectoconus* and *Haploconus*. The figures of these teeth are here reproduced.

In *C* (*Synconodon*), the crowns are laterally compressed, thus bringing the primary proto-, para- and metacones, both of the trigon and trigonid, very close together. This compression of the primary cones is also true of *F* (*Ectoconodon*), in which type the outer wall is reinforced as in *Ectoconus* by accessory tubercles.

¹ Osborn, 'Upper Cretaceous Mammals,' Bull. Am. Mus. Nat. Hist., Vol. V, pp. 325-329.

This compression is an essential character of the Periptychidæ. The upper and lower molars of *Protolambda*, *Hl*, *A* and *Al*, on the other hand, resemble those of the Pantolambdidiæ.

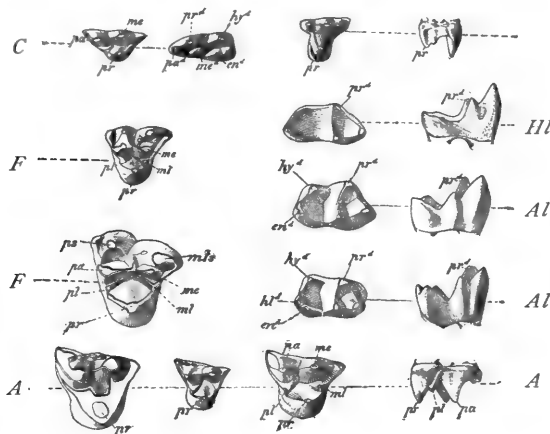


FIG. 1. LARAMIE TRITUBERCULATES.

C. Synconodon sexicuspis. Upper and lower molar types. Nos. 2218, 2220. Am. Mus. Coll.

F. Ectoconodon petersoni. Upper molar types. Nos. 2224, 2223. Am. Mus. Coll.

A. Protolambda hatcheri. Upper molar types. Nos. 2201-3. Am. Mus. Coll.

Lower molars *Hl*, *Al* (possibly correlated), Nos. 2241, 2230, 2231. Am. Mus. Coll.

These types may now be defined as follows :

Synconodon, gen. nov.

Type.—Isolated upper and lower molars. Am. Mus. Coll., Nos. 2218, 2220.

Definition.—Molars long and narrow. Trigons laterally compressed, primary cones approximated. Talonid well developed.

S. sexicuspis, sp. nov.

Definition.—Talonid of lower molars with three cusps, hypoconid, hypoconulid, entoconid. Type as above. Fig. 1, *C*.

Ectoconodon, gen. nov.

Type.—Isolated superior molars. Loc., Laramie. Am. Mus. Coll., Nos. 2223, 2224.

Definition.—Superior molars very broad. Trigon laterally compressed. Two external prominent cones (parastyle and metastyle), reinforcing the outer wall of the crown.

E. petersoni, sp. nov.

Superior molars with conules and a rudimentary mesostyle. Type as above. Fig. 1, *F*.

Protolambda,¹ gen. nov.

Type.—Four isolated upper molars. Loc., Laramie. Am. Mus. Coll., Nos. 2201-3.

Definition.—Superior molars with open trigon and elongate outer wall. Paracone and metacone laterally compressed. Conules subrescensitic. Parastyle prominent.

P. hatcheri,² sp. nov.

With rudimentary spur, metastyle on posterior external border.

Type, as above. Fig. 1, A.

The lower molars *Hl* and *Al*, in Fig. 1, probably are associated with this type.

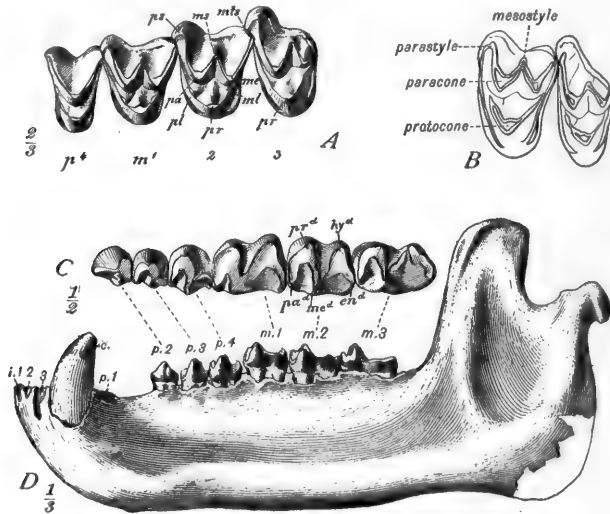


Fig. 2. *Pantolambda cavirictus*. A, superior molars, No. 963; B, diagram of same; C, inferior molars, crown view, No. 3961; D, lower jaw, type of *P. cavirictus*. Am. Mus. Coll.

These types are quite distinct from the trituberculates described by Marsh³ from the Laramie, namely, *Didelphops*, *Cimolestes*, *Pedomys*, *Telacodon*, *Batodon*, so far as these are known.

These animals are defined and placed here *hypothetically* merely to show that *in the Upper Cretaceous are found types of upper and lower teeth capable of giving origin to the teeth of the Amblypoda.*

¹ Having a type of tooth antecedent to that of *Pantolambda*.

² Dedicated to Mr. J. B. Hatcher, the well-known writer and explorer.

³ Discovery of Cretaceous Mammalia, Pts. I, II, III, Am. Jour. Sci., July, 1889, to Mch., 1892.

EVOLUTION OF THE MOLARS IN THE AMBLYPODA.

The upper and lower molars of the Periptychidæ are purely bunodont, characterized by a compressed trigon, the development of accessory external cusps, and crescentic internal cusps upon the superior premolars. The latter recall the teeth of *Pantolambda*. *Ectoconus* is the only type in which the lower premolars tend to become molariform.

The *Pantolambda* superior molar (Fig. 2 A) shows a crescentic disposition of the three primary cones, which are, however, closely approximated as in the Periptychidæ, the outer wall of the crown extending widely into the parastyle. The lower molar shows a lofty trigon distinguished by the marked elevation of the metaconid, and a talonid best shown in Fig. 2 D. No true hypoconulid is developed. From the entoconid a spur extends forwards and inwards, to which the designation 'entoconid 2' may be given, as seen in Fig. 3. This little cusp becomes a very important feature of the crown in *Bathyopsis* and *Uintatherium*.

The *Coryphodon* superior molar (Fig. 4), as homologized by Cope, Earle and the writer, exhibits a protoloph and an ectoloph consisting of a greatly reduced paracone, a vestigial mesostyle and strongly crescentic metacone. In the last superior molar these ectoloph elements are transformed into a single oblique lophoid crest. The inferior *Coryphodon* molar (Fig. 3) shows a greatly elevated protoconid, an enlarged metaconid and depressed paraconid. The talonid consists of a hypoconid, entoconid and a low spur, the entoconid 2, prophesied in *Pantolambda*.

From this, the *Bathyopsis* and *Uintatherium* lower molar is readily derived, as shown in Fig. 3, simply by the fission of the metaconid into the metastylid, *mlid*, and further reduction of the paraconid and entoconid 2. This fission is an ad-

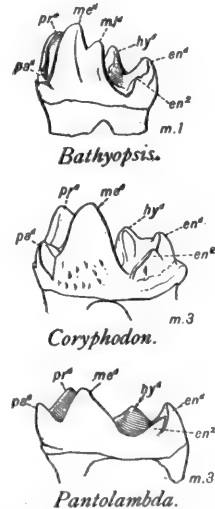


Fig. 3. Lower molars, Amblypoda. Diagrams showing evolution of crown. Not to scale.

prc protoconid; *pac* paraconid; *me* metaconid; *mlid* metastylid; *hy* hypoconid; *en* entoconid; *en.2* entoconid 2.

ditional analogy with the Horse molar to those which the writer has already pointed out.

The superior molar of *Bathyopsis* is unknown. That of *Uintatherium* probably represents, as Cope supposed, the ectoloph swung around so as to form with the protoloph a V opening outwards. Just internal to the apex of the V the hypococone is often developed.

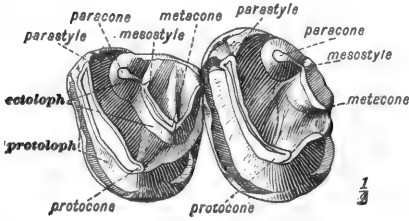


Fig. 4. Upper molars of *Coryphodon testis*, showing primary and secondary elements. Am. Mus. Coll., No. 274.

We thus observe a set of profound changes resulting finally in the unique lophodont crown of *Uintatherium*.

B. EVOLUTION OF THE UNGULATE FOOT FROM THE CREODONT TYPE.

Cope's famous generalization as to the serial character of the primitive ungulate foot, supported and extended by Osborn, has been recently disputed by Matthew (1897, p. 320) upon the very strong ground that most of the earliest, *i. e.*, basal Eocene, feet are non-serial or displaced; so far as known, both the Creodont carpus and tarsus are certainly non-serial. Cope's generalization

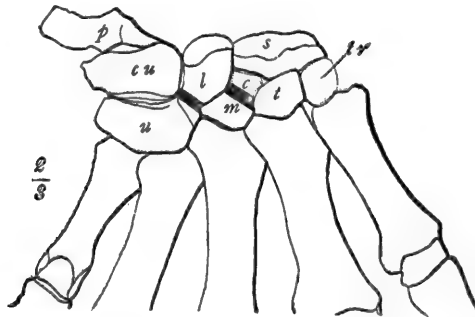


Fig. 5. Creodont carpus (*Dissacus carnifex*), heavy lines showing hypothetical protungulate displacement.

therefore appears to be non-consistent with his own theory that the Ungulates sprang from Creodonts.

The evidence *as to the earliest types* stands thus :

	<i>Creodonta.</i>	<i>Amblypoda.</i>	<i>Condylarthra.</i>	<i>Meniscotherium.</i>
Carpus	Non-serial.	Non-serial.	Non-serial.	Non-serial.
Tarsus	Non-serial.	Non-serial.	Serial.	Serial.

Carpus.—Matthew's conclusion is important as concentrating our attention upon the *interlocking* or *alternating* (lunar on unciform, scapho-centrale on magnum) carpus of such a Creodont type as *Dissacus* (Fig. 5), from which the *carpus* of the *Amblypoda* and *Condylarthra*, and probably of all Ungulata, may be derived.

The manner in which this was probably effected is :

<i>Amblypoda.</i>	<i>Condylarthra.</i>
Absorption or coalescence of centrale.	Absorption or coalescence of centrale.
Lunar remaining on unciform.	Magnum greatly enlarged and spreading beneath lunar, which is thus separated from unciform.
Magnum somewhat enlarged.	

The *enlargement of the magnum*, as observed in both *Amblypoda* and *Condylarthra*, would tend to *readjust* the primitive Creodont interlocking or displaced arrangement, and, especially where the weight is concentrated on the median toes, give us the *secondarily serial Phenacodus* type.

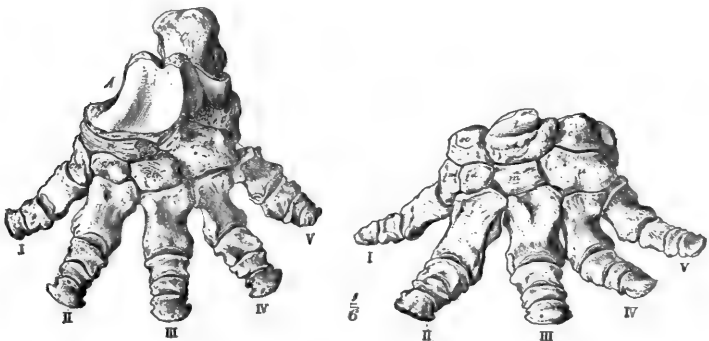


Fig. 6. Pes and Manus of *Coryphodon testis*, viewed from above, showing enlarged magnum. Am. Mus. Coll., No. 258.

Tarsus.—In the tarsus the case is different; while the non-serial Amblypod (*Pantolambda*) tarsus can be directly derived from the Creodont, the serial Condylarth tarsus probably arose from an unknown serial Creodont. Hence a double or parallel derivation of the two-hoofed orders, as follows :

<i>Protungulate</i>	Persistent atypical displacement in	Carpus secondarily serial. Tarsus persistently serial.	Carpus and tarsus typically displaced.
<i>Creodonta.</i>	carpus and tarsus.		
Tarsus interlocking, }	.....<i>Amblypoda.</i>		
Carpus interlocking, }	.....<i>Condylarthra.</i> <i>Diplarthra.</i>		
Tarsus serial. ....	.....	

Other characters of the primitive foot are given in the following synopsis, also upon pages 184, 187, 188, 216 of this Bulletin :

2.—SYNOPSIS OF THE EVOLUTION OF THE AMBLY- PODA.

The subjoined table brings out the three important laws of phylogeny as applied to taxonomy :

First.—The *persistent primitive* characters (*P.p.*) are also the *ordinal characters*, which serve to separate this phylum from the Condylarthra, Proboscidea, Hyracoidea, Diplarthra and other ungulate orders.

Second.—The *primitive* (*Pr.*) *progressive*, (*Pg.*) and *retrogressive characters* (*Re.*) constitute the *subordinal characters*.

Third.—Among the above characters are innumerable characters both in skull, limb and foot structure in which the Amblypoda *parallel* certain Perissodactyla, Artiodactyla and Proboscidea. The latter are mainly approached in the adaptations to great body weight, which first misled Cope to place this group with the Proboscideans.

Primitive [*Pr.*], Persistent primitive [*P.φ*], Progressive [*Pg.*] and Retrogressive [*Re.*] Characters.

	<i>Taligrada.</i>	<i>Pantodonta.</i>	<i>Dinocerata.</i>
SKULL.	<p><i>P.φ.</i> Brain small, olfactory lobes large, hemispheres smooth, cerebellum exposed.</p> <p><i>Pr.</i> No air cavities. Sagittal crest. Frontoparietal sutures open.</p> <p><i>P.φ.</i> Anterior nares terminal.</p> <p><i>Pr.</i> Premaxillæ separate, reaching nasals.</p> <p><i>Pr.</i> Maxillaries smooth.</p> <p>Frontals smooth.</p> <p><i>Pr.</i> Parietals smooth.</p> <p><i>Pr.</i> Nasals smooth, extending between orbits.</p> <p><i>P.φ.</i> Mastoid (periotic) widely exposed, perforate, bordering auditory meatus.</p> <p><i>Pr.</i> No alisphenoid canal.</p> <p><i>P.φ.</i> Zygomatic arches slender.</p> <p><i>Pr.</i> Mandibular condyle elevated, facing upwards.</p>	<p>The same.</p> <p><i>Pg.</i> Extensive air cavities. Cranium flattened. Frontoparietal sutures closed.</p> <p>The same.</p> <p>Premaxillæ grooved above, separate, not reaching nasals.</p> <p>The same.</p> <p><i>Pg.</i> Frontals with supraorbital knobs.</p> <p><i>Pg.</i> Rudimentary parietal horns.</p> <p>The same, shortened, extending between orbits.</p> <p>The same, much compressed.</p> <p>The same.</p> <p>The same.</p> <p>Condyle elevated, facing obliquely.</p>	<p>The same.</p> <p>The same.</p> <p>The same.</p> <p><i>Re.</i> Premaxillæ divergent, edentulous, reaching nasals.</p> <p><i>Pg.</i> Maxillaries with horns.</p> <p>The same.</p> <p>Large parietal horns.</p> <p><i>Pr.</i> Nasals with rudimentary horns; reduced in length.</p> <p>The same, widely exposed and perforate, bordering auditory meatus.</p> <p><i>Pg.</i> An alisphenoid canal.</p> <p>The same.</p> <p><i>Pg.</i> Condyle depressed, facing backwards.</p>
DENTI-TION.	<p><i>Pg.</i> Molars triangular (tritubercular), selenodont.</p> <p><i>Pr.</i> Paracone complete.</p> <p>Superior premolars composed of two crescents, unlike molars.</p> <p><i>Pr.</i> Superior incisors present.</p> <p><i>Pr.</i> Canines round, normal.</p>	<p>Molars triangular, selenolophodont.</p> <p><i>Pg.</i> Paracone reduced.</p> <p>The same.</p> <p>The same present.</p> <p><i>Pg.</i> Canines round, trihedral, or compressed, enlarged.</p> <p>The same.</p>	<p>Molars triangular, lophodont.</p> <p><i>Re.</i> Paracone wanting.</p> <p>Superior premolars submolariform.</p> <p><i>Re.</i> The same absent, or vestigial.</p> <p><i>Pg.</i> Superior canines lance-shaped. Inferior, incisiform.</p>
VERTEBRÆ.	<p><i>Pr.</i> Cervicals short, dorsals and lumbar with short spines.</p>	<p>The same.</p>	<p>The same.</p>

	<i>Taligrada.</i> <i>Continued.</i>	<i>Pantodonta.</i> <i>Continued.</i>	<i>Dinocerata.</i> <i>Continued.</i>
VERTEBRÆ.	<i>P. p.</i> D. L. — ?. Sacrales unknown.	<i>Pr.</i> D. = 15, L. = 5. Sacrales unknown.	D. L. = ? Sacrales = 4.
RIBS.	<i>Pr.</i> Very short.	The same.	The same.
ARCHES.	<i>Pr.</i> Scapula acuminate, fossæ subequal. <i>Pr.</i> Ilium acuminate.	<i>Pg.</i> The same, infraspinatus fossæ somewhat enlarged. <i>Pg.</i> Ilium, border expanded.	<i>Pg.</i> Scapula triangular; infraspinatus fossæ greatly enlarged. The same.
FORE-LIMB.	<i>Pr.</i> Bent outwards at elbow: manus everted.	The same.	<i>Pg.</i> Straight, or vertical at elbow.
HUMERUS.	<i>Pr.</i> An entepicondylar foramen. <i>Pr.</i> Prominent deltoid and ectepicondylar (supinator) crests.	<i>Pg.</i> No entepicondylar foramen. <i>Pg.</i> Entepicondyle somewhat reduced.	The same. The same.
RADIUS AND ULNA.	<i>Pr.</i> Subequal. <i>Pr.</i> Ulna, posterior border convex.	The same. <i>Pg.</i> The same, concave.	The same. The same, concave.
CARPUS.	<i>Pr.</i> Lunar resting upon cuneiform. <i>Pr.</i> An os centrale. <i>Pr.</i> Magnum small. <i>Pr.</i> Plantigrade.	The same. <i>Pg.</i> Os centrale united. <i>Pg.</i> Magnum larger. <i>Pg.</i> Sub-digitigrade.	The same. The same. The same. Digitigrade.
FEMUR.	<i>Pr.</i> Prominent third trochanter.	<i>Re.</i> Reduced third trochanter.	No third trochanter.
TIBIA.	<i>P. p.</i> Rudimentary spine and cnemial crest. Femoral facets, approximate.	The same. The same, approximate.	The same. The same, confluent.
FIBULA.	<i>Pr.</i> Articulating with calcaneum.	The same.	<i>Pg.</i> Not articulating with calcaneum.
TARSUS.	<i>Pr.</i> A tibiale. <i>Pr.</i> Mesocuneiform small. <i>Pr.</i> Astragalus with neck.	<i>Pg.</i> A tibiale, variable. <i>Pg.</i> The same, enlarged. <i>Pg.</i> Astragalus without neck.	A tibiale, variable. The same, enlarged. The same.

	<i>Taligrada.</i> <i>Continued.</i>	<i>Pantodonta.</i> <i>Continued.</i>	<i>Dinocerata.</i> <i>Continued.</i>
TARSUS.	<i>P.p.</i> Astragalar foramen. <i>Pr.</i> An astragalo-cuboidal facet. <i>Pr.</i> Astragalo-tibial facet very limited and facing obliquely outwards. <i>Pr.</i> A calcaneo-fibular facet. <i>Pr.</i> Mts. V. curved with prominent 'peroneus brevis' process. <i>Pr.</i> Plantigrade.	The same, variable. The same. <i>Pg.</i> The same, extended, horizontal, approaching astragalo-navicular facet anteriorly. The same. <i>Pg.</i> The same straight, process reduced. <i>Pg.</i> Subdigitigrade.	The same, variable. The same. <i>Pg.</i> The same, extended, horizontal, separated from astragalo-navicular facet anteriorly. <i>Pg.</i> No calcaneo-fibular facet. The same, straight; process vestigial. <i>Pg.</i> Digitigrade.
FEET.	<i>Pr.</i> Pentadactyle and isodactyle.	The same.	The same.

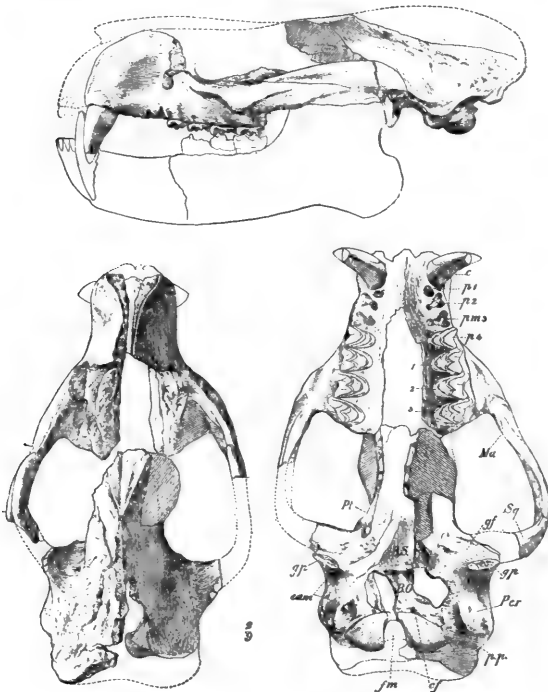


Fig. 7. *Pantolambda cavirictus*. Cotype. Lateral, inferior and superior views of cranium. Am. Mus. Coll., No. 963.

3.—SYSTEMATIC REVISION.

Order AMBLYPODA *Cope*.

Most primitive order of Ungulates known. *Brain* very small, with smooth cerebral hemispheres, large olfactory lobes and exposed cerebellum. *Dentition* brachyodont: Superior molars triangular (tritubercular, bunodont, selenodont, lophodont), rarely with functional hypocone. *Feet* pentadactyl, isodactyl; plantigrade (as in Bear) to subdigitigrade (as in Elephant). *Displacement* in carpus (unlike Diplarthra); lunar resting on unciform only; in tarsus (like Diplarthra), astragalus resting on cuboid. A tibiale tarsi. Astragalus perforated or grooved.

The three suborders are very widely separated.

SUBORDINAL CHARACTERS.

<i>Taligrada</i> Cope.	<i>Pantodonta</i> Cope.	<i>Dinocerata</i> Marsh.
<i>Dentition.</i>		
Typical Eutherian formula.	The same.	No superior incisors.
Molars tritubercular selenodont.	Lopho-selenodont.	Lophodont.
Premolars simple, with two crescents.	Premolars simple, two crescents.	Premolars submolariform.
<i>Skull.</i>		
Nasals, frontals and parietals smooth. A sagittal crest. No alisphenoid canal; no air cavities.	Rudimentary parietal horns. Cranium flattened. No alisphenoid canal. Air cavities.	Nasal, maxillary and parietal horns. Cranium flattened. An alisphenoid canal. Air cavities.
<i>Limbs.</i>		
Plantigrade. An entepicondylar foramen. A 3d trochanter. An os-centrale. Fibula articulating with calcaneum. Astragalus with neck.	Semi-plantigrade. No entepicondylar foramen. A 3d trochanter. No os-centrale. Fibula articulating with calcaneum. Astragalus without neck.	Sub-digitigrade. Entepicondylar foramen. A 3d trochanter. Os-centrale wanting. Fibula not articulating with calcaneum. Astragalus without neck.

Suborder TALIGRADA *Cope.*

Family PERIPTYCHIDÆ *Cope.*

Molars bunodont, primitive triangle compressed in superior molars; secondary internal cusps developed (protostyle and hypocone). Lower molars with hypoconulid. Third and fourth upper and lower premolars enlarged.

Family PANTOLAMBIDÆ¹ *Cope.*

Molars selenodont, primitive triangle less compressed. Lower molars without hypoconulid. No secondary internal cusps.

Family PERIPTYCHIDÆ *Cope.*

In 1892 (op. cit., p. 47) Osborn pointed out that *Periptychus* is distinguished from the order Condylarthra (in which it had been placed by Cope) first, because the *tarsus is not serial*, there being a displacement of the astragalus upon the cuboid; second,

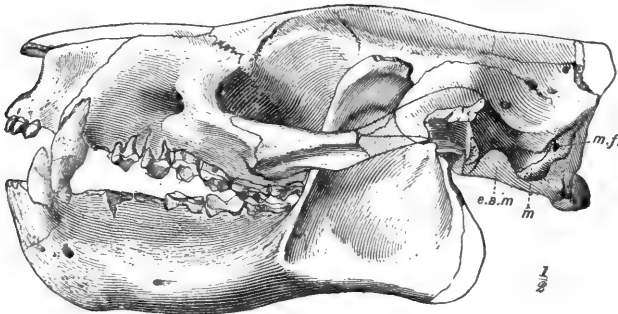


Fig 8. *Pantolambda bathmodon*. Lateral view of skull, showing wide exposure of mastoid. Composition of Nos. 2550 and 2549, Am. Mus. Coll.

because it has the *strictly trigonal molar* of the Amblypoda. In 1897² Cope adopted this view and removed the Periptychidæ to the Amblypoda. The close comparison of *Pantolambda* and *Periptychus* given below fully confirms this step. The condition of the upper premolars as composed of two crescents and (unlike

¹ See Osborn and Earle, 1892, p. 49.

² Am. Nat., 1897, p. 335. Matthew has, however, retained the Periptychidæ in the Condylarthra.

the Condylarthra) with little or no tendency to acquire the molar pattern, is essentially similar in the two families.

Subfamily ANISONCHINÆ *O.&E.* Subfamily PERIPTYCHINÆ *O.&E.*

Smaller forms. ? Arboreal.
Superior molars with conules suppressed or wanting. Paraconid reduced or wanting. Astragalus short and wide,¹ with deeper trochlea.

Larger forms. ? Terrestrial.
Superior molars well developed. Paraconid strong. Astragalus with shallower trochlea.²

The genera and species of Periptychidæ, as recently revised by Matthew,² are given in the following geological table.

	Cretaceous.		Basal Eocene.		Lower Eocene.			Middle Eocene.			
	Laramie.	Puerco.	Torrejon.	Wasatch.			Wind River.	Bridger.			
				Lower.	Middle	Upper.		Bridger.	Washakie.	Uinta, A and B.	
UINTATHERIIDÆ								×	×	×	
BATHYOPSIDÆ								×			
CORYPHODONTIDÆ				×	×	×	×				
PANTOLAMBIDÆ.											
Pantolambda cavirictus			×								
“ bathmodon			×								
PERIPTYCHIDÆ.											
Ectoconus ditrigonus		×									
Periptychus rhabdodon			×								
“ carinidens			×								
“ coarctatus		×									
Conacodon entoconus		×									
“ cophater		×									
Haploconus lineatus			×								
“ corniculatus			×								
Anisonchus sectorius			×								
“ gillianus		×									
Hemithlæus kowalevskianus		×									
INCERTÆ SEDIS.											
Ectoconodon	×										
Synconodon	×										
Protolambda	×										

¹ Matthew, Bull. Am. Mus. Nat. Hist., 1897, p. 297.

² Op. cit., p. 265.

Family PANTOLAMBIDIDÆ Cope.

Genus *Pantolambda* Cope.

Dentition typical. First upper premolar one-rooted. Second, third and fourth three-rooted, with internal cones. Canines rounded.

P. bathmodon.

Type: Mandibular ramus, No. 3956.
Smaller size. Both dental series continuous.

P. cavirictus.

Type: Jaw, No. 3961.
Larger size. First lower premolar close to canine and separated from second by a wide diastema. Premolars reduced in size.

*P. cavirictus*¹ Cope.

The type lower jaw, described and figured by Cope (Am. Nat., Vol. XVIII, p. 1111) is peculiar in the close apposition of the first lower premolar to the canine, and the wide diastema behind it. This is the largest type known and the diastema is probably prophetic of the diastema invariably observed in *Coryphodon*, (Fig. 2).

The skull (Fig. 7) was mistakenly described by Osborn and Earle in 1895 (1895,² p. 43) as *P. bathmodon*. It differs in its much greater size from *P. bathmodon*, and in the absence of diastemata from the *P. cavirictus* jaw. Unlike *Coryphodon* the upper canines are mainly worn upon the inner posterior surface.

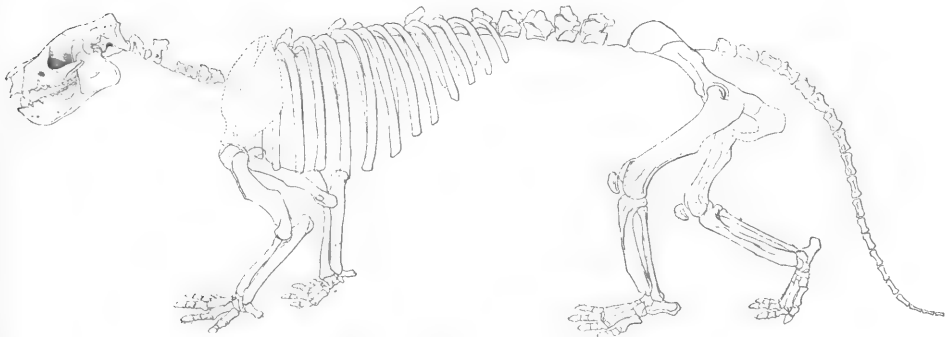


Fig. 9. Skeleton of *Pantolambda bathmodon*. Scapula wholly, pelvis partly restored. Composition from several individuals. One-eighth natural size.

¹ Am. Nat., Vol. XVII, 1883, p. 968.

² Am. Nat., Vol. XVI, 1882, p. 418.

P. bathmodon¹ Cope.

The composition skeleton of *P. bathmodon* measures 2 feet 9 inches (830 mm.) from the premaxillaries to the back of the ischiac symphysis, and 1 foot 1¾ inches at the withers. It is thus about the size and proportions of a large Wolverine (*Gulo luscus*).

Excepting in the selenodont teeth, it typifies the *hypothetical Protungulate*, being more primitive than either *Euprotogonia* or *Phenacodus*. The step is that of the Bear, the feet very broad and spreading, the wrist and ankle being slightly raised off the ground, and the phalanges terminating in hoofs.

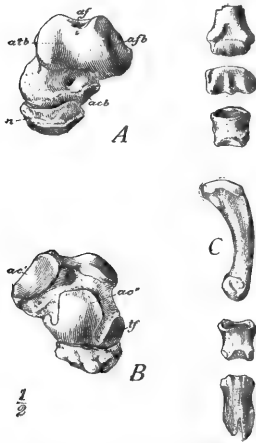


Fig. 10. *Pantolambda bathmodon*. Astragalus, metacarpal III and phalanges. Am. Mus., Cope Coll., No. 3957.

The vertebræ preserved (Nos. 2549, 2551) indicate a short neck (C. 6 = 10 mm.) as in *Periptychus*, and a back increasing in strength and power as we pass towards the lumbar region. Thus the dorsals are short anteriorly (D. 5 = 15 mm., No. 2549) and indicate less separation of the zygapophysial and rib-tubercle facets than in *Phenacodus*. The lumbar (L. 4 = 25 mm., No. 2549) are longer; unlike most Creodonts they present horizontal rather than vertical zygapophysial facets. The tail is long and powerful.

PRIMITIVE OR PROTUNGULATE CHARACTERS.—Among the *persistent primitive* or Creodont characters of *Pantolambda* are the following:

Brain small, olfactory lobes large, hemispheres smooth. Skull with a sagittal crest; terminal anterior nares; nasals very long and expanding posteriorly; mastoid (periotic) widely exposed and forming lower posterior border of external auditory meatus; tympanic bones rudimentary; zygomatic arches slender; no alisphenoid canal; basi-cranial foramina separate.

Dentition typical; no diastemata; molars tritubercular, incisors small, cylindrical; canines rounded. Girdles: scapula unknown; ilium acuminate as in *Phenacodus*.

¹ See Cope, Am. Nat., Vol. XVII, p. 406.

Fore-limb strongly bent outwards at elbow (as in Creodonts and Carnivora), manus everted. Humerus with powerful deltoid, pronator (entepicondylar) and supinator (ectepicondylar) crests; ulna with a convex posterior border; carpus with an os centrale, an extremely small magnum and short trapezoid, causing the metacarpal IV to be inserted proximally between the trapezoid and magnum (Fig. 12).

Hind-limb straight, with three trochanters upon the femur (Fig. 11). Tibia with a rudimentary spine, a very long cnemial crest (Fig. 11) and femoral facets approximate. Tibia (Fig. 11) articulating with calcaneum. Probably an *os-tibiale* (Fig. 12). Mesocuneiform short (analogous to trapezoid in the carpus), so that metatarsal IV articulates between ento- and ectocuneiforms (analogous to metacarpal IV). Articulation between tibia and astragalus slanting obliquely inwards, very limited in extent, bounded posteriorly

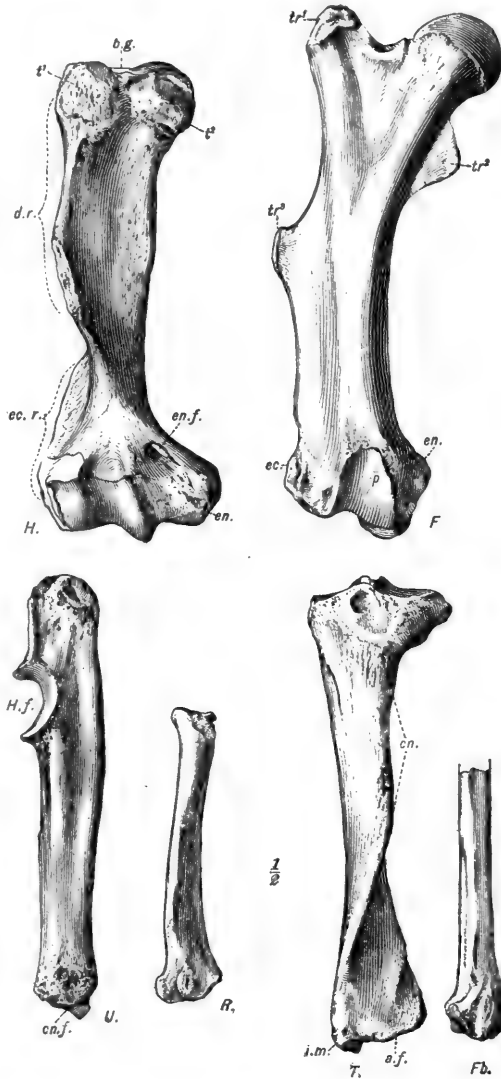


Fig. 11. *Pantolambda bathmodon*. Anterior view of fore and hind limbs, showing powerful development of crests and trochanters as in the Creodonts. Humerus, No. 2549. Femur, No. 2523 (2551, 2549). Tibia, No. 2551. Ulna, Nos. 2550, 2547. Radius, No. 2547 (2546). Am. Mus. Coll.

by astragalar foramen which issues posteriorly between the ectal and sustentacular facets (Fig. 12) (as in Creodonta). Astragalo-navicular head broad convex; two astragalo-calcaneal facets only. Fifth metatarsal curved with a prominent external tuberosity for the *peroneus brevis* muscle, as in the Bear.

All these osteological characters are shared by Periptychus, so far as the skeleton of the latter genus is known; (the carpus of Periptychus is unknown). The skull, vertebræ and proportions of the limb bones in the two types are remarkably similar.

ORDINAL OR AMBLYPOD CHARACTERS.—*Primitive ordinal characters.* It will be observed in the definition of the Amblypoda, p. 180, that many of these above-described primitive characters persist throughout the evolution of the order, and therefore rank as *ordinal*.

MEASUREMENTS: SKULL, TEETH, SKELETON.

	P. BATHMODON.		P. CAVIRICTUS.	
	Mus. Nos.	Mm.	Mus. Nos.	Mm.
Skull, condyles to premaxillaries . . . est.	2548	157	963	est. 272
Molar-premolar series, superior		055	"	088
inferior	2550	060	396I	I18
Lower jaw, symphysis to angle	2550	126	"	est. 25I
Fore-limb: Humerus, total length	2549	124		
Radius, "	2547	083		
Manus, "	"	08I		
Hind-limb: Femur, "	255I	148		
Tibia, "	"	119		
Pes, "	"	109	3963	184
Ilium, total length, as restored	"	111		
" width		03I		
RESTORED SKELETON.				
Skull to perpendicular of ischiac symphysis		830		
Height at shoulder blade		350		
" ilium		332		

SPECIALIZED ORDINAL CHARACTERS.—There are, however, many structures in *Pantolambda* which amply affirm Cope's view, that *Pantolambda* is the ancestral type of the great lower and middle Eocene forms. These are: the separation of the premaxillæ

in the median line (as in *Coryphodon* and *Uintatherium*), the widely exposed mastoid (as in *Uintatherium*); the nasals extending far back between orbits (as in *Coryphodon*); the molars triangular and selenodont leading to the *Coryphodon* type. The scapula is unknown, probably acuminate as in *Peryptychus*. The most striking likenesses to *Coryphodon* in the fore-limb are in the muscular crests of the humerus, the outward flexure of the elbow, the displacement of the lunar upon the unciform.

STRUCTURE OF THE FEET IN PANTOLAMBDA.

Both manus and pes are of exceptional interest. The terminal phalanges are hoof-bearing.

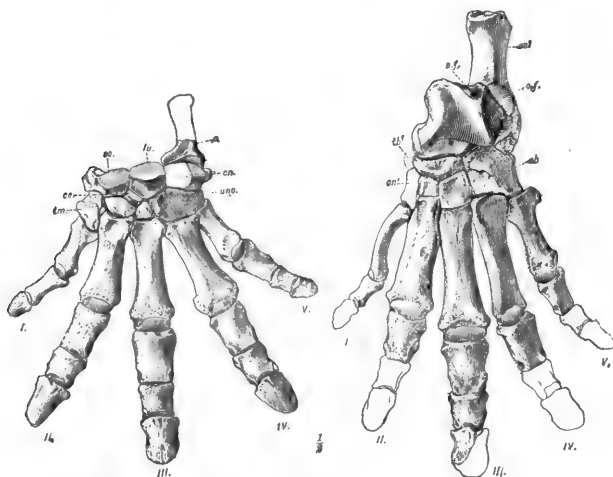


Fig. 12. *Pantolambda bathmodon*. Superior view of carpus No. 2546, partly restored, and tarsus (composition No. 2551), showing essential Creodont structures. Coll. Am. Mus. Nat. Hist.

Fore-foot.—As carefully put together by Dr. Matthew (see Fig. 12), the manus certainly possessed a separate *centrale*. Other exceptional features are the curvature of Mtc.I and the proportions of the distal carpals.

<i>Pantolambda bathmodon.</i>	} Magnum smallest. 4 mm.	Trapezoid intermediate. 9 mm.	Trapezium large. 16 mm.

These proportions show that the evolution of the carpus in the Amblypoda marks an *enlargement of the magnum* and *trapezium* and absorption or coalescence of the *centrale*.

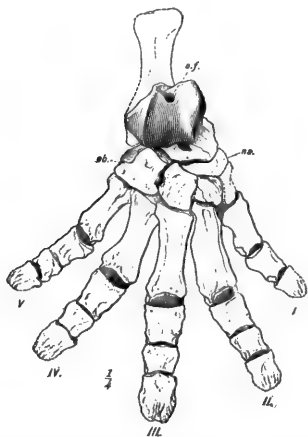


Fig. 13. *Pantolambda cavirictus*. Right pes, directly from above. No. 3963, Am. Mus. Coll.

Hind-foot.—The very large pes, probably belonging to *P. cavirictus* (No. 3963), and small pes of *P. bathmodon* (No. 2550) agree in the many primitive characters enumerated in the Table, p. 178. Analogous to the manus we find a curved first metapodial (Mts. I). As in *Periptychus* and in *Ursus* the fifth metapodial bears a prominent process for the *peroneus brevis* abductors. As in most Creodonts the cuboid is wedge-shaped proximally for the calcaneum and astragalus, and the astragalo-tibial facet faces obliquely inwards (instead of upwards as in *Coryphodon*); this facet is very narrow, bounded by the astragalar foramen posteriorly and

a deep pit anteriorly. A very important feature in this species is the thinning out of the inner side of the navicular, bringing the ectocuneiform almost into contact with the astragalus.

Comparative Measurements.

	<i>P. bathmodon.</i>	<i>P. cavirictus.</i>
	MM.	MM.
Astragalus, greatest diameter.....	20	44
Tarsals, transverse measurement.....	33	68
Metatarsal I.....	23	35
" II.....	34	Est. 60
" III.....	40	61
" IV.....	36	60
" V.....	28	50

Suborder PANTODONTA *Cope*.

The Pantodonta or Coryphodontia are distinguished by a very great increase in size, the large development of the upper and

lower canines, the lopho-selenodont molar teeth, and the broad-topped skulls. These and other advances upon the *Pantolambda* type were effected in the interval between the deposition of the Torrejon or Upper Puerco and the Wasatch Beds.



Fig. 14. Skull of *Coryphodon testis*. Male specimen, No. 2867, as mounted in skeleton. Lower jaw, No. 2872. Am. Mus. Coll. The back part of the skull is elevated by distortion.

REVISION AND CRITERIA OF SPECIES.

Twenty-one species were named by Cope, with as little regard for the laws of individual variation as for the association of skeletons with teeth or of jaws with skulls. It is *a priori* improbable that such numerous species should have coexisted, considering that all the collections come from a few levels and a single geographical region. Our knowledge of large living quadrupeds, such as the African Rhinoceros, shows that rarely more than two species of one genus coexist, and these have different local feeding habits. The writer has found the same to be true of the Eocene Titanotheres of Wyoming. Earle's revision of the species (1892), therefore, marked a valuable advance but left much to be done, owing to his lack of comparative material at the time.

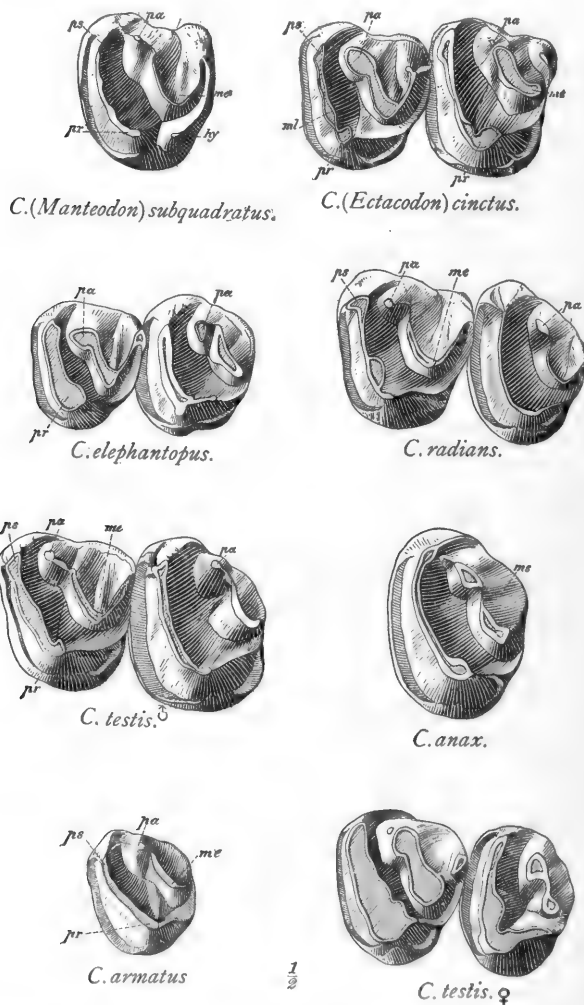


Fig. 15. Typical upper molars. *C. subquadratus*, type; *C. cinctus*, type; *C. elephantopus*, cotype; *C. radians*, type; *C. testis*, male, No. 274; *C. anax*, type; *C. armatus*; *C. testis*, type, female. All in the Am. Mus. Coll.

Altogether there are about thirteen distinct species known at present, which are distributed as in the following Table.

	WASATCH.					WIND RIVER.
	N. M.	WYOMING.				WYOMING.
	New Mexico.	Evanston.	Black Buttes.	Gray Bull, Big Horn Mts.	Clark's Fork.	Buffalo Basin, Big Horn Mts.	Wind River Mts.
SERIES I.						
<i>C. wortmani</i>						×
SERIES II.						
<i>C. testis</i>				×		
" <i>repandus</i>				×		
" <i>marginatus</i>				×		
" <i>cinctus</i>				×		
" <i>semicinctus</i>		×				
" <i>lobatus</i>	×			×		
" <i>anax</i>				×		×
" <i>pachypus</i>						×
" <i>elephantopus</i>	×					×
" <i>cuspidatus</i>	×					
" <i>obliquus</i>	×			×		
" <i>latipes</i>		×				
" <i>latidens</i>	×					
" <i>ventanus</i>						×
SERIES III.						
<i>C. armatus</i>			×			×
" <i>simus</i>	×					
" <i>molestus</i>	×					
" <i>lomas</i>	×					
INCERTÆ SEDIS.						
<i>C. radians</i>		×		×		
" <i>hamatus</i>		×				
" <i>subquadratus</i>				×		
" <i>curvicristis</i>				×		
" <i>singularis</i>						×

MOLAR TYPES.—It is essential, first, to clearly conceive the correlated changes taking place in the upper and lower molar teeth, as shown in the accompanying figures and diagrams.

In the *upper molars* :

1. *Pantolambda* (Fig. 2) exhibits the triangular upper molar ancestral to *Coryphodon*, ectoloph (with crescentic cones and meso-style) at *right angles* to protoloph

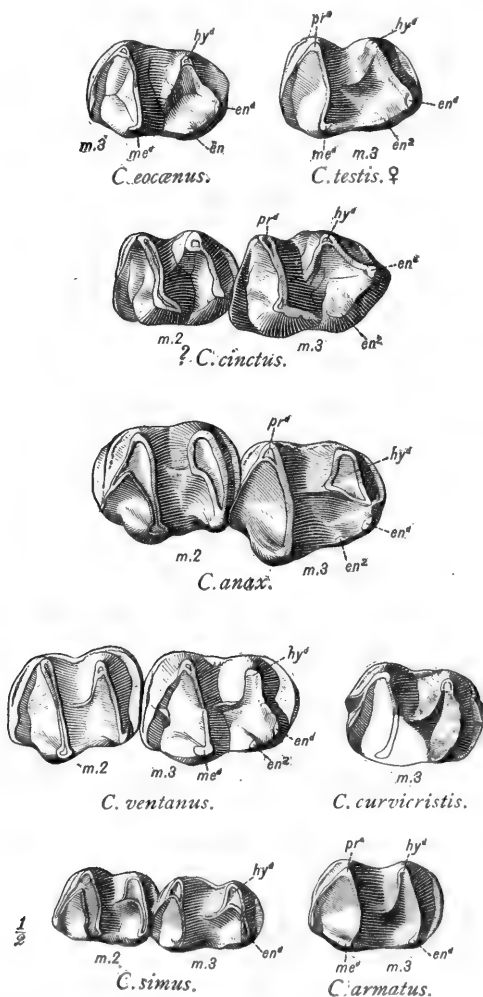


Fig. 16. Typical lower molars. *C. eocanus*, cast of Owen's type. *C. testis*. *C. cinctus*, variety, with triangular heel. No. 4329. *C. lobatus*, typical lower molar, No. 4305. *C. ventanus*, type, No. 2970. *C. curvicristis*, type, No. 4326. *C. simus*, No. 2563. *C. armatus*, type, No. 4316. All in the Am. Mus. Coll.

2. *C. radians* presents an intermediate stage, ectoloph (with crescents and mesostyle disappearing) *oblique* to protoloph (Fig. 15).

3. *C. armatus* presents a final stage, oval crown, ectoloph (a slightly concave crest) *parallel* to protoloph (Fig. 15).

The second upper molar slowly goes through the same phases as the third, and both approach the *Uintatherium* pattern.

In the *third lower molar* various species of *Coryphodon* exhibit (Fig. 16):

1. *Primitive stage*, a trilobed heel (hypoconid, entoconid, entoconid 2); crests *oblique*, heel with three main cusps, *C. eocanus*.

2. *Intermediate stage*, a heel with two main cusps (hypoconid, entoconid),

third cusp (entoconid 2) degenerate; crests *less oblique*, *C. testis*.

3. *Final stage*, a bilobed heel (hypoconid, entoconid), entoconid 2 absent, crests *transverse*, *C. simus*. A tooth exactly of the Tapir or Lophiodon type.

Thus the crests of the upper and lower molars slowly become transverse, and simultaneously also preserve their mutual interlocking shear; the stages, 1, 2 and 3, in each being probably correlated.

It is, however, extremely difficult to determine the species by these principles alone, because the hypolophid, or posterior crest, of the third lower molar seems to be highly variable, not in its *obliquity of angle*, but in the greater or less development of the *entoconid 2*, as frequently seen upon opposite sides of the same jaws (*e. g.*, Nos. 2868 and 4321).

CUTTING TEETH.—The *canines* aid us: the primitive form is *round* (persisting in *C. wortmani*) as in *Pantolambda*; the intermediate form is *triangular* and antero-posteriorly compressed (*C. testis*, *C. ventanus*); the final form is flattened and laterally compressed (*C. armatus*), paralleling the *Uintatherium* type, because the long axis of the blade is longitudinal.

SKULL.—When fully known, the top of the skull will prove highly distinctive. At present we know only the comparatively primitive crested type (Fig. 18 *B*), and the flattened type (Fig. 18 *C*), which approaches *Uintatherium*.

[*May, 1898.*]

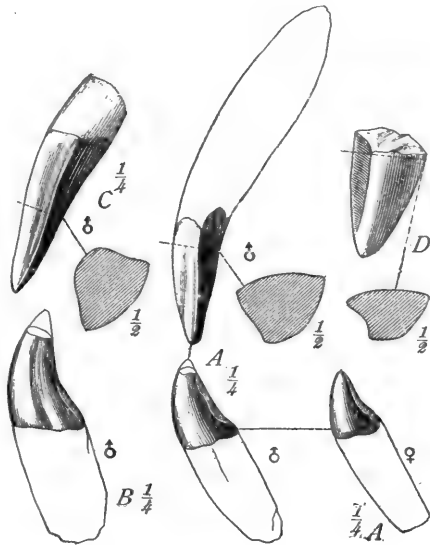


Fig. 17. Upper and lower canines, lateral views and sections. *A*, *Coryphodon testis*, ♂, male upper and lower canines, No. 274. ♀, female lower canine. *B*, *C. anax*, male lower canine, No. 4328. *C*, *C. ventanus*, male upper canine, No. 2970. *D*, *C. armatus*, upper canine and section, No. 4315. This very small canine is upon double the scale of the other teeth.

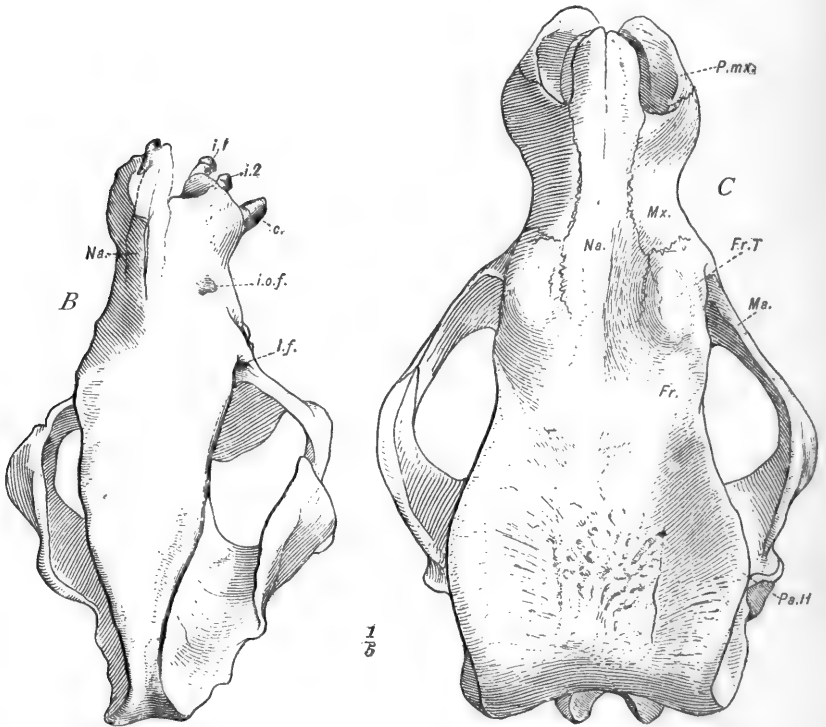
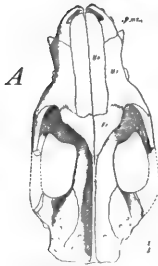


Fig. 18. Comparative view of Crania of *A, Pantolambda bathmodon*, small, of *B, Coryphodon wortmani*, intermediate, of *C, Coryphodon testis*, large, showing flattening of the upper surface of the cranium, and appearance of parietal horns, *Pa H.* All one-fifth natural size.

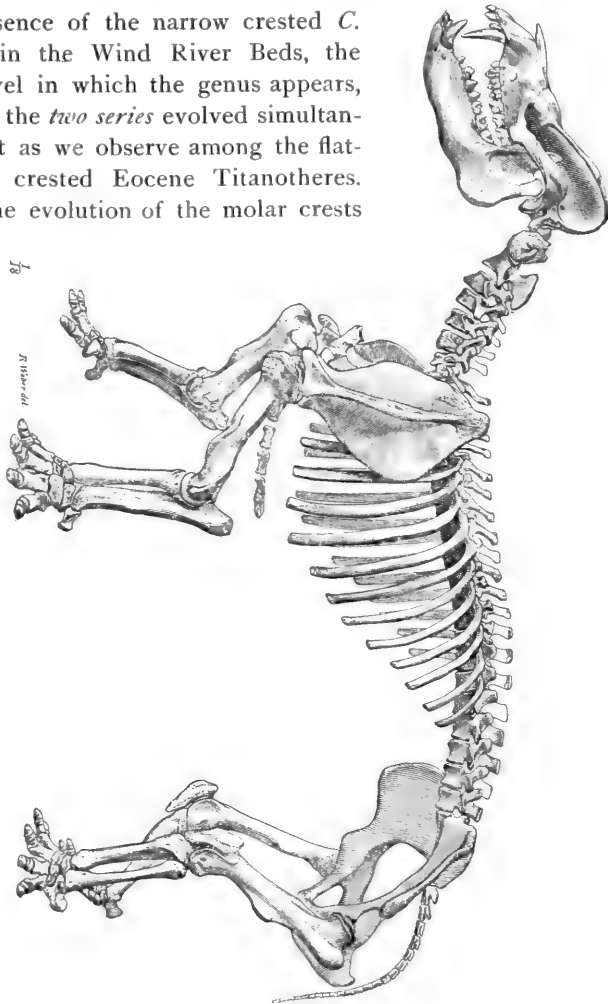


Disregarding synonyms and partially known types, these characters, together with the form of the canines, indicate three series, or lines of species, typified as follows :

<i>Levels.</i>	<i>Series I.</i>	<i>Series II.</i>	<i>Series III.</i>
	Primitive. Narrow crested skull. Canines rounded.	Specialized. Broad crested skulls. Canines triangular. Second lower incisors enlarged; third ditto reduced. Lower molar crests oblique to transverse. M_3 trilobate to bilobate.	Specialized. Medium crested skulls. Canines laterally compressed, grooved. Molar crests nearly or quite transverse. M_3 bilobate.
Wind River Wasatch...	<i>C. wortmani.</i>	<i>C. elephantopus.</i>	<i>C. armatus.</i>

The presence of the narrow crested *C. wortmani* in the Wind River Beds, the highest level in which the genus appears, shows that the *two series* evolved simultaneously, just as we observe among the flattened and crested Eocene Titanotheres. In each the evolution of the molar crests

Fig. 18a. *Coryphodon testis*. Mounted skeleton in the American Museum of Natural History.



from *oblique* to *transverse* angles, with degeneration of the entonoid, loss of crescents, etc., was apparently parallel.

The *sex* characters, as clearly shown in numerous specimens of *C. testis*, are: Males larger, with powerful upper and lower canines; females smaller, with smaller upper and lower canines. (See Fig. 17.)

Among the specific or variable characters in the skeleton are the presence or absence (compare Earle) of the tibial facet, of the astragalar foramen, and of the articulation of the cuneiform with Mtc. V, which variation is similarly observed in *Uintatherium*, as shown by Marsh. ('Dinocerata,' p. 107.)

None of the generic characters assigned by Cope to *Bathmodon*, *Ectacodon*, *Metalophodon* and *Manteodon* appear to the writer to be valid, as they rest either upon errors in field collection or upon individual variations.

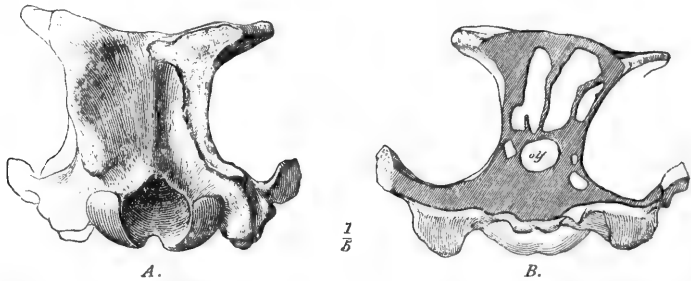


Fig. 10. *Coryphodon elephantopus*, showing flat-topped skull. *A*, view of occiput; *B*, transverse section of cranium through region of olfactory lobes, showing air cells. Coll. U. S. Nat. Mus., No. III.

Series II.—LARGE CORYPHODONS WITH BROAD, FLAT-TOPPED SKULLS, RUDIMENTARY PARIETAL HORNS, TRIANGULAR CANINES.

12. *C. elephantopus* Cope.

Type, U. S. Nat. Mus. Coll. Superior molar 3; inferior molar 3. Loc., New Mexico. This type has been temporarily displaced.

Cotype, No. III, U. S. Nat. Mus. Coll. Skull with upper dentition complete; inferior dentition and fragmentary jaw.

Definition.—Superior molars=158 ♂. Skull characters as in *C. testis*, excepting m^3 more quadrate (cotype) with slightly convex mesostyle; m^3 (type) with hypolophid and entoconid 2; incisors equal sized.

Synonyms.

C. obliquus Cope. Type, U. S. Nat. Mus. Coll. A single fragmentary inferior molar. Hypolophid oblique. Entoconid 2 reduced.

This is a smaller animal than *C. testis*, but is found upon a higher level.

Cope's association of type and cotype is open to some question. The type has been temporarily lost, and unfortunately the

TABLE SHOWING THE PROPOSED SPECIES WITH ORIGINAL NAMES, NATURE OF TYPE, ETC.

Spec's No.	NAME.	DATE.	TYPE.	FIGURE.
1	<i>Coryphodon eocœvus Owen</i>	Hist. Brit. Foss. Mamm., 1846, p. 299....	Inf. m. 2 and m. 3....	Figs. 103, 104.
2	" <i>anthracoides Blainville</i>	Ann. d. Sc. Nat., VI, 1856, p. 87.....	Skull and teeth.	
3	" <i>oweni Hebert</i>	Proc. Am. Phil. Soc., Feb. 16, 1872, p. 418.	Sup. m. 2 and 3 with	
4	<i>Bathmodon radians Cope</i>	" " " " " " " " " " " "	skeleton	Tert. Ver., pls. 45-57.
5	" <i>semicinctus Cope</i>	" " " " " " " " " " " "	Teeth.	
6	<i>Metaphodon armatus Cope</i>	" " " " " " " " " " " "	Superior molars.....	Tert. Ver., pl. 49.
7	<i>Bathmodon latipes Cope</i>	" " " " " " " " " " " "	Skeleton	" " " " " " " " " " " "
8	" <i>brevipes</i>	Proc. Acad. Nat. Sci. Phila., 1873, p. 103,	Inferior molars.....	Pal. of N. M., pl. 55.
9	" <i>stimus Cope</i>	Rep. Vert. Fos. N. M. Wheeler, 1874, p. 120.	Sup. and inf. molars,	" " " " " " " " " " " "
10	" <i>molestus Cope</i>	" " " " " " " " " " " "	p. 121a	" " " " " " " " " " " "
11	" <i>lomas Cope</i>	" " " " " " " " " " " "	p. 121b	" " " " " " " " " " " "
12	" <i>elephantopus Cope</i>	" " " " " " " " " " " "	Last sup. and inf. m. 3,	" " " " " " " " " " " "
13	" <i>latidens Cope</i>	Syst. Cat. Vert. N. M., 1875, p. 29.....	Jaw with teeth.	" " " " " " " " " " " "
14	" <i>cuspidatus Cope</i>	" " " " " " " " " " " "	Inferior molars 3....	" " " " " " " " " " " "
15	<i>Coryphodon hamatus Marsh.</i>	Am. Jour. Sci. and Arts., 1876, p. 426....	Sup. and inf. molars,	Mon. of Dinocerata,
16	" <i>obliquus Cope</i>	Pal. of New Mexico, Wheeler, 1877, p. 207,	" " " " " " " " " " " "	p. 52.
17	" <i>lobatus Cope</i>	" " " " " " " " " " " "	" " " " " " " " " " " "	Vert. Pal. N. M., pl. 47.
18	<i>Mantodon subquadratus Cope</i>	Proc. Amer. Phil. Soc., Dec. 16, 1881, p. 166,	Last sup. m. with	" " " " " " " " " " " "
19	<i>Ectacodon cinctus Cope</i>	" " " " " " " " " " " "	incisors.....	Tert. Vert., pl. 44a.
20	<i>Coryphodon anax Cope</i>	" " " " " " " " " " " "	Superior molars.....	" " " " " " " " " " " "
21	" <i>repandus Cope</i>	" " " " " " " " " " " "	Sup. and inf. molars,	" " " " " " " " " " " "
22	" <i>curvicastris Cope</i>	" " " " " " " " " " " "	Inferior m. 2 and 3	" " " " " " " " " " " "
23	" " <i>marginatus Cope</i>	" " " " " " " " " " " "	Sup. m. 2 and mand.	" " " " " " " " " " " "
24	<i>Metaphodon testis Cope</i>	" " " " " " " " " " " "	with teeth.....	" " " " " " " " " " " "
25	<i>Bathmodon pachyypus Cope</i>	" " " " " " " " " " " "	Superior molars 3....	" " " " " " " " " " " "
26	<i>Coryphodon ventanus Osborn</i>	Proc. Acad. Nat. Sci. Phila., 1882, p. 294.	Skeleton	" " " " " " " " " " " "
27	" <i>wortmani Osborn</i>	Bull. Amer. Mus., Nat. Hist., X, 1898, p. 210.	Jaw and teeth.....	Op. cit., fig. 16.
28	" <i>singularis Osborn</i>	" " " " " " " " " " " "	Skull.	" " " " " " " " " " " "
		" " " " " " " " " " " "	p. 212	" " " " " " " " " " " "
		" " " " " " " " " " " "	p. 214, Tarsus.	" " " " " " " " " " " "

1 Name only.

TABLE OF COMPARATIVE MEASUREMENTS—*Continued.*

Species Number.	Sex.	Museum Number.	Pm. and M. Sup. Inf.	M. 3. long. trans.	M. 3. long. trans.	M. 3. long. trans.	Skull. inc to vert. cond.	Scap. Hum.	Rad.	Met. III	Pelvis, trans. long.	Fem.	Tib.	Mis. III.	Ast. Tr.
14	♂	275	158	30	39		e440								
	?	Nat. Mus. 4324				e36	23								
	?	Nat. Mus. 276	e134	155	24	37	36	25							
	♂	4321	e174			39	26								
	♂	4351						309	e190	60					
7		4311							234						
		4312							320						
		4313													71
		e140	154	26	36	34	21				305			
9	♂	e125			30	19								
	♀	2563	156			33	26								
13	♂	2977	154	27	39							340			
	♂	2970	e185			42	31								
6	♂		28	38										
	♀	148	30	37					76					
10	♂	Nat. Mus.		30	37										
	♀													
11	?													
	?													
22	?													
	?	4326													
15	♂													
	♂	Yale Mus. 164	186												
28	♂													
	♂	2980													365 218 48 61

¹ Measurements taken from teeth as figured by Marsh. e = Measurements estimated, especially where pm. † is wanting.

characteristic last lower molar, m^3 in the cotype, is wanting. The species must therefore rest upon the characters of the cotype. No lower teeth were found with the fine palate (No. 275, Am.

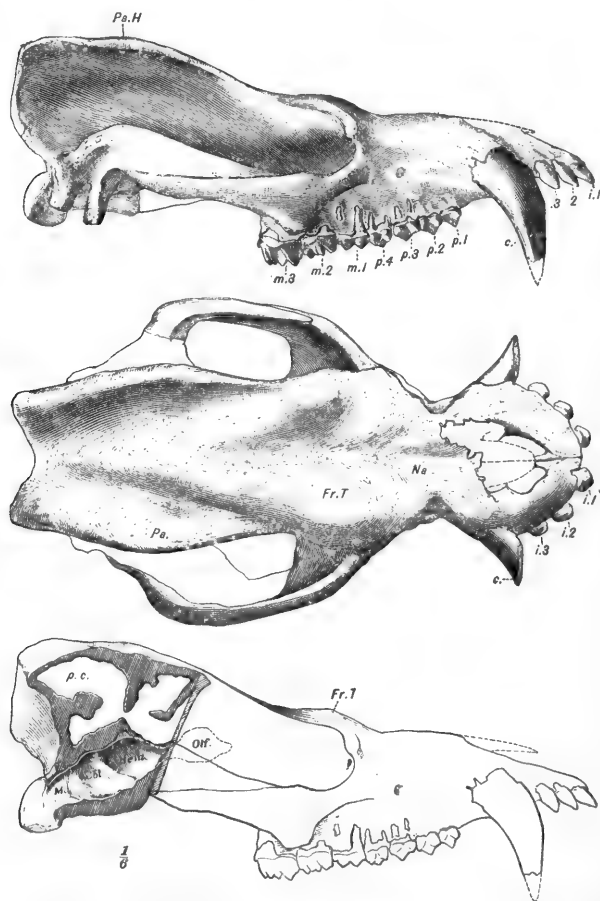


Fig. 20. *Coryphodon elephantopus*. Cotype. Lateral, superior and sectional views of cranium. No. 111, U. S. Nat. Mus. Coll.

Mus.) rightly associated with the cotype by Earle. The cranial and dental characters of the cotype (Fig. 20) are those of *C. testis* and *C. lobatus* upon a smaller scale; m^3 has a well-marked postero-external elbow (Fig. 15), and the paracone is sharply dis-

tinct from the metacone; the ectoloph thus does not form a continuous crest as in the supposed type. The parietal protuberances or rudimentary horns *Pa.H*, are less pronounced but equally rugose; the premaxillary symphysial borders are extensive although without contact; the incisors are equal in size, *i* 1 and *i* 3 being fully as large as *i* 2 in both jaws. This is therefore a smaller and perhaps more primitive type than either *C. lobatus* or *C. testis*, although skull No. 275 is definitely recorded by Wortman from the Buffalo Basin, the highest true Wasatch level.

Unfortunately the characteristic last lower molar is missing in the cotype; the series *pm* 1-*m* 2 measure 122 mm. The lower jaws of *C. elephantopus* are also represented either by Cope's *C. obliquus* or by his *C. latidens* (see below). The former is more probably the case for the following reason. According to the ratio of upper and lower teeth established in the *C. testis* jaws (see Table, p. 199, No. 3829), the lower grinders in *C. elephantopus* should measure 167 mm. The type lower molar of *C. obliquus* approximately agrees with this size (see Table, p. 199) and character. The last lower molar of *C. obliquus* agrees closely with that of the supposed type of *C. elephantopus*. We may therefore consider the greater or less development of the entoconid 2, which these molars present, as variations similar to those which we have observed in the other species of this series, namely, *C. testis* and *C. lobatus*.

No complete jaw is nearer this size than No. 4321 (Am. Mus., Cope Coll.), in which the lower grinders measure 172 mm.; this specimen is also significant because the last inferior molar on the right side agrees in form with *C. cuspidatus* (*i.e.*, entoconid 2, distinct), while the same tooth on the left side agrees with *C. obliquus* (*i.e.*, entoconid 2, obsolete). Another proof of the variability of these cusps. This jaw, however, may belong to a small female of *C. testis*.

INCERTÆ SEDIS.

21. *Coryphodon repandus* Cope.

Type, No. 4309, Am. Mus., Cope Coll. Superior and inferior molars *m*¹, *m*², *m*₃, *m*₄. Symphysis of lower jaws. Size=*C. testis*, male. Loc., Big Horn, Wyoming.

This is an indeterminate type. It is distinguished by angulation of ectoloph in m^3 (as in *C. elephantopus*, cotype); perhaps also by the more transverse direction of hypolophid in m^3 ; second incisors only slightly larger than first and third (as in *C. elephantopus*, cotype). The nearest resemblance is therefore to *C. elephantopus*, from which it is distinguished by larger size. Superior molars No. 4366, from New Mexico, furnish a transition in the angular form of the ectoloph of m^3 to the *C. testis* type. Altogether *C. repandus* is of very doubtful validity.

19. *C. cinctus* Cope.

C. (Ectacodon) cinctus. Type: No. 4341, Am. Mus., Cope Coll. Superior molars complete. A strong cusp appearing at postero-external angle of m^2 . Loc., Big Horn, Wyoming.

The distinctive feature of this type, viz., the quadrate form and postero-external basal cusp of m^3 (Fig. 15), and to a less extent on m^2 , are either individual variations or valid specific characters. They are certainly not generic.

Lower teeth which may possibly be correlated (Nos. 4329, 4334, 266) have a triangular heel upon the last lower molar (Fig. 16), with entoconid very distinct and extremely short and oblique hypolophid.

24. *C. testis* Cope.

24. *C. (Metalophodon) testis* Cope. Type: No. 4317, Am. Mus., Cope Coll. Superior molar series. Originally distinguished by reduction of posterior crescent spur in m^2 .

Definition.—Sup. molars=169 ♀ to 182 ♂. Inf. molars=172 ♀ to 192 ♂. Third superior molar typically oval, with oblique posterior crest with primitive paracone, mesostyle and meta-crescent more or less distinct. Third inferior molar with oblique hypolophid, entoconid 2 reduced or vestigial. Second incisor the largest.

This includes the most completely known Coryphodon. It has been heretofore described by Earle and the writer as *C. radians*, but is now found to be distinct. The identification with Cope's type of *C. testis* is made by means of a careful comparison with the superior molars in the female skull No. 2963. The form and measurements are identical. As this skull undoubtedly belongs

to the same species as the male skull (Fig. 21) and skeleton, all the characters of this fine type are now available.

This is the largest *Coryphodon* but one, and is very abundant in the Middle Wasatch levels, being represented by a magnificent series of skulls and skeletons in our collection. From these the sexual characters are clearly made out. The large male skull is used in the complete mounted skeleton, Fig. 18 A. The smaller

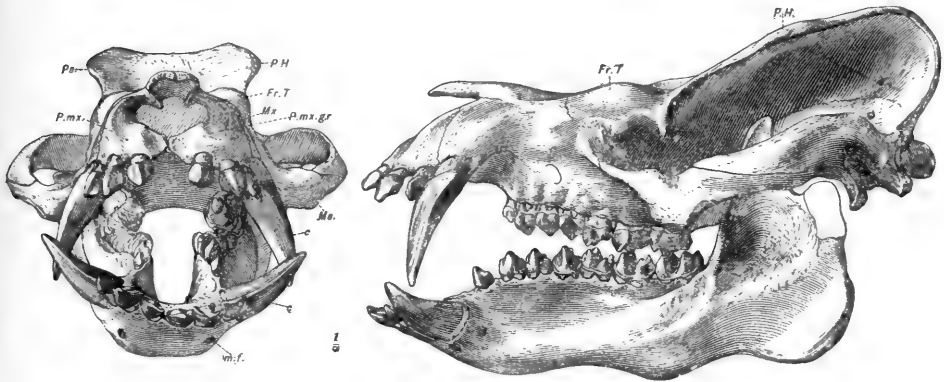


Fig. 21. *Coryphodon testis*. Large male, showing rudimentary parietal horns. Upper canines partly restored. Skull No. 2867, lower jaw, No. 2872. Am. Mus. Coll.

female type of this species is represented in the skull No. 2963, and jaws (Nos. 2868, 259) in contrast with the powerful male skulls (Nos. 2829, 2867) and jaws (4322).

Variations in the last lower molar are considerable, from an oblique to a bilobed (No. 259) or less oblique condition of the posterior crest, with all the stages in reduction of the entoconid 2. Exactly similar variations are found in the lower molars of the larger and smaller members of Series II. The development of entoconid 2 also varies in the posterior molars upon opposite sides of the same jaws of several specimens of *C. lobatus*.

The osteological characters have been fully described and figured by the writer (this Bulletin, 1898, pp. 81-91). Full characters of the vertebral column are shown in Fig. 23.

Certain specimens (skull, No. 2866) of the still larger *C. lobatus* have been found below it, and the much smaller *C. elephantopus*

occurs in the higher levels of Buffalo Basin, Wyoming. Our scanty evidence therefore appears to indicate a retrogression in size in this series, but this is an inference by no means certainly established.

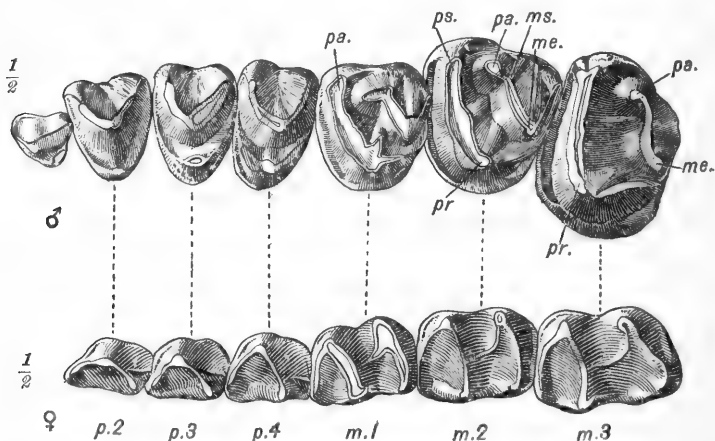


Fig. 22. *Coryphodon testis*. Superior molar series, male (Am. Mus. Coll. No. 274); inferior molar series, female (Am. Mus. Coll. No. 2863).

17. *C. lobatus* Cope.

Type, Nat. Mus. Coll. Sup. molar 3; inf. molar 3; part of sup. and inf. canine, indeterminate.

Definition.—Sup. molars=193 ♂. Inf. molars=196 ♂. Dental characters as in *C. testis*, excepting elongation of protoloph and degeneration of posterior metacone crescent in m². Astragalus usually lacking astragalar foramen. Cranium massive, with widened parietal horn rudiments.

Synonyms.

20. *Coryphodon anax*. *Type*: No. 4327, Am. Mus., Cope Coll. Superior molar 3; inferior molars, premolars and incisors. *Loc.*, Big Horn, Wyoming.

25. *C. (Bathmodon) pachypus* Cope. *Type*: No. 4335, Am. Mus., Cope Coll. Astragalus, calcaneum, pelvis, femur, &c. Indeterminate type. *Loc.*, Big Horn, Wyoming.

This is the largest *Coryphodon* known; it surpasses *C. testis* in size, the ratio being 50:45, as indicated by the femora.

Unfortunately the name *C. lobatus* is prior to the more appropriate *C. anax*, and must supersede it. The lower molars defined

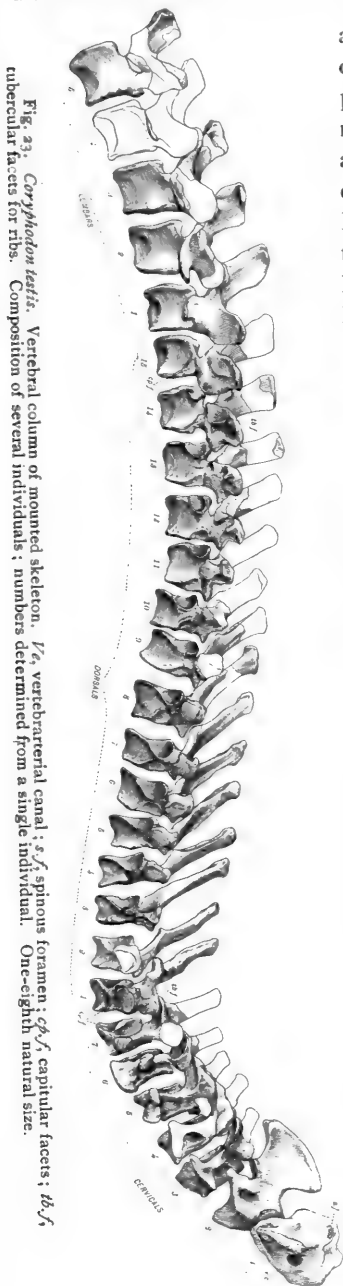


Fig. 23. *Coryphodon testis*. Vertebral column of mounted skeleton. *v*, vertebral canal; *s*, spinous foramen; *ca*, capitular facets; *th*, tubercular facets for ribs. Composition of several individuals; numbers determined from a single individual. One-eighth natural size.

as *C. lobatus* Cope, which may be considered as indeterminate types, present exactly the *C.anax* measurements (see Table, p. 198), and exhibit an oblique hypolophid and depressed entoconid 2 upon m_3 , as shown in Fig. 16. This may be considered the typical *C. lobatus* or *C.anax* third lower molar. It is well shown in the large jaw, No. 4333, and in the fragment, No. 4305.

A variation, No. 266, in molars of the *C. lobatus* size is paralleled by a variation, No. 4239, in molars of the *C. cinctus* size, as represented in Fig. 16, in which the three cusps form a posterior triangle, as also in *C. cuspidatus* (No. 4324). If these are not variations they represent three distinct species, which is possible but not probable.

Synonym.—The skeleton defined as *C. pachypus* by Cope (No. 4335) undoubtedly belongs here. The astragalus of *C. pachypus* and of another specimen (No. 2870) exhibit no astragalar foramina, and show a wider interval on the front face of the astragalus between the tibial and navicular facets than we find in *C. testis*.

The massive male skull in our collection (No. 2866) is most interesting in its progressive development of the parietal horn thickenings, parallel with those of *Uintatherium*. Its geological level, however, according to Wortman, is below that of *C. testis*, an observation very difficult to reconcile with the more advanced evolution of its skull and molar teeth.

14. *C. cuspidatus* Cope.

Type, Nat. Mus. Coll. Fragmentary inferior molars 2 and 3, and a portion of the jaw. Originally distinguished by prominent entoconid 2.

Cotype, No. 276, Am. Mus. Coll. Complete lower dentition; upper pm²-m³. This specimen was referred to *C. obliquus* by Earle (1892, p. 162).

Definition.—Inferior m.pm.=154. Superior m.pm.=150. Last superior molar oval, antero-posteriorly compressed. Last inferior molar with oblique hypolophid and more or less prominent entoconid 2. Metaconid with rudimentary metastylid. Inferior incisors unequal in size.

This is a diminutive *Coryphodon*, of the size and very similar in molar type both to *C. eocænus* Owen, from the London Clay, and to *C. owenii* Hébert, from the Suessonian of France. The characters of Cope's type are very indefinite; the complete upper

and lower series of teeth, No. 276, therefore serve as a cotype to define this species, the most diminutive of the series. The last lower molar of the right side agrees in form and measurement with Cope's type, although the entoconid 2 is less prominent and isolated; on the left side the entoconid 2 is nearly obsolete, again demonstrating the variability of this cusp. The very small lower canines indicate that the animal is a female.

The enlarged second incisors and general form of m₃ confirm its reference to Series II. A unique feature is the reduplication of the metaconid in m₂ and m₃ into a rudimentary metastylid, parallel with the large metastylid of *Uintatherium*. Another example of this species is No. 4324.

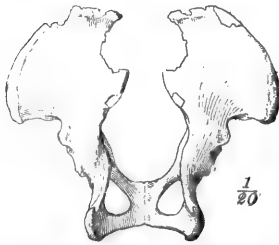


Fig. 24. Back view of pelvis of *Coryphodon lobatus*. Am. Mus., Cope Coll., No. 4335.

13. *C. latidens* Cope.

Type, Nat. Mus. Coll, ♂. Lower jaws and teeth, left premaxillary and incisors, superior canine. Loc., New Mexico.

Definition.—Inferior m. and pm.=156. Inferior molars short and broad with crests nearly or directly transverse (angle= \approx 85°); entoconid 2 vestigial or wanting. Inferior incisors equal sized. Superior canines nearly straight, antero-posteriorly compressed, subtriangular, with an external ridge.

This imperfectly-known animal appears to represent a rather small and specialized form in Series II.

It is distinguished from the type of *C. elephantopus* by the straighter and more compressed superior canine observed in the type, by the transverse position of the crests of the inferior molars, and by the absence of entoconid 2. As shown in the Table, p. 199, the measurements of Cope's *C. latidens* type are identically the same as those of *C. simus*, although Cope speaks of the latter as being much smaller than the former.

Cope has suggested the possible association of *C. latidens* with the cotype skull of *C. elephantopus*. It appears to be distinguished, however, by the form and compressed section of the superior canine. It is, however, certainly related to Series II by the sub-triangular form of the canine and the characteristic swelling of the jaw below m_3 . Unfortunately the types have been temporarily misplaced, and no determination of this question by direct comparison can be made at present. If these jaws should prove to belong to *C. elephantopus*, the species *C. obliquus* will have to be revived.

It will be noted that both types come from New Mexico. In New Mexico, also true Wasatch, we found in 1897 a lower jaw (No. 2563, Fig. 16) of extremely small size, associated with *Meniscotherium*, *Ambloctonus* and *Didymictis*, which may represent a female of this species. Unfortunately the canines are not preserved. The total lower grinding series does not exceed 125 mm., so that this is the smallest Coryphodon jaw known; the last lower molar measures only 30×19 mm.; the posterior crest forms an angle of 85° with the long angle of the jaw; a minute vestige of the entoconid 2 can however be observed.

22. *Coryphodon curvicristis* Cope.

Type, No. 4326, Am. Mus., Cope Coll. Lower jaw fragments containing $pm.4$ to m_3 ; canine.

Definition.—Molar crests transverse. Posterior crest of m_3 directly transverse, crenulate, depressed. Superior incisors with sharply angulate anterior faces. Canines as in *C. testis*.

The systematic position of this species (Fig. 16) is indeterminate. It resembles *C. latidens* in the transverse crest angulation

and in the rather broad proportions of the molars, but exceeds this species in size. The complete superior canine determines the position of the animal in Series II. The canine is powerful, curved and antero-posteriorly compressed, partly as the result of pressure. The inferior premolars are exceptionally short.

A fourth member of this series, *C. ventanus*, is found in the Wind River Beds. It appears to resemble *C. latidens* in the form of the superior canines.

Series III.—SMALLER CORYPHODONS. SPECIALIZED. RELATIVELY NARROW, FLAT-TOPPED SKULLS, (?) WITHOUT PARIETAL HORN RUDIMENTS. CANINES COMPRESSED Laterally AND GROOVED ANTERIORLY. LOWER MOLARS ELONGATE, CRESTS NEARLY OR QUITE TRANSVERSE; M_3 BILOBATE, NO ENTOCONID 2.

In 1872 Cope defined certain teeth as *Metalophodon armatus*, mistaking the posterior superior molars, m^3 , of two individuals for m^2 and m^3 of one individual, as can be proved by a comparison with his type of *C. molestus*. The latter type moreover gives us the cranial characters and constitutes a valuable cotype.

6. C. (*Metalophodon*) *armatus*.

Type, No. 4315, Am. Mus., Cope Coll. Superior m^3 , m^2 , premolars, superior canine and incisors; two individuals, probably mingled, fully adult.

Cotype, No. 4316, Am. Mus., Cope Coll. Superior m^2 and m^3 , m_3 , premolars, etc., juvenile.

Definition.—Upper and lower canines greatly compressed, with a deep antero-internal groove upon the upper canine. M^2 with powerful anterior crest, m_3 without entoconid 2. Lower molars elongate, crests lunate, nearly transverse. (Angle with long axis of jaw, 81° .)

Synonyms.

9. *C. simus* Cope. Type, U. S. Nat. Mus. Coll. Inferior m and pm=154. Fragmentary skull, probably female. Superior canine. Mandibular rami and teeth. Loc., New Mexico.

10. *C. molestus* Cope. Type, U. S. Nat. Mus. Coll. Skull, dentition and parts of skeleton. Loc., New Mexico.

11. *C. lomas* Cope. Type, U. S. Nat. Mus. Coll. Posterior inferior molar. Loc., New Mexico.

The slender crests and the elongate form of the posterior lower molars in this species at once distinguish it as a type from members of the foregoing series, since they form an angle of 81° , or nearly a right angle, with the long axis of the jaw, and *m*₃ is entirely devoid of the entoconid (Fig. 16).

Specimen No. 4315, Fig. 17, gives the most distinctive character, shown again in Cope's type of *C. molestus* (Cope, 1877, Pl. LVI, fig. 4), which agrees with *C. armatus*, namely, the flattened form of the canines. Cope himself referred *C. lomas* to *C. molestus* (1877, p. 237). The type of *C. simus* has lower teeth of the same character, rather long and narrow. The upper canines are, however, described by Cope as triangular and grooved; this raises a doubt as to the reference of this type to *C. armatus*.

The juvenile type specimen of *C. molestus* demonstrates the flat-topped character of the skull (Coll. U. S. Nat. Mus., No. 1119, Cope, *op. cit.*, Pl. LVI); the skull is far less expanded laterally, when seen from above, than any of the skulls in Series II; but this may be in part due to its juvenile and undeveloped condition.

"The inferior canine," observes Cope, "has a flat interior and convex exterior face, which are separated by anteriorly and posteriorly directed cutting edges." The most distinctive feature of the canines therefore is that the antero-posterior diameter greatly exceeds the transverse, as in *Uintatherium*. An aberrant feature is the antero-external groove. The median incisors are as large or larger than the others:

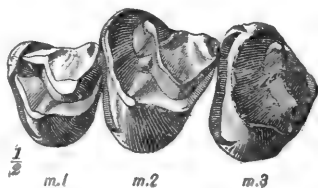


Fig. 25. *Coryphodon armatus* superior molars, left side (type of *C. molestus* Cope).

ISERTÆ SEDIS.

23. *C. marginatus* Cope.

Type, No. 4374, Am. Mus., Cope Coll. Superior molar 3, canine and pm. Loc., Big Horn, Wyoming.

This indeterminate type resembles *C. armatus* in the form of m^3 , but differs from it in the form of the canine, which is less compressed and may possibly represent a milk tooth. The canine corresponds with Cope's description of that of *C. simus*.

WIND RIVER TYPES.

Cope's Wind River material of *Coryphodon*, all of which is now in the American Museum (Nos. 4811, fragments of skull and teeth; 4812, lower molar, incisors and fragments; 4813, lower jaw and fragments; 4814-4817, fragmentary teeth; 4818), merely sufficed to determine the existence of this genus in these beds.

Our Wind River collection and the determination of manus No. 4351 (Am. Mus., Cope Coll.) as belonging to the Wind River Beds, is therefore of very great importance. It demonstrates that *Coryphodonts of considerable diversity and size persisted into the Wind River period.*

Owing to the general scarcity of fossil remains in these beds, the relative abundance of these animals cannot be estimated. Of intermediate size is the jaw of No. 2976, described below as *C. ventanus*; of smaller size there is a well-preserved skull (No. 2977), type of the new species *C. wortmani*. They represent respectively the persistence of at least two series, namely of Series I, and of Series III now discovered for the first time.

SUCCESSORS OF SERIES II.

26. *Coryphodon ventanus*, sp. nov.

Type, No. 2976, Am. Mus. Coll. Jaws and lower teeth. Superior incisors and canine. L. metacarpal IV.

Definition.—Size of *C. testis* ♂. Inferior m and pm series= e 172. Superior canines posteriorly compressed, with antero-internal depression and long

sharp external ridge. Lower canines with short external ridge near apex. Second incisors enlarged; lateral incisors much reduced. Posterior inferior molars with crests more transverse than in *C. testis* (angle = 74°) a persistent entoconid 2. (? Cuneiform articulating with Mtc. V.)

This species is clearly distinguished from *C. testis* by the form of the canines, which in this animal are comparatively straight and lance-shaped (Fig. 17), the long axis transverse (unlike *Uintatherium*), with an antero-internal groove which is

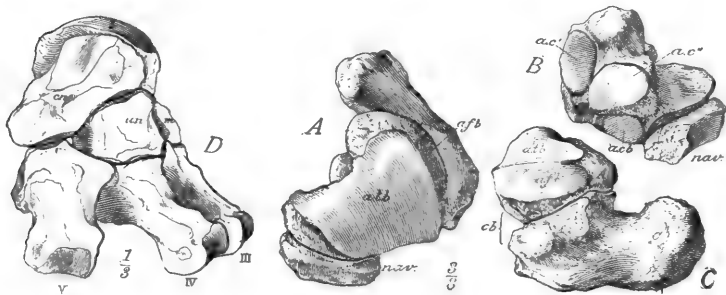


Fig. 26. Foot structure of *Coryphodon*. *D*, external view of manus of *C. ventanus* (No. 4351, Coll. Am. Mus.); *A*, superior view of astragalus and calcaneum found near *C. simus*, no tibial facet (Bathmodon type); *B*, lower surface of astragalus, showing calcaneal and cuboidal facets; *C*, external view of calcaneum and astragalus, showing reduction of tibio-calcaneal facet. (Coll. U. S. Nat. Mus.)

worn away by the lower canine. They resemble those of *C. latidens* Cope (except in the groove), but are much less compressed than those of *C. armatus* Cope, besides having the long axis in a different plane. The posterior crest of m_3 (Fig. 16) differs from those of *C. armatus* and *C. simus* in form and in the retention of an entoconid 2, and from that of *C. testis* in being slightly less oblique. Another character is the very rapid increase in size of the molar series as we pass backward: $m_1=28$, $m_3=42$.

To this species belong Nos. 2982, 4813, 4812, 277*B*, and 2978 of our collection. The latter contains the complete lower teeth which exhibit the marked disproportion between the second and the first and third incisors embodied in the definition of this species. The incisor proportions are indicated by the length of roots, $i_1=36$, $i_2=59$, $i_3=28$.

The metacarpal IV agrees in length (54 mm.), and lends some probability to an association with that of the complete carpus No. 4351 from the Wind River.¹ This associated complete carpus (Fig. 26) agrees with some specimens of *Uintatherium* in the very exceptional character *that the cuneiform articulates with Metacarpal V.*

Series I.—PRIMITIVE, NARROW-CRESTED SKULLS. CANINES ROUNDED. INCISORS SUBEQUAL IN SIZE.

The lower teeth are unknown, and the ancestral members of this series have not thus far been determined in the underlying Wasatch formation.

27. *Coryphodon wortmani*, sp. nov.

Type, No. 2977, Am. Mus. Coll. Loc., Wind River, Wyo.

Definition.—Superior m and pm=154. Superior canines rounded. Occiput very high and narrow. Supratemporal ridges converging posteriorly to form a comparatively narrow sagittal crest.

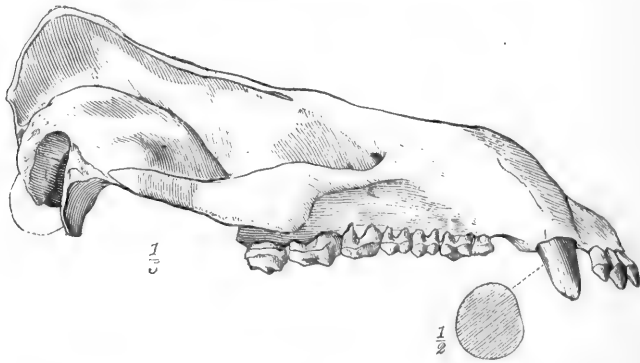


Fig. 27. *Coryphodon wortmani*, type. Lateral view of skull and section of superior canine.²

The discovery of this type (Figs. 18 and 27) in the high level of the Wind River Beds is most surprising. It is far more primitive both in its narrow cranium and rounded canines than any of the

¹ This carpus was mistakenly described by Cope as coming from the Wasatch. Dr. Wortman identifies it as found by himself in the Wind River.

² Dedicated to my colleague Dr. J. L. Wortman.

C. testis series found in the Middle Wasatch. It appears like a direct successor of *Pantolambda covirictus*.

The median incisors are equal to the others, the lateral incisors being slightly the smallest. The canines have a rounded crown somewhat flattened in front by wear. The superior grinding series present a rudimentary posterior crescent on m^2 and an oval m^3 with short oblique ectoloph. The most unique features are the form of the occiput and the cranium as defined above, which is intermediate between that of *Pantolambda* and *Coryphodon armatus*.

The metatarsal V is short and robust (= 42 mm.), with the characteristic peroneus tuberosity of the true *Coryphodon*. Both femora are finely preserved (length, = 340 mm.), being of the smallest size known.

INSERTÆ SEDIS.

The position of the following types with reference to the Series I-III, which we have been considering, is uncertain.

4. *Coryphodon radians* Cope.

Type, No. 4300, Am. Mus., Cope Coll. Superior molars 1, 2 and 3. Probably associated lower jaw, No. ? 4300. Portions of skeleton. Loc., Evanston, Wyoming.

Definition.—Third superior molar with a spur (metacrescent) upon the posterior crescent of the ectoloph. Third inferior molar without entoconid 2, hypolophid nearly transverse. Lower canines somewhat incisiform.

This classic species, which rests upon somewhat uncertainly associated upper and lower teeth, jaws and skeleton, was the first described in America. The structure of the last upper molar is shown in Fig. 15. The last lower molar has crests nearly as transverse and simple as in *C. latidens*. The most distinctive structure is the lower canine which, although badly broken, exhibits a distinct flare at the base of the inner face, as in the incisors, and is apparently becoming incisiform, an interesting approach to *Uintatherium*.

15. *Coryphodon hamatus* Marsh.

Type, Yale Museum No. 1330. Skull and dentition much worn.

Cotype, Yale Museum No. 1334. Female skull with perfect superior and inferior dentition. Loc., Evanston, Wyoming.

Synonym.

18. *Coryphodon* (*Manteodon*) *subquadratus* Cope. Type, No. 4340, Am. Mus., Cope Coll. Superior molar 2, incisors and fragmentary premolar. Loc., Big Horn, Wyoming.

Definition.—Size large. Superior molars with quadrate crowns and well developed hypocones upon m 1 and m 2. Inferior molars with nearly transverse crests; m₃ without entoconid 2.

This species was mistakenly associated with *C. elephantopus* by Earle. In size it equals *C. testis*, but it is well distinguished by the quadrate form of the superior molar teeth in which, according to the figures of Marsh (*Dinocerata*, Fig. 55, p. 52), a representative of the hypocone is present. This is developed from the ridge extending backwards from the protocone. In the inferior molar teeth the crests are nearly transverse, and there is no trace of the entoconid 2.

The unique quadrate tooth with a prominent hypocone, type of *Manteodon subquadratus* (Fig. 15), was without reason considered by Cope as a third superior molar. It proves, upon comparison with Marsh's cotype made by Dr. Matthew, to resemble a second superior molar of *C. hamatus*. It differs, however, from *C. hamatus* in the more distinct development of the posterior spur of the metacone crescent, a character which may subsequently prove to give it distinct specific rank.

The type skull of *C. hamatus* is somewhat fractured. The top of the skull of the cotype, a female, is considerably narrower than that of *C. testis*, female, presenting a condition intermediate between that of *C. testis* and *C. armatus*. The canines in this animal, as in other females, are small.

28. *Coryphodon singularis*, sp. nov.

Type, A hind limb, tibia, fibula and pes No. 2980. Loc., Wind River, Wyo.

A small and unique hind foot and limb from the Wind River Beds, found upon the level of *C. wortmani*, is of excep-

tional interest (Fig. 28). Associated lower tooth fragments, put together by Dr. Matthew, resemble those of a small *Coryphodon*, and clearly separate this animal from *Bathyopsis*. The differences from the pes of *Coryphodon* are very significant, as follows :

1. Navicular laterally reduced, excluded from cuboid by ectocuneiform, a unique condition.
2. Ectocuneiform enlarged, articulating with astragalus (unique).
3. Second or middle phalanges greatly abbreviated upon all digits, I-V, as in *Uintatherium* manus.
4. Front surface of astragalus widened, separating tibial and navicular facets as in *Uintatherium*.
5. Tibia long and slender, unlike *Coryphodon*.

The measurements of the metatarsals are as follows :

Mts. I=22. Mts. II=42. Mts. III=48. Mts. IV=42. Mts. V=34.
Other measurements in Table on page 199.



Fig. 28. *Coryphodon singularis*. Superior and lateral views of pes. Am. Mus. Coll. No. 2980

This animal thus shows one progressive character (4), two entirely unique and distinctive characters (1, 2); the latter, together with (5), sharply separate it from *Coryphodon*; two characters, 3, 4, parallel or approach *Uintatherium*. The other Wind River species, *C. wortmani* and *C. ventanus*, are distinguished from this by their typical metapodials, one of which is known in each type.

The associated femur (No. 2970) is proportioned like the tibia, long and slender.

Prophetic of this type, perhaps, is the pes of *Pantolambda cavirictus* (Fig. 12), in which the navicular is reduced upon the outer side and the ectocuneiform is elongated so as to nearly come in contact with the astragalus.

FOOT STRUCTURE.

Cope (1884, 1, p. 1120) proposed the theoretical groups, *Platyarthra* (with flat astragalus) and *Amblypoda hyodontia* (astragalus without a neck) from which to derive the Amblypoda. Both groups are superfluous now that it is clear that the ancestral Amblypoda can be derived directly from the Creodonta, all of which possess an astragalar neck.

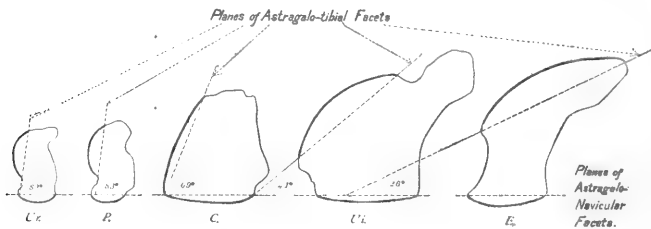


Fig. 29. Angles formed by tibio-astragalar astragalo-navicular facets, to exhibit widening of front face of astragalus. *Ur*, *Ursus*; *P*, *Pantolambda*; *C*, *Coryphodon testis*; *Ui*, *Uintatherium*; *E*, *Elephas*.

The transition is simple. By *shortening of the neck of the astragalus* (Fig. 29 *P.* and *C.* and *Ui.*) the tibio-astragalar facet is gradually brought almost into confluence anteriorly with the astragalo-navicular facet, as in *C. radians*. In *C. lobatus* and *C. singularis* this space widens as in *Uintatherium*.

1. The variables in these feet are the *astragalar foramen* and the *tibiale facet*. From our present knowledge both these structures (inherited in *Coryphodon* from *Pantolambda*) are *useless or vestigial, inconstantly developed and therefore not constant specific characters*.

In Fig. 26 (identical with *Coryphodon* III, Cope, 1877, Pl. 60), a small astragalus and calcaneum is shown which lacks both astragalar foramen and tibiale facet. In *C. lobatus* (No. 4335, type of *C. pachypus*) there is a large tibiale facet, while the astragalar

foramen is not even grooved. In No. 2870 the tibiale facet is irregular, and a groove represents the astragalar foramen. In *C. testis*, No. 258, the tibiale facet is irregular, the astragalar foramen is wanting; in No. 2869 it is completely bridged over; in No. 4300 (Cope's cotype) it is partly bridged over.

2. In the relative constancy of the tibiale facet and of the astragalar foramen or groove, the pes of *Uintatherium mirabile* is therefore more primitive than that of *Coryphodon*.

CONCLUSION OF PART I.

The phylogenetic conclusions drawn from this analysis of the Taligrada and Pantodonta will be more fully discussed at the close of Part II of this paper, which will treat of the Dinocerata.

The two main results thus far brought out are these: First, the demonstration of a number of separate phyletic lines of Coryphodons; these lines probably represent the local differentiations of the Coryphodon type in adaptation to different feeding ranges, that is, swamp, plain, and upland. The second result is, that certain Coryphodons approach the Dinocerata in some structures as closely as they depart widely from them in others; for example, *C. armatus* resembles *Uintatherium* in canine type, but differs from it in skull type; *C. testis* approaches *Uintatherium* in the upper posterior portion of the skull, but differs from it widely in the anterior portion of the skull, and in the structure of the canine teeth; *C. radians* shows the assumption of the incisiform shape by the lower canines, so distinctive of *Uintatherium*. But no Coryphodon is fully known which fills all the conditions of an ancestor of *Uintatherium*. Until the skull of *Bathyopsis* is known the transition between the above types will remain obscure.

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Article XII.—ADDITIONAL CHARACTERS OF THE GREAT HERBIVOROUS DINOSAUR CAMARASAU- RUS.

BY HENRY FAIRFIELD OSBORN.

WITH THIRTEEN FIGURES IN TEXT.

This gigantic reptile was found in the famous Como Bluffs of Wyoming by Dr. J. L. Wortman, of the Museum party of 1897, and Prof. Wilbur C. Knight, of the University of Wyoming. The Museum number is R. 222. The bones include the left ilium, the ischia and pubes of both sides, the right and left femora, the left tibia and astragalus, the right scapula and coracoid, two shattered cervicals, two complete dorsal vertebræ, two incomplete dorsals, three or four incomplete ribs, coalesced spines of three sacral vertebræ and one sacral centrum, twenty caudals and twelve chevron bones. With the exceptions stated, the bones are in a remarkable state of preservation, having been worked out with exceptional skill by Mr. Granger and others, under the direction of Mr. Hermann.

This is a large individual. The identification is provisional. The measurements, in comparison with those taken from the type of *B. excelsus* Marsh, are as follows:

	<i>Brontosaurus excelsus.</i>	American Museum No. 222.
Length of femur.....	5 ft. 9 in.	5 ft. 10 in.
“ “ tibia.....	3 ft. 6 in.	3 ft. 8 in.
“ “ pubis.....	3 ft. 10 in.	3 ft. 10 in.
“ “ ischium.....	3 ft. 8 in.	3 ft. 9½ in.
“ “ scapula.....	5 ft. 3 in.	5 ft. 7 in.
“ “ coracoid.....	2 ft. 2½ in.	2 ft. 5 in.

The new points of greatest importance are :

First.—The discovery of the hitherto unknown characters of the anterior caudal vertebræ.

Second.—The apparent resemblances of *Camarasaurus* Cope to *Amphicælias*¹ Cope, to *Brontosaurus* Marsh, *Atlantosaurus* Marsh, and *Apatosaurus* Marsh.

¹This has been anticipated by Marsh (Am. Jour. Sci., Aug., 1881) in his first classification of the Dinosauria, in which *Amphicælias* is bracketed after *Camarasaurus*, and placed in the *Atlantosauriæ*. In the final classification of the Dinosauria, however ('The Dinosauria of North America,' p. 241), *Camarasaurus* and *Amphicælias* are removed to the *Morasauriæ*.

Third.—The observation of structural analogy to certain struthious birds in the anterior dorsals and posterior cervicals.

I. HABITS AND SIZE OF THE ANIMAL IN RELATION TO ITS
STRUCTURE.

The estimate given by Marsh of the total length of this animal is nearly or quite 60 feet; the tail is figured at about 24 feet. Since the vertebra believed by Marsh to be the third caudal is probably the 10th or 11th, the tail should be increased to over 30 feet in length, by the addition of at least seven large anterior caudals. The total number of caudals is estimated at 40 as against 37 in *Diplodocus*. Marsh has attributed to *Brontosaurus* 27 precaudal vertebræ, or 13 cervicals and 14 dorso-lumbar. From reasons given below it is probable that there was a larger number of dorso-lumbar, which would still further increase the length of the animal to considerably over 60 feet.

We can only conceive of the Camarasaur as a great wading and swimming quadruped, enjoying a habitat similar to that of the Upper St. John River, Florida, at the present time, namely, a relatively firm bottom gently graded to all depths, supporting a richly luxuriant aquatic vegetation, the river banks bordered by sloping shallows of sand (Colorado, Cañon City Beds) or clays (Wyoming, Como Beds). As imagined by Cope in his picture of *Amphicælias* ('Century Magazine,' November, 1887), the animal could walk along the bottom, raising the anterior portion of its body. We believe also that it could swim rapidly, propelled by its light but long and powerful tail, which would be useless upon land. The abundance of cartilage around all the limb joints and the non-osseous nature of many of the carpals and tarsals afford positive evidence that the limbs were not continuously subjected to the hard impact of the enormous weight of the body by motion on land. Feeding was done in the water and along the shores. Excursions upon shore were therefore like those of the Alligator, mainly for breeding and egg-laying purposes, and they exposed the animal to attack by the Megalosaurs. By means of powerful mid- and posterior-dorsal spines and opisthocœlous vertebræ, the entire anterior part of the

body, *while in the water*, could be raised or lowered with the great acetabulum acting as a fulcrum, thus presenting an analogy to the Hadrosaurs, which exerted a similar movement *upon land*. The long neck, similar in structure and almost as flexible as that of an Emeu (*Dromæus*), could thus pass through a prodigious arc in the search for food either under or above water. The neck motion apparently involved the anterior non-spine-bearing dorsals

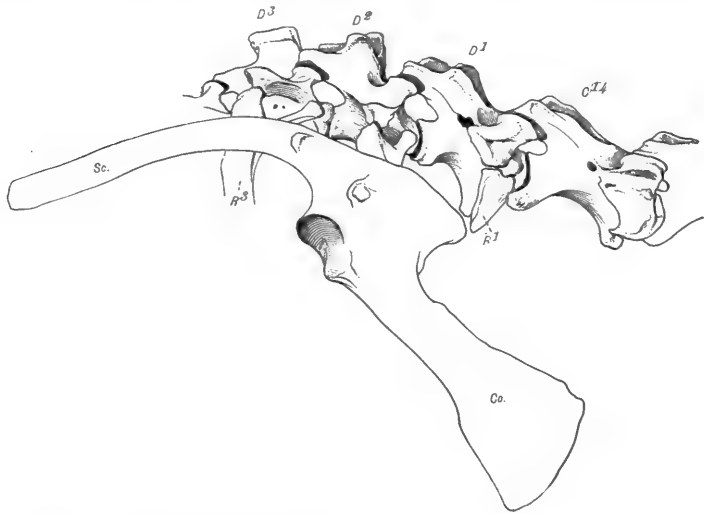


Fig. 1. *Dromæus*. Cervicals 13 and 14; dorsals 1 and 2, showing absence of median spines. Dorsal 3, showing large blunt median spine, resembling that of the *Camarasaurus* dorsal, Fig. 11 of this Bulletin, Am. Mus. Coll., No. 607.

as in *Dromæus*, behind which the comparatively inflexible large spine-bearing dorsals rose to maximum height in the sacrum for the insertion of the ligamentum nuchæ and elevator muscles.

The importance of such an hypothesis of function will appear in the following description and discussion, and it applies to all the Cetiosauria, namely, to the *Morosaurus* and *Diplodocus* types as well, which so far as known *are uniform with the Camarasaur type in the peculiar bird-like structure of the posterior cervicals and anterior dorsals* and in the possession of a very powerful swimming tail.

Ten of the caudals in our specimen afford an interesting illustration of the cause of the distribution of these large skeletons

over a considerable surface. The dorsal spines, and in some cases the sides of the centra are found to be deeply gashed with the sharp teeth of a carnivorous Dinosaur. The upper portion of several spines, in fact, is entirely bitten away, the upper surface containing jagged transverse grooves, which prove that the carnivore was of great power, and applied its pointed teeth with strong effect to the gristle and muscles upon the sides of this prodigious tail.

TABLE I.—MEASUREMENTS OF VERTEBRÆ.

	Centrum, Longitudinal.	Centrum, Transverse.	Centrum, Vertical.	Centrum to top of Spine.	Capitular Pro- cesses Trans- verse.	Tubercular Pro- cesses Trans- verse.	Transverse Processes.	Estimate of Missing Verte- bræ.
Anterior dorsal.	?	e310	310	1050	470	e864		
Posterior dorsal.	?	368	340	1280	.....	e715		
First caudal....	162	383	335	1075	.....	.....	957	
e 2d caudal.....	164	.....	e350	.....	.....	.....	.....	<3 & 4
e 5th caudal....	168	360	324	892	.....	.....	e695	<6 & 7
e 8th caudal....	177	340	300	830	.....	.....	615	
e 9th caudal....	167	333	300	798	.....	.....	622	<10&11
e 12th caudal ¹	179	305	274	712	.....	.....	587	
e 13th caudal....	170	283	260	633	.....	.....	537	
e 14th caudal....	173	282	258	598	.....	.....	505	<15
e 16th caudal....	180	272	248	548	.....	.....	e444	
e 17th caudal....	180	256	228	520	.....	.....	e395	<18&19
e 20th caudal ²	185	220	205	?	.....	.....	e265	
e 21st caudal ²	192	210	194	?	.....	.....	172	
e 22d caudal ²	200	202	186	?	.....	.....	137	
e 23d caudal ²	198	194	176	?	.....	.....	.....
e 24th caudal ²	205	184	175	?	.....	.....	.....
e 27th caudal ²	203	171	162	.....	.....	.....	.....	<25&26
e 28th caudal ²	197	170	155	.....	.....	.....	.....
e 30th caudal ²	200	152	146	.....	.....	.....	.....	<29
e 31st caudal ²	203	148	136	.....	.....	.....	.....
e 36th caudal ²	185	127	115	.....	.....	.....	.....	<32&35
e 40 total.....	.....	.....	.....	.....	.....	.....	.....	<37

NOTE.—Many interesting facts are brought out by the exact measurements of the caudals given in this Table. The centra decrease steadily in their transverse and vertical diameters, but they increase steadily in the longitudinal diameter as far back as the 26th caudal, then begins a decrease. Thus the estimated 31st caudal measures 203 mm.; the 36th caudal, measuring 185 mm., probably marks the natural decrease towards the tip of the tail. A constant ratio of decrease, however, characterized the dorsal spines.

¹ Measurements agree approximately with supposed 4th caudal, Marsh.

² Summits of spines bitten off and grooved by large cutting teeth.

2. DESCRIPTION OF SKELETON.

The mid-dorsal (Fig. 2) corresponds closely with the supposed 'posterior-dorsal,' described by Marsh as belonging to *Brontosaurus excelsus* (Fig. 12). With the exception of the anterior portion of the centrum and the extremities of the tubercular processes, this vertebra is in a remarkable state of preservation, the neural spine

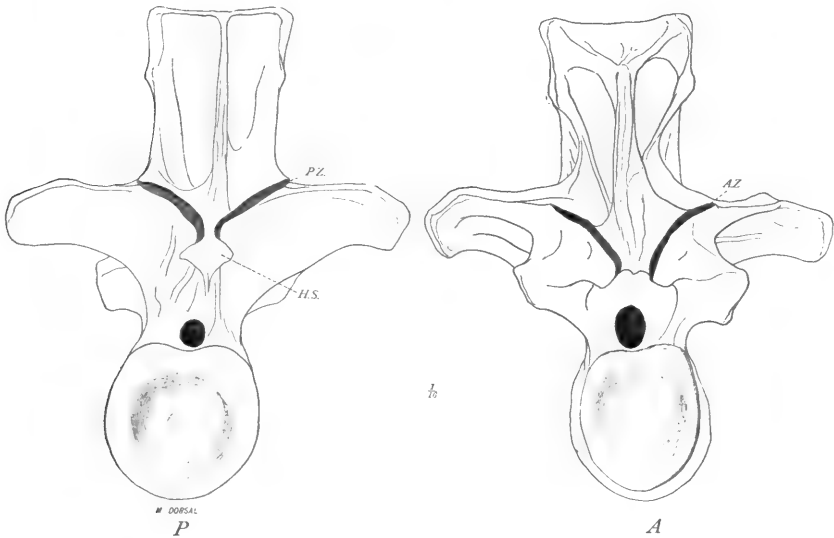


Fig. 2. *Camarasaurus*. Mid-dorsal. *A*, anterior view. *P*, posterior view. Am. Mus. Coll. R. 222. Approximately $\frac{1}{10}$ natural size.

being complete upon the anterior face, and lacking only the upper and lateral portions. It displays the characteristic hyposphen, the complex laminated and excavated condition of the spine, and a pair of small cavities upon the sides of the centra.

The true posterior dorsal (Fig. 3) is a superb vertebra, in nearly perfect preservation, lacking only the anterior portion of the tip of the spine, parts of the extremities of the tubercular processes, and the anterior face of the centrum. It corresponds closely with Cope's type of *Amphicælias altus* (Fig. 13) both in form and measurement, and in the lateral cavities of the centra.

It is possible, however, that Cope's type represents a *Diplodocus*.

The mid- and posterior-dorsal vertebræ are so different that Cope supposed that they represented different genera, viz., *Camarasaurus* and *Amphicalias*.

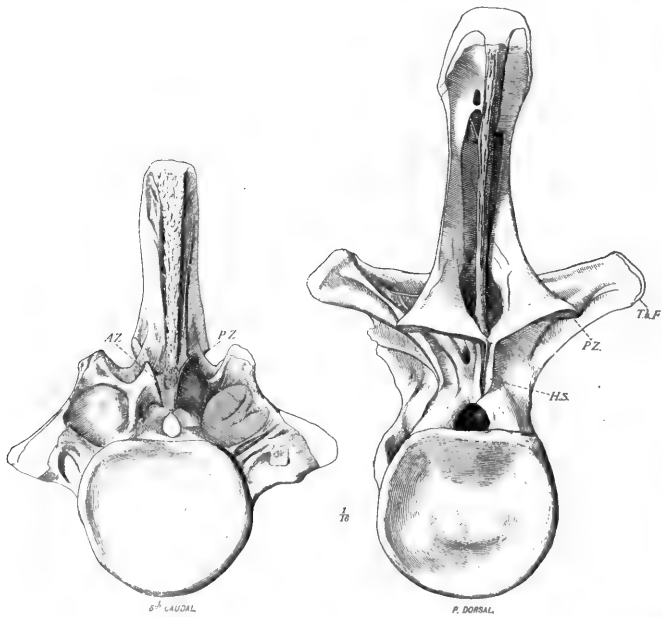


Fig. 3. *Camarasaurus*. Estimated 5th caudal. Posterior dorsal vertebra. Am. Mus. Coll. R. 222. Approximately $\frac{1}{18}$ natural size.

The sacrum is represented in this specimen by a *single large free sacral vertebra*, and by the coalesced spines of *three sacrats*. The significance of these facts will be pointed out later.

The tail of *Camarasaurus* includes a far more powerful and complex series of vertebræ than has been indicated in the figures and descriptions of Marsh.

Immediately behind the sacrum, the first caudal of *Camarasaurus* (Fig. 4) is an entirely unique vertebra, extending laterally into two great transverse plates, which may have come in contact at their extremities with the posterior portions of the ilia. These plates are concave anteriorly. The pre- and post-zygapophyses

are small and obliquely inclined inwards; the anterior face of the spine has a prominent rugose crest, similar to the crest upon the posterior face of the spine, but the latter (posterior crest) sinks between two prominent laminæ, which extend downward to support the post-zygapophyses, *pz.*

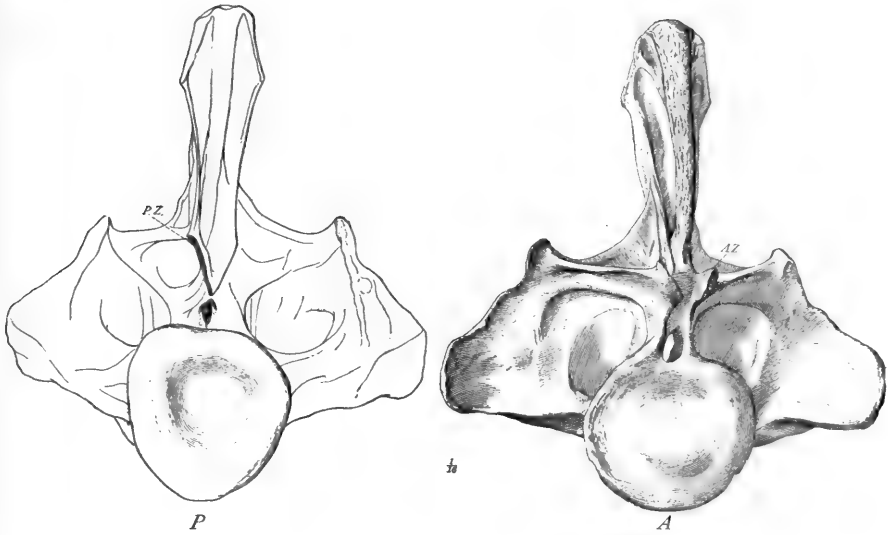


Fig. 4. *Camarasaurus*. First caudal. *A*, anterior view. *P*, posterior view. Am. Mus. Coll. R. 222. Approximately $\frac{1}{10}$ natural size.

Behind this highly specialized vertebra, three vertebræ were probably intercalated, only one of which is preserved in our collection, giving us the transition to the vertebra estimated as the 5th caudal (Fig. 3).

This supposed 5th caudal (Figs. 3, 5) exhibits a marked reduction of the spine as well as of the transverse lamina; the posterior surface of this lamina being excavated by two deep depressions. This vertebra was followed probably by two, which are missing, so that the fourth preserved in our collection is estimated as the 8th caudal (Fig. 5); in this the transverse lamina is still more reduced, and the lateral pockets upon the posterior face are wanting. Behind this is the supposed 9th caudal, which
[*June, 1898.*]

approaches in its structure that which Marsh has figured as the 4th, but is somewhat more complex. Here follows another interval (Fig. 5), in which would lie the vertebræ described by Marsh as the 4th. (Fig. 6.)

The estimated 12th, 13th and 14th succeed each other with a regular diminution in size, and a steady reduction of the trans-

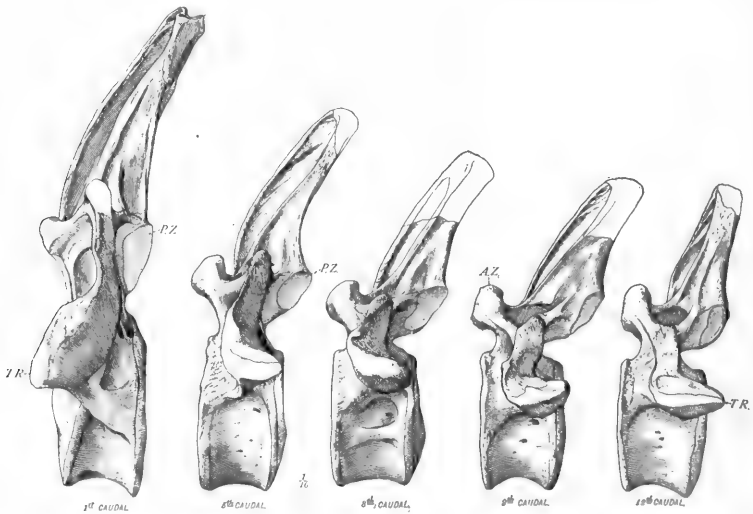


Fig. 5. *Camarasaurus*. Anterior caudals. First caudal and 5th, 8th, 9th, 12th caudals as estimated. Am. Mus. Coll. R. 222. Approximately $\frac{1}{16}$ natural size.



Fig. 6. *Brontosaurus excelsus*. Supposed 4th caudal vertebra. After Marsh, 1847, Plate xxiv. Approximately $\frac{1}{16}$ natural size.

verse processes, which gradually transforms into a horizontal plate. The next vertebra preserved is the estimated 16th, which exhibits a very marked reduction in the transverse process, and this disappears entirely in the supposed 20th and 21st, in front of which at least two vertebræ are missing. (See also Note 1, p. 233.)

The missing 16th and 17th vertebræ were probably detached in the manner described above, and the 16 or 20 vertebræ at the end of the tail were also drawn away. In front of the 15th no tooth marks are observed.

3. HISTORICAL NOTES.

Large Cetiosauria have been named from these and similar beds¹ in Colorado, as follows :

No. 1. *Titanosaurus montanus* Marsh.—Am. Jour. Sc., July, 1877, p. 87.—Golden, Colorado.

No. 2. *Camarasaurus supremus* Cope.—Pal. Bull. 25, Aug. 23, 1877, Proc. Am. Phil. Soc.—Cañon City, Col.

No. 3. *Caulodon diversidens*² Cope.—Pal. Bull. 26, p. 193.—Cañon City, Col.

No. 4. *Tichosteus lucasani*³ Cope.—Pal. Bull. 23, p. 194, Nov. 21, 1877. Proc. Am. Phil. Soc.—Cañon City, Col.

No. 5. *Atlantosaurus* (*Titanosaurus*) *montanus* Marsh.—Am. Jour. Sc., Dec., 1877, p. 514.—Colorado.

No. 6. *Apatosaurus ajax* Marsh.—Am. Jour. Sc., Dec., 1877.—Colorado.

No. 7. *Apatosaurus grandis* Marsh.—Am. Jour. Sc., Dec., 1877, p. 515.—Colorado.

No. 8. *Amphicælias altus* Cope.—Pal. Bull. 26, Dec. 10, 1877. Proc. Am. Phil. Soc.—Cañon City, Col.

No. 9. *Amphicælias latus* Cope.—Pal. Bull. 26, Dec. 10, 1877. Proc. Am. Phil. Soc.—Cañon City, Col.

No. 10. *Symphyrrophus musculosus*⁴ Cope.—Pal. Bull. 26, p. 246, Jan. 12, 1898.—Cañon City, Col.

No. 11. *Atlantosaurus immanis* Marsh.—Am. Jour. Sc., March, 1878, p. 241.—Colorado.

No. 12. *Brontosaurus excelsus* Marsh.—Am. Jour. Sc., Dec., 1879.—Como, Wyoming.

The rapid and profound transformations in the characters of the vertebræ in different parts of the back bone give these animals an entirely unique position among reptiles, and largely explain the diversities of view as well as the numerous generic references held by different authors, as indicated in the following brief résumé :

(1) The first notice of these animals in American literature was by Marsh,³ under the name of *Titanosaurus montanus*. This generic name had been shortly before employed by Lydekker.⁴ (2) The second notice was by Cope,⁵ in which the name *Camarasaurus* was proposed. The species *Camarasaurus supremus* was based upon a number of dorsal vertebræ from the supposed Dakota Beds of Colorado, near Cañon City. In 1878⁶ these remains were

¹ These beds are equivalent to the Wealden of England, from which many large Dinosaurs have been described, of the same order (Cetiosauria) and possibly representing the same genera.

² Never fully characterized or figured.

³ Notice of a new and Gigantic Dinosaur, Am. Journ. Sc., July, 1877, p. 88.

⁴ Rec. Geol. Surv. Ind., Vol. IV, p. 38, 1877.

⁵ On a Gigantic Saurian from the Dakota Epoch of Colorado. Pal. Bull., XXVI, Published Aug. 23, 1877.

⁶ On the Saurians recently discovered in the Dakota Beds, etc.—Am. Nat., Feb., 1878, p. 71.

figured. It now appears that the anterior dorsal vertebra (Fig. 2, p. 73, of Cope's article), characterized like the cervicals, by the absence of the median spine, was correctly determined by Cope. In this vertebra the hyposphen is less accented than in the vertebra figured upon the following page (Fig. 5, p. 75), in which the hyposphen is sharply defined, and there is also a median dorsal spine. (5) The fifth notice was by Marsh,¹ in which the name *Atlantosaurus*

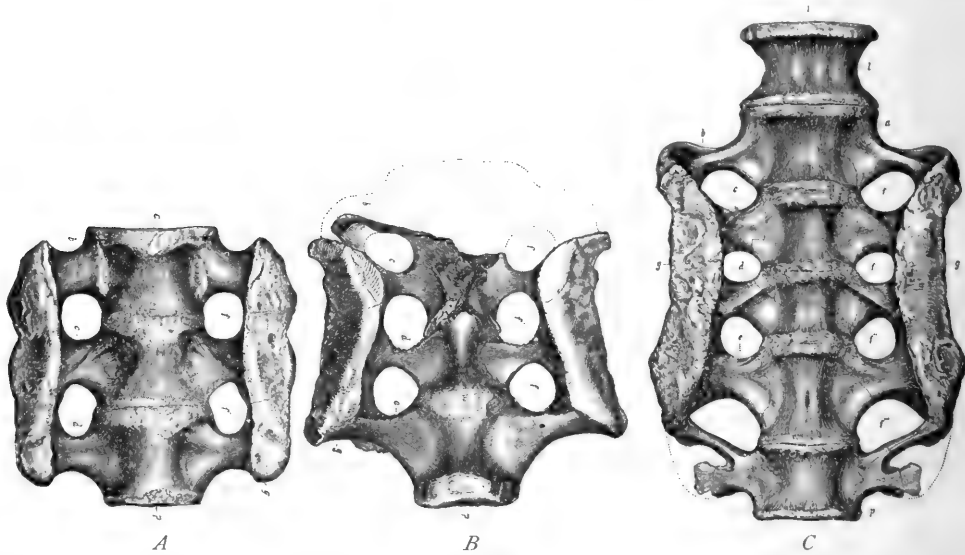


Fig. 7. SACRA OF CETIOSAURIA.

A, *Apatosaurus ajax*. Three coalesced sacra. After Marsh, 1897, Plate xvii.

B, *Atlantosaurus montanus*. Three coalesced sacra and portion of a fourth. After Marsh, 1897, Plate xvii.

C, *Brontosaurus excelsus*. Five coalesced sacra. After Marsh, 1897, Plate xxiii. All figures approximately $\frac{1}{2}$ natural size.

was proposed to replace *Titanosaurus*. (6) In the same paper the new genus, *Apatosaurus ajax*, was distinguished by the opisthocœlous cervicals with hollow centra; anterior dorsals with similar characters; posterior lumbar with flat articular faces; sacral vertebræ more solid; anterior caudals biconcave; chevrons not united above. (7) In the same paper the species *A. grandis* is described with the following measurements:

Length of femur..... 1050 mm.
 Transverse diameter of proximal end..... 340 mm.

(8) The eighth notice by Cope was based upon characters of the posterior dorsal vertebræ. The vertebra (Fig. 13, p. 80) with a very prominent dorsal spine, re-

¹ Notice of new Dinosaurian Reptiles from the Jurassic Formation. Am. Jour. Sc., Dec., 1877, p. 514.

ferred to *Amphicalias altus*, agrees closely with that here shown to belong to *Camarasaurus*. (12) In the twelfth notice (Marsh, 1879) a new type, *Brontosaurus excelsus*, was defined. Characters: Sacrum composed of five thoroughly coössified vertebræ; in other respects resembling *Morosaurus* from the Como Beds of Wyoming. The succeeding notices of these animals are fully embraced in Marsh's Memoir, "The Dinosaurs of North America," published in 1897. Here (pp. 166-241) the order Sauropoda and family Atlantosauridæ are described, the latter, however, not including the genus *Camarasaurus*, which is placed in the *Morosauridæ* (page 241).

COMPARATIVE MEASUREMENTS OF LIMBS, ARCHES, VERTEBRÆ.

	<i>Camarasaurus supremus</i> . ¹	<i>Camarasaurus</i> No. 222, Am. Mus.	<i>Amphicalias altus</i> . ¹	<i>Apatosaurus grandis</i> .	<i>Brontosaurus excelsus</i> . ²
Total length of scapula	1517	1597	..	..	1600
Greatest diameter of coracoid	690	736	..	..	672
Antero-posterior, ilium . . . . .	..	1373	..	..	..
Total length of ischium . . . . .	..	1150	..	..	1118
" " pubis . . . . .	..	1168	1060	..	1168
" " femur	1820	1776	1930 ³	1050	1750
Height of ant-dorsal spine	830	1050	..	..	948
" post-dorsal spine . . . . .	..	1280	1100	..	..
Length, centrum ant-dorsal	275	..	..	..	276
Median caudal . . . . .	..	..	..	..	..

It is *a priori* improbable that so many different genera of gigantic Saurians of similar size co-existed. It is against the principles of evolution that closely similar types of equal size should occupy the same territory at the

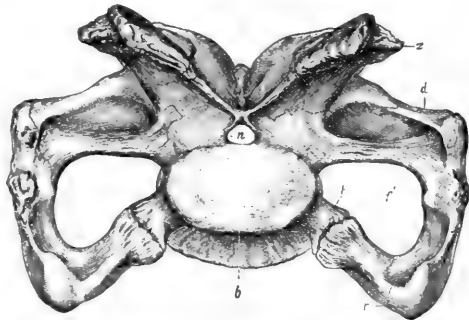


Fig. 8. *Brontosaurus excelsus*. Posterior vertebra. After Marsh, 1897. Plate xxi. Approximately $\frac{1}{10}$ natural size.

¹ These measurements are given in Cope's second paper upon *Camarasaurus*. (Am. Phil. Soc., Dec., 1877, pp. 242-245.)

² These measurements are approximate, as no exact measures have been published.

³ Cope gave the length of this femur as 6 feet 4 inches (=1930), and described it as longer than that of *Camarasaurus*, but in his metric table it is by misprint assigned 1524 mm.

same time. It appears moreover to the writer that the evidence which has been brought forward to demonstrate such an exceptional condition is inadequate and is capable of different interpretation, as follows :

Amphicalias having been shown to be in all probability related to *Camarasaurus*, the only absolute basis of separation of the remaining types is the number of sacral vertebræ, as in the definitions of Marsh and Cope :

<i>Apatosaurus.</i>	<i>Camarasaurus.</i>	<i>Atlantosaurus.</i>	<i>Brontosaurus.</i>
3 sacrals.	4 sacrals.	4 sacrals.	5 sacrals.

This definition does not separate *Atlantosaurus* from *Camarasaurus*; the type sacrum of *Atlantosaurus* (Fig. 7*B*) is, however, fractured anteriorly, and this animal may therefore have possessed 5 sacrals, like

Brontosaurus (Fig. 7*C*).

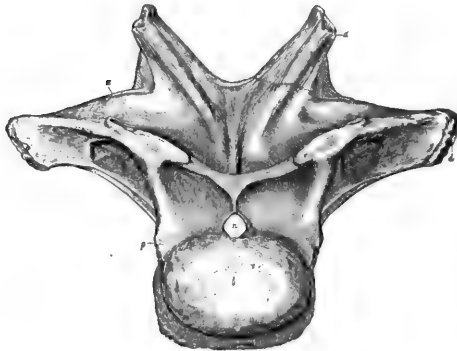


Fig. 9. *Apatosaurus ajax*. Dorsal vertebra. After Marsh, 1897, Plate xviii. Approximately $\frac{1}{15}$ natural size.

The three coalesced sacral spines and the single free sacral centrum in our specimen suggest the following hypothesis, namely, that *Camarasaurus* had five sacral vertebræ; three of these constantly coalesced both by centra and neural spines, two others coalesced less constantly and possessed free spines.

Such difference in the growth and degree of coalescence is shown to be probable (1) by *Diplodocus*, in which at least three vertebræ coalesce by centra but only two coalesce by spines; (2) by our specimen, No. 222, in which (closely resembling *Brontosaurus* in every other respect) one centrum is free and three spines are coalesced; (3) by the type of *B. excelsus*, in which three spines are coalesced, as figured. (See also Note 2, p. 233.)

The removal to a distance of one or both of the freer sacral vertebræ is quite explained by the fact that these skeletons are

in the great majority of cases very much disturbed and confused before embedding. An instance in point is the loss of all the anterior caudals in Marsh's otherwise excellent *B. excelsus* specimen.

Let us suppose that the three early united vertebræ (of the more primitive Cetiosaur sacrum) were found alone, the others having been detached and lost, we would then have the genus *Apatosaurus*; if one of the freer vertebræ had united we would have the genus *Atlantosaurus* or *Camarasaurus*; if both of the freer vertebræ had united we would have *Brontosaurus*.

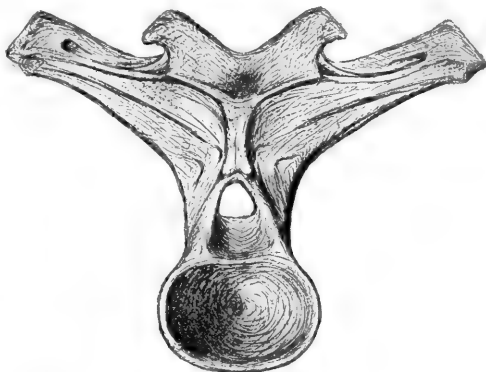


Fig. 10. *Camarasaurus supremus* type. Anterior dorsal vertebra. After Cope. Approximately $\frac{1}{10}$ natural size. Compare *Morosaurus*, Marsh, 1897, fig. 31, p. 181.

4. ANTERIOR DORSAL VERTEBRÆ OF THE CETIOSAURS ARE OF AVIAN TYPE.

Anterior dorsals without median spines have been described by Cope in *Camarasaurus* (Fig. 10) and by Marsh in *Apatosaurus* (Fig. 9), *Morosaurus* and *Diplodocus*. This condition seems so general as to constitute almost an ordinal character of the Cetiosaurs.

These vertebræ are, moreover, remarkable in resembling those of certain Struthious birds such as *Dromæus* (Fig. 1), in the absence of median spines, in the elevation of lateral spinous processes above the zygapophyses, and in the abrupt development of a median spine upon the third or fourth dorsal.

It is also not improbable that the abrupt transition from vertebræ without median spines to a vertebra with a strong median spine (*Dromæus*, D 3) is paralleled in the blunt spine of the *Camarasaurus* dorsal (Fig. 11), which may well represent D 3 or

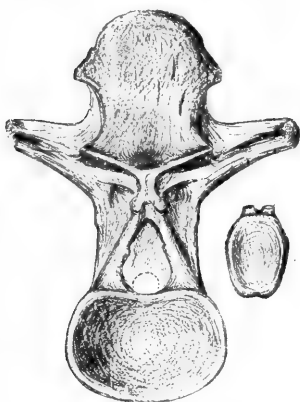


Fig. 11. *Camarasaurus supremus*. Anterior dorsal. Supposed to be the first possessing a median spine. After Cope. Approximately $\frac{1}{16}$ natural size.

D4. Behind this would appear the transversely expanded mid-dorsal spines of the *Brontosaurus*¹ (Fig. 12) type, and of our specimen, No. 222 (Fig. 2). Behind this again would appear the posterior dorsal of the *Amphicælias* type (Fig. 13) or the still more posterior dorsal of our specimen, No. 222 (Fig. 3).

The difference between these three types of vertebræ (Figs. 9, 12 and 3) is so profound that it seems hardly possible that they could be compressed within the limits of 14 dorso-lumbar—the number which Marsh has figured

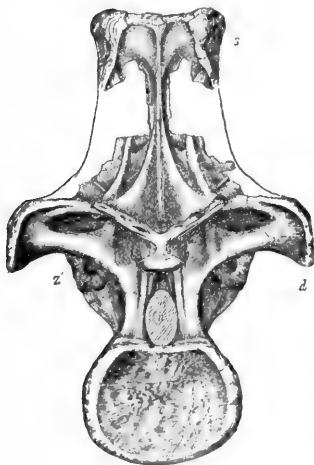


Fig. 12.

Fig. 12. *Brontosaurus excelsus*. Dorsal vertebra. After Marsh, 1897, Plate xxi. Approximately $\frac{1}{16}$ natural size.

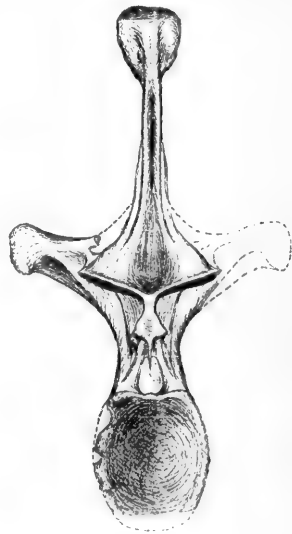


Fig. 13.

Fig. 13. Posterior dorsal of *Amphicælias altus*, type. After Cope. Approximately $\frac{1}{16}$ natural size.

¹ This is mistakenly determined by Marsh ('Dinosaurs of North America,' p. 169) as a "posterior dorsal."

in *Brontosaurus*. There were, therefore, in all probability, more dorso-lumbar than 14. Cope has assigned 20 dorso-lumbar to *Camarasaurus*.

So far as habit and function are involved, the transition from the lateral spined to the median spined dorsals, as in *Dromæus*, probably indicates that *Camarasaurus* had a comparatively free anterior dorsal region, consisting of two or more vertebræ, which bore short ribs and moved in all directions with the neck.

The differences in proportion, in length of limb and in other parts subject to age, sex and individual variation noted in these different specimens are undoubtedly superseded by genuine specific differences which mark the *Camarasaurus* of different geological levels, also by generic differences, which, however, are still to be positively determined by more careful and thorough exploration, and by comparison of the type specimens. The generic name *Camarasaurus* is therefore provisionally employed here.

NOTE 1.—CENTRA OF CAUDALS.

There is also great diversity in the caudal centra.

The first caudal centrum is *biconvex*.

The second to the estimated seventeenth caudal centra are *procaudous*.

The estimated twentieth caudal centrum and all behind it are *amphicaudous*.

NOTE 2.—SIZE SACRUM.

The four sacra of *Camarasaurus* exhibit exactly the same measurement as the four anterior sacra of *Brontosaurus*.

Article XIII. — REVISION OF THE SPECIES OF
EUCHLOË INHABITING AMERICA, NORTH OF
MEXICO.

By WILLIAM BEUTENMÜLLER.

PLATES XIII AND XIV.

The present paper is based upon the material contained in the collections of the Museum, W. H. Edwards (in possession of Dr. Holland), Dr. Ottolengui, Dr. Skinner, Dr. Strecker, J. Doll, and also that of the late B. Neumoegen. I am also under obligation to Dr. Scudder for bringing to me his type of *A. thoosa*.

The Butterflies of this country very much need revision, especially the genera *Argynnis*, *Melitæa*, *Lycæna* and *Colias*, in fact nearly all of the larger genera contain too many 'so-called species.' I expect to publish, from time to time, the results of my studies on the Butterflies, and I would earnestly appeal to those who are also studying these insects to do likewise, so as to enable us to get a clearer and more definite understanding of the species.

The name *Euchloë* was erected by Hübner (Verz. Bekant. Schmett., 1816, p. 94) for the European species *ausonia*, *tagis*, *cardamines* and *eupheno*; the Indian *eucharis* (*cæneos*) and the North American *genutia* (*midea*).

Boisduval (Spec. Gen., I, 1836) used *Anthocharis* in the same sense as Hübner, for a mixed lot of species, including those mentioned by Hübner.

Doubleday (Gen. Diurn. Lepid., 1847) placed ten species in *Anthocharis* (sens. restrict.) and many other species in *Callosune*, to which genus he also refers *eucharis* (*cæneos* Hüb.).

Herrich-Schæffer (Corr.-Blatt. Zoöl.-Min. Verein, Regensburg, Vol. XXI, 1867, p. 105) established the genus *Midea* for *genutia*, which consequently is the type of the genus. The name *Midea* is based on one of the synonyms of *genutia*, and is perfectly tenable. Scudder (Generic Names for Butterflies, 1875, p. 113) considered

genutia the type of *Anthocharis*, but this view cannot hold since Herrich-Schæffer had already used *Midea* for it.

Hübner's name *Euchloë* has been employed for *cardamines* only, by Westwood (Brit. Butt., 1841, p. 30), Stephens (1850) and Kirby (1858), and therefore must be considered as the type of the genus. This has been pointed out by Kirby (Zoöl. Record, 1872, p. 339) and Scudder (*l. c.*, p. 169) also specifies *cardamines* as the type of *Euchloë*.

From the above it will be seen that *Midea* may be used for *genutia*; *Euchloë* for *cardamines* and allied species. And I would here propose that *Anthocharis* be used for *ausonia* Hüb. and allied species.

The genus *Euchloë* may be divided into three groups, which may be separated as follows:

Euchloë Hübner.

Fore wings with 12 veins; veins 6-9 on a short stalk, sometimes with vein 6 free.

Costa straight, apex rounded. *sara* (and varieties), *cardamines*,
gruneri, *pyrothoë*, and *eupheno* (*euphenoides*).

Anthocharis Boisduval.

Fore wings with 12 veins; veins 6-9 on a long stalk, sometimes with vein 10 also on a stalk.

Costa slightly sinuate (especially in the male); apex pointed—
ausonides, *creusa*, *lotta*, *olympia*, *ausonia*, *bellemia*, *tagis*, *charlonia*
and *levellandii*.

Midea Merrich-Schæffer.

Fore wings with 11 veins; veins 6-8 on a stalk; vein 9 absent; more or less falcate. *genutia*, *pima*, *cethura*, *lanceolata* and *bioti* (Asia).
Fore wings with 12 veins; strongly falcate. *scolymus* (Japan).

The venation is subject to variation. In the many specimens of *cardamines*, *sara*, *reakirtii* and allies which I have examined, veins 6-9 are usually on a short stalk, but in many individuals of the same species vein 6 is free from apex of cell and is not stalked, thus leaving only veins 7-9 on a stalk. The same is also the case with *ausonia*, *ausonides*, etc. In these veins 6-9 are usually on a long stalk, with vein 10 from cell or on a short stalk. Little or no dependence can therefore be placed on

the movements of veins 6 and 10, from a generic point of view, in the genus *Euchloë*, and I consider all the species mentioned in this paper congeneric, *Anthocharis* and *Midea* being nothing more than subdivisions of *Euchloë* not entitled to generic rank.

Synopsis of Species.

- Fore wings with a large red apical patch in both sexes.
 - Color white or yellow. Size large. Sexes dissimilar.
 - Hind wings beneath with loose clusters of scales.....*sara*.
 - Color white; size medium.
 - Hind wings beneath heavily marked with clusters of scales—
 - var. *reakirtii*.
 - Hind wings beneath with markings confluent.var. *julia*.
 - Color yellow.
 - Markings on hind wings beneath as in *reakirtii*..*stella*.
 - Color white; sexes similar.
 - Hind wings beneath with irregular green bands connected by branches... ..*cethura*.
 - Hind wings beneath with markings very much confluent—
 - var. *morrisonii*.
- Fore wings falcate; ♀ without orange apical patch.
 - Hind wings beneath sprinkled with cluster of patches.....*genutia*.
- Fore wings without orange apical patch. White in both sexes.
 - Hind wings beneath with green marbling in form of irregularly connected bands.
 - White ground-color of hind wings beneath opaque.....*ausonides*.
 - White ground-color of hind wings beneath glistening.
 - With large discal patch on fore wings..... *lotta*, sp. nov.
 - With small discal spot on fore wings..... *creusa*.
 - With marbling on hind wings beneath confluent..... var. *elsa*.
 - Costa of hind wings beneath pink.
 - With apex of fore wings above black... ..*olympia*.
 - With black on apex of fore wings above broken or faintly indicatedvar. *rosa*.
- Large species; with hind wings beneath heavily sprinkled with brown clusters of scales.....*lanceolata*.

***Euchloë sara* (Bdv.).**

PLATE XIII, FIGS. 4 AND 5.

Anthocharis sara BOISDUVAL, Ann. Ent. Soc. France, Vol. X, 1852, p. 285; Lepid. Calif. 1860, p. 12; LUCAS, Rev. Zool. 1852, p. 330; W. H. EDWARDS, Butt. N. Am. Vol. I, pl. II; Can. Ent. Vol. XXIV, 1892, p. 52; HY. EDWARDS, Pacific Coast Lepid. Dec. 1876; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.
Anthocharis flora WRIGHT, Can. Ent. Vol. XXIV, 1892, p. 154; SKINNER, l. c. p. 114.

Male.—Upper side white or pale yellow, bases scaled with black. Fore wings with a large bright red sub-apical patch, bordered within by a broad black oblique band running from the middle of the costa to a little above the

hind angle. This band shows a tendency to become disconnected at the middle. Outwardly, at the apex and margin, bordered with black, serrated within and becoming broken into two spots about the middle of the margin. Hind wings with the nervures more or less tipped with black at the outer margin. Under side: Fore wings with patch bright orange and smaller than above. At end of cell is a double black spot, the transverse band absent. Apex white, instead of black, sprinkled with olive green; extreme outer margin narrowly yellow, with small black dots. Hind wings with veins yellow and marbled with olive green patches. Expanse 40-44 mm.

Female.—Upper side white or yellow. Apical patch smaller, orange, transverse black band absent. At end of cell is an elongate, black discal bar; outwardly the patch is edged by a sinuous black stripe, which is sometimes more or less distinct and broken. Outer margin of wing bordered by a series of black dashes, in form of spots, pointed inwardly. The space between the stripe and spots is yellow. Hind wings and under side same as in the male. Expanse, 40-50 mm.

Habitat.—California to Vancouver.

***Euchloë sara* var. *reakirtii* (Edw.).**

PLATE XIII, FIG. 6.

Anthocharis reakirtii W. H. EDWARDS, Trans. Am. Ent. Soc. Vol. II, 1869, p. 369; Butt. N. Am. Vol. I, 1870, pl. i, figs. 1-4; Can. Ent. Vol. XXIV, 1892, p. 52; H. Y. EDWARDS, Pacific Coast Lepid. No. 22, 1876, p. 6; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Anthocharis thoosa W. H. EDWARDS, Can. Ent. Vol. XI, 1879, p. 87.

Male and *Female*.—Upper sides white and marked as in *sara*, but the black band on fore wing in the male as a rule much heavier and more continuous. On the under side the apex and outer margin of the fore wings is more heavily sprinkled with dark olive green, and the hind wings are uniformly and densely covered with dark olive green patches, much more so than in *sara*. Expanse, 28-40 mm.

Habitat.—California, Oregon and Washington to Vancouver, Arizona.

***Euchloë sara* var. *stella* (Edw.).**

Anthocharis stella W. H. EDWARDS, Can. Ent. Vol. XI, 1879, p. 87; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Marked like *reakirtii*, but both male and female are yellow instead of white. Expanse, 35 mm.

Habitat.—Nevada, California, Oregon, Vancouver, Arizona, Idaho.

Euchloë sara var. **julia** (*Edw.*).

PLATE XIII, FIG. 7.

Anthocharis julia W. H. EDWARDS, Trans. Am. Ent. Soc. Vol. IV, 1872, p. 62; STRECKER, Lepid. Rhop.-Het. 1873, p. 50, pl. vi, figs. 6, 7; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Synchlōe thoosa SCUDDER, Bull. U. S. Geo. Surv. Hayden, Vol. IV, 1878, p. 257.

Anthocharis thoosa SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Male.—White and marked like *reakirtii*, but the oblique band on the fore wings is disconnected, or nearly so, at the middle. On the under side of the hind wings the patches are confluent. Expanse, 30 mm.

Female.—Yellow and resembles *stella* on the upper side.

Habitat.—Colorado, Utah, Montana, New Mexico, Arizona.

Sara may be readily known by its large size and by having the marbling on the underside of the hind wings less heavily marked, while in some individuals it is merely a sprinkling of small patches. It is the summer brood of *reakirtii*, as has been proven by Mr. Koebele (W. H. Edwards, Can. Ent., XXIV, p. 52) who states that *sara* of May and June proceeds from the eggs laid by *reakirtii* in March, and that some pupæ go over the winter to produce *reakirtii* in early spring, and that the product of *sara* was *reakirtii* of next spring.

With this conclusive evidence there can be no question as to the identity of *sara* and *reakirtii*. I have examined four specimens of *flora*, and they are the same as *sara*, with the black marginal spots on the hind wings somewhat heavier. It is not even worthy of a varietal name.

Reakirtii may be known from *sara* by being smaller and by having the markings on the hind wings beneath much heavier, though in a large series of specimens there is considerable variation as to the intensity of the patches. There are also examples which have the disc of the wings above yellow, but the majority of specimens are white. Dr. Skinner considers *julia* and *stella* slight modifications of *reakirtii*, and I fully agree with him. *Reakirtii* varies from white to yellow, and in large series of specimens it is quite difficult to separate *stella* and *julia*. *Julia*, how-

ever, has the markings on the hind wings beneath confluent, the marbling being in large patches, and in the male the black bar on the fore wings is angulate and broken in the middle. The females are either yellow or white. Scudder's *thoosa* was described from a single female example, and is the same as *julia*. The specimens described as *thoosa* by W. H. Edwards (Can. Ent., XI, 1879, p. 87) are the same as *reakirtii*. In *stella* both the male and female are yellow, but the markings on the hind wings beneath are like those of *reakirtii* in pattern.

Euchloë ausonides (Boisd.).

PLATE XIV, FIG. 1.

Anthocharis ausonides BOISDUVAL, Ann. Ent. Soc. France, Ser. 2, Vol. X, 1852, p. 286; Lepid. California, 1869, p. 40; LUCAS, Revue Zool. 1852, p. 349; W. H. EDWARDS, Proc. Ent. Soc. Phil. Vol. II, 1863, p. 81; Butt. N. Amer. Vol. II, 1874, pl. I; Can. Ent. Vol. XXIV, 1889, pp. 52 and 109; MEAD, Rep. U. S. Geog. Surv. Wheeler, Vol. V; Zool. 1874, p. 747; H. V. EDWARDS, Pacific Coast Lepid. July 6, 1874; COCKERELL, Ent. Am. Vol. V. 1889, p. 34; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Male.—Upper side white, bases black. Fore wings with a black apical patch, broken on the costa by a white spot and on the outer margin by two or three white streaks. At end of cell is a discal bar of variable breadth. Costa speckled with black. Hind wings uniform white. Under side: Fore wings white, spot on disc repeated. Apical patch olive green instead of black. Hind wings mottled with green, in form of three irregular, wavy, connected transverse bands, the outer one throwing out forked branches to the margin. Expanse, 30–40 mm.

Female.—Similar to the male, but as a rule the hind wings above are suffused with a creamy white, especially so in the Californian specimens. Discal bar on fore wings heavier and the apical patch is usually more broken, the inner part forming a sinuous line. Expanse, 32–47 mm.

Larva.—Head small, round, green speckled with black; body covered with minute black granules from each of which springs a short hair. On each side are two longitudinal lead-colored stripes and one along the dorsum. The intervening spaces are yellow; lateral stripes edged below with white shading into yellow. Legs black; thoracic feet greenish yellow. Length, 28 mm.

Chrysalis.—Slender, cylindrical, thickest in the middle, tapering therefrom evenly, the ends being of nearly equal size. Triangular at the middle beneath, and the thorax above slightly waved. Color gray-brown, covered with fine longitudinal darker streaks. Length, 23 mm.

Food-plants.—Cruciferous plants.

Habitat.—California to Alaska, British America, Arizona, Utah, Montana, Colorado.

***Euchloë ausonides* var. *coloradensis* (Hy. Edwards).**

Anthocharis coloradensis HY. EDWARDS, Papilio, Vol. I, 1881, p. 50.

Like *ausonides*, but the discal bar on the fore wings is in form of a small, black, lunate spot instead of a broad bar. The under side of the hind wings have the markings of a somewhat deeper green.

Habitat.—Rocky Mountains, Colorado, Montana.

This is a common species wherever it occurs. In California it makes its appearance at the end of February, if the weather is moderately warm, and is on the wing until May. In Colorado it makes its appearance in May and June. It is single brooded, and the larva very much resembles that of *Pieris protodice*. The insect is closely allied to, if not the same as, the European *Euchloë ausonia*. The European species is double brooded, and as far as I can learn the larva is also different from our species. It is supposed by some collectors that *ausonides* is the spring form of *creusa* (*hyantis*), but W. H. Edwards (Can. Ent., XXIV, 109) contradicts this by stating that he had, in different years, bred from pupæ four examples of typical *ausonides*, all in the month of March.

***Euchloë creusa* (Doubl.-Hew.).**

PLATE XIV, FIG. 2.

Anthocharis creusa DOUBLEDAY & HEWITSON, Gen. Diur. Lepid. 1847, p. 56, pl. 7; HY. EDWARDS, Pacific Coast Lepid. No. 22, Dec. 18, 1876; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Anthocharis hyantis W. H. EDWARDS, Trans. Am. Ent. Soc. Vol. III, 1871, p. 205; HY. EDWARDS, Pacific Coast Lepid. No. 28, June 17, 1878; MEAD, Psyche, Vol. II, 1878, p. 183.

Male.—Similar to *ausonides*, pure white and of a different shade. The discal mark almost always uniform in size and shape. Apical marks as in *ausonides*. Markings of hind wings beneath as in *ausonides*, but the white spaces are more shining. It is also much smaller on an average. Expanse, 35 mm.

Female.—Similar to the male, but the black markings on the fore wings are a little more prominent.

[July, 1898.]

Larva.—Head and body apple green, very minutely dotted with black, and with a pure white stigmatal stripe or line.

Food-plant.—Various species of cruciferous plants.

Habitat.—California, Colorado, British America.

Hy. Edwards (Pacific Coast Lepid., No. 22, 1876) states that after an examination of a figure of *creusa*, from Dr. Butler, *hyantis* is the same species. W. H. Edwards, in his list of Butterflies of 1877 makes *hyantis* a synonym of *creusa*, and in his list of 1879 (Append. Bull. N. Am.) *hyantis* is entirely omitted. In 1878 Hy. Edwards changed his former opinion (Pacific Coast Lepid., No. 28, June 17) and re-established *hyantis* as a valid species, and it is so placed at the present time. I have recently had the opportunity of consulting Doubleday & Hewitson's work on 'Genera of Diurnal Lepidoptera,' in the library of the American Entomological Society, and find that the figure of *creusa* agrees very well with the insect described by W. H. Edwards as *hyantis*, the types of which I examined in Dr. Holland's collection. The upper side only of *creusa* is figured, and no description is given, but there can hardly be any doubt as to its identity with *hyantis* or possibly *ausonides*. At any rate it is not what we at present know as *creusa*, as it is labeled in collections. Found in June and July.

Euchloë creusa var. **elsa**, var. nov.

PLATE XIV, FIG. 3.

Male and Female.—Upper sides like *creusa*, but the hind wings beneath have the bands confluent, with small clear spaces and streaks. Expanse, 32 mm.

Habitat.—Laggan, British Columbia.

This is undoubtedly a variety of *creusa*, and it bears the same relationship to this species that *morrisonii* does to *cethura*, and it is closely allied to *orientalis* of Asia. It may be known by the almost uniform green markings on the hind wings beneath. Two examples are in the collection of Dr. Holland and Dr. Strecker; one specimen in each of the collections of Dr. Ottolengui and Mr. Doll.

Euchloë lotta, sp. nov.

PLATE XIV, FIG. 4.

‡ *Anthocharis creusa* HY. EDWARDS, Pacific Coast Lepid. No. 28, 1878; W. H. EDWARDS, Lists of N. Am. Diurnals.

Male and Female.—Like *creusa*, but the discal spot is always much larger, broader and in form of a cloud-like patch above and below. Hind wings beneath, with the marbled surface darker and the spaces between somewhat glistening white. Expanse, 32 mm.

Habitat.—Colorado, Arizona, Utah, Southern California.

This is the species which heretofore was known as *creusa*. I am of the opinion that it may be a variety of *creusa* (*hyantis*), from which it differs only in the larger size of the black spot on the fore wings.

Euchloë olympia (*Edw.*).

PLATE XIV, FIG. 5.

Anthocharis olympia W. H. EDWARDS, Trans. Am. Ent. Soc. Vol. III, 1871, p. 266; Butt. N. Am. Vol. II, 1874, pl. 2, and Vol. III, 1889, p. 2; STRECKER, Lepid. Rhop.—Het. 1874, p. 64. pl. 8; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Male.—Pure white, blackish at base. Fore wings with a grayish black discal bar and a black apical patch enclosing a white spot on the costa. Under side: Fore wings with discal bar much reduced, lunate, white centrally; a green sub-apical mark on the costa and one on the outer margin. Hind wings white, beneath with a rosy tint along the costa and crossed by three bands; the first band is near the base, forming a circle; the second is a little in front of the middle, with irregular edges, and sends a branch into the third band on the submedian vein; the third band begins on the inner margin and curves towards the outer margin, which it strikes in three branches. A short dash on the outer angle, between the second and third bands. Female similar to the male. Expanse, 33-37 mm.

Euchloë olympia var. *rosa* (*Edw.*).

Anthocharis rosa W. H. EDWARDS, Papilio, Vol. II, 1882, p. 45; Butt. N. Am. Vol. III, 1889, pl. 2; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Like *olympia*, but the apical patch is fainter in color and much broken, being indicated by a grayish black shade or scales at the extreme apex and a subapical spot on the costa and outer margin. These two spots are sometimes connected by grayish-black scales and form an oblique sinuous line.

Habitat.—West Virginia to Texas and Nebraska.

Euchloë cethura (*Felder*).

PLATE XIII, FIGS. 1, 2.

Anthocharis cethura FELDER, Reise Navarra, Lep. Vol. II, 1865, p. 182, No. 174, pl. 25, figs. 1 and 2; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Anthocharis cooperi BEHR, Trans. Am. Ent. Soc. Vol. II, 1869, p. 304; EDWARDS, Butt. N. Am. Vol. I, 1870, pl. I, figs. 5-8.

Anthocharis angelina BOISDUVAL, Lepid. Calif. 1869, p. 40.

Male.—Upper side white, sometimes tinged with pale yellow; base of wings black. Fore wings with an orange subapical patch, as in the female of *reakirtii*, bordered outwardly by a row of connected or disconnected wedge-shaped spots. At the end of the cell is a prominent black discal bar. Costa streaked with black. Hind wings with a minute black spot on each nervure on the margin. Under side: Fore wings with subapical patch canary yellow, shaded and irrorated with greenish yellow beyond. Fringes spotted with black. Discal mark reduced or obsolete. Hind wings white with green or greenish yellow patches or confluent irregular bands, with clear white spaces between and a row of clear spaces at the margin. Expanse, 28-35 mm.

Female.—Similar to the male, but has the orange patch on the fore wings much smaller, and in some specimens it is more or less wanting. The outer streaks connect with a black line at the end of the orange patch. Otherwise like the male. Expanse, 28-35 mm.

Habitat.—Southern California (San Diego, Kern River).

Euchloë cethura var. **morrisonii** (*Edw.*).

PLATE XIII, FIG. 3.

Anthocharis morrisonii W. H. EDWARDS, Papilio, Vol. I, 1881, p. 43, and Vol. III, 1883, p. 43; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, 1896, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 268.

Male.—Upper sides and under side of fore wings same as *cethura*. Hind wings beneath densely covered with green or yellowish green, with only a few small, clear white openings about the middle and a series of clear openings around the edges, those on the outer margin triangular. Size same as *cethura*.

Habitat.—Southern California.

Cethura, as far as we know at present, is found only in southern California. It occurs in barren *mesa* lands, particularly on the summits of small hills, in March. I have examined the types of *morrisonii*, and they are without much doubt a variety or seasonal form of *cethura*. It only differs from *cethura* by the intensity of the green color on the hind wings beneath. We possess a female of *morrisonii* in which the orange subapical patch is absent, thus making it superficially resemble the female of *hyantis*.

Euchloë pima (*Edw.*).

PLATE XIII, FIG. 8.

Anthocharis pima W. H. EDWARDS, Can. Ent. Vol. XX, 1888, p. 158; Butt. N. Am. Vol. III, 1889, pl. II, figs. 6-9; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Male.—Bright lemon with a bright orange subapical area, broadly bordered outwardly by black, the outer and costal parts of which are alternately pale yellow and black. In the orange space, at the end of the cell, is a conspicuous black bar. The lower part of the outer border sends a shoot inwards which shows a tendency to connect with the lower end of the discal bar. Hind wings uniform yellow, with a minute black dot at the end of each nervure. Under side: Fore wings lemon yellow; orange area much reduced. Apical region marked with green. Costa very pale yellow, with black points. Discal spot smaller than above. Hind wings heavily marbled with green in form of irregular confluent bands; spaces between yellow. Expanse, 40 mm.

Female.—Similar to the male.

Habitat.—Arizona.

This is the only species known in this country in which both sexes are of the same color and with the marking similar. Dr. Richard Kunze writes me as follows about the habits of the insect: "It flies in Pima and Maricopa Counties, Arizona, principally during March. It affects the desert near mountains, and during the heat of mid-day ascends loftier surroundings, either for purpose of assembling or to enjoy cool breezes. On the north side of the mountains are found herbaceous plants and annuals, which thrive best where the palo verde tree, a prickly *Parkinsonia microphylla*, affords a little shade to tender annuals. *A. pima* rifles the flowers of a hirsute plant called *Amsinckia spectabilis*, a foot high, bearing very small, yellow, funnel-shaped flowers. I

never observed *pima* feeding on other flowers. I have followed and watched this insect flying along arroyos or dried-up channels, which carry the surface water to lower levels, and where one finds the greatest number of herbaceous plants during March and April, or the spring of the Arizona desert. I have noticed *pima* hovering over a yellow flowered composite two feet high, and examined its leaves and branches, yet I did not find eggs or larvæ, as often as I had opportunity to investigate. *Pima* on that occasion may have been looking for its mate, because the few I took there were all males, and if any such which I failed to net were females, it would have been difficult to differentiate between the sexes on the wing, as both are exactly alike in color. Besides the female is very rare, in proportion as 1 to 20. *Pima* is single brooded."

Euchloë genutia (*Fabr.*).

PLATE XIV, FIG. 7.

Papilio genutia FABRICIUS, Entom. Syst. Vol. III, 1793, p. 193.

Mancipium vorax midea HÜBNER, Samml. Exot. Schmett. 1806-19, Vol. I, pl. 142.

Euchloë midea HÜBNER, Verzeich. Bek. Schmett. 1816, p. 94.

Pieris genutia GODART, Encyl. Meth. Vol. IX, 1819, pp. 118, 168.

Libythea genutia GODART, Encyl. Meth. Vol. IX, Suppl. 1819, p. 806.

Pieris l'herminieri GODART, Encyl. Meth. Vol. IX, 1819, pp. 118, 167, 168.

Midea HERRICH-SCHÆFFER, Corr.-Blatt. Zool.-Min. Verein, Regensburg, Vol. XXI, 1867, p. 105; KIRBY, Cat. Diurnal Lepid. 1871, p. 508.

Anthocharis genutia BOISDUVAL, Spec. Gen. Lepid. Vol. I, 1836, p. 565; MORRIS, Synop. Lepid. N. Am. 1862, p. 20; SCUDDER, Can. Ent. Vol. IV, 1872, p. 74; Generic Names for Butterflies, 1875, p. 113; Butt. N. Eng. Vol. II, 1889, p. 1147; W. H. EDWARDS, Butt. N. Am. Vol. II, 1878, pl. II; *l. c.* Vol. III, 1888, pl. I; Can. Ent. Vol. XIII, 1881, p. 211, and Vol. XXIV, 1892, p. 109; FRENCH, Butt. E. U. S. 1886, p. 118; SKINNER & AARON, Can. Ent. Vol. XXI, 1889, p. 129; ROWLEY, Can. Ent. XXII, 1890, p. 123; MARTINDALE, Ent. News, Vol. III, 1892, p. 240; SKINNER, Ent. News, Vol. VI, 1895, p. 146; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, 1897, p. 208.

Euchloë genutia BUTLER, Cat. Fabr. Lepid. 1869, p. 214; SCUDDER, Syst. Revis. Am. Butt. 1872, p. 42.

Male.—White. Fore wings falcate, apex orange edged with yellow and black dots at the margin. At the end of the discal cell is a small rounded spot. Costa sprinkled with black. Hind wings with a small black dot on the edge of each vein. Under side white with the apex scaled with olive brown and the orange patch absent, or very slightly indicated. Discal spot present, also a marginal row of small black dots. Hind wings uniformly and densely marbled with olive brown patches and spots on a yellowish ground. Expanse, 34 mm.

Female.—Differs from the male by the absence of the apical orange patch, which is rarely indicated by a pale orange shade. Discal and marginal dots somewhat larger than in the male. Expanse, 34 mm.

Habitat.—Massachusetts to Texas.

Larva.—Dark yellow green, glossy under side, feet and legs lighter. Along the back is a yellow stripe and a broader, white one along each side. On each segment above are six shining black tubercles, each of which has a short black hair, which thickens at the end. On the second and third segments the tubercles are arranged straight across, those on the first and fourth to last segments are placed in triangle. From the third to last segments below the band is also a row of tubercles, one to each segment. Last segment with a blackish plate. Head white and green, with a small black spot on each lobe and one below crossing the triangle, covered with small white tubercles. Length about 24 mm.

Food-plants.—*Sisymbrium thaliana*, *Arabis perfoliata* and *Cardamine*.

The species may be known by the strongly falcate wings, by means of which it differs from all the other species of the group. It is single brooded. In the North it appears in April and May and in the South in April. It is found in open woods and is not difficult to capture.

***Euchloë lanceolata* (Boisd.).**

PLATE XIV, FIG. 6.

Anthocharis lanceolata BOISDUVAL, Am. Ent. Soc. France, 2 Ser. Vol. X, 1852, p. 284; Lepid. Calif. 1869, p. 12; LUCAS, Revue Zool. 1852, p. 338; MORRIS, Synop. N. Am. Lepid. 1862, p. 21; SCUDDER, Proc. Bost. Soc. Nat. Hist. XII, 1869, p. 406; STRECKER, Lepid. Rhop.-Het. 1873, p. 49; HY. EDWARDS, Pacific Coast Lepid. No. 22, 1876; MEAD, Psyche, Vol. II, 1878, p. 182; W. H. EDWARDS, Butt. N. Am. Vol. III, 1881, pl. I; SKINNER, Journ. N. Y. Ent. Soc. Vol. IV, p. 114; BEUTENMÜLLER, Journ. N. Y. Ent. Soc. Vol. V, p. 208.

Anthocharis edwardsii BEHR, Trans. Am. Ent. Soc. Vol. II, 1869, p. 304.

Euchloë edwardsii KIRBY, Cat. Diurn. Lepid. 1871, p. 508.

Midea lanceolata KIRBY, Cat. Diurn. Lepid. Vol. I, 1871, p. 509.

Male.—Upper side white. Fore wings with a small discal spot at the end of the cell. Apex more or less shaded with black and the fringes are also black. Hind wings with a few black points around the apex. Under side: Fore wings very pale yellowish white, apex pure white with brownish scales in form of streaks. Discal spot curved, fringes yellow at base and edged with black. Hind wings white and thickly covered with transverse, broken streaks, which become confluent on the costal region to about the middle of the wing; on the

costa is a short white dash directed downwards, veins marked with brown. Expanse, 45 mm.

Female similar to the male. Expanse, 50 mm.

Larva.—Upper side apple green, shading off laterally with pale blue, which is bordered by a distinct bright stripe just above the spiracles; next to this line is a slightly broader one, pure white. Under side and legs apple green, the former bluish along the middle. Each segment is covered with fine black points, arranged in transverse rows, each with a fine black bristle. Head rounded, pale green, thickly dotted with black. Length about 30 mm.

Habitat.—Nevada, California, Yukon River, Alaska.

EXPLANATION OF PLATES.

PLATE XIII.

- Fig. 1.—*Euchloë cethura* (male).
 Fig. 2.— “ “ (female).
 Fig. 3.— “ “ var. *morrisonii* (female).
 Fig. 4.— “ *sara* (male).
 Fig. 5.— “ “ (female).
 Fig. 6.— “ “ var. *reakirtii* (male).
 Fig. 7.— “ “ var. *julia* (male).
 Fig. 8.— “ *pima* (male).

PLATE XIV.

- Fig. 1.—*Euchloë ausonides* (male).
 Fig. 2.— “ *creusa* (male).
 Fig. 3.— “ “ var. *elsa* (male).
 Fig. 4.— “ *lotta* (male).
 Fig. 5.— “ *olympia* var. *rosa* (male).
 Fig. 6.— “ *lanceolata* (male).
 Fig. 7.— “ *genutia* (male).

The detached wings on the right hand sides represent the under sides.



1



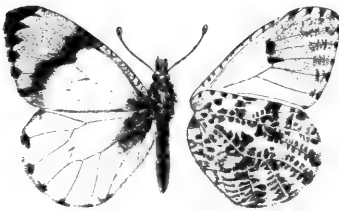
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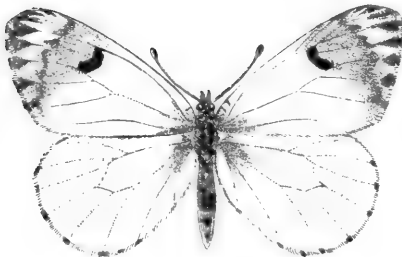
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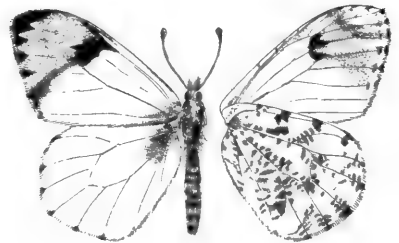
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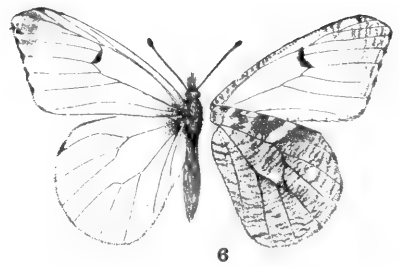
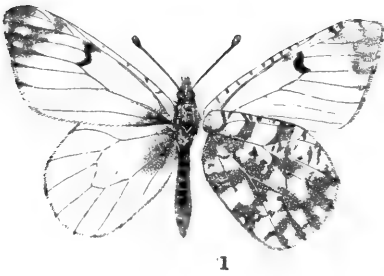
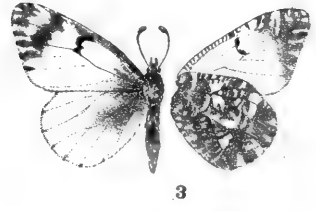
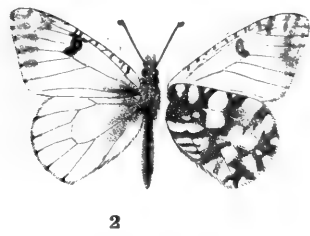
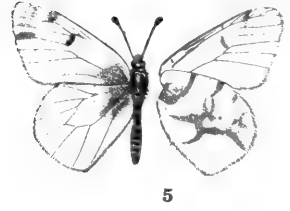
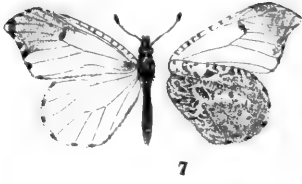
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L.H. JOUET

- 1. *Euchloë cethura* (male).
- 2. " " (female).
- 3. " " var. *morrisonii*.
- 4. " *sara* (male).

- 5. *Euchloë sara* (female).
- 6. " " var. *reakirtii*.
- 7. " " var. *julia*.
- 8. " *pima*.





1. *Euchloë ausonides*.
 2. " *creusa*.
 3. " " *var. elsa*.
 4. " " *lotta*.

5. *Euchloë olympia* *var. rosa*.
 6. " *lanceolata*.
 7. " *genitia*.

Article XIV.—REVISION OF THE CHICKAREES, OR
NORTH AMERICAN RED SQUIRRELS (SUBGENUS
TAMIASCIURUS).

By J. A. ALLEN.

The Red Squirrels or Chickarees are the smallest of the true Squirrels in North America, and are distinguished not only by small size, but by the possession of a relatively short tail and a rather distinctive pattern of coloration. These features are combined with a reduced upper premolar, which is not only so minute as to be non-functional, but is often absent, either on one or both sides of the jaw, being wanting in about thirty per cent. of the specimens examined, throughout the group, regardless of the species. The only wonder is that so functionless an organ should persist so uniformly over such a large geographical area, while size and color are more or less variable. In view of these combined peculiarities, Trouessart, in 1880 (Bull. Soc. d'Études Scient. d'Angers, 1880, p. 81), very properly raised the group to the rank of a subgenus, under the name *Tamiasciurus*. It is confined to northern North America, and embraces several species and a considerable number of additional subspecies.

Without going into a detailed history of the group, it may be well to recall its status at two earlier periods, namely, 1857 and 1877. Baird, in 1857 (Mam. N. Amer., pp. 260-277), recognized three species, as follows: (1) *Sciurus hudsonius*; (2) *S. fremonti* (of which only two specimens were then known); (3) *S. richardsonii*, and (4) *S. douglasii*.

In 1877 the present writer (Mon. N. Am. Roden., pp. 672-700), reduced the three species to one, with two additional subspecies. During the following twenty years a considerable number of new forms were described, so that at the close of 1897 some twelve forms were current, to which five are now added. The following comparative list indicates the status of the group at these four dates.

BAIRD, 1857.

1. *Sciurus hudsonius*.
2. " *fremontii*.
3. " *richardsonii*.
4. " *douglasii*.

AUTHORS, 1897.

1. *Sciurus hudsonicus*.
2. " " *loquax*.
3. " " *dakotensis*.
-
4. *S. hudsonicus richardsonii*.
-
5. *S. hudsonicus vancouverensis*.
6. *S. douglasii*.
-
7. *S. hudsonicus orarius*.
8. " " *californicus*.
9. " " *mearnsi*.
10. *S. fremonti*.
-
11. *S. fremonti mogollonensis*.
12. " " *grahamensis*.

ALLEN, 1877.

1. *Sciurus hudsonius*.
2. " " var. *fremonti*.
3. " " var. *richardsoni*.
4. " " var. *douglassi*.

ALLEN, 1898.

- I. *Sciurus hudsonicus (Exl.)*.
2. " " *loquax Bangs*.
3. " " *dakotensis Allen*.
4. " " *baileyi Allen*.
5. " " *ventorum Allen*.
6. " " *richardsonii Bachm.*
7. " " *streatori Allen*.
8. " " *vancouverensis All.*
9. *S. douglasii Bachm.*
10. " " *cascadensis Allen*.
11. " " *mollipilosus Bachm.*
12. " " *californicus Allen*.
13. *S. mearnsi (Townsend)*.
14. *S. fremonti Bachm.*
15. " " *neomexicanus Allen*.
16. " " *mogollonensis Mearns*.
17. " " *grahamensis Allen*.

During the last ten years material relating to the Chickarees has rapidly accumulated. In 1877 I had before me all the specimens then extant in the larger museums of this country, aggregating about 390, of which about 90 were skulls without skins. The skins were mostly in bad condition, such as now would be regarded as practically worthless in comparison with the standard now demanded. Many were without definite localities, and a much larger number without date of collecting. Little was then known, or could readily be learned from the material then available, regarding the striking seasonal changes of coloration that characterize these animals. In recent years this has been made a matter of careful investigation,¹ and new light has thus been thrown upon the character of otherwise misleading specimens. With now about four times the number of specimens in hand, nearly all of satisfactory character, it is a pleasure to again retrace the work of two decades ago; and while my material is still grossly inadequate, it suffices to amend at many points former erroneous conclusions. For example, there are very few specimens as yet

¹ 'On Seasonal Variations in Color in *Sciurus hudsonius*.' By J. A. Allen. *Bull. Am. Mus. Nat. Hist.*, III, 1891, pp. 41-44.

available from New Mexico and Utah, practically none from Nevada, and important areas of large extent in Oregon, Washington and British Columbia are unrepresented, as are also some of the outlying buttes and mountain ranges east of the Rocky Mountains in Montana and Wyoming.

In this connection it gives me pleasure to acknowledge my indebtedness to those who have so generously assisted me with material. In addition to that contained in the American Museum, numbering about 350 specimens, I am indebted especially to Dr. C. Hart Merriam, Chief of the Biological Survey, U. S. Department of Agriculture, for generously placing at my disposal the vast series of Chickarees, collected under his direction during the last ten years, as well as the specimens from his own collection, the whole aggregating about 735 specimens. I am also indebted to Mr. F. W. True, Executive Curator of the U. S. National Museum, for the use of the specimens under his charge, containing many that were in my hands in 1877, and also the type and topotypes of *Sciurus h. mearnsi* Townsend. Also to Mr. Samuel N. Rhoads for a large series from British Columbia, of special interest as representing new localities; and also to Mr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia, for securing to me the opportunity of examining the types of Bachman's *Sciurus fremonti* and *Sciurus douglasii*, which were almost indispensable for the satisfactory determination of these two species. The total number of specimens used as the basis of the present paper is 1385, or more than four times the amount available in 1877, and incomparably better in quality.

The subgenus *Tamiasciurus* is a compact group, its members presenting many features in common, while others are distinctively characteristic of particular sections of the group. The 17 forms here recognized cluster around three principal types, from which they have obviously been derived, namely, *Sciurus hudsonicus*, *Sciurus fremonti*, and *Sciurus douglasii*. These three types, so far as now appears, do not intergrade, although obviously derived from a common ancestor, at some not very remote period. The range in size, from the smallest to the largest, is not great, the total length varying only from about 290 mm. in the smaller phases of *Sciurus hudsonicus* to about 355 mm. in *Sciurus fre-*

monti mogollonensis, with a corresponding range in length of skull of from 43.5 mm. to about 49 mm. There is even a still closer agreement in the relative proportion of parts, as for example, the length of the tail to the total length, which rarely varies much from 40 per cent., the individual variation much more than overlapping the difference shown by distinct species. They all also have certain color markings in common.

All the forms undergo marked seasonal changes in color, but they are approximately parallel in all the forms, so that when once understood for one form, a key is available for the others. In winter the ears are rather prominently tufted, but they are tuftless at the height of the summer pelage. The soles of the feet are heavily furred in winter, especially at the northward, and comparatively naked in summer. In winter the pelage is much thicker, longer and softer than in summer, there being two annual molts. The winter pelage is retained till late in the season, especially at the northward and in mountainous districts, where the winter coat remains practically intact, though more or less worn and bleached, till late in June, and more or less of it often remains till into July. The acquisition of the full summer pelage is thus delayed till late in August or even later, and the new winter coat is not much developed till into November, and is usually not perfect till late in December. Thus early summer specimens—May till July 10—are usually in mixed pelage, and are thus exceedingly instructive. The black lateral line, present in all the forms in summer, is irregularly obsolete in winter, sometimes only a trace lingering, while sometimes (apparently in animals born the previous year) it is well pronounced, and in several of the western forms is never so much obscured in winter as it is at the same season in the eastern forms. The following synopsis will serve to show what characters are held more or less in common, and what are the distinctive features of the species and subspecies as here recognized.

COMMON CHARACTERS.—*Winter Pelage*.—A broad median reddish dorsal band, extending from the top of the head more or less on to the tail, contrasting with the gray of the sides and outer surface of limbs and feet; ventral surface white (except in some of the forms of *S. douglasii*), more or less vermiculated with black; ears tufted; soles heavily furred.

Hudsonicus Group.

- a^1 Coloration above light ; black bar at tip of tail narrow.
 - b^1 Central area of the tail with the hairs clear red, the red area bordered with a submarginal zone of black, and with a broader subapical bar of black.
 - c^1 Median dorsal band and central dorsal area of tail clear bright red.
 - Size small ; total length about 310. *hudsonicus loquax.*
 - Size large ; total length above 340 *hudsonicus dakotensis.*
 - c^2 Median dorsal band and central dorsal area of tail paler, the red hairs sparingly and narrowly ringed with black.
 - Size small ; total length about 310. *hudsonicus* (proper).
 - Size large ; total length about 340. *hudsonicus baileyi.*
- a^2 Coloration above much darker ; black bar at tip of tail much broader.
 - b^2 Central red area of tail above much restricted and darker, the hairs more conspicuously ringed with black.
 - c^3 Median dorsal band and central area of upper surface of tail dark red.
 - d^1 Size large, total length above 330.
 - Greater part of upper surface of tail black. . . .
 - hudsonicus richardsonii.*
 - About apical fourth of tail black. *hudsonicus ventorum.*
 - About apical third of tail black. *hudsonicus streatorii.*
 - d^2 Smaller, total length about 305.
 - Apical third of tail black. *hudsonicus vancouverensis.*

Douglasii Group.

- a^1 Tail fringed with yellow or yellowish.
 - Under parts, in summer, deep orange. *douglasii* (proper).
- a^2 Tail fringed with white.
 - b^1 White tail-fringe narrow. Under parts, in summer, deep buff.
 - Size small ; total length about 315. *douglasii mollipilosus.*
 - Rather larger. *douglasii cascadenis.*
 - b^2 White tail-fringe broad.
 - Under parts, in summer, pale buff. *douglasii californicus.*
 - Under parts, in summer, creamy white. *mearnsi.*

Fremonti Group.

- a^1 Median dorsal band pale yellowish rufous. *fremonti* (proper).
- a^2 Median dorsal band brighter yellowish rufous.
 - Smaller, total length about 325. *fremonti neomexicanus.*
 - Larger, total length about 340. *fremonti mogollonensis.*
 - Similar to *mogollonensis*, but paler. *fremonti grahamensis.*

Sciurus hudsonicus (Erxl.).

NORTHERN CHICKAREE.

Hudson Bay Squirrel, PENNANT, Syst. Quadr. 1771, No. 206 α, 280, pl. xxvi, fig. 1. Hudson Bay.

Sciurus vulgaris FORSTER, Phil. Trans. LXII, 1772, 378. Not *S. vulgaris* LINN., 1758.

Sciurus vulgaris, ε, *hudsonicus* ERXLEBEN, Syst. Anim. 1777, 416 = *Hudson Bay Squirrel*, PENNANT, as above.

Sciurus hudsonius PALLAS, Nov. Spec. Glires, 1778, 376; GMELIN, Syst. Nat. I, 1788, 147. Also of SCHREBER, ZIMMERMANN, etc.

Sciurus hudsonius BAIRD, Mam. N. Am. 1857, 260, pl. xlvi, fig. 1.

Sciurus hudsonius, var. *hudsonius* ALLEN, Proc. Bost. Soc. Nat. Hist. XVI, 1874, 288; Mon. N. Am. Roden. 1877, 672; Bull. Am. Mus. Nat. Hist. III, 1891, 41.

Sciurus hudsonicus ALLEN, Bull. Am. Mus. Nat. Hist. VI, 1894, 325.

Sciurus hudsonicus hudsonicus BANGS, Proc. Biol. Soc. Wash. X, 1896, 159.

Winter Pelage.—Above with a broad median band of rufous, varying from light yellowish rufous to deep rufous, extending from top of head nearly to end of tail; sides of body and outer surface of limbs to the toes olivaceous gray, the hairs plumbeous at base, then alternately ringed with a very pale tint of yellowish and black, and slightly tipped with black; ear tufts dusky, the hairs slightly tipped with rufous. Below grayish white, the hairs extensively plumbeous at base, then white and conspicuously ringed or tipped with black, giving a general grayish effect. Tail above with a broad central area of yellowish rufous, bordered with a band of black, widening at the tip into a broad subterminal bar, with a conspicuous outer fringe of pale yellowish rufous, lighter than the central area; below the central area is yellowish gray, with the black border and yellowish outer fringe nearly as above.

Post-breeding or Summer Pelage.—Whole upper surface, including flanks, pale yellowish rufous, strongest and brightest on outer surface of limbs and feet; a conspicuous black lateral line; ventral surface pure white; ears like the back and without ear tufts; tail colored nearly as in winter, but narrower and less full.

MEASUREMENTS.¹

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Fort Simpson, N. W. T.. ²	6	317 (305-333)	116 (92-134)	46 (43-47)
Nulato, Alaska	1	316	119	49
Hamilton Inlet, Labrador ³	4	309	120.5	47.75
Digby, Nova Scotia ³	10	296	118.2	45.2
Amherst, N. H. ⁴	9	284 (276-305)	118 (89-127)	46 (43-48)
South Twin Lake, Me. ⁵ ..	5	290 (273-299)	107 (98-114)	45.5 43-46)

¹ The external measurements given in this paper, unless otherwise stated, were taken by the collector from the specimens in the flesh before skinning. The name of the collector is given in footnotes as voucher for the measurements. Very few of the specimens from Arctic America were measured by the collector, and the skins are in such condition as to preclude satisfactory measurement.

² Collected and measured by B. R. Ross.

³ From Outram Bangs, Proc. Biol. Soc. Wash., 1896, p. 160.

⁴ Measured from alcoholic specimens by J. A. Allen (from Mon. N. Am. Roden., p. 687).

⁵ Collected and measured by John Rowley.

	No. of Spec.	SKULLS. ¹		
		Total Length.	Postorbital Breadth.	Length of Nasals.
Ft. Simpson, N. W. T. ²	10	47 (45.7-48.3)	16 (15.7-16.5)	14.2 (13.2-14.5)
Upton, Oxford Co., Me. ²	12	43.7 (42.4-44.9)	15.3 (14.5-17.3)	12.5 (12-13.5)
South Twin Lake, Me.	5	43.3 (43-44.3)	13.4 (13-14.5)	12.3 (11.5-13)
Trousers Lake, N. B...	6	43 (41.5-44)	13.8 (13.5-14)	11.8 (11.3-12.4)

Geographic Range.—Cold Temperate Subregion,³ east of the Rocky Mountains, or the Hudsonian and Canadian Faunæ (east of the Rocky Mountains). In other words, from northern New England, northern New York, northern Ontario, and northern Minnesota northward, including Alaska north of the Alaskan Mountains. Probably also outlying areas in the Adirondack region and in parts of the Appalachian Highlands.⁴ Toward the southern border of this general area, it gradually merges into *S. hudsonicus loquax*.

*Material Examined.*⁵—Total, 130 specimens, from the following sources and localities:

Alaska:⁶ Fort Yukon, April and Oct., L. M. Turner, 14 spec.; Nulato, March 8, L. M. Turner, 1 spec.; do., summer, W. H. Dall, 2 spec.; Kowak River, July 20, C. H. Townsend, 1 spec.; Lake Iliamna, winter, C. L. McKay, 3 spec.; Fort Reliance, Sept. 12-Oct. 16, E. W. Nelson, 6 spec.; Upper Yukon, E. W. Nelson, 7 spec.; Koyukuk River, W. H. Dall, 1 spec.; Port Graham, Cook Inlet, April 9, C. H. Townsend, 1 spec.; Saldovoi, Cook Inlet, April, C. H. Townsend, 3 spec.

Labrador:⁶ Dr. J. B. Gilpin, 1 spec.

North West Territory:⁶ Hudson Bay, Dr. E. Coues, 1 spec.; Fort Good Hope, C. P. Gaudet, 1 spec.; Fort Anderson, August, R. P. MacFarlane, 1 spec.; Fort Rae, L. Clarke, Jr., 2 spec.; Fort Simpson, March 19, April 6 and 29, May 9, Bernard R. Ross, 4 spec.; do., Dec. 15, R. Kennicott, 1 spec.; Ungava, Nov. 11-Jan. 31, March and April, L. M. Turner, 20 spec.

Quebec: Port Daniel, Aug. 11, C. C. Young, 1 spec. (A. M. N. H.).

Manitoba: Red River, winter, D. Gunn, 2 spec. (U. S. N. M.); Roseau River, Nov. 27, Dr. E. A. Mearns, 2 spec. (A. M. N. H.); Rat Portage, Oct. 12, Ernest Seton Thompson, 1 spec. (A. M. N. H.); do., Oct. 22, 2 spec.

¹ In the skull measurements given in this paper, 'total length' is taken from the front border of the nasals to the most projecting part of the occipital plane; 'postorbital breadth' is the width across the frontals at the notch behind the postorbital processes; 'length of nasals' is their total length; 'width of nasals' (see next table) is the breadth at point of greatest expansion near the anterior border.

² From Allen, *Mon. N. Am. Roden*, p. 688.

³ See Bull. Am. Mus. Nat. Hist., IV, 1892, pp. 221-224, pl. vi (map).

⁴ According to Mr. Bangs (*Proc. Biol. Soc. Washington*, X, 1896, p. 159), specimens from "the tops of the higher Alleghanies to Roan Mountain, North Carolina," belong to this form. As noted later, I cannot accept this view. I have at this writing no specimens from the Adirondacks nor from the higher parts of the Catskills.

⁵ In crediting the material examined the following abbreviations are used: A. M. N. H. = American Museum of Natural History; U. S. N. M. = U. S. National Museum; Coll. Dept. Agr. = U. S. Department of Agriculture Collection; Coll. C. H. M. = private collection of Dr. C. Hart Merriam; Coll. S. N. R. = private collection of Mr. Samuel N. Rhoades.

⁶ All from U. S. National Museum.

(Coll. C. H. M.); Carberry, Jan. 3, Ernest Seton Thompson, 1 spec. (Coll. C. H. M.).

North Dakota: Turtle Mountain, July 28, Dr. E. Coues, 1 spec. (U. S. N. M.); do., July 10, Dr. L. B. Bishop, 2 spec. (A. M. N. H.). These are not typical, they being lighter and yellower, thus approaching *S. h. baileyi*.

Nova Scotia: Halifax, Dr. J. B. Gilpin, 1 spec. (U. S. N. M.).

Prince Edward Island: Georgetown, Oct. 26–Nov. 1, R. T. Young, 3 spec. (Coll. R. T. Y.).

New Brunswick:¹ Gulquack Lake, Victoria Co., Oct. 1–15, J. Rowley, 5 spec.; Trousers Lake, Victoria Co., Oct. 5–9 and 23, J. Rowley, 10 spec.; Forks of Tobique River, Victoria Co., Nov. 5–25, J. Rowley, 10 spec.

Maine:¹ South Twin Lake, Penobscot Co., Oct. 12–17, J. Rowley, 6 spec.; Waddley Brook, Washington Co., Oct. 8–19, Jenness Richardson, 9 spec.

Vermont:¹ Rutland, Nov., W. W. Granger, 2 spec.; North Clarendon, Sept. 11, W. W. Granger, 2 spec.

Sciurus hudsonicus loquax Bangs.

SOUTHERN CHICKAREE.

Sciurus hudsonicus loquax BANGS, Proc. Biol. Soc. Wash. X, 1896, p. 161 (Dec. 28, 1896). Liberty Hill, Conn.

Winter Pelage.—Similar to that of *S. hudsonicus* proper, but the median dorsal band is a brighter, deeper red, and the rest of the upper surface more yellowish and less olivaceous, with the black annulations narrower; below with the white much less strongly vermiculated with black; central area of tail above more strongly reddish. The submarginal black zone of the tail is narrower, and the red hairs of the central area are clear red, *i. e.*, not ringed with black.

Summer Pelage.—In general much redder and more brightly colored. General coloration above strong, reddish yellow; feet ochraceous or reddish ochraceous, this color extending up the fore arm and leg; below clear white.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Hastings, N. Y. ²	10	308 (292–321)	122.5 (102–140)	44.5 (40–48)
S. Nyack, N. Y. ³	16	305 (286–313)	116 (92–133)	47 (44.5–50.8)
Syracuse, N. Y. ⁴	6	308 (296–321)	124 (121–133)	
Ft. Snelling, Minn. ⁵	20	334 (297–356)	130.2 (118–146)	49.9 (47–52)
Camp Douglass, Wis. ⁵	7	324 (315–340)	137 (132–144)	49 (48–50)
Magnetic City, foot of Roan Mt., N. C. ⁶	7	340 (319–356)	139 (127–152)	40.4(35.6–45.7)

¹ All from American Museum of Natural History.

² Collected and measured by John Rowley.

³ Collected and measured by C. L. Brownell.

⁴ Collected and measured by M. M. Green.

⁵ Collected and measured by Dr. E. A. Mearns.

⁶ Collected and measured by Dr. A. G. Wetherby. Evidently the measurement of the hind foot was not taken in the usual manner, as the skins indicate a foot of average length.

SKULLS.

	No. of Spec.	Length.	Breadth at Post-orbital Notch.	Length of Nasals.	Width of Nasals.
S. Nyack, N. Y. . . .	6	44.5 (43-45.7)	14 (13-14.5)	13 (12.2-14)	6.5 (6.2-7)
Hastings, N. Y. . . .	10	44.4 (43-44.6)	14 (13.3-14.9)	12.2 (11-13)	6.3 (6-7)
Garrettsville, O. . . .	10	44.7 (44-46.5)	14.1 (13.3-15.2)	13 (12-14)	6.3 (6-6.7)
Ft. Snelling, Minn. . . .	10	46.9 (45.5-48.5)	14.1 (13.3-14.8)	13.9 (13-14.8)	6.5 (6-7.2)
Roan Mt., N. C. . . .	7	45.7 (45-47)	14.6 (14.3-15.2)	13.7 (13-14.6)	6.6 (6.2-7.2)

Geographic Range.—Alleghanian and Carolinian Faunæ of the Humid Province.

Material Examined.—Total number of specimens, 236, from the following sources and localities :

Ontario: Hyde Park, Jan. 16 and Feb. 5, John A. Morden, 2 spec. (U. S. N. M.); Lorne Park, Sept., Jan., Feb., March, Ernest Seton Thompson, 5 spec. (U. S. N. M.); do., April 16, Sept. 24, Dec. 17, Ernest Seton Thompson, 4 spec. (A. M. N. H.); Linwood, July 7 and 22, S. E. Atkinson, 4 spec. (A. M. N. H.).

Wisconsin:¹ Camp Douglass, Juneau Co., July and August, Dr. E. A. Mearns, 27 spec.

Minnesota:¹ Fort Snelling, March 4-April 19 and June 29, Dr. E. A. Mearns, 25 spec.; Oronoco, Olmsted Co., July 13, Dr. E. A. Mearns, 2 spec. (A. M. N. H.); Houston, Houston Co., July 18, Dr. E. A. Mearns, 1 spec.; Excelsior, Scott Co., Sept. 28, A. Lano, 1 spec.

New York:¹ New York City, May 27, J. Richardson, 1 spec.; Hastings, Westchester Co., Jan. 5, 10, 12, Feb. 22, 23, March 18, April 8, 15, 30, May 13, June 9, 17, 23, 30, July —, Aug. 11, 12, 18, 23, 30, Sept. 12, 15, 24, Oct. 9, 17, 24, 29, Nov. 4, 8, 10-12, 27, 29, Dec. 4, 16, 23, J. Rowley, 61 spec.; Hartsdale, Westchester Co., May 16, J. Richardson, 1 spec.; Dunwoodie, Westchester Co., May 4, C. Allen, 1 spec.; South Nyack, Rockland Co., Jan. 2-4, 6, 16, 23-29, June 11, Oct. 16-19, Nov. 12, Dec. 14-17, C. L. Brownell, 25 spec.; Highland Falls, Putnam Co., May 5, Nov. 20, Jan. 26, Feb. 6, Dr. E. A. Mearns, 6 spec.; Cornwall, Orange Co., Oct. and Nov., C. Allen, 11 spec.; Blauveltville, Rockland Co., Jan. 1, C. L. Brownell, 1 spec.; Kiskatom, Greene Co., Aug. 25, L. S. Foster, 1 spec.; Lawyersville, Schoharie Co., April 19 and 30, L. D. Howell, 2 spec.; Stamford, Delaware Co., July, Clarence A. Smith, 4 spec.; Syracuse, Onondaga Co., Aug. 30, M. M. Green, 2 spec., Alder Creek, Onondaga Co., Sept. 7-13, M. M. Green, 8 spec.

New Jersey:¹ Newton, July 5, J. Richardson, 2 spec.

Pennsylvania:¹ Erie, George B. Sennett, 5 spec.

Ohio:¹ Ravenna, Feb. 3-5, March 10, C. P. Streator, 5 spec.

Indiana:¹ La Porte Co., Feb. 7 and April 29, F. M. Noe, 3 spec.

¹ All from American Museum Natural History.

North Carolina: Asheville, Dec., F. W. Fain, 1 spec. (A. M. N. H.); Magnetic City, foot of Roan Mt., Dec. 22-24, Jan. 4, July 15-29, A. G. Wetherby, 7 spec. (Coll. Dept. Agric.); Roan Mt., alt. 3000-6000 feet, April 29, 30, Aug. 2, Sept. 6, Oct. 31, Elmer Edson, 7 spec. (Coll. Dept. Agric.).

Red Squirrels from Massachusetts, New York, New Jersey, the States bordering the Great Lakes, southern Ontario, and thence westward to Wisconsin and southern Minnesota, and southward in the Appalachian Highlands, are quite different in coloration from the Red Squirrels of Arctic America (Labrador west to Alaska), in both winter and summer pelages, the northern form being much paler in general coloration than the southern. In winter pelage the northern form has the median dorsal band much paler red and narrower, and the hairs over the rest of the dorsal surface are more broadly annulated with black, while the white of the under parts is heavily vermiculated with black, in comparison with the comparatively slight and inconstant vermiculation seen in the southern form. In summer pelage the southern form is markedly brighter and redder. The black zone bordering the red central area of the tail is much broader in the northern form, and the red hairs of its central area are slightly varied with black instead of being wholly red.

In size the difference is less well characterized, owing to great local variation in this respect. Apparently Arctic specimens are larger than the average of southern specimens, but unfortunately very few measurements of specimens from the far North are available. The smallest specimens examined are from New Hampshire, Maine, Nova Scotia, and New Brunswick, which are much smaller even than specimens from northern New Jersey and southern New York, while the largest are from southern Minnesota, and Roan Mountain, North Carolina, these rather exceeding in size the specimens from Arctic America, as shown by the tables of measurements given respectively under *hudsonicus* and *loguax*.¹

As regards coloration, there is a complete intergradation between *hudsonicus* and *loguax*, specimens from northern New England and New Brunswick being in this respect about as well referable to the one form as the other. In coloration the Roan Mountain

¹ The skull measurements, in this and other cases, give a surer standard of comparison for size than do the external measurements, which are taken by different persons, the skulls being all measured by myself after strictly the same method.

specimens closely resemble specimens from southern Ontario and western New York, and also northern New England, from which they differ chiefly in larger size. In general features they are 'intermediates' between the two forms, but much nearer *loquax* than typical *hudsonicus* of Arctic America.

Sciurus hudsonicus dakotensis *Allen.*

BLACK HILLS CHICKAREE.

Sciurus hudsonicus dakotensis ALLEN, Bull. Am. Mus. Nat. Hist. VI, 1894, 325, Nov. 7, 1894. Black Hills, S. Dak.

Winter Pelage.—Median dorsal band light yellowish rufous; rest of upper parts and outside of limbs and feet yellowish gray, the hairs pale fulvous narrowly ringed with black; ventral surface clear white (without vermiculations in the only specimen seen); tail above with the central area like the back, the black border narrow, fringed with fulvous; tail below with the central area pale gray basally, passing into very pale fulvous distally; bordered and fringed as above.

Summer Pelage.—Above pale yellowish olivaceous gray, the hairs finely annulated with black; feet, outside of shoulders and edge of thighs yellowish rufous; lateral line obsolete (wanting in 12 specimens out of the 18 examined, and clearly indicated in only 2, both young of the year); ventral surface pure white; tail above bright yellowish rufous, much lighter than in the northern (*S. hudsonicus*) and eastern (*S. h. loquax*) forms of the group, with the usual narrow black submarginal band and yellow fringe; tail below with the central area grizzled yellowish and black.

Measurements.—Average of 5 adults: Total length, 346 (338-356); tail vertebræ, 145 (143-149); hind foot, 51 (50.8-52-3).

Skulls.—Average of 7 specimens: Total length, 49¹ (47-50); breadth at postorbital notch, 14.2 (13.8-14.8); length of nasals, 14 (13-15); width of nasals, anteriorly, 7 (6-7.3).

Geographic Range.—The Black Hills of South Dakota and adjoining portions of Wyoming.

Material Examined.—Sixteen (18) specimens, as follows:

South Dakota: Black Hills, Glendale and Squaw Creek, July 21 and Sept. 3-5, W. W. Granger, 10 spec. (A. M. N. H.); Deadwood, Oct. 7 and 8, Dr. B. W. Evermann, 3 spec. (U. S. N. M.); Black Hills, Sept. 20 and Oct. —, Dr. F. V. Hayden, 4 spec. (U. S. N. M.).

Wyoming: Belle Fourche (western edge of Black Hills), Oct. 21, Vernon Bailey, 1 spec. (Coll. C. H. M.)

¹ Adults all = 50 mm.

This is practically an isolated form, distinguished by large size and pale coloration. It is larger even than the very large forms of *S. h. loquax* found in southern Minnesota, and at Roan Mountain, N. C., and in coloration is the palest of all the subspecies here recognized.

***Sciurus hudsonicus baileyi*, subsp. nov.**

BAILEY'S CHICKAREE.

Winter Pelage.—Above, with a broad median reddish band; rest of dorsal surface pale yellowish gray; below white, finely vermiculated with black.

Summer Pelage.—Above yellowish olivaceous, the hairs pale yellow narrowly ringed with black; fore and hind feet ochraceous orange to reddish orange, this color extending to the shoulders and edge of thighs; a distinct blackish lateral line (present in at least 90 per cent. of the specimens); below white, usually with a distinct wash of yellow; tail above with the central area dark cherry red, varying to yellowish red, and extending about three-fourths the length of the tail, most of the hairs being, however, narrowly ringed with black, giving a grizzled effect; central area bordered by a zone of black, with an outer, rather broad fringe of pale yellow; lower surface of tail pale yellowish gray, slightly grizzled with black, bordered as above with a black band and a pale yellow fringe.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Bighorn Mts., Wyo. ¹ . . .	7	344 (320-359)	141 (132-153)	52 (51-53)
Laramie Mts., Wyo. ² . . .	3	336 (333-339)	139 (124-148)	50.3 (49-52)
Pryor Mts., Mont. ¹	5	342 (320-350)	133 (123-151)	52 (50-53)
Big Snowy Mts., Mont. ³	6	323 (313-330)	130 (121-138)	50 (50-50)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Anterior width of Nasals.
Bighorn Mts., Wyo.	5	48.8 (47.5-49.5)	14.4 (14-14.5)	14.8 (14.2-16)	7.2 (7-7.7)
Pryor Mts., Mont.	4	47.8 (47-49)	14.4 (14.1-15)	13.9 (13-14.8)	7.2 (7-7.5)
Big Snowy Mts., Mont.	6	46.6 (46-48)	14 (13.8-14.3)	13.7 (13.3-14)	7.5 (6.6-8)

Type, No. 56,040; U. S. Nat. Mus. (Dept. Agric. Coll.), ♂ ad., Bighorn Mountains (alt. 8400 ft.), Wyoming, Sept. 19, 1893; Vernon Bailey, for whom this subspecies is named.

¹ Collected and measured by V. Bailey.

² Collected and measured by W. W. Granger.

³ Collected and measured by V. Bailey and B. H. Dutcher.

Geographic Range.—Outlying mountain ranges of central Wyoming and eastern Montana, and northward into Alberta in the eastern foot-hills of the Rocky Mountains. Its range includes the Bighorn, Pryor and Laramie Mountains in Wyoming, and the Big Snowy, Bear Paw and Little Rocky Mountains in Montana, and probably other outlying, pine-covered buttes and hills.

*Material Examined.*¹—Total number of specimens, 43, from the following localities and sources:

Wyoming: Bighorn Mts., alt. 8400 feet, Sept. 19 and 20, Vernon Bailey, 6 spec.; head of Smith's Fork (east base of Bighorn Mts.), Aug. 2, J. A. Loring, 2 spec.; Sherman (southern end of Laramie Mts.), Sept. 9-11, W. W. Granger, 3 spec. (A. M. N. H.); Laramie Mts., Aug. 11, W. S. Wood, 1 spec. (U. S. N. M.).

Montana: Bear Creek, Bear Paw Mts., June 19, A. H. Howell, 1 spec.; Pryor Mts., July 12-17, V. Bailey, 6 spec.; Big Snowy Mts., Aug. 22-25, V. Bailey and B. H. Dutcher, 7 spec.

Alberta: Banff, Aug. 27, J. A. Loring, 2 spec.; Jasper House, Aug. 26 and Oct. 5, J. A. Loring, 6 spec.; Edmonton, Aug. 27, J. A. Loring, 1 spec.; Cache Picot, Oct. 14, J. A. Loring, 3 spec.; Corral and Henry House, Oct. 24, J. A. Loring, 2 spec.; Muskeg Creek, Sept. 24-28, J. A. Loring, 3 spec.

Sciurus hudsonicus baileyi probably intergrades at the north with true *S. hudsonicus*, from which it differs, in summer pelage, in the much more olivaceous and darker tint of the dorsal surface, in the pale fulvous wash of the ventral surface, and in the red-and-black grizzled upper surface of the tail. It differs similarly, but in greater degree, from *S. h. dakotensis*, which is a much paler form. With *S. h. richardsonii*, it scarcely needs comparison, owing to the darker, deeper red of the upper parts of the latter, and its much greater amount of black in the tail. Its nearest ally is *S. h. ventorum*, which is geographically its near neighbor at the southwest, finding its eastern limit in the Wind River Mountains, while *S. h. baileyi* occupies the Laramie and Bighorn Mountains a little further to the eastward. The chief difference between these two forms consists in the less yellowish and decidedly darker olivaceous cast of the dorsal surface of *S. h. ventorum* in summer pelage, and the grayness of the lower surface of the tail. What the differences may be in winter pelage cannot now be determined, owing to lack of material.

¹ From the U. S. Department of Agriculture Collection, unless otherwise credited.

Sciurus hudsonicus ventorum, subsp. nov.

WIND RIVER MOUNTAINS CHICKAREE.

Winter Pelage.¹—Above with a narrow median band of dark rufous, narrower and less dark than in *S. h. richardsoni*, but much darker and less yellowish than in *S. h. baileyi*; rest of dorsal surface, and legs and feet gray, suffused with pale yellowish, the hairs being yellowish gray, ringed with black; a dusky lateral line obscurely indicated; below white without (in the specimens examined) black vermiculation; tail above centrally dark yellowish rufous, bounded by the usual zone of black and pale yellowish outer fringe, the black zone being of about the usual width in *S. hudsonicus*, *S. h. loquax* and *S. h. baileyi*; the tail is thus very different from that of *S. h. richardsonii*; lower surface of tail gray, grizzled sparingly with black.

Summer Pelage.—Above nearly uniform dark olivaceous, with the sides of the shoulders and outer edge of thighs heavily suffused with strong reddish fulvous; upper surface of feet ochraceous; the dusky lateral line as a rule narrow and rather indistinct as compared with most other members of the *S. hudsonicus* group; tail above without a well defined central area of reddish (owing to the hairs being narrowly but profusely ringed with black), bordered with a zone of black of the usual extent, and broadly fringed with fulvous; tail below with a broad central area of gray faintly suffused with grayish fulvous, with the dark outer border and fulvous fringe as above.

Type, No. 56,030, U. S. Nat. Mus. (Dept. of Agric. Coll.), ♀ ad., South Pass City, Wyoming, Sept. 6, 1893; Vernon Bailey.

Geographic Range.—Wind River Mountains region and northward along the eastern base of the Rocky Mountains to at least Mystic Lake, and probably to the Belt ranges east of Helena, and thence westward to the head of the Snake River in Idaho, and south along the Idaho and Wyoming boundary to the Wasatch Mountains in northeastern Utah. Its range thus includes not only the Wind River and Gros Ventre Ranges, but the Shoshone and Beartooth Mountains, the whole of the National Yellowstone Park region, and the outlying ranges east of the Main Divide to central Montana; to the westward and southward it includes the Snake River, Cariboo, Thompson, Blackfoot, Bear River, Bannock and Wasatch Ranges, with their outlying and included or connected spurs.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
South Pass City, Wyo. ² ...	10	331 (318-350)	134.7 (121-142)	51.6 (49-53)
Lake Fork, Wyo. ²	3	334 (328-344)	134 (131-138)	50.3 (50-51)
Beartooth Mts., Mont. ³ ..	7	325.4 (300-345)	132 (125-145)	52 (49-55)

¹ The winter pelage is not well shown by any specimens now available. This description is based on two poor skins taken in the Wind River Mountains by Dr. F. V. Hayden, May 31 and June 3, 1860.

² Collected and measured by Vernon Bailey.

³ Collected and measured by Vernon Bailey and B. H. Dutcher.

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Anterior Width of Nasals.
South Pass City, Wyo.	8	47.8 (47-49)	15 (14.5-15.5)	14 (13.2-15)	7.3 (7-8)
Beartooth Mts., Mont.	4	47.4 (46.3-48.3)	14 (13.3-14.8)	13.7 (13-14.2)	7 (6.4-7.3)

*Material Examined.*¹—Total number of specimens, 68, from the following localities and sources:

Wyoming: South Pass City, Sept. 5-7, V. Bailey, 21 spec.; La Barge Creek, Thompson's Plateau, Aug. 5, V. Bailey, 2 spec.; Bull Lake, east base of Wind River Range, Aug. 20-23, J. A. Loring, 5 spec.; Lake Fork, east slope of Wind River Range, alt. 9600-10,000 feet, Aug. 21-24, V. Bailey and J. A. Loring, 10 spec.; Wind River Mountains, May 31, June 3, Dr. F. V. Hayden, 2 spec. (U. S. N. M.); Yellowstone Lake, July, F. J. Huse, 4 spec. (U. S. N. M.).

Idaho: Henry's Lake, Sept. 8, Dr. C. H. Merriam, 1 spec. (U. S. N. M.); Fire Hole Basin, head of Snake River, Sept. 17, Dr. C. H. Merriam, 2 spec. (U. S. N. M.); Island Park, Snake River, alt. 6,000 feet, Aug., M. J. Elrod, 3 spec. (U. S. N. M.); head of Crow Creek (southeastern Idaho), July 30, V. Bailey, 2 spec.

Utah: Laketown (east base Wasatch Mts.), July 21 and 22, V. Bailey, 2 spec.; Salt Lake City (west slope Wasatch Mts.), Oct. 30, V. Bailey, 1 spec. (Coll. C. H. M.).

Montana: Beartooth Mts., July 26-Aug. 1, V. Bailey and B. H. Dutcher, 8 spec.; Mystic Lake, Sept. 27 and 28, Dr. C. W. Richmond, 5 spec. (Coll. C. H. M.).

The Mystic Lake Series is not typical, the upper surface having more of a reddish cast, thus approaching *S. h. richardsonii*, as it also does in having much more black on the tail; they are thus intergrades between *S. h. ventorum* and *S. h. richardsonii*.

Sciurus hudsonicus ventorum finds its nearest ally in *S. h. baileyi*, from which it differs in much darker and more olivaceous coloration above; the upper surface of the tail has the rufous of the central area more varied with black, and the under surface is grayer and less suffused with fulvous. The differences are not great, but are readily appreciable and fairly constant.

S. h. ventorum is thus one step nearer *S. h. richardsonii*, from which it differs strikingly in its less red and more olivaceous upper parts, and in the greatly reduced amount of black in the tail. It doubtless intergrades with *richardsonii* at the northward, Mystic Lake specimens being fairly good intermediates, though much nearer *ventorum* than *richardsonii*.

¹ From U. S. Department of Agriculture Collection, unless otherwise credited.

Sciurus hudsonicus richardsonii (*Bachman*).

RICHARDSON'S CHICKAREE.

Sciurus richardsonii BACHMAN, Proc. Zool. Soc. Lond. 1838, 100; BAIRD, Mam. N. Am. 1857, 318.
Sciurus hudsonius var. *richardsoni* ALLEN, Mon. N. Am. Roden. 1877, 673.

Winter Pelage.—Above with a broad median band of chestnut rufous, the hairs finely annulated with black; rest of upper surface, including limbs and feet, brownish gray, the hairs ringed with pale fulvous and black, the general effect being a rather dark gray with a wash of fulvous; tail above with a narrow central area of dark rufous, more or less grizzled with black, and extending generally only about half the length of the tail; rest of the tail intense black, with a slight fringe of yellowish on the sides for about two-thirds the length from the base, exceptionally extending all around the tail, including the tip; black lateral line generally prominent, sometimes more or less obscured; tail below yellowish gray centrally, the rest black, or wholly black at the surface with the base of the hairs gray or grayish fulvous; below white, finely vermiculated with black, the dark plumbeous under-fur showing more or less through the surface, giving a general effect (with the vermiculations) of grayish white; ears well tufted, the apical half blackish.

Summer Pelage.—Above nearly uniform rufous olivaceous, the hairs being ringed with fulvous or reddish fulvous and black; feet ochraceous to reddish orange, this color extending over the fore arm to the sides of the shoulder, and generally over the hind limbs to the edge of the thigh; black lateral line strongly developed; ventral surface generally clear white, the plumbeous under fur usually more or less tinging the surface; tail above with a narrow deep reddish central area, extending one-half to two-thirds the length of the tail, the hairs being basally yellowish chestnut rufous, more or less ringed and varied with black; rest of upper surface of tail black, with a yellowish or rufous fringe, generally confined to the sides, the tip being wholly black; lower surface of tail with the central area gray, grizzled with black, with more or less fulvous suffusion.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Birch Creek, Id.	4	333.5 (330-338)	134 (120-147)	49.5 (47-51)
Salmon R. Mts., Id. . . .	6	340 (325-352)	134 (124-148)	51.5 (51-52)
Saw Tooth Lake, Id. . . .	4	336 (330-342)	134 (130-138)	52 (51-53)
Cœur d'Alene, Id.	10	333 (321-350)	135 (125-142)	51.7 (47-54)
Mullan, Id.	4	338 (318-345)	135 (129-139)	51 (49-53)
St. Mary's Lake, Mont. . .	6	331.5 (322-345)	135 (132-143)	50.5 (50-51)
Colville, Wash.	9	336 (323-353)	129 (124-136)	50.8 (49-52)
Wallowa Lake, Ore.	6	327 (316-345)	135 (128-141)	51.2 (49-53)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Anterior width of Nasals.
Cœur d'Alene, Id..	4	47.6 (46-48.5)	14.8 (14.4-15.6)	14.6 (14.2-15)	7 (6.7-7.2)
Mullan, Id.	3	47.7 (47.2-48.6)	14.2 (14-14.5)	14.5 (14-15.2)	7.3 (7-7.7)
Moscow, Id	3	47.5 (47-48.6)	14.9 (14.8-15)	14.5 (14.8-15)	7 (7-7.2)
St. Mary's La., Mt.	5	47.6 (46.3-49.3)	14.5 (14-15)	14.4 (13.8-15)	7 (6-7.3)
Wallowa Lake, Or.	5	48 (47.6-48.6)	14.5 (14.2-15)	14.2 (14-14.3)	7.2 (6.8-7.7)
Colville, Wash. . . .	5	47.6 (46.8-48.6)	15 (14.5-15.2)	14.2 (13.2-14.7)	7 (6.6-7.2)

Geographic Range.—Western border of northern Montana, central and northern Idaho, northeastern Oregon, northeastern Washington, and thence northward into southeastern British Columbia—in other words, the Bitterroot and Cœur d'Alene Mountains on the western border of Montana; the Lost River, Salmon River, Pahsimeroi and Saw Tooth Mountains in central Idaho, and westward in the Craig and Seven Devils Mountains to the Powder River and Blue Mountains of Oregon; thence through northern Idaho, and west in the mountains of northeastern Washington to Colville, and northward into the Kootenai District of eastern British Columbia. The extent of its range northward along the main Rocky Mountains cannot now be determined, owing to absence of material from the area in question. It appears to reach its maximum of differentiation in the Cœur d'Alene and Bitter Root Mountains, although specimens from central Idaho (the type region) are scarcely distinguishable.

Material Examined.—Total number of specimens, 164, from the following localities and sources:

Idaho:¹ Head of Big Lost River (type locality), Sept. 25, Dr. C. H. Merriam and V. Bailey, 1 spec.; head of Wood River, Sept. 25, Merriam and Bailey, 1 spec.; Saw Tooth Lake, Sept. 26-28, Merriam and Bailey, 5 spec.; Saw Tooth City, Oct. 2, A. H. Howell, 1 spec.; Birch Creek, Aug. 6-11, V. Bailey and B. H. Dutcher, 4 spec.; Crow Creek, July 30, V. Bailey, 1 spec.; Lost River Mts., July 29, V. Bailey, 2 spec.; Pahsimeroi Mts., Sept. 14-15, Merriam and Bailey, 5 spec.; Salmon River Mts., Aug. 19-Sept. 5, Merriam, Bailey, Dutcher and Streater, 15 spec.; Seven Devils Mts., Sept. 2, V. Bailey, 1 spec.; Craig Mts., Aug. 27, V. Bailey, 3 spec.; Moscow, Latch Co., April 8-13, Clay McNamee, 8 spec. (A. M. N. H.); do. Aug. 31, Clay McNamee, 4 spec.; do. April 10, 2 spec. (U. S. N. M.); Mullan, Shoshone Co., June 8-16, C. P. Streater, 7 spec.; Fort Sherman, Kootenai Co., March 4 and Dec. 4, Dr. J. C. Merrill, 2 spec.; Camp Kootenai, Aug. 30, Dr. J. C. Kennerly, 1 spec. (U. S. N. M.); St. Mary's, Oct. 1, Dr. George Suckley, 2 spec. (U. S. N. M.); Priest Lake, Kootenai Co., Sept. 30-Oct. 2, R. T. Young, 3 spec.; Bonners Ferry, Kootenai Co., July 15, J. A. Loring, 1 spec.; Fiddle Creek, Kootenai Co., Sept. 3, A. H. Howell, 1 spec.; Cœur d'Alene, Kootenai Co., May 25-30, C. P. Streater, 10 spec.; do. Aug. 12, A. H. Howell, 3 spec.

¹ All from U. S. Department of Agriculture Collection.

Oregon:¹ Wallowa Lake, Aug. 25–Sept. 14, V. Bailey and R. T. Young, 6 spec. ; Elgin, Blue Mts., May 28, E. A. Preble, 2 spec. ; Meacham, Blue Mts., June 2, E. A. Preble, 1 spec.

Washington:¹ Blue Creek, Blue Mts., Aug. 30–Sept. 3, C. P. Streator, 7 spec. ; Marshall, Spokane Co., Oct. 8, 9, C. P. Streator, 6 spec. ; Loon Lake, Stevens Co., Sept. 26, V. Bailey, 1 spec. ; Colville, Stevens Co., April 28–30, C. P. Streator, 15 spec.

Montana:² Thompson's Pass, Missoula Co., July 29–Aug. 6, A. H. Howell, 5 spec. ; Silver, Missoula Co., June 24–26, C. P. Streator, 3 spec. ; Flathead Lake, June 13, A. H. Howell, 1 spec. ; Coram, Flathead Co., June 25, A. H. Howell, 1 spec. ; Paola, Flathead Co., June 20, V. Bailey, 1 spec. ; Tobacco Plains, Flathead Co., July 4–6, Bailey and Howell, 3 spec. ; Bear Creek, Flathead Co., June 19, A. H. Howell, 1 spec. ; Summit, Teton Co., June 14, 15, V. Bailey, 5 spec. ; St. Marys Lake, Teton Co., June 1–6, V. Bailey, 4 spec. ; do. May 24 and June 4, A. H. Howell, 2 spec. ; Bitter Root Valley, winter, J. Pearsall, 8 spec. (U. S. N. M.).

British Columbia : Nelson, Kootenai Dist., July 20, J. A. Loring, 3 spec. (Dept. Agr. Coll.); do. Aug. 16–19, S. N. Rhoads, 5 spec. (Coll. S. N. R.); Deer Park, Prof. J. Macoun, 1 spec. (A. M. N. H.).

The Nelson specimens are not typical, they strongly approaching *S. h. streatori*, particularly in size, and for this reason the measurements of the Nelson specimens are entered with the measurements of *streatori* (see p. 268).

***Sciurus hudsonicus streatori*, subsp. nov.**

STREATOR'S CHICKAREE.

Winter Pelage.—Similar to that of *S. h. richardsonii*, but with much less black in the tail. Above with the broad dark chestnut rufous median band vermiculated with black; below gray or grayish white, the hairs extensively plumbeous at base, then white strongly vermiculated with black, giving a gray effect; dusky lateral line generally wanting or obsolete. Tail above with the central area rufous chestnut, grizzled with black, and occupying nearly the whole surface, being broad and extending nearly four-fifths the length of the tail; a narrow submarginal zone of black, and a subapical broad bar of black; outer fringe pale yellowish, well developed; tail below with a very broad central area of grizzled gray and black, faintly suffused with pale fulvous.

Summer Pelage.—Above similar to that of *S. h. richardsonii*, but general color more olivaceous and less rufous; tail with the black portions greatly reduced and the outer yellowish fringe more developed, essentially as in winter. Lateral line very broad and black.

¹ All from U. S. Department of Agriculture Collection.

² From U. S. Department of Agriculture Collection, unless otherwise credited.

There is much individual variation in the color of the dorsal surface, some specimens being dark olivaceous, as dark as in *S. douglasii*, while others are as ruddy as average examples of *S. h. richardsonii*.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Nelson, B. C. ¹	5	312 (280-315)	114 (110-116)	50 (49-51)
Lac la Hache, B. C. ¹ ...	4	316 (300-325)	114.5 (100-123)	49 (47-50)
Field, B. C. ¹	3	316 (290-330)	124 (115-130)	50 (49-51)
Vernon, B. C. ¹	8	322 (315-330)	122 (120-128)	51.3 (50-52)
Bounaparte, B. C. ¹	3	316 (308-320)	119 (110-120)	50 (49-51)
Ashcroft, B. C. ²	10	332 (296-355)	129 (105-144)	51.4 (50-54)
Kamloops, B. C. ²	7	315 (282-341)	133 (128-144)	51.4 (51-52)
Shuswap, B. C. ²	9	318 (280-340)	127 (107-141)	52 (49-54)

SKULLS.

	No of Spec.	Length.	Postorbital Breadth.	Length of Nasals	Anterior Width of Nasals.
Ashcroft, B. C.	6	48 (47-49.2)	14.6 (13.8-15.7)	14.6 (13.4-15)	7 (6.5-8)
Kamloops, B. C.	3 ³	47.2 (47-47.7)	14.1 (13.8-14.6)	13.5 (13-14)	7 (6.8-7.2)
Shuswap, B. C.	4	48 (47-48)	14.2 (14-14.5)	13.9 (13.5-14.3)	7 (6.7-7.2)

Type, No. 2054, Am. Mus. Nat. Hist., ♂ ad., Ducks, British Columbia, Aug. 3, 1889; C. P. Streator, for whom this subspecies is named.

Geographic Range.—Central part of northern Washington, from the Columbia River northward over central British Columbia. It occupies the Okanagan District of Washington, from the head of Lake Chelan northward. At Lake Chelan and Fort Spokane it meets *S. douglasii* without intergrading; at Marcus and Conconully it intergrades with *S. h. richardsonii*, which occupies the area immediately to the eastward, as it does also in the Kootenai District, in south-eastern British Columbia.

Material Examined.—Total number of specimens, 93, from the following localities and sources:

Washington:⁴ Fort Spokane, Spokane Co., Sept. 27, 28, C. P. Streator, 5 spec.; Cheney, July 22, J. A. Loring, 1 spec.; Conconully, Okanagan Co., Sept. 8-10, J. A. Loring, 3 spec.; head of Lake Chelan, Okanagan Co., Aug. 19, 20, C. P. Streator, 2 spec.; Marcus, Stevens Co., Sept. 21, Bailey and Young, 4 spec., and one typical *richardsonii*.

British Columbia:⁵ Ducks (type locality), Aug. 1-16, C. P. Streator 5 spec. (A. M. N. H.); Kamloops, Aug. 20-28, C. P. Streator, 7 spec. (A. M. N. H.); do., June 18, Prof. J. Macoun, 1 spec. (A. M. N. H.); do., July 14, S. N. Rhoads, 2 spec. (Coll. S. N. R.); Ashcroft, June 26 and

¹ Collected and measured by S. N. Rhoads.

² Collected and measured by C. P. Streator.

³ All rather young.

⁴ All from U. S. Department of Agriculture Collection.

⁵ From U. S. Department of Agriculture Collection, when not otherwise credited.

July 9-12, C. P. Streator, 5 spec. (A. M. N. H.); do., Aug. 11-13, C. P. Streator, 10 spec.; do., June 4, 9, S. N. Rhoads, 2 spec. (Coll. S. N. R.); Shuswap, Sept. 3-6, C. P. Streator, 9 spec.; Sicamous, Oct. 1, 2, C. P. Streator, 4 spec.; Vernon, July 20-Aug. 6, S. N. Rhoads, 14 spec. (Coll. S. N. R.); Revelstoke, April 13, Prof. J. Macoun, 1 spec. (A. M. N. H.); Field, Aug. 27, S. N. Rhoads, 5 spec. (Coll. S. N. R.); Glacier, Aug. 11, 12, J. A. Loring, 2 spec.; Bounaparte, June 14-16, S. N. Rhoads, 3 spec. (Coll. S. N. R.); Clinton, June 20-July 6, S. N. Rhoads, 4 spec. (Coll. S. N. R.); Lac la Hache, July, S. N. Rhoads, 4 spec. (Coll. S. N. R.).

S. hudsonicus streatori is closely related to *S. h. richardsonii*, with which it intergrades along the western and northern border of the range of the latter, namely, in the Kootenai District of British Columbia and in eastern Spokane County, Washington. Specimens from Fort Spokane, Cheney, Conconully, and Marcus, Washington, are about as well referable to one form as the other. Of five specimens from Marcus, one is typical *richardsonii*, while the others are *streatori*. At the westward, in the coast region of British Columbia, it intergrades with *S. h. vancouverensis*. The northern limit of its range is not at present determinable.

It differs from true *S. h. richardsonii* in the greatly reduced amount of black in the tail, and the more olivaceous tone of its upper surface in summer pelage. *It also has a much shorter tail.* It differs from *S. h. vancouverensis* as pointed out under that form. Specimens from Field and Glacier, in the Rocky Mountains, on the line of the Canadian Pacific Railway, shade strongly toward *richardsonii*.

Sciurus hudsonicus vancouverensis Allen.

VANCOUVER CHICKAREE.

Sciurus hudsonius vancouverensis ALLEN, Bull. Am. Mus. Nat. Hist. III, 1890-91, 165 (Nov. 14, 1890). Duncan Station, Vancouver Island, B. C.

Winter Pelage.—Above like *S. h. richardsonii*, except that the black area of the tail is one-half to two-thirds smaller; below gray with a brownish tinge, sometimes brownish heavily vermiculated with dusky; generally the hairs are ashy-white, finely and profusely vermiculated with dusky, with only a slight tinge of brownish; tail nearly as in *S. h. streatori*.

Summer Pelage.—Above dark olivaceous, sometimes with a tinge of reddish—nearly as in *S. h. streatori* and *S. douglasii*; below white, generally with a tinge of fulvous, varying to a strong wash of pale yellow.

MEASUREMENTS.¹

	No. of Spec.	Total Length.	Tail Vertebræ.	Hind Foot.
Wellington, Vanc. Isl.	1	303	124	50
Goldstream, Vanc. Isl.	11	308 (295-325)	120 (104-130)	50.1 (49-52)
Comox, Vanc. Isl.	4	309 (303-315)	120 (114-128)	50.4 (50-52)
Wrangel, Alaska.	7	297 (290-310)	115 (103-121)	49.4 (48-52)
Loring, Alaska.	4	296 (290-305)	118 (110-124)	49.5 (49-50)
Juneau, Alaska.	6	307 (300-315)	126 (120-132)	49.7 (48-51)

SKULLS.

	No of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Anterior Width Nasals.
Duncan, Vanc. Isl	5	45.6 (44.5-46)	14.6 (14.3-15)	12.8 (12-13.6)	6.5 (6-6.8)
Comox, Vanc. Isl. . .	3	45.7 (45-46.3)	15.2 (14.9-15.8)	12.6 (12.3-13)	7 (6.8-7.3)
Goldstream, Vc. Isl.	9	46.3 (45.6-47.3)	15.6 (14.6-15.6)	13 (12.4-13.4)	7.3 (6.8-7.6)
Wrangel, Alaska. . .	9	44.7 (43.3-46.3)	15.2 (14.2-15.8)	12.6 (12-13.4)	6.6 (6.2-7.3)
Loring, Alaska. . . .	4	44.8 (44.6-45.1)	14.9 (14.8-15)	13.3 (13-13.6)	6.5 (6.2-7.2)
Juneau, Alaska. . . .	4	44.2 (43.2-45)	14.6 (14.1-15)	12.6 (12.3-12.8)	6.5 (6.2-7)

Geographic Range.—Vancouver Island, and the coast region of northern British Columbia, north at least to Sitka.

*Material Examined.*²—Total number of specimens, 90, from the following localities and sources:

Vancouver Island: Duncan Station, Oct. 1-9, C. P. Streator, 7 spec. (A. M. N. H.); Goldstream, May 9-23, C. P. Streator, 15 spec.; do., June 5-23, S. N. Rhoads, 16 spec. (Coll. S. N. Rhoads); Comox, May 31-June 8, C. P. Streator, 4 spec.; do., June 23, F. W. True and Dr. D. W. Prentiss, 2 spec. (U. S. N. M.); Wellington, May 23, C. P. Streator, 1 spec.; Departure Bay, May and Aug., C. H. Townsend, 7 spec. (U. S. N. M.); Victoria, June and July, S. N. Rhoads, 3 spec. (Coll. S. N. R.).

British Columbia: Inverness, mouth of Skeena River, Aug. 23, E. A. Preble, 1 spec.

Alaska: Wrangel, Aug. 31-Sept. 10, C. P. Streator, 13 spec.; do., Summer, 1 spec. (Coll. C. H. M.); Yakutat, July 13, C. P. Streator, 1 spec.; Loring, Sept. 19, 20, C. P. Streator, 8 spec.; Juneau, Aug 16-25, C. P. Streator, 11 spec.

The Alaska specimens appear to be rather smaller than those from Vancouver Island, but the difference is probably more apparent than real, as with a few exceptions the Alaska specimens are young of the year, taken mostly in August, while the Van-

¹ All collected and measured by C. P. Streator. Several of the Alaska specimens are evidently young of the year, which doubtless accounts for the slightly smaller size of the Alaska series.

² From U. S. Department of Agriculture Collection, when not otherwise credited.

couver specimens, of which measurements are here given, are all adult,—May and June specimens.

The peculiar faint yellowish wash below, which is very different in tone and appearance from that of members of the *douglasii* group, is quite a pronounced feature in *vancouverensis*, though shared, but in less degree, by both *streatori* and *baileyi*. In winter pelage, in *vancouverensis*, this pale rusty or fulvous tint suffuses the heavily vermiculated under surface, which is only a little less prominent, but of a different shade, than in the winter pelage of *S. douglasii*.

Sciurus hudsonicus vancouverensis was based originally on six specimens in summer pelage from Duncan Station, Vancouver Island. In the original description (*l. c.*) it was compared with what is here recognized as *S. h. streatori*, no specimens of true *S. h. richardsonii* being then at hand. The measurements given were only approximate, being taken from skins badly prepared. The present material renders it possible to give correct measurements, and to make full comparison with its allies.

S. h. vancouverensis is closely related to *S. h. streatori*, with which it intergrades near the coast region of British Columbia. It is a coast form resembling in coloration *S. h. richardsonii* of the interior mountains, except that in winter pelage the ventral surface is more heavily vermiculated and more or less suffused with brownish. In this last feature it differs markedly from *S. h. streatori*, as well as in being less olivaceous and more suffused with rufous in summer pelage. It is also smaller than *S. h. streatori*, and consequently very much smaller than *S. h. richardsonii*.

REVIEW OF THE *Sciurus hudsonicus* GROUP.

The *Sciurus hudsonicus* group is made up of a number of closely related, intergrading forms, the most strongly differentiated of which, in their extreme phases, are true *S. hudsonicus* of the Arctic districts, the somewhat isolated *S. h. dakotensis* of the Black Hills region of South Dakota, and *S. h. richardsonii* of the mountains of central Idaho and the Cœur d'Alene and Bitter Root regions of northern Idaho and adjoining parts of Montana and Washington. Taking the range of *S. h. richardsonii* as a point of departure, we have two pale forms adjoining *S. h. richardsonii* on

the east and south—to the east and southeast the *S. h. baileyi*, a pale form of the more arid region between the plains and the eastern base of the Rocky Mountains, in central and southeastern Wyoming and eastern Montana; to the southward, *S. h. ventorum*, a less pale form of the Wind River region, and thence southward to the Wasatch range. West of the Rocky Mountains, to the northward, and cut off from the range of *S. h. ventorum* by the intervention of typical *S. h. richardsonii* and *S. douglasii californicus*, we meet with *S. h. streatori*, a pale form of the somewhat arid interior of British Columbia, and to the west of this, in the Columbian and Sitkan coast region (including Vancouver Island) the darker and more heavily vermiculated and suffused *S. h. vancouverensis*. None of these forms are strongly marked except *S. h. richardsonii*, which, however, unquestionably intergrades with *baileyi*, *ventorum* and *streatori*; but the slight differences in all these forms are fairly constant (allowing for exceptional individual variation) over large areas, characterized respectively by well marked differences in physical conditions.

Besides the differences in the general coloration of the upper parts, the greatly lessened amount and darker tint of the red in the tail is a striking feature of the western forms as compared with the eastern. The red in the tail is at the maximum and lightest in tint in *S. h. dakotensis*; there is much less in *S. h. baileyi*, a further reduction and darkening of the tint in *S. h. ventorum*, *S. h. streatori*, and *S. h. vancouverensis*, the greatest reduction, however, and the darkest tint occurring in *S. h. richardsonii*.

In the East, south of Canada and northern New England and northern New York, only *S. h. loquax* occurs; it intergrades at the northward with *S. hudsonicus*, with a rather broad connecting area where neither form is typically represented. Within the area of *loquax*, as here assigned, there is no very well defined variation in coloration characteristic of particular areas, whatever may exist being masked by the wide range of individual variation at all seasons. Variations in size with locality, however, are quite marked, with, at the same time, such gradual intergradation over the intervening areas, and with no very tangible color differences, that it has not been deemed advisable to recognize in nomenclature local variations in size, although very marked when

the extremes are compared, as, for example, northern Maine and New Brunswick with southern Minnesota and Wisconsin.

As melanistic examples of the *Sciurus hudsonicus* group are extremely rare, it may be of interest to note that the present material includes one example, in winter pelage, wholly intense black. It was collected by Dr. W. H. Dall, at Nulato, Alaska, and is No. 8930 of the U. S. National Museum collection (original No. 502).

Sciurus douglasii Bachman.

DOUGLAS'S CHICKAREE.

Sciurus douglasii GRAY, Proc. Zool. Soc. Lond. 1836, 88 (*nomen nudum*); BACHMAN, Proc. Zool. Soc. Lond. 1838, 99 ("Columbia River," summer pelage); BAIRD, Mam. N. Am. 1857, 275 (in part).

Sciurus hudsonius douglasii ALLEN, Proc. Bost. Soc. N. H. XVII, 1874, 288; Mon. N. Am. Roden. 1877, 673 (in part).

Sciurus belcheri GRAY, Ann. & Mag. Nat. Hist. X, 1842, 263; Zool. Voy. Sulphur, I, 1845, 33, pl. xii, fig. 2. Mouth of Columbia River.

Sciurus suckleyi BAIRD, Proc. Acad. Nat. Sci. Phila. 1855, 333; Mam. N. Am. 1857, 276, footnote. Puget Sound, winter pelage.

Winter Pelage.—Above with a broad median band of dark ferruginous, the hairs ringed near the tip with black and chestnut; rest of upper parts, limbs and feet, dark brownish gray, the hairs being ringed with a much lighter shade of ferruginous than on the back, the general effect tending to gray; dusky lateral line generally present, varying from obsolete to well defined; under parts strong buffy gray varying to ochraceous, profusely vermiculated with black, the general effect in average specimens being buffy gray. Tail above centrally for two-thirds its length of nearly the same color as the median dorsal band, but more coarsely varied with black, and with the tips of the hairs yellow or yellowish; the black submarginal zone narrow and obscured; a broad subterminal band of black; outer fringe of tail yellow or yellowish, narrowest across the end of the tail; below the tail is grizzled rusty and black, with the submarginal black zone and the broad subterminal black band more distinct than above, as is also the yellow marginal fringe. Ears conspicuously tufted with blackish.

Summer Pelage.—Above dark olivaceous brown with a tinge of reddish, the hairs being minutely punctated with deep ferruginous; lateral line broad and intensely black; feet deep orange rufous, extending with diminishing intensity to the shoulder; ventral surface orange, varying from orange yellow to deep reddish orange; tail much as in winter pelage but narrower and less full.

In general effect the color, both above and below, in both pelages, is subject to much individual variation, but especially in summer, dependent upon the

depth of the rufous suffusion above, and of the intensity of the orange tint below. In coördination with this the tail fringe varies from deep yellowish rufous to yellowish white.

MEASUREMENTS.

	No. of Spec.	Total Length.	Tail Vertebrae.	Hind Foot.
Marshfield, Ore. ¹ ...	6	316 (305-336)	123 (113-132)	49.5 (49-50)
Yaquina Bay, Ore. ² ...	4	314 (295-343)	127 (117-144)	48.5 (47-50)
Newport, Ore. ² ...	5	316 (310-323)	129 (121-134)	50 (49-51)
Neah Bay, Wash. ³ ...	14	315 (305-325)	128 (122-135)	50 (49-51)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Breadth of Nasals.
Marshfield, Ore. . .	3	47 (46-48.2)	14.7 (14.5-15)	14 (12.8-14)	6 (5.5-6.2)
Yaquina Bay, Ore. .	5	46.7 (45-47.5)	14.7 (14.2-15.2)	13.3 (12-14)	6.5 (6-7)
Neah Bay, Wash. . .	5	46 (44.5-47)	14.4 (14-16)	12.7 (12.5-13)	6.9 (6-7.2)

Geographic Range.—The immediate vicinity of the Pacific coast in Oregon and Washington, from about Cape Blanco to Juan de Fuca Strait. In its extreme development it is limited to within about 50 to 100 miles of the coast. To the southward it merges into *S. d. mollipilosus*, and to the eastward grades into *S. d. cascadenis*. Specimens from Myrtle Point, Coos Co., Oregon, are apparently intergrades with *mollipilosus*; specimens from Glendale and Cleveland, Douglas Co., and from Eugene, Lane Co., Oregon, have the tail fringed with white, but the under parts are much more ochraceous than in true *cascadenis*. North of Eugene, *S. douglasii* appears to reach the Willamette Valley, as shown by specimens from Corvallis, Salem and Portland; while Kalama specimens from further north, on the Columbia River, are more or less intermediate between the true coast and the Cascades forms. Further north in Washington, specimens from Tenino (Thurston Co.) and Roy (western Pierce Co.) have the white-fringed tails of the interior form, while Fort Steilacoom, Tacoma, and Port Townsend specimens are referable to the coast form. There are no specimens from east of the great network of sounds connected with Admiralty Inlet, so that whether the coast form occurs to the eastward of these waterways present material does not determine, but it seems probable, as specimens from Mt. Vernon, Hamilton and Sauk, in the Skagit Valley, are either the coast form or intermediates closely approaching it. Further north, however, on the east coast of the Strait of Georgia, *S. douglasii* is replaced by *S. d. cascadenis*, the white-tailed form found further south only in the interior.

¹ Collected and measured by J. E. McLellan.

² Collected and measured by B. J. Bretherton.

³ Collected and measured by E. A. Preble and R. T. Young.

*Material Examined.*¹—Total number of specimens, 120, from the following localities and sources:

Oregon: Type, "Columbia River," J. K. Townsend (Coll. Acad. Nat. Sci. Phila.); Marshfield, Coos Co., Aug. 25-30, J. E. McLellan, 7 spec.; Scottsburgh, Douglas Co., Sept. 19, J. E. McLellan, 1 spec.; Gardiner, Douglas Co., Sept. 4, J. E. McLellan, 1 spec.; Florence, Lane Co., Sept. 24, J. E. McLellan, 1 spec.; Seaton, Lane Co., Oct. 10, J. E. McLellan, 2 spec.; Yaquina Bay, Lincoln Co., March 8 and July 27, B. J. Bretherton, 4 spec.; do., Dec. 7, C. P. Streator, 1 spec.; Newport (on Yaquina Bay) Aug. 3, 5, 31, and Sept. 4, B. J. Bretherton, 6 spec.; Grand Ronde, Polk Co., Nov. 27, J. E. McLellan, 1 spec.; McCoy, Yamhill Co., Oct. 19, B. J. Bretherton, 1 spec.; Tillamook, Tillamook Co., June 30, Dr. A. K. Fisher, 1 spec.; do., Nov. 8, J. E. McLellan, 1 spec.; Astoria, Clatsop Co., July 30, Dr. T. S. Palmer, 1 spec.; Forest Grove, Washington Co., July 7-9, C. McNamee, 2 spec.; Beaverton, Washington Co., June 1, 1 spec. (Coll. C. H. M.); do., Feb. 8-March 26, A. W. Anthony, 3 spec. (U. S. N. M.); Portland, June 24, Dr. A. K. Fisher, 1 spec.; Eagle Creek, Clackamas Co., Nov. 18, B. J. Bretherton, 1 spec.; Salem, Nov. 1-16, C. P. Streator, 4 spec.; Colquit City, F. S. Matteson, 1 spec. (U. S. N. M.).

Washington: Kalama, Cowlitz Co., Oct. 14, 15, C. P. Streator, 7 spec. (not typical); Pacific Co., April 29, July 17-21, A. H. Helme, 4 spec. (A. M. N. H.); Cape Disappointment, Pacific Co., Oct. 14, 15, C. P. Streator, 5 spec. (A. M. N. H.); Aberdeen, Chehalis Co., Aug. 13, Dr. T. S. Palmer, 1 spec.; Quinniault Lake, Chehalis Co., July 17, R. T. Young, 1 spec.; Chehalis Co., March 1 and Nov. 14, Dr. L. C. Tony, 2 spec. (Coll. C. H. M.); Steilacoom, Pierce Co., Aug. 27-30, Dr. T. S. Palmer, 3 spec.; do., Oct. 7, C. P. Streator, 1 spec.; Fort Steilacoom, Jan. and March, Dr. Geo. Suckley, 3 spec. (*Sciurus suckleyi* Baird—U. S. N. M.); American Lake, Pierce Co., March 25, S. N. Rhoads, 2 spec. (Coll. S. N. R.); Tacoma, Pierce Co., Aug. 20, Dr. A. K. Fisher, 1 spec.; Nesqually, Pierce Co., April 4-17, S. N. Rhoads, 5 spec. (Coll. S. N. R.—the Pierce County specimens are not typical); North Fork of Skokomish River (Olympic Mts.), Aug. 26-31, B. J. Bretherton, 5 spec.; Lake Cushman, Mason Co., June 27 and July 7, C. P. Streator, 2 spec.; Port Townsend, Aug. 28, 29, Dr. C. Hart Merriam, 2 spec. (Coll. C. H. M.); Neah Bay, Clallam Co., May 25-June 8, R. T. Young, 10 spec.; do., May 15-June 8, E. A. Preble, 4 spec.; do., Aug. 31, Sept. 1, Dr. C. Hart Merriam, 3 spec. (Coll. C. H. M.); Suez, Clallam Co., May 18, R. T. Young, 2 spec.; Lapush, Clallam Co., June 16-18, R. T. Young, 3 spec.; Mt. Vernon, Skagit Co., Sept. 7, Dr. T. S. Palmer, 1 spec.; do., Dec. 28, C. P. Streator, 1 spec.; do., June 29, E. A. Preble, 1 spec.; Sauk, Skagit Co., Sept. 11, C. P. Streator, 1 spec.; Hamilton, Skagit Co., Sept. 11-14, C. P. Streator, 8 spec.; Simiahmoo, Whatcom Co., Sept., Dr. J. H. Kennerly, 1 spec. (U. S. N. H.).

¹ From U. S. Department of Agriculture Collection, when not otherwise credited.

Sciurus douglasi mollipilosus *Aud. & Bach.*

REDWOOD CHICKAREE.

Sciurus mollipilosus AUD. & BACH. Proc. Acad. Nat. Sci. Phila. 1842, 316 ;
 Quad. N. Am. I, 1849, 157, pl. xix. Coast of Northern California.
Sciurus hudsonicus orarius BANGS, Proc. Biol. Soc. Wash. XI, 1897, 281,
 Dec. 30, 1897. Philo., Mendocino Co., Cal.

Winter Pelage.—Above similar to *S. douglasii*, but the median dorsal band is less dark, and the sides are more decidedly grayish in general effect ; below pale buffy gray, heavily vermiculated with black. Tail nearly as in *S. cascadenis*, being fringed with white instead of yellow.

The coloration below is generally gray with a slight tinge of buff, but varies to strong buff.

Summer Pelage.—Very similar, both above and below, to *S. douglasii*, except that the tail is fringed with white ; the general tone of the upper parts, however, is more olivaceous and less ferruginous, and the lower parts are less deeply tinted.

MEASUREMENTS.

	No. of Spec.	Length.	Tail Vertebrae.	Hind Foot.
Crescent City, Cal. ¹	4	321 (316-330)	126 (123-135)	50.8 (50-52)
Sherwood, Cal. ²	5	314 (299-336)	135 (127-147)	46.5 (45-50)
Willets, Cal. ²	3	317 (314-347)	135 (121-146)	50 (45-55)
Philo, Cal. ³	14	316 (302-327)	136 (127-148)	50.8 (50.8-50.8)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Width of Nasals.
Crescent City, Cal.	3	46.6 (45.6-47.3)	15.4 (15.3-15.6)	13.6 (13-14.6)	7.1 (7-7.2)
Willets, Cal.	2	45.5 (43.6-46.5)	14.7 (14.5-14.8)	13 (12.8-13.1)	6.5 (6-7)
Sherwood, Cal.	5	44.3 (42.4-45.8)	14.7 (14.2-15)	12.7 (12.2-13)	6.8 (6.2-7.6)

Geographic Range.—Pacific coast region of northern California, west of the Coast Range, from Sonoma County (Petaluma) north into Curry County (Port Oxford), Oregon. Grades into *S. d. californicus* in the Siskiyou region.

*Material Examined.*⁴—Total number of specimens, 16, from the following localities and sources :

California: Cazadero, Mendocino Co., July 4, J. E. McLellan, 1 spec. ; Willets, Mend. Co., alt. 1700-2000 ft., F. Stephens, May 5 and 22, 3 spec. ; Sherwood, Mend. Co., alt. 2400-2700 feet, May 9-12, F. Stephens, 6 spec. ; Eureka, Humboldt Co., May 23, Dr. T. S. Palmer, 1 spec. ; Crescent City, Del Norte Co., June 25, Dr. T. S. Palmer, 3 spec. ; Gasduct, Del Norte Co., Oct. 25, J. A. Loring, 1 spec.

Oregon: Port Oxford, Curry Co., Aug. 16, J. E. McLellan, 1 spec.

¹ Collected and measured by Dr. T. S. Palmer.

² Collected and measured by F. Stephens.

³ Collected and measured by C. A. Allen (from Bangs, Proc. Biol. Soc. Wash., Vol. XI, 1897, p. 282).

⁴ All from U. S. Department of Agriculture Collection.

Sciurus douglasii cascadenis, subsp. nov.

CASCADES CHICKAREE.

Winter Pelage.—Almost indistinguishable, both above and below, from *S. d. mollipilosus*, being similarly characterized by the white fringed tail and rather paler tints, in comparison with *S. douglasii*.

Summer Pelage.—More olivaceous above and less deeply orange below than either *S. douglasii* or *S. d. mollipilosus*, varying from yellowish buff to buffy ochraceous, thus strongly approaching *S. d. californicus*, with which it intergrades to the east and south.

MEASUREMENTS.

	No. of Spec.	Length.	Tail Vertebrae.	Hind Foot.
Mt. Hood, Ore. ¹	2	325 (320-330)	135 (130-138)	50.5 (50-51)
Bald Mt., Ore. ³	1	322	132	51
Mt. Ranier, Wash. ²	1	303	125	50
Lake Chelan, Wash. ⁴	11	333 (315-348)	133 (113-146)	52.8 (51-54)
Hamilton, Wash. ⁴	8	287 (270-325)	115.6 (102-125)	48.6 (47-51)
Port Moody, B. C. ⁴	17	309 (290-318)	123 (116-131)	49 (46-51)
Agassiz, B. C. ⁴	9	307 (292-321)	125 (113-132)	50.9 (48-52)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	NASALS.	
				Length.	Ant. Breadth.
Hamilton, Wash.	2	46.4 (45.8-47)	14.9 (14.8-15)	13.2 (12.4-14)	6.7 (6.5-7)
Lake Chelan, Wash.	5	48.5 (47.6-49)	14.5 (14-15)	13.8 (13.3-14.3)	7 (6.7-7.1)
Port Moody, B. C.	5	45.1 (43.6-46)	14.9 (14.5-15.4)	12.9 (12.4-13.4)	6.3 (6-6.6)
Agassiz, B. C.	4	45.9 (45-46.6)	14.6 (14.3-15.2)	13.1 (12-14.2)	6.3 (6-6.7)
N. Westminster, B. C.	8	46.2 (46-46.5)	14.9 (14-15.3)	13.7 (13-14.6)	6.5 (6.2-7)

Geographic Range.—The Cascades region of Oregon and Washington, north into British Columbia, including also the coast region at the mouth of the Fraser River, and north at least to Rivers Inlet (about 51° 30'), some fifty miles north of Vancouver Island. In Oregon this form prevails south in the Cascades to the vicinity of Fort Klamath; and, west of the Cascades, to Glendale, Cleveland, Eugene and Sweet Home, and in Washington, to Tenino, Roy and Snoqualmie Falls.

Type, No. 80,229, U. S. Nat. Mus. (Dept. Agr. Coll.), ♂ ad., Mt. Hood, Oregon, Sept. 9, 1896; V. Bailey.

¹ Collected and measured by V. Bailey.

² Collected and measured by Dr. A. K. Fisher.

³ Collected and measured by B. J. Bretherton.

⁴ Collected and measured by C. P. Streater.

*Material Examined.*¹—Total number of specimens, 107, from the following localities and sources :

Oregon : Glendale, Douglas Co., Dec. 18 (C. P. Streator), and June 18 (Dr. A. K. Fisher), 2 spec. ; Elk Head, Douglas Co., April 20, A. Todd, 1 spec. (U. S. N. M.) ; Eugene, Lane Co., Nov. 21, C. P. Streator, 1 spec. ; Sweet Home, Linn Co., Nov. 28, and Jan. 27, W. C. Swann, 3 spec. (U. S. N. M.) ; Bald Mt., head of Clackamas River, Nov. 10, B. J. Bretherton, 1 spec. ; Eagle Creek, Clackamas Co., Nov. 18, B. J. Bretherton, 1 spec. ; Permia Lake, west base of Mt. Jefferson, Oct. 2-5, J. A. Loring, 4 spec. ; Mt. Hood, Sept. 9 and 10, V. Bailey, 2 spec.

Washington : Goldendale, Klickitat Co., July 8, W. K. Fisher, 1 spec. ; Cleveland, Klickitat Co., July 28, W. K. Fisher, 2 spec. ; do., July 12, Bailey and Loring, 2 spec. ; Trout Lake, Klickitat Co., June 28, J. A. Loring, 2 spec. ; Tenino, Thurston Co., June 30, R. T. Young, 2 spec. ; Ashford, Pierce Co., Aug. 9, W. K. Fisher, 2 spec. ; Roy, Pierce Co., Aug. 18, V. Bailey, 1 spec. ; Mt. Ranier, Aug. 6, Dr. A. K. Fisher, 1 spec. ; Easton, Kittitas Co., July 3-20, C. P. Streator, 4 spec. ; Kecheelus Lake, Kittitas Co., Aug. 15, Dr. A. K. Fisher, 1 spec. ; Wenatchee, Kittitas Co., Sept. 19, J. A. Loring, 3 spec. ; Natchez River, Yakima Co., July 28, W. K. Fisher, 1 spec. ; Snoqualmie Falls, Kings Co., June 1, C. H. Townsend, 3 spec. (U. S. N. M.) ; head of Lake Chelan, Okanagan Co., Aug. 13-21, C. P. Streator, 10 spec. (not typical, they approaching *californicus*, particularly in large size, and somewhat in color).

British Columbia : Head of Rivers Inlet, Aug. 27-Sept. 3, E. A. Preble, 3 spec. ; Burrard Inlet, May 4, Prof. J. Macoun, 1 spec. (A. M. N. H.) ; Gibson's Landing, Howe Sound, July 23, E. A. Preble, 1 spec. ; Lund, July 16, 17, E. A. Preble, 2 spec. ; Langley, July 9, E. A. Preble, 1 spec. ; Hastings, Nov. 21, C. P. Streator, 1 spec. ; Port Moody, July 26-31, and Oct. 25-Nov. 1, C. P. Streator, 18 spec. ; Mt. Lehman, June 2 and 9, C. P. Streator, 3 spec. (A. M. N. H.) ; New Westminster, April 23-May 20, C. P. Streator, 14 spec. (A. M. N. H.) ; do., Nov. 2, H. W. Elliott, 1 spec. (U. S. N. M.) ; Agassiz, Nov. 28-Dec. 6, C. P. Streator, 9 spec. ; Sumas, March 2 and June 10, S. N. Rhoads, 2 spec. (Coll. S. N. R.).

***Sciurus douglasii californicus* (Allen).**

CALIFORNIA CHICKAREE.

Sciurus hudsonius californicus ALLEN, Bull. Am. Mus. Nat. Hist. III, 1890-91, 165 (Nov. 14, 1890). Blue Cañon, Placer Co., Cal.

Winter Pelage.—Above similar to *S. d. cascadenis*, but the median band of a much paler shade of chestnut, and the general color much lighter and grayer

¹ From U. S. Department of Agriculture Collection, when not otherwise credited.

in general effect. Tail broad and full, with generally less chestnut at the base of the hairs and the outer white fringe much broader and intense, clear white. Ventral surface grayish white, without fulvous tinge and with little or no vermiculation, and this mainly at the sides of the ventral area.

Summer Pelage.—Above similar to *S. d. cascadenis*—almost indistinguishable, in fact, but rather lighter and grayer in general effect. Ventral surface pale fulvous, varying from cream white to pale fulvous; feet ochraceous, with a conspicuous deep ochraceous band along the front edge of the thigh; fore arm ochraceous, the inner surface only a little paler than the outer. Tail narrow and slender, usually very little chestnut at base of hairs, and the fringe pure white, as in winter, but narrower.

The contrast between the coloration of the ventral surface in true *S. douglasii* and typical *S. d. californicus*, in both the summer and winter pelages, is thus very striking, but in the Cascades region of Oregon and Washington, the two completely intergrade through *S. d. cascadenis*.

MEASUREMENTS.

	No. of Spec.	Length.	Tail Vertebrae.	Hind Foot.
Mt. Whitney, Cal. ¹	9	322 (290-344)	131 (116-142)	51.3 (47-55)
Buck's Ranch, Cal. ²	6	319.5 (307-325)	128.3 (126-133)	52 (51-54)
Lassen Creek, Cal. ³	7	341 (331-348)	148 (137-156)	53 (52-55)
Siskiyou, Ore. ³	6	332 (325-338)	131 (126-135)	52.3 (52-54)
Fort Klamath, Ore. ⁴ ..	8	331 (308-340)	137 (126-144)	52.6 (52-55)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Width of Nasals.
Mt. Whitney, Cal ...	4	47.4 (47-48.5)	14.3 (13.8-15)	13.4 (12-14.5)	6.9 (6.5-7)
Buck's Ranch, Cal....	4	46.1 (44.6-47)	14.3 (14-15)	12.9 (12-13.4)	6.7 (6.3-7.2)
Donner, Cal.....	6	47.9 (47-49)	14.5 (14.3-15)	13.6 (13-14.8)	7 (6.7-7.3)
Siskiyou, Ore....	5	47.4 (46.2-47.8)	14.8 (14.2-15)	13.3 (13-13.5)	6.8 (6.3-7.3)
Fort Klamath, Ore... 4	4	47.4 (46.5-48.5)	14.9 (14.8-15)	14.1 (14-14.3)	6.9 (6.5-7)

Geographic Range.—The Sierra Nevada region of central and northern California, north in Oregon, east of the Cascades, to the Maury Mountains and Strawberry Butte, over which region it prevails with little change and may be considered typical, and nearly typical *californicus* prevails westward in Oregon to the eastern base of the Cascades, where it passes into *cascadenis*.

Material Examined.⁵—Total number of specimens, 174, from the following localities and sources:

Nevada: Near Bijou, June 4, C. A. Keeler, 3 spec.

¹ Collected and measured by B. H. Dutcher.

² Collected and measured by F. Stephens.

³ Collected and measured by C. P. Streater.

⁴ Collected and measured by Vernon Bailey and E. A. Preble.

⁵ From the U. S. Department of Agriculture Collection, when not otherwise credited.

California: Kern River, Kern Co., Sept. 4, E. W. Nelson, 1 spec.; Kern Lakes, Kern Co., Aug., V. Bailey, 1 spec.; E. Fork of Keweah River, Tulare Co., July 30, V. Bailey, 1 spec.; Mt. Whitney, Tulare Co., June 23-Aug. 31, B. H. Dutcher, 8 spec.; do., Aug. 20 and 31, Dr. Fisher and V. Bailey, 2 spec.; do., Sept 6 and 10, H. W. Henshaw, 5 spec. (U. S. N. M.); Mineral King, Fresno Co., Sept. 9, Dr. A. K. Fisher, 1 spec.; San Joaquin River, Fresno Co., July 25 and 28, E. W. Nelson, 2 spec.; do., alt. 8000 feet, July 28 and 29, F. Stephens, 2 spec.; S. Fork of King River, Fresno Co., Aug. 15, Dr. A. K. Fisher, 1 spec.; Mammoth, Fresno Co., alt. 8400 feet, July 22, F. Stephens, 2 spec.; Bishop Creek, Fresno Co., alt. 8000 feet, Aug. 4, F. Stephens, 1 spec.; Sierra Nevada, Fresno Co., July 22-24, E. W. Nelson, 4 spec.; Sequoia National Park, Merced Co., Aug 4-7, Dr. A. K. Fisher, 4 spec.; S. Fork Merced River, Merced Co., Aug. 3, E. W. Nelson, 1 spec.; Soquel Mill, Merced Co., alt. 5500 feet, Dec. 1 and 2, J. E. McLellan, 2 spec.; Markleville, Alpine Co., alt. 5800 feet, Aug. 30 and Sept. 1, F. Stephens, 2 spec.; Michigan Bluff, Placer Co., Oct. 27, V. Bailey, 1 spec.; Blue Cañon, Placer Co., Oct. 7-13, C. A. Allen, 9 spec. (A. M. N. H.); do, Oct. 16-20 and June 3, 6, C. A. Allen, 4 spec.; Summit, Placer Co., alt. 4500 feet, July 1, F. Stephens, 1 spec.; do., Aug. 19-22, J. E. McLellan, 2 spec.; Atwell's Mill, alt. 6300 feet, Nov. 19, J. E. McLellan, 1 spec.; Pyramid Peak, Eldorado Co., July 18, W. W. Price, 1 spec. (A. M. N. H.); Silver Lake Amador Co., June 27 and 28, J. Diefenbach, 2 spec. (A. M. N. H.); Donner, Nevada Co., June 1-4, J. A. Loring, 3 spec.; do., June 11-18, C. A. Allen, 6 spec. (Coll. C. H. M.); do., June 7, C. A. Allen, 2 spec. (A. M. N. H.); Nevada City, Nevada Co., Aug. 7-10, C. P. Streator, 6 spec.; Buck's Ranch, Plumas Co., alt. 5100 feet, June 22-24, F. Stephens, 6 spec.; Greenville, Plumas Co., alt. 4500 feet, F. Stephens, 2 spec.; Oroville, Butte Co., alt. 3400 feet, June 17, F. Stephens, 1 spec.; Lassen Creek, Modoc Co., alt. 5200-6000 feet, July 25-Aug. 2, F. Stephens, 10 spec.; Camp Bidwell, Modoc Co., July 25, H. W. Henshaw, 1 spec. (U. S. N. M.); Grizzly Creek, Lassen Co., June 21, F. Stephens, 1 spec.; Mt. Lassen, Lassen Co., Sept. 16, C. H. Townsend, 3 spec. (U. S. N. M.); Honey Lake, Lassen Co., June 20, H. W. Henshaw, 1 spec. (U. S. N. M.); Big Valley Mts., Lassen Co., Sept. 15-20, C. P. Streator, 5 spec.; Mt. Shasta, Shasta Co., July, C. H. Townsend, 3 spec. (U. S. N. M.); Fort Crook, Trinity Co., Oct. 24, D. F. Parkinson, 1 spec. (U. S. N. M.); do., John Feilner, 1 spec. (U. S. N. M.); Carberry, Trinity Co., May 18, C. P. Streator, 1 spec.; Shelly Creek, Siskiyou Co. (Siskiyou Mts.), Oct. 16-25, J. A. Loring, 3 spec.

Oregon: Siskiyou, Jackson Co., Sept. 27-Oct. 7, C. P. Streator, 8 spec.; Diamond Lake, Jackson Co., Aug. 13, E. A. Preble, 1 spec.; Prospect, Jackson Co., Aug. 30, E. A. Preble, 1 spec.; Fort Klamath, Klamath Co., Feb. 18-28, and Jan. 17, S. Parker, 9 spec.; do., Jan., Feb. and Aug., Capt. C. Bendire, 6 spec. (Coll. C. H. M.); do., Aug. 12, Dr. C. H. Merriam, and V. Bailey, 2 spec.; do., Sept. 8-11, E. A. Preble, 6 spec.; do., Feb. 18, S.

Parker, 1 spec. (Coll. C. H. M.); do., Nov. 9 and 19, and Dec. 18, Dr. J. C. Merrill, 4 spec. (U. S. N. M.); do., Aug. 31, H. W. Henshaw, 1 spec. (U. S. N. M.); Swan Lake Valley, June 12, 13, V. Bailey, 2 spec.; Naylox, Klamath Co., Sept. 19, E. A. Preble, 1 spec.; W. Sink Creek, east base of Mt. Thiel- sen, Klamath Co., Aug. 25, 26, Merriam and Bailey, 2 spec.; Warner Mts., Lake Co., Aug. 2, 3, Merriam and Bailey, 4 spec.; do., Aug. 9, H. W. Hen- shaw, 1 spec. (U. S. N. M.); Maury Mts., Lake Co., June 30, and July 31, V. Bailey, 2 spec.; ten miles north of Harney, Harney Co., July 10, E. A. Preble, 1 spec.; Camp Harney, Harney Co., Jan. 9, Capt. C. Bendire, 1 spec. (U. S. N. M.); Buck Creek, Crook Co., July 4, V. Bailey, 1 spec.; Bend, Crook Co., Aug. 2, E. A. Preble, 1 spec.; Pengra, Crook Co., Aug. 7, E. A. Preble, 1 spec.; Strawberry Butte, Grant Co., July 13, V. Bailey, 2 spec.; ten miles west of Wapineta, Wasco Co., Sept. 5, V. Bailey, 1 spec.

REVIEW OF THE *Sciurus douglasii* GROUP.

The present material is greatly inadequate for a satisfactory study of the *S. douglasii* group as developed in California, Oregon, Washington and British Columbia. There are apparently three forms along the coast, one of which (the northern) also occurs in the interior, while a fourth is wholly confined to the interior. These are, beginning at the southwest: (1) *S. douglasii molipilosus*, of the redwood belt, west of the Coast Range, which extends from Sonoma County, California, into Curry County, Oregon, intergrad- ing with *S. d. californicus* in the Siskiyou region, and with *dou- glasii* proper at the northward; (2) *S. douglasii* of the immediate coast region of Oregon and Washington, being confined mainly to within 50 to 100 miles of the coast, but extending also up the Skagit Valley, and intergrading on the east with *S. d. cascaden- sis*; (3) *S. d. cascaden- sis*, of the coast region of southwestern British Columbia, and thence southward throughout the Cascades, not only in the mountains proper, but to varying distances from the base, both to the east and the west, intergrading to the westward with *S. douglasii*, and to the southeastward with *S. d. californicus*; (4) *S. d. californicus*, of the Sierra Nevada region of California and southern Oregon, ranging in the interior at least to the Maury Mountains and Strawberry Butte, where it still retains nearly its typical features. A series of specimens from Lake Chelan, Washington, is almost referable to this form (being paler

and larger), showing that it probably ranges, perhaps somewhat modified, much to the northward of the limits shown by the present restricted material.

The extreme phases of the group are *S. douglasii* of the coast and *S. d. californicus* of the interior, which are exceedingly unlike; the coast forms are all considerably smaller than *californicus*, and much more strongly colored, particularly below, yet the coast and interior forms appear to completely intergrade through *cascadensis*. *Californicus* is especially characterized by the pale (creamy white to buff) coloration of the ventral surface in the summer pelage, and, in the winter pelage, by the absence in large degree of dusky vermiculations, and any tinge of yellow below. The series of 32 specimens from the vicinity of Fort Klamath, representing all seasons of the year, is especially interesting, since at about this point *californicus* passes into *cascadensis*. Of 14 specimens in winter pelage, about one-half are typical *californicus*, being white below and only slightly vermiculated—about like winter specimens from the southern Sierra Nevada; the others show somewhat more vermiculation, but are all without the fulvous wash of coast specimens, except one, which is heavily vermiculated and as strongly suffused with fulvous below as average specimens from Neah Bay. Of the 18 summer specimens, all but three are typical *californicus*, differing very little from a similar series from the mountains of central California, the remaining three closely resembling average coast specimens. On the other hand, a series of 11 specimens from Siskiyou decidedly approaches the coast form. Specimens from the Warner and Maury Mountains and Strawberry Butte are fairly typical *californicus*.

In the interior forms the tail is fringed with pure white—broadly so in *californicus*, more narrowly in *cascadensis*—and with yellow or yellowish in the central coast form (*douglasii*). There is, however, much variation in this respect, both individual and geographical, the fringe of the tail being occasionally decidedly yellowish white rather than yellow at localities on the coast, and again yellowish white instead of white at some localities in and east of the Cascades; while over quite a belt about midway between the west base of the Cascades and the coast, the tail fringe averages yellowish white rather than either yellow or white,

this belt being occupied by intergrades between *douglasii* and *cascadensis*. In large series from points on the coast, usually about one specimen in ten has the tail fringed with white.

S. d. cascadensis is really little more than a vast assemblage of intergrades between the interior (*californicus*) and coast (*douglasii*) forms, as a whole much nearer *douglasii* than *californicus*. The examination of much further material will be necessary to determine whether or not it is a sufficiently stable and distinct enough form to warrant permanent recognition.

It may here be noted that there is a marked tendency to albinism on the ventral surface in the whole *S. douglasii* group, less pronounced, however, in *californicus*, owing to its lighter under surface, than in the other forms. This is manifested in the presence of a white spot in the axillary region, varying in different specimens from a few white hairs to a large area of white. It is more frequent at some localities than at others; thus, in British Columbia, at Port Moody, in a series of 17 specimens, only two are thus marked, and none in 15 from New Westminster, while out of 22 from Agassiz, Sumas, Mt. Lehman, etc., one in three have more or less white in the axillary region. In Washington (various localities) only about one in twelve is thus marked. In 98 specimens from various localities in Oregon, 22 are marked with white, and three out of fifteen from the coast of northern California. Specimens with much white in the axillæ are apt to show traces of white elsewhere on the lower parts, as on the lower part of the throat and middle of the breast.

The earliest name presumably applied to any member of the group is *Sciurus douglasii* Gray (P. Z. S., 1836, p. 88), a *nomen nudum* given to a specimen collected "by the late Mr. Douglas in North America." Two years after a Squirrel was described by Dr. Bachman (P. Z. S., 1838, p. 99) under the same name, and without indication of locality, but later Bachman states (Aud. & Bach., Quad. N. A., I, p. 371) that "his specimens" were obtained "by Mr. Townsend," "on the Columbia River." The locality is thus unfortunately indefinite. It is evident from the original description that the specimens could not have had a white-fringed tail, as it says, "on the extremity of the tail the hairs are black from the roots, tipped with light brown"; yet the hairs from

the sides of the tail are said to be "tipped with soiled white," or probably yellowish white. The specimen would thus seem to be an intermediate between the coast form and that of the interior, here called *cascadensis*. Under these circumstances it seemed very desirable to examine the type specimen, which proves to be still extant in the collection of the Academy of Natural Sciences of Philadelphia. Through the kind offices of Mr. Witmer Stone, the specimen¹ is now before me, and proves to be, as the description indicates, a specimen in which the tail is fringed with yellowish white, and thus probably from the lower part of the Columbia,—doubtless from Vancouver or below. It agrees well with specimens from about this point,—much more nearly than with specimens from the Cascades region further eastward. Although it is not strictly typical of the coast form, it so decidedly approaches it that it seems best to restrict the name *douglasii* to the coast phase of the group, as represented at the mouth of the Columbia River.

In 1841 Audubon and Bachman described another Squirrel of this group under the name *Sciurus mollipilosus* (Proc. Acad. Nat. Sci. Phila., 1841, p. 102), from the "northern parts of California," or, as said more definitely later (Quad. N. Am., I, p. 158): "Our specimens were obtained in the northern part of California, near the Pacific Ocean." This definitely fixes the name on the Redwood Chickaree of the coast region of northern California, recently re-described by Mr. Bangs (Proc. Biol. Soc. Wash., XI, 1897, p. 281) as *Sciurus hudsonicus orarius*, from specimens collected at Philo, Mendocino County, California.

In 1842 Gray described a *Sciurus belcheri* (Ann. and Mag. Nat. Hist., X, 1842, p. 263), based on a specimen collected by Capt. Belcher, on the voyage of the 'Sulphur,' at the "mouth of the Columbia River" (Voy. Sulphur, Zoöl., I, p. 33). As Capt. Belcher's party went as far up the Columbia River as Fort Vancouver, and as the tail of *S. belcheri* is described as "black and red varied, with long white tips to the hairs," it may well have been an intergrade from Fort Vancouver, and must thus be considered as a synonym of *S. douglasii* Bachm.

¹ It bears the following on the label: "286. Type of *Sciurus douglasii* Bach. Columbia River, J. K. Townsend. The specimen was formerly mounted, and is still in a good state of preservation. It is in full summer pelage, and must have been taken in August or September.

In 1855 Baird (Proc. Acad. Nat. Sci. Phila., 1855, p. 333) gave the name *Sciurus suckleyi* to winter specimens obtained at Puget Sound, which he afterward (Mam. N. Am., 1857, p. 276, footnote) referred to *S. douglasii*; and the types and topotypes, as well as the description, show the reference to have been properly made.¹ It thus unfortunately happens that none of the names given to members of the *S. douglasii* group are available for the form here named *cascadensis*.

Baird, in 1857, seemed to harbor a suspicion that *S. douglasii* would be found to intergrade with *S. richardsonii*, a surmise that I thought my material in 1877 clearly proved. The present material seems to establish the contrary, since it shows that at several points it meets forms of the *hudsonicus* group (*S. h. streatori* and *S. h. vancouverensis*) without indication of intergradation. A series of 12 specimens collected at the head of Lake Chelan, Okanagan Co., Washington, by Mr. C. P. Streator, Aug. 13-21, contains 10 examples of *S. d. cascadenis* (or *californicus*?) and 2 of *S. hudsonicus streatori*. The former all have the ventral surface varying from pale buff to deep orange buff; the *streatori* specimens are clear grayish white below, with a subapical broad black bar on the upper surface of the tail, which is lacking in all the other specimens. Thus the two series are respectively typical of the two forms in question. Yet the *streatori* specimens were taken on the same day, by the same collector, as some of the others, and doubtless at the same place, showing that a phase of *douglasii* and *streatori* here meet without intergrading. Thence northward on the eastern shore of the Strait of Georgia to Howe Sound (opposite Comox, Vancouver Isl.), and eastward along the Fraser River as far as Agassiz, *S. d. cascadenis* appears to exclusively prevail, while at Ashcroft, a short distance east of Agassiz, only *S. h. streatori* is found. Thus *S. d. cascadenis* meets (except for a narrow strait) *S. h. vancouverensis* on the west and north, and *S. h. streatori* on the east, without intergradation, so far as present evidence goes.

Three specimens from the head of Rivers Inlet, far up on the

¹ Prof. Baird also identified both his *S. suckleyi* and *S. mollipilosus* Aud. and Bach. with *S. douglasii*. He says: "I have already referred to the probable identity of my *S. suckleyi* with this species [*S. douglasii*], and I have no doubt that the *Sciurus mollipilosus* of Audubon and Bachman is the cinereous [=winter] pelage ascribed to the above species [*S. douglasii*]."—Mam. N. Am., 1857, p. 277.

coast of British Columbia, unexpectedly prove to be *S. d. cascadenensis*, instead of *S. h. vancouverensis*; but the intermediate coast region southward to about the mouth of Fraser River is wholly unrepresented in the present collection.

Sciurus mearnsi (*Townsend*).

MEARNS'S CHICKAREE.

Sciurus hudsonius mearnsi TOWNSEND, Proc. Biolog. Soc. Washington, XI, 146, June 9, 1897. (Not the synonymy.) San Pedro Martir Mts., L. Cal.

Sciurus hudsonicus californicus ALLEN, Bull. Am. Mus. Nat. Hist. V, 1893, 199; not *ibid.* III, 1890, 165, 167.

Winter Pelage.—Similar to *S. d. californicus*, but paler and grayer above, with the dorsal band a paler, more yellowish shade of chestnut.

Summer Pelage.—Probably similar to that of *S. d. californicus* but lighter above and with the lower parts only faintly washed with cream white, and the feet, both fore and hind, very much paler ochraceous.

Measurements.—Total length, 325; tail vertebræ, 125; hind foot (from skin), 51.

Skull.—Total length, 48.5; postorbital breadth, 14.9; length of nasals, 14; width of nasals in front, 7.

Material Examined.—Total number of specimens, 4, as follows:

Lower California: San Pedro Martir Mts., April 29 and May —, C. H. Townsend, 3 spec. (U. S. N. M.); do., alt. 8200 feet, May 18, A. W. Anthony, 1 spec. (A. M. N. H.).

The four specimens available for examination were all taken in the San Pedro Martir Mountains, Lower California, April 29 to May 18, and are hence in worn winter coat. The feet have begun to show the coloration of the summer pelage, and in one specimen this is well developed also over the anterior two-thirds of the ventral surface. The hind feet are white with a faint tinge of fulvous; the fore feet are in change to strong buff. The fulvous tint on the lower parts, and particularly on the inner surface of the fore limbs, shows that the affinities of this form are with *S. douglasii californicus* rather than with *S. fremonti mogollonen-*

sis. In other respects it is quite as near the latter as the former, the general coloration of *mogollonensis* and *californicus* being often closely similar.

Sciurus mearnsi is separated from the ranges of both *californicus* and *mogollonensis* by a wide interval of country, where at the present time no representative of either group exists, or apparently can exist. It seems therefore proper to treat this form as a fully segregated species, there being no possibility of its intergradation with either of its northern affines, which it still so closely resembles, being evidently a recent derivative of the *californicus* stock.

Sciurus fremonti Aud. & Bach.

FREMONT'S CHICKAREE.

Sciurus fremonti AUD. & BACH. (ex TOWNSEND MS.) Quad. N. Am. III, 1853, 237, pl. cviiix, fig. I (Park region, Colorado?); BAIRD, Mam. N. Am. 1857, 272.

Sciurus hudsonius var. *fremonti* ALLEN, Proc. Bost. Soc. Nat. Hist. XVII, 1874, 288; N. Am. Roden. 1877, 673.

Sciurus hudsonicus fremonti ALLEN, Bull. Am. Mus. Nat. Hist. VI, 1894, 325.

Winter Pelage.—Above gray, with a broad, not sharply-defined median band of pale yellowish rufous; the hairs of the median band are plumbeous at the base, broadly tipped with yellowish rufous and narrowly ringed with black; on the sides the hairs are broadly tipped with very pale fulvous and ringed with black, with a general gray effect; fore and hind limbs, including upper surface of feet, like sides of body; an obscure, nearly obsolete dusky lateral line; below grayish white, rather profusely annulated with dusky. Tail above with the central hairs yellowish rusty, rather brighter than the middle of the back, varied with black, forming an indistinct central area; lateral hairs fulvous basally, subapically broadly banded with black and tipped broadly with white; terminal fifth or sixth black, slightly fringed with white; below gray or pale fulvous gray centrally, with a broad zone of black and a conspicuous fringe of white; ears slightly tufted with dusky.

Summer Pelage.—Above nearly uniform yellowish gray, varying in different specimens to pale rufescent gray; upper surface of feet ochraceous, the fore feet, including fore arm, brighter and stronger ochraceous than the hind; a strong, deep black lateral line; ventral surface white or grayish white; tail colored nearly as in winter, but narrower, and edged more narrowly with white.

MEASUREMENTS.

	No. of Spec.	Length.	Tail Vertebrae.	Hind Foot.
South Park, Col. ¹	3	316 (310-320)	120 (117-123)	49 (48.3-49.5)
Long's Peak, Col. ²	3	320 (320-320)	133 (130-137)	49 (48-49)
Fort Garland, Col. ³	3	333 (326-342)	132 (130-133)	50.8 (50.8-50.8)
Cochetope Pass, Col. ⁴	7	320 (303-335)	128 (114-139)	48.4 (46-51)
Uintah Mts., Utah ⁵	5	326 (305-345)	127 (102-145)	49.5 (48-50)
Fort Bridger, Wyo. ⁵	3	327 (323-334)	134 (128-140)	50 (47-52)
Wood's P. O., Wyo. ⁵	5	327 (310-342)	133 (121-140)	50 (49-51)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Width of Nasals.
Mill City, Col.	3	47.5 (46.5-49)	14.9 (14.8-15)	14.3 (14-14.4)	7.3 (7-7.8)
Cochetope Pass, Col.	5	45.8 (42.2-48)	14.6 (13.6-15)	14.1 (13-15)	7.2 (7-7.5)
Uintah Mts., Utah.	1	47.8	14.7	15	7.5

Geographic Range.—The mountainous portions of Colorado, reaching the extreme southern border of Wyoming at Woods P. O., and Uintah Mountains of Utah; also reaching the southern boundary of Wyoming at Fort Bridger.

Material Examined.—Total number of specimens, 64, from the following localities and sources:

Colorado: Type (exact locality not known), J. C. Fremont, summer (probably June, 1844), 1 spec. (Coll. Acad. Nat. Sci. Phila.); Arkins, Larimer Co., Feb. 5, 8, R. S. Weldon, 2 spec. (A. M. N. H.); Estes Park, Larimer Co., June 9, W. G. Smith, 2 spec. (U. S. N. M.); headwaters of Laramie River, Larimer Co., Aug. 20-30, Dr. E. Coues, 5 spec. (U. S. N. M.); Middle Park, Grand Co., July 26, J. Stevenson, 1 spec. (U. S. N. M.); Berthoud's Pass, Middle Park, J. Stevenson, 1 spec. (U. S. N. M.); Ward, Boulder Co., June 9, J. A. Loring, 1 spec.; do., Oct. 25, Nov. 15, 20, Dennis Gale, 3 spec. (Coll. C. H. M.); Mill City, June 20, July 9, C. H. Eagle, 3 spec. (A. M. N. H.); Long's Peak, Boulder Co., Aug. 6-8, E. A. Preble, 5 spec. (Dept. Agr. Coll.); Georgetown, Clear Creek Co., July and Oct., G. E. Marsh, 2 spec. (U. S. N. M.); Granite, Park Co., Oct. 16, J. H. Batty, 1 spec. (U. S. N. M.); no locality, J. H. Batty, 3 spec. (U. S. N. M.); Twin Lakes, Lake Co., summer, Dr. J. T. Rothrock, 2 spec. (U. S. N. M.); Central Colorado (without definite locality or date), Dr. F. V. Hayden (= J. H. Batty?), 2 spec. (U. S. N. M.); Sangra de Christo Pass, Aug. 9, C. E. Aiken, 1 spec. (U. S. N. M.); Monshower Meadows, near Cochetope Pass, Sauguache Co., Aug. 6-21, J. A. Loring, 11 spec. (Dept. Agr. Coll.); Fort Garland, Costilla Co., June 3 and 4, H. W. Henshaw, 2 spec. (U. S. N. M.); Silverton, San Juan Co., Oct. 17, J. A. Loring, 1 spec. (Dept. Agr. Coll.).

¹ Collected and measured by J. A. Allen (from Mon. N. Am. Roden., p. 691).

² Collected and measured by E. A. Preble.

³ From Allen, Mon. N. Am. Roden., p. 691.

⁴ Collected and measured by J. A. Loring.

⁵ Collected and measured by Vernon Bailey.

Utah: Uintah Mts., June 4, V. Bailey, 1 spec.; do., Sept. 21, V. Bailey, 3 spec. (Coll. C. H. M.); do., Dr. F. V. Hayden (=H. D. Schmidt), 1 spec. (U. S. N. M.).

Wyoming: Fort Bridger, Uintah Mts., Sept. 19, V. Bailey, 3 spec. (Coll. C. H. M.); Bridger's Pass, Uintah Mts., July 31, W. S. Wood, 1 spec. (U. S. N. M.); Wood's P. O., Medicine Bow Mts., Aug. 9 and 13, V. Bailey, 5 spec. (Coll. C. H. M.).

New Mexico: Chama, Taos Co., Dec. 22, J. A. Loring, 1 spec. (Dept. Agr. Coll.).

The type locality of *Sciurus fremonti* is not definitely known. Audubon and Bachman state in their original description of the species (*l. c.*): "We possess no information in regard to this animal farther than that it was obtained on the Rocky Mountains." They further say: "The only specimen we have seen was obtained by Colonel Frémont; it was procured on the Rocky Mountains, on his route by the South Pass to California." Baird (*l. c.*), evidently loosely paraphrasing Audubon and Bachman, says the specimen described by Audubon and Bachman "was collected in 1849 [*lege* 1844?] by Colonel Frémont somewhere in the vicinity of the South Pass, and is now in the Museum of the Philadelphia Academy of Natural Sciences." He identified with it a specimen from Sawatch Pass, Rocky Mountains, these two examples, being, he says, "all that as yet have come to the notice of naturalists."

Through the kind intervention of Mr. Witmer Stone, of the Philadelphia Academy of Natural Sciences, I have in hand the type specimen obtained by Frémont. It proves to be the form of Chickaree found throughout the Rocky Mountains of Colorado, to which the name *fremonti*, since 1857, has been currently applied. It shows also that it could not have come from "the vicinity of the South Pass," at the southern end of the Wind River chain in Wyoming, the form there being the very different *Sciurus hudsonicus ventorum*.

An examination of the type shows it to be in winter pelage, the soles being heavily furred, the ears well tufted, and the general pelage that of winter or late spring. Even the feet, where change to summer coat first begins to appear, show very little departure from winter conditions. The specimen might have been taken in May, or even as late as the middle of June. The label on the

specimen ("285, Type") is evidently of very recent date, and erroneously attributes the specimen to "J. K. Townsend," and gives the locality as "South Pass, Rocky Mts." I wrote to Mr. Stone regarding this point, and he kindly replied as follows (under date of May 20, 1898): "The specimen, along with others, seems to have been presented by Townsend to our Academy; he apparently received it from Fremont. You will notice that Audubon [and Bachman] gives the species as *S. fremonti* TOWNSEND. The occurrence of Townsend's name on the label, instead of Fremont's, is due to the fact that museum records of old days seem to have placed more stress on the donor than the collector. The label now on the specimen I transcribed from the base of an old stand, about 1890, on which the animal was mounted. There is no other specimen of *S. fremonti* in our collection."

From the above it is evident that beyond reasonable doubt this specimen is the actual type of Audubon and Bachman's "*Sciurus fremonti* Townsend." It therefore becomes important to determine as nearly as possible the type locality. Reference to Fremont's reports to the U. S. War Department shows that his two visits to the region of the South Pass were respectively in August, 1842, and August, 1843, and that the season alone thus rules out of consideration this locality as the source of the type of *Sciurus fremonti*. On his return journey, in 1844, he skirted the southern Wasatch Mountains as far north as Utah Lake, and then turned eastward to the north Fork of the Platte, in Colorado, which he reached June 11, passing up the North Platte to the headwaters of the Arkansas, and down this river to the Plains at the present site of Pueblo, Colorado, which point he reached June 29. The specimen which became the type of *Sciurus fremonti* could not have been taken in the Wasatch range, as the present material shows that the form of Chickaree occurring near Utah Lake is *Sciurus hudsonicus ventorum*. On the other hand, it might have been taken in the Park region of Colorado, where this, and only this form of Chickaree is known to occur, and the season—June 11-26—fully agrees with the condition of the specimen, as already stated. Probably, therefore, the Park region of central Colorado may be safely considered as the type locality of *Sciurus fremonti*.

Sciurus fremonti neomexicanus, subsp. nov.

TAOS CHICKAREE.

Winter Pelage.—Similar to *S. fremonti*, but the median dorsal band much brighter yellowish rufous, nearly as in *S. f. mogollonensis*, but size much smaller than the latter.

Summer Pelage.—The summer pelage is not represented in the present material, but is probably very nearly like that of *S. f. mogollonensis*.

Measurements.—Average of 7 specimens from Rayado Cañon, April 1, 1895: Total length, 321 (308-330); tail vertebrae, 133 (127-145); hind foot, 48.5 (45-52).

Skull.—Average of 4 specimens (part of the above), total length, 45.9 (43.5-47.3); postorbital breadth, 14.9 (14.6-15.2); length of nasals, 14.3 (13.7-15); width of nasals at anterior border, 7 (6.4-7.5).

Type, No. 71,690, U. S. Nat. Mus. (Dept. Agr. Coll.), ♂ ad., Rayado Cañon, Colfax Co., New Mexico, April 1, 1895; C. Barber.

Geographic Range.—Taos Range, New Mexico.

Material Examined.—Total number of specimens, 11, from the following localities and sources:

New Mexico: Rayado Cañon, Colfax Co., April 1, C. Barber, 7 spec. (Dept. Agr. Coll.); Martinez, Colfax Co., Dec. 13, C. Barber, 2 spec. (Dept. Agr. Coll.); Hall's Peak, Mora Co., Oct. 14, C. Barber, 2 spec. (U. S. N. M.).

In coloration *S. f. neomexicanus* very closely resembles *S. f. mogollonensis*, in this respect being much nearer this form than to *S. fremonti*. It is, however, essentially of the same size as *S. fremonti*, and is thus much smaller than *S. h. mogollonensis*, with relatively much shorter nasals.

Sciurus fremonti mogollonensis (Mearns).

ARIZONA CHICKAREE.

Sciurus hudsonius mogollonensis MEARNS, Bull. Am. Mus. Nat. Hist. II, 1887-90, 277 (Feb. 21, 1890). Mogollon Mts., Arizona.

Sciurus fremonti mogollonensis MERRIAM, N. Am. Fauna, No. 3, 48 (Sept. 11, 1890).

Sciurus hudsonicus mogollonensis ALLEN, Bull. Am. Mus. Nat. Hist. VII, 1895, 243.

Winter Pelage.—Similar to *S. fremonti*, except that the median dorsal band is of a brighter, stronger tint of yellowish rufous. Tail and lower parts similar.

Summer Pelage.—Similar in all respects to *S. fremonti*, except that the rufous suffusion of the upper parts is much brighter and stronger.

MEASUREMENTS.

	No. of Spec.	Length.	Tail Vertebrae.	Hind Foot.
Mogollon Mts., Ariz. ¹	16	356 (327-385)	142 (127-158)	52.8 (51-56)
San Francisco Mts., Ariz. ²	14	332 (320-365)	138 (130-156)	53 (50-55)
White Mts., Ariz. ³	8	322 (310-336)	131 (126-138)	51 (49-53)

SKULLS.

	No. of Spec.	Length.	Postorbital Breadth.	Length of Nasals.	Width of Nasals.
Mogollon Mts., Ariz.	10	49.4 (48.5-51.5)	15.2 (14.2-15.4)	15.6 (14.5-16.2)	7.8 (7.3-8)
White Mts., Ariz.	4	46.9 (46-48.2)	14.9 (14.8-15)	14.8 (14.2-15.2)	7.2 (7-7.5)

Geographic Range.—The higher mountains and plateaus of central Arizona, from the Douglas fir belt to timber line.

Material Examined.—Total number of specimens, 44, from the following localities and sources:

Arizona: Mogollon Mts., May 23-27, Dr. E. A. Mearns, 13 spec. (A. M. N. H.); San Francisco Mts., June 6-19, Dr. E. A. Mearns, 4 spec. (A. M. N. H.); Baker's Butte, July 21 and Aug. 22, Dr. E. A. Mearns, 2 spec. (A. M. N. H.); San Francisco Mts., July 31-Oct. 5, Merriam and Bailey, 16 spec. (Dept. Agr. Coll.); Little Spring, San Francisco Mts., Sept. 20, Dr. L. Stejneger, 1 spec. (U. S. N. M.); Springville, Aug. 29, E. W. Nelson, 1 spec. (Dept. Agr. Coll.); White Mts., Aug. 9-12, B. C. Condit, 7 spec. (A. M. N. H.).

***Sciurus fremonti grahamensis* (Allen).**

MOUNT GRAHAM CHICKAREE.

Sciurus hudsonicus grahamensis ALLEN, Bull. Am. Mus. Nat. Hist. VI, 1894, 350 (Dec. 7, 1894); *ibid.* VII, 1895, 244. Mt. Graham, Arizona.

Summer Pelage.—Differing from that of *S. f. mogollonensis* in being yellower and less rufescent above, with the central area of the tail ochraceous above and nearly white below.

The winter pelage is not represented.

Measurements.—Three adult specimens give the following: Total length, 332 (325-340); tail vertebrae, 134 (130-140); hind foot, 55 (53-57); ear from crown, 28 (27-28).

¹ Collected and measured by Dr. E. A. Mearns (from Bull. Am. Mus. Nat. Hist., II, p. 278).

² Collected and measured by Dr. C. Hart Merriam and V. Bailey (from N. Am. Fauna, No. 3, p. 49).

³ Collected and measured by B. C. Condit (from Bull. Am. Mus. Nat. Hist., VII, p. 244).

Skull.—Average of two specimens : Total length, 48 (47.5–48.5) ; postorbital breadth, 15.4 (15.2–15.6) ; length of nasals, 15.1 (14.6–15.6) ; width of nasals at anterior border, 7.5 (7.2–7.8).

Whether the great length of the hind foot in this form is a constant feature must be determined by examination of further material.

Geographic Range.—The fir zone on the summit of Mt. Graham, Arizona.

Material Examined.—The 3 specimens thus far examined are as follows :

Arizona : Graham Mts., July 18 and 19, Price and Condit, 3 spec. (A. M. N. H.).

S. fremonti grahamensis is very closely related to *S. f. mogollonensis*, from which, however, it seems to be readily separable, as stated above, so far at least as present material is concerned. The two forms are, moreover, geographically well isolated.

REVIEW OF THE *Sciurus fremonti* GROUP.

The *Sciurus fremonti* group is sharply differentiated from the *S. hudsonicus* group, although separated at several points by only a slight geographical interval. *S. fremonti* proper is found apparently throughout the mountains of Colorado, ranging northward to the northern extremity of the Medicine Bow Range, which extends a few miles over the Wyoming border. In the Laramie Mountains, the next range to the northeastward, and only a few miles distant, is found the entirely distinct, and very different *S. h. baileyi*. The Chickaree found at Wood's P. O., in the Medicine Bow Mountains, is true *S. fremonti*, while the Chickaree from the southern end of the Laramie Mountains, less than thirty miles to the eastward, is a pale phase of *S. h. baileyi*.

Typical *S. fremonti* is represented in the present material by specimens from several points in the Uintah Mountains, including the vicinity of Fort Bridger, Wyoming, while from the Bear River and Wasatch Mountains, only thirty to fifty miles to the westward of points where *S. fremonti* occurs, *S. h. ventorum* is the only Chickaree represented in the material now in hand. In neither case is there apparent any evidence of intergradation.

In southern Colorado true *S. fremonti* grades toward what is here called *S. f. neomexicanus*, a phase which in coloration is hardly separable from *S. mogollonensis*. At present our knowl-

edge of the distribution of the Chickarees in southern Colorado and New Mexico is very limited. A single winter specimen from Chama, New Mexico, almost on the Colorado boundary, seems referable to true *fremonti*, but all the specimens from the eastern slope of the Taos Mountains, in Colfax and Mora Counties, New Mexico, are very different from specimens from central and northern Colorado.

S. f. mogollonensis differs from *S. fremonti* in its much brighter and more yellowish dorsal region in both pelages, and also in its larger size, especially as shown by the skull measurements, and in the relatively greater length of the nasals. *S. f. neomexicanus* agrees in size and in the relative length of the nasals with *S. fremonti*, but with *S. f. mogollonensis* in coloration.

The species most nearly related to *S. fremonti* is *S. douglasii*, as represented in *S. d. californicus*, where the resemblance is often so close, in the case of winter specimens, that their separation, without reference to the localities, would be exceedingly difficult; yet the same individuals in summer pelage, would differ so markedly in the coloration of the ventral surface as to leave not the slightest doubt as to their true relationships. In *S. fremonti*, *S. f. mogollonensis* and *S. d. californicus*, the tail is conspicuously fringed with white, in contrast with the yellow-fringed tail of true *S. douglasii*, and of all the members of the *S. hudsonicus* group.

COMPARATIVE MEASUREMENTS.—Continued.

SPECIES.	LOCALITY.	EXTERNAL.			CRANIAL.				
		No. of Spec.	Length.	Tail Vertebrae.	Hind foot.	No. of Spec.	Length.	Postor. Br (dth. Nasals.	
<i>S. h. richardsoni</i> .	Mullan, Id.	4	338	135	51	3	47.7	14.2	14.5
"	St. Mary's Lake, Mont.	6	332	135	50.5	5	47.6	14.5	14.4
"	Colville, Wash.	9	336	129	50.8	5	47.6	15	14.2
"	Wallowa Lake, Ore.	6	327	135	51.2	5	48	14.5	14.2
<i>S. h. streatorii</i> .	Nelson, B. C.	5	312	114	50				
"	Lac la Hache, B. C.	4	316	114.5	49				
"	Field, B. C.	3	316	124	50				
"	Vernon, B. C.	8	322	122	51.3				
"	Bouaparte, B. C.	3	316	119	50	6	48	14.6	14.6
"	Ashcroft, B. C.	10	332	129	51.4	3	47.2	14.1	13.5
"	Kamloops, B. C.	7	315	133	51.4	4	48	14.2	13.9
"	Shuswap, B. C.	11	308	120	50.1	4	48	15.6	13
"	Goldstream, Vanc. Isl., B. C.	11	308	120	50.1	9	46.3	15.6	13
<i>S. h. Vancouverensis</i>	Duncan, Vanc. Isl., B. C.					5	45.6	14.6	12.8
"	Comox, Vanc. Isl., B. C.	4	309	120	50.4	3	45.7	15.2	12.2
"	Wrangel, Alaska.	7	297	115	49.4	9	44.7	15.2	12.6
"	Loring, Alaska.	4	296	118	49.5	4	44.8	14.9	13.8
"	Juneau, Alaska.	6	307	126	49.7	4	44.2	14.6	12.6
<i>Sciurus douglasii</i> .	Marshfield, Ore.	6	316	123	49.5	3	47	14.7	14
"	Yaquina Bay, Ore.	4	314	127	48.5	5	46.7	14.7	13.3
"	Newport, Ore.	5	316	129	50				
"	Neah Bay, Wash.	14	315	128	50	6	46	14.4	12.7
<i>S. d. mollipilus</i> .	Crescent City, Cal.	4	321	126	50.8	3	46.6	15.4	13.6
"	Sherwood, Cal.	5	314	135	46.5	5	44.3	14.7	12.7
"	Willits, Cal.	3	317	135	50	2	45.5	14.7	13
"	Philo, Cal.	14	316	136	50.8				
<i>S. d. cascadenis</i> .	Mt. Hood, Ore.	2	325	135	50.5				

COMPARATIVE MEASUREMENTS.—Continued.

SPECIES.	LOCALITY.	EXTERNAL.				CRANIAL.			
		No. of Spec.	Length.	Tail Ver-te-bræ.	Hind foot.	No. of Spec.	Length.	Postor. Br'dth.	Length of Nasals.
<i>S. d. cascadenis.</i>	Hamilton, Wash.	8	287	115.6	48.6	2	46.4	14.9	13.2
"	Lake Chelan, Wash.	11	333	133	52.8	5	48.5	14.5	13.8
"	Port Moody, B. C.	17	309	123	49	5	45.1	14.9	12.9
"	Agassiz, B. C.	9	307	125	50.9	4	45.9	14.6	13.1
"	New Westminster, B. C.	..	..	..	..	8	46.2	14.9	13.7
<i>S. d. californicus.</i>	Mt. Whitney, Cal.	9	322	131	51.8	4	47.4	14.3	13.4
"	Buck's Ranch, Cal.	6	319.5	128.3	52	4	46.1	14.3	12.9
"	Donner, Cal.	..	..	..	..	6	47.9	14.5	13.6
"	Lassen Creek, Cal.	7	341	148	53	..	..	..	..
"	Siskiyou, Cal.	6	333	131	52.3	5	47.4	14.8	13.3
"	Ft. Klamath, Ore.	8	331	137	52.6	4	47.4	14.9	14.1
<i>Sciurus nearnsi.</i>	San Pedro Martir Mts., L. C.	1	325	125	51	1	48	14.9	14
<i>Sciurus fremonti.</i>	South Park, Col.	3	316	120	49	..	..	..	..
"	Long's Peak, Col.	3	320	133	49	..	..	..	..
"	Fort Garland, Col.	3	333	132	50.8	..	..	..	..
"	Mill City, Col.	..	..	..	..	8	47.5	14.9	14.3
"	Cochetope Pass, Col.	7	320	128	48.4	5	45.8	14.6	14.1
"	Uintah Mts., Utah.	5	326	127.9	49.5	1	47.8	14.7	15
"	Fort Bridger, Wyo.	3	327	134	50	..	..	..	..
"	Wood's P. O., Wyo.	5	327	133	50	..	..	..	..
<i>S. f. neomexicanus.</i>	Rayado Cañon, N. Mex.	7	321	133	48.5	4	45.9	14.9	14.3
<i>S. f. mogollonensis.</i>	Mogollon Mts., Ariz.	16	356	142	52.8	10	49.4	15.2	15.6
"	San Francisco Mts., Ariz.	14	332	138	53	..	..	..	..
"	White Mts., Ariz.	8	322	131	51	4	46.9	14.9	14.8
<i>S. f. grahamensis.</i>	Mt. Graham, Ariz.	3	332	134	55	2	48	15.4	15.1

SUMMARY OF MATERIAL EXAMINED.

Sciurus hudsonicus	130
“ “ loquax	236
“ “ dakotensis	18
“ “ baileyi	43
“ “ ventorum	68
“ “ richardsonii	164
“ “ streatori	93
“ “ vancouverensis	90
Sciurus douglasii	120
“ “ mollipilosus	16
“ “ cascadenis	107
“ “ californicus	174
Sciurus mearnsi	4
Sciurus fremonti	64
“ “ neomexicanus	11
“ “ mogollonensis	44
“ “ grahamensis	3

Article XV.—DESCRIPTIONS OF THREE NEW FORMS
OF POCKET-MICE FROM THE MEXICAN BORDER
OF THE UNITED STATES.

By EDGAR A. MEARNS.

Perognathus pacificus, new species.

SAN DIEGO POCKET-MOUSE.

Type from the edge of the Pacific Ocean, at the last Mexican boundary monument (No. 258). No. 61,022, U. S. National Museum, skin and skull. Adult female, nursing young. Collected July 12, 1894, by Dr. Edgar A. Mearns. (Original number, 3787.)

General Characters.—Similar to *P. binaculatus* Merriam, but slightly smaller, with less conspicuous post-auricular patches, more hairy tail, larger and more quadrate lower premolar, and widely separated audital bullæ.

Color.—Upper surface pale ochraceous drab, finely and thickly lined with black. Eyelid, spot at base of whiskers, and ear blackish, the latter without a white spot on its inferior margin. Orbital area (nose to ear) pale buff. Post-auricular spot and lateral line ochraceous buff. Feet and under surfaces white. Tail concolor, hoary at base and dusky at tip.

Measurements.—Average of three adults: length, 109 mm.; tail vertebræ, 53; ear from crown, 4.7; hind foot, 15.5. Skull, 19 by 11.2 mm.

Cranial and Dental Characters.—Skull small, highly arched and strongly declined anteriorly. Nasal bones and nasal premaxillaries ending about even posteriorly. Audital bullæ small, and widely separated anteriorly. Lower premolar quadrate, larger than last molar.

Remarks.—This very small Pocket-mouse was found only on a flat, often submerged by high ocean tides, at the mouth of the Tijuana River, where it appeared to be abundant. The Coast Range Mountains, to the eastward, are inhabited by a very different species, *Perognathus longimembris* (Coues), in the Sonoran Zone, and *P. l. alticolus* (Rhoads), in the Transition Zone.

Perognathus longimembris bangsi, new subspecies.

BANGS'S POCKET-MOUSE.

Type from Palm Spring, Colorado Desert, southern California. No. 5304, collection of E. A. and O. Bangs. Skin and skull of adult female. Collected April 13, 1896, by Mr. E. C. Thurber. (Original number, 644.)

Geographical Range.—Tropical and Lower Sonoran Zones of the Western Desert Tract; known only from the Colorado Desert, California.

Color.—Above pallid, much as in the two species of *Dipodomys* inhabiting the same area; upper surface pale, slightly vinaceous buff, faintly and finely lined with black. Sides without a sharply-contrasting ochraceous stripe. Under parts and feet white. Tail white, faintly dusky in a narrow dorsal stripe, with the slightly penicillate extremity pale hair brown. Head without any distinctly dusky markings, except a narrow blackish edging to the eyelid. Ear scantily haired internally, white and buffy externally, with a plain white spot at base, above and below.

A specimen from White Water, California, also collected by Mr. Thurber, is slightly darker than those from Palm Springs.

Measurements.—Length, 138 mm.; tail vertebrae, 80; hind foot, 19. Skull, greatest length, 21; greatest breadth, 12.

Cranial and Dental Characters.—Skull closely resembling that of *Perognathus longimembris* (Coues); nasals ending posteriorly considerably in front of the pointed posterior extremities of the nasal branches of the premaxillary bones; mastoid and tympanic bullae greatly inflated, and projecting prominently behind the plane of the occiput.

Remarks.—This subspecies, which I have named in honor of Mr. Outram Bangs, the well-known mammalogist, differs from typical *P. longimembris* in its extremely pallid coloration. The upper surface lacks the decidedly dusky admixture of the latter, and also the sharply defined ochraceous lateral stripe.

Perognathus (Chætodipus) eremicus, new species.

EASTERN DESERT POCKET-MOUSE.

Type from Fort Hancock, El Paso County, Texas. No. $\frac{21953}{26054}$, U. S. National Museum. Adult female. Collected June 27, 1893, by Dr. Edgar A. Mearns. (Original number, 2380.)

General Characters.—This Pocket-mouse belongs to the *Perognathus penicillatus* group, of which it is almost the smallest and palest member. The skull, though small, is peculiar in its heavy ossification, squarish configuration, and the large size of the teeth. Ears small. Pelage coarse, without spines or bristles.

Color.—Upper surface whitish drab tinged with fawn color, faintly lined with dusky; sides with a faint line of ecru-drab; feet and under surfaces, except extreme tip of tail, white; upper surface and tip of tail all round light hair brown; face without markings; whiskers colorless, or hair brown; claws colorless.

Measurements.—Average of six adults, four males and two females, from the type locality: length, 163 mm.; tail vertebræ, 83; tail to end of hairs, 96; ear from crown, 4.4; ear from anterior base, 9.1; length of head (nose to occiput), 27.2; length of hind foot, 22.1. Skull, 25 by 13.5 mm.

Cranial and Dental Characters.—Skull massive, broad and wide anteriorly across the zygomata. The premaxillaries are remarkably heavy, ending well behind the truncated posterior extremities of the nasals. The mastoid cells are flattened and divided by a prominent ridge; tympanic bullæ large, almost meeting anteriorly below the basisphenoid. Teeth large.

Comparisons.—*Perognathus penicillatus* Woodhouse is much larger than the present species, darker in color, with the basal two-thirds of the hair of "a lustrous tint of fresh cut lead" instead of pale grayish drab.

Perognathus obscurus Merriam is also larger and darker. It has relatively smaller teeth, a lighter skull with zygomatic arches less expanded anteriorly and lacking the prominent osseous ridge across the mastoid.

Perognathus (Chatodipus) intermedius canescens Merriam is a closely related member of the *penicillatus* group. It differs from *P. eremicus* in being one of the largest instead of one of the smallest members of the group, and has the skull much narrower across the maxillary arms of the zygomata. The color is darker, the upper surface being "drab-gray, plentifully lined with dusky on median part of back and rump." *Perognathus eremicus* requires no comparison with other members of the genus.

Remarks.—This species is based on six specimens from Fort Hancock and two from El Paso, Texas. About one hundred miles west of the latter place is the type locality of *Perognathus obscurus* Merriam. As no specimens of *Chatodipus* were obtained between these two points, it is impossible to decide as to the intergradation of these forms. Whether *Perognathus eremicus* intergrades with the Mexican form *canescens* likewise remains to be determined.

Article XVI.—A STUDY OF THE VERTEBRATE
FAUNA OF THE HUDSON HIGHLANDS, WITH
OBSERVATIONS ON THE MOLLUSCA, CRUSTA-
CEA, LEPIDOPTERA, AND THE FLORA OF THE
REGION.

By EDGAR A. MEARNS,
Assistant Surgeon U. S. Army.

I.—INTRODUCTION.

The mountainous section of the Hudson Valley, beginning at the Fishkill Mountains and Storm King, and extending south for 20 miles to Kidd's Point or Caldwell's Landing, is known as the 'Highlands of the Hudson.' Restricting the scope of this paper to the immediate Hudson River drainage on the east and west, we have as the field of observation an area about 20 miles square.

The topography of this region is rough, the country abounding in rugged mountains, belonging to the Alleghany chain, with peaks rising to heights between 1500 and 2000 feet, and the Hudson River—a long brackish estuary—winding below. Rocky ledges and vertical cliffs on the sides next to the river give a bold character to the scenery, which is beautified by a varied arborescent flora and dashing mountain streams. A charm is added by the islets in the Hudson, which are often joined to the shore by green salt-marshes, fretted with tide-creeks, and, in summer, flecked with flowers. Numerous small lakes occupy basins among the hills, at various levels, some close to the Hudson, others near the summits of the mountains.

This region belongs essentially to the Transition Life Zone, though with local traces of the faunas of the Lower Boreal and Upper Austral Zones. It contains elements of three recognized faunas: Alleghanian, Carolinian and Canadian. The prevailing fauna and flora are, of course, Alleghanian, but there are distinct evidences of an overlying Carolinian tinge on low ground near the Hudson, and a slighter capping of the Canadian on the peaks and high spruce-grown swamps.¹

¹ In the interior of the Catskill Mountains, farther up the Hudson, where the streams have an altitude of from 1500 to 2000 feet, with neighboring mountains reaching 4000 feet, the Canadian element predominates over the Alleghanian in the valleys, and alone prevails on the mountains.

The period covered by the following observations is, rather difficult to state with exactness, as this region was my birthplace, and my home during the first twenty-seven years of my life, so that it is impossible to say when they began; but most of the collections were made between the years 1872 and 1884 (when I entered the military service and was ordered to the West).¹ During those years, from my country home two miles south of the West Point Military Academy (latitude, $41^{\circ} 23'$ north; longitude, $3^{\circ} 3'$ east) as a center, I ransacked almost all of this area. Again, in September and October, 1896, several weeks were spent in making collections about my old home; in this I was greatly assisted by my children.²

For assistance in verifying names and identifying specimens my grateful acknowledgments are due to the curators of the several departments of the Smithsonian Institution and United States National Museum, especially to Miss M. G. Rathbun, Mr. James E. Benedict, Mr. Charles T. Simpson, Mr. Barton A. Bean, Dr. Tarleton H. Bean, and Dr. Leonhard Stejneger.

The flora of the Hudson Highlands, as would be inferred from the above remarks on the topography and floral position of the region, is somewhat varied, and rather extensive for an area of no more than 400 square miles. A general collection of Spermatophyta and Pteridophyta was made by my wife during the years 1882 and 1883, and again in 1896. These plants were donated to the American Museum of Natural History, in New York, where they have been determined and catalogued by Mr. L. P. Gratacap. The country is well wooded in most parts, though, owing to the shallowness of the soil, which is mostly rocky, the trees seldom grow to a large size. On account of the sterility of the soil much of the land is still wild, and supports but a small population. The forests are largely composed of coniferous and deciduous trees mixed, the coniferous being, however, most abundant on the river banks, and the deciduous greatly outnumbering the coniferous in the back country. Following is a list of the trees, shrubs, and woody vines found by us in the Hudson Highlands: ³

¹ These early collections now belong to the American Museum of Natural History in New York.

² These last collections were sent to the U. S. National Museum at Washington.

³ The scientific names of the trees are printed in **heavy-faced** type, and those of the shrubs and vines in *italics*.

TREES, SHRUBS AND WOODY VINES.

1. *Pinus rigida* Miller. Pitch Pine.
2. *Pinus strobus* Linn. White Pine.
3. *Larix laricina* (DuRoi). Tamarack.
4. *Picea mariana* (Miller). Black Spruce.
5. *Tsuga canadensis* (Linn.). Hemlock.
6. *Thuja occidentalis* Linn. Arborvitæ.
7. *Juniperus communis* Linn. Common Juniper.
8. *Juniperus virginiana* Linn. Red Juniper ; Red Cedar.
9. *Taxus minor* (Michx.). Ground Hemlock ; American Yew.
10. *Juglans cinerea* Linn. Butternut.
11. *Juglans nigra* Linn. Black Walnut.
12. *Hicoria alba* (Linn.). Mockernut Hickory.
13. *Hicoria ovata* (Miller). Shagbark Hickory.
14. *Hicoria glabra* (Miller). Pignut Hickory.
15. *Hicoria minima* (Marshall). Bitternut Hickory.
16. *Comptonia peregrina* (Linn.). Sweet-Fern.
17. *Populus balsamifera* Linn. Balsam Poplar.
18. *Populus heterophylla* Linn. Swamp Cottonwood.
19. *Populus tremuloides* Michx. Aspen.
20. *Salix cordata* Muehl. Heart-leaved Willow.
21. *Salix discolor* Muehl. Pussy Willow ; Glaucous Willow.
22. *Salix babylonica* Linn. Weeping Willow.
23. *Salix fragilis* Linn. Brittle Willow.
24. *Salix nigra falcata* Pursh. Crescent-leaf Willow.
25. *Carpinus caroliniana* Walter. Blue Beech.
26. *Ostrya virginiana* (Miller). Hop Hornbeam.
27. *Corylus americana* Walter. Hazel-nut.
28. *Corylus rostrata* Ait. Beaked Hazel-nut.
29. *Betula lenta* Linn. Sweet Birch.
30. *Betula lutea* Michx. Yellow Birch.
31. *Betula nigra* Linn. Red Birch ; River Birch.
32. *Betula populifolia* Marshall. White Birch.
33. *Alnus incana* (Linn.). Speckled or Hoary Alder.
34. *Alnus rugosa* (Ehrhart). Smooth Alder.
35. *Fagus latifolia* (Muenchhausen). Beech.
36. *Castanea dentata* (Marshall). Chestnut.
37. *Quercus alba* Linn. White Oak.
38. *Quercus coccinea* Muenchhausen. Scarlet Oak.
39. *Quercus pumila* (Marshall). Bear Oak.
40. *Quercus platanooides* (Lamarck). Swamp White Oak.
41. *Quercus prinus* Linn. Chestnut Oak.
42. *Quercus rubra* Linn. Red Oak.

43. **Quercus velutina** Lamarck. Yellow Oak.
44. **Ulmus americana** Linn. White Elm.
45. **Ulmus pubescens** Walter. Slippery Elm.
46. **Celtis occidentalis** Linn. Sugarberry; Hackberry.
47. **Morus rubra** Linn. Red Mulberry.
48. **Liriodendron tulipifera** Linn. Tulip-tree.
49. **Sassafras sassafras** (Linn.). Sassafras.
50. *Benzoin benzoin* (Linn.). Spice-bush.
51. *Ribes cynosbati* Linn. Wild Gooseberry.
52. *Ribes lacustre* (Pursh). Swamp Gooseberry.
53. *Ribes floridum* L'Her. Wild Black Currant.
54. *Hamamelis virginiana* Linn. Witch Hazel.
55. **Platanus occidentalis** Linn. Sycamore; Buttonball.
56. *Spiræa salicifolia* Linn. Common Meadow-Sweet.
57. *Spiræa tomentosa* Linn. Hardhack; Steeple-Bush.
58. *Aronia arbutifolia* (Linn.). Red Choke-berry.
59. *Aronia nigra* (Willd.). Black Choke-berry.
60. **Amelanchier canadensis** (Linn.). Shad-bush; Service-berry.
61. **Cratægus coccinea** Linn. Scarlet Haw.
62. **Cratægus tomentosa** Linn. Black Haw.
63. *Rubus odoratus* Linn. Purple Flowering Raspberry.
64. *Rubus strigosus* Michx. Wild Red Raspberry.
65. *Rubus occidentalis* Linn. Black Raspberry; Thimbleberry.
66. *Rubus villosus* Ait. High Blackberry.
67. *Rubus canadensis* Linn. Dewberry.
68. *Rubus hispidus* Linn. Running Swamp Blackberry.
69. *Rosa blanda* Ait. Early Wild-rose.
70. *Rosa lucida* Ehrh. Dwarf Wild-rose.
71. *Rosa carolina* Linn. Swamp Rose.
72. *Rosa rubiginosa* Linn. Sweetbrier.
73. **Prunus pennsylvanica** Linn. Pin Cherry.
74. **Prunus serotina** Ehrh. Black Cherry.
75. **Prunus virginiana** Linn. Choke Cherry.
76. *Cassia marylandica* Linn. Wild Senna.
77. **Gleditschia triacanthos** Linn. Honey Locust.
78. **Robinia pseudacacia** Linn. Locust.
79. *Xanthoxylum americanum* Miller. Prickly Ash.
80. *Ptelea trifoliata* Linn. Hop-tree.
81. **Ailanthus glandulosa** Desfont. Ailanthus.
82. **Rhus hirta** (Linn.). Staghorn Sumach.
83. *Rhus copallina* Linn. Dwarf Sumach.
84. *Rhus glabra* Linn. Smooth Sumach.
85. *Rhus radicans* Linn. Poison Ivy; Poison Oak.
86. *Rhus vernix* Linn. Poison or Swamp Sumach.
87. *Ilex verticillate* (Linn.). Black Alder; Winterberry.

88. *Celastrus scandens* Linn. Climbing Bitter-sweet.
89. *Staphylea trifolia* Linn. American Bladder-nut.
90. **Acer pennsylvanicum** Linn. Striped Maple.
91. **Acer rubrum** Linn. Red Maple ; Swamp Maple.
92. **Acer saccharinum** Linn. Silver Maple.
93. **Acer saccharum** Marshall. Sugar or Rock Maple.
94. *Acer spicatum* Lamarck. Mountain Maple.
95. *Vitis labrusca* Linn. Summer Grape.
96. *Vitis aestivalis* Michx. Frost Grape.
97. *Parthenocissus quinquefolia* (Linn.). Virginian Creeper.
98. **Tilia americana** Linn. Basswood.
99. *Cornus amomum* Miller. Kinnikinnik.
100. **Cornus alternifolia** Linn. Blue Dogwood.
101. *Cornus canadensis* Linn. Dwarf Cornel ; Bunch-berry.
102. **Cornus florida** Linn. Flowering Dogwood.
103. *Cornus candidissima* Marshall. Panicked Cornel.
104. **Nyssa sylvatica** Marshall. Black Gum ; Pepperidge.
105. *Clethra alniifolia* Linn. Sweet Pepperbush.
106. *Ledum grænlændicum* Oeder. Labrador Tea.
107. *Azalea nudiflora* Linn. Pink Azalea ; May-apple.
108. *Azalea viscosa* Linn. White Swamp Honeysuckle.
109. *Rhododendron maximum* Linn. Rhododendron.
110. *Kalmia angustifolia* Linn. Sheep Laurel.
111. *Kalmia glauca* Ait. Pale Laurel.
112. *Kalmia latifolia* Linn. Mountain Laurel.
113. *Arctostaphylos uva-ursi* (Linn.). Bearberry.
114. *Gaylussacia resinosa* (Ait.). Black Huckleberry.
115. *Vaccinium corymbosum* Linn. Swamp Blueberry.
116. *Vaccinium pennsylvanicum* Lamarck. Dwarf Blueberry.
117. *Vaccinium vacillans* Kalm. Low Blueberry.
118. *Vaccinium stamineum* Linn. Deerberry ; Foxberry ; Dangleberry.
119. **Fraxinus americana** Linn. White Ash.
120. **Fraxinus nigra** Marshall. Black Ash.
121. **Catalpa catalpa** (Linn.). Common Catalpa.
122. *Cephalanthus occidentalis* Linn. Buttonbush.
123. *Sambucus canadensis* Linn. Common Elder.
124. *Sambucus pubens* Michx. Red-berried Elder.
125. *Viburnum acerifolium* Linn. Dockmackie.
126. *Viburnum dentatum* Linn. Arrow-wood.
127. **Viburnum lentago** Linn. Nannyberry ; Sheepberry.
128. *Lonicera sempervirens* Linn. Trumpet Honeysuckle.
129. *Diervilla diervilla* (Linn.). Bush Honeysuckle.

MOLLUSKS.

Of Mollusks, the following-named species were collected :¹

1. *Limax maximus* Linn. Common Slug.—Abundant. Other species of this genus occur.

2. *Mesomphix fuliginosus* Griffith.—Rare at Highland Falls; common at Highland (opposite Poughkeepsie), Ulster County, N. Y.

3. *Pyramidula alternata* Say.—Apparently not common in the Highlands, but abundant at Highland, farther up the Hudson.

4. *Polygyra tridentata* Say.—Common on shaded, stony slopes; most abundant near the Hudson River. It was also collected at Highland, Ulster County, N. Y., and at the Delaware Water Gap, Pa.

5. *Polygyra fallax* Say.—One specimen from Highland Falls, in Orange County.

6. *Polygyra albolabris* Say.—This is the common snail of the region, and occurs at all altitudes. During protracted droughts, a devastating forest fire not infrequently sweeps over one of our mountains, always leaving thousands of scorched snail-shells, mostly of this species, exposed to view in its path. The toothed variety was collected at Highland, N. Y., and at Delaware Water Gap, Pa., in 1889, but never in the Hudson Highlands.

7. *Polygyra thyroides* Say.—Abundant; also common at Delaware Water Gap, Pa.

8. *Polygyra hirsuta* Say.—A common shell, under stones in shady places, at Highland Falls, in Orange County, and at Highland, in Ulster County.

9. *Polygyra monodon* Rackett.—One specimen from Long Pond, Orange County; abundant at Highland, Ulster County, N. Y., and at the Delaware Water Gap, Pa.

10. *Succinea obliqua* Say.—Wet woods, at high altitudes; also collected in Ulster and Greene Counties, N. Y., and at Delaware Water Gap, Pa.

11. *Limnæa columella* Say.—One specimen from a swampy stream, near Highland Falls, September 14, 1896.

12. *Limnæa elodes* Say.—Very common on margins and tide-creeks of the brackish river marshes.

13. *Limnæa catascopium* Say.—Abundant on the river marshes.

14. *Planorbis trivolvis* Say.—Common in the Hudson and in ponds.

¹ A much larger collection of shells was gathered in the Highlands years ago, but the specimens have been distributed among several museums and private collections, and a manuscript list of them is not now accessible. All save one of the species here given were collected during the autumn of 1896, the specimens being in the U. S. National Museum collection.

15. *Planorbis bicarinatus* Say.—Abundant in Highland Lake and Echo Lake.
16. *Physa heterostropha* Say.—Very numerous in weedy ponds and streams, as well as in the tide-creeks of the river marshes.
17. *Physa ancillaria* Say.—Very abundant in brackish marshes along the Hudson River.
18. *Campeloma decisa* Say.—Highland Lake, in the Highlands. My mother collected this shell on Lake Champlain.
19. *Cingula minuta* Totten.—Very abundant on the edges of Consook Marsh, and other river marshes, beside the Hudson.
20. *Sphaerium partumeium* Say.—Rather common in ponds and slow streams, even in the highest suitable places in the mountains.
21. *Pisidium abditum* Hald.—Swamps and sluggish streams.
22. *Unio radiatus* Gmel.—Hudson River at estuary of Moodna Creek, Orange County, N. Y., where a remarkably large specimen was taken May 3, 1882.
23. *Unio complanatus* Solander.—Long Pond, four miles west of Highland Falls; abundant.
24. *Anodonta fluviatilis* Dill.—Long Pond and Highland Lake.
25. *Anodonta implicata* Say.—Highland Lake.

NOTE.—I have found egg-cases of *Fulgur canaliculata* Linn. on Consook Island, more than fifty miles above the mouth of the Hudson River; but the shells were never seen there.

CRUSTACEANS.

Some of the large marine Crustaceans ascend the Hudson River; and our fresh-water streams, ponds and stagnant pools are the home of numerous small species. The most conspicuous Crustaceans of the Highlands are those included in the following list:

1. *Callinectes sapidus* Rathbun. Common Edible Crab.—This toothsome articulate usually appears in this section of the Hudson River late in summer, but its numbers vary greatly in different years. Small young were exceedingly numerous at Consook Island, in September and October, 1896. The specimens were identified by Miss M. J. Rathbun.
2. *Platyonichus ocellatus* (Herbst). Lady Crab.—During the winter of 1877-78 this species was abundant on the flats along the Hudson. Specimens were taken through the ice, at Iona Island, by Dr. C. Hart Merriam and myself.

3. *Panopeus harrisi* (Gould).—This small crab is abundant in tide-pools and tide-creeks along the Hudson. Specimens were taken at Consook Island, October 3, 1896.

4. *Cambarus bartoni* (Fabric.). Crawfish; Fresh-water Lobster.—Common in all our mountain brooks, living under stones, and breeding in nests or caverns in the beds of streams. Those who angle for black bass pronounce the Crawfish a most seductive bait.

5. *Penæus brasiliensis* Latr. Shrimp.—Croton and Hudson Rivers.

6. *Palmonetes vulgaris* (Say). Big Shrimp; American Prawn.—Hudson River.

7. *Livoneca ovalis* (Say).—This parasite is common upon the gills of the young bluefish (*Pomatomus saltatrix*), which here goes by the name of "snap mackerel."

8. *Gammarus* sp.—This lively animal abounds in the eel grass along the shores of this part of the Hudson.

9. *Branchipus vernalis* Verrill.—April 29, 1883, Dr. Louis A. di Zerega and myself found numbers of this crustacean in a large, swampy, stagnant pool near the Hudson River. They swam with considerable swiftness "on their backs," and were difficult to capture. Most of them, however, were lying quiet upon the green algæ covering the bottom of the pool, but seemed not to care to burrow and hide in the debris. Their forked tails were bright red; otherwise, except their eyes and a dorsal—not superficial—dark line, they were almost white. One female, carrying a batch of dark-colored eggs, was captured and preserved, together with many other specimens.

NOTE.—Carapaces of the King Crab (*Limulus polyphemus* Latr.) are occasionally found beside the Hudson. I have never taken a living 'Horse-foot'; but on one occasion a fresh one was seen hanging from a tree on Consook Island, in the Hudson River, beside a shad-fishing camp.

LEPIDOPTERA.

A small collection of Lepidoptera, gathered at Highland Falls, New York, during the summer of 1883, was submitted to Mr. William Beutenmüller, curator of Entomology in the American Museum of Natural History, who identified the species as follows:

<i>Papilio turnus</i> Linn.	<i>Hemaris buffaloensis</i> .
" <i>asterias</i> Fab.	<i>Sphinx cinerea</i> Harris.
" <i>crephontes</i> Cramer.	<i>Actias luna</i> Drury.
<i>Melitæa phaëton</i> Cramer.	<i>Telea polyphemus</i> Fab.
<i>Vanessa antiopa</i> Linn.	<i>Automeris io</i> Fab.
<i>Limenitis ursula</i> Fab.	<i>Arctia virgo</i> Linn.

II—VERTEBRATES OF THE HUDSON HIGHLANDS.

FISHES.¹

Besides the Hudson River, the waters of the Hudson Highlands comprise several good-sized mountain brooks and a number of ponds or small lakes.

1. **Petromyzon marinus** *Linnaeus*. GREAT SEA LAMPREY ; LAMPREY EEL.—Dr. James E. DeKay (Zoölogy of New York, Part IV, 1842, p. 380) writes: "I have observed them at Albany in the spring, and was assured that they were taken a few miles below that city." In the Highlands it is well known to the fisherman as the 'Lamper Eel.' Both old and young (= *P. nigricans*) specimens were taken in the Highlands.

2. **Carcharhinus obscurus** (*Le Sueur*). DUSKY SHARK.—Several were taken in the lower part of the Hudson River during the summer of 1881, and one as far up the river as Peekskill.²

3. **Acipenser sturio** *Linn.* COMMON SHARP-NOSED STURGEON.—I have not seen them much more than two feet in length. The fishermen take numbers of them in their nets, but rarely use them for food, or offer them for sale.

4. **Acipenser brevirostris** *Le Sueur*. SHORT-NOSED STURGEON.—Special nets are used by the fishermen who make a business of fishing for Sturgeons, and the fishes are skinned, sliced and sold under the name of 'Albany beef.' Individuals weighing several hundred pounds are sometimes taken. This fish often leaps high out of the water—"to see how far they are from Albany," the skippers say, the residents of that ancient town

¹ I collected fishes in the Hudson Highlands from 1874 to 1883, and again in the autumn of 1896. These collections numbered 399 entries; and all of the individuals of the same species, if taken at the same time and place, were usually entered under one number. The specimens collected in 1896 were preserved in formalin, and are in the collection of the United States National Museum. The earlier collections are in the American Museum of Natural History in New York. Of the latter, sixteen specimens (ten species) were mounted, and the rest preserved in alcohol. All of the species collected in 1896 were included in the earlier collections.

² As Sharks are frequently captured in the lower course of the Hudson, and also in the East River, it is probable that several other species occur, at times, in the Highlands. About 1876, Mr. Gilbert Ward, of Cornwall-on-Hudson, while rowing a pleasure party on the Hudson, between West Point and Cornwall, struck a Shark with an oar, and captured it. From the description of it given me by a fisherman who saw it, I supposed it to be a Hammer-headed Shark, *Sphyrna zygaena* (Linn.).

being notorious by reason of their sturgeon-devouring propensity. It not infrequently leaps from the water to alight, unintentionally, in a passing small boat, where, if of large size and agile, it occasions inconvenience to the passengers.

5. *Ameiurus catus* (Linn.). WHITE CAT; CHANNEL CAT OF THE POTOMAC.—This species is abundant in the Hudson, where it is called 'Lake Cat' and 'Fork-tailed Cat' by the fishermen. It often swims near the surface, and is taken in shad and ice nets, specimens so caught often weighing from five to ten pounds each.

6. *Ameiurus nebulosus* (Le Sueur). HORNED POUT; COMMON BULLHEAD; SMALL CATFISH.—This species is found in abundance in the Hudson River, and in every pond and stream of this region, where I have searched for it. The maximum weight here is about two pounds. It is chiefly carnivorous,¹ and will take any sort of bait, from a living shiner to a grasshopper or worm. Occasionally I have seen it taken upon live bait through holes in the ice, but it rarely bites in winter.

7. *Catostomus commersonii* (Lacépède). COMMON SUCKER; FINE-SCALED SUCKER; BROOK SUCKER; WHITE SUCKER.—Found in great numbers in the Hudson River, and in our ponds and streams. In the Hudson, and also in our small mountain lakes, I have found it throughout the year. In cold weather it is edible, but scarcely so at other times. It is caught in seines and fykes, and is frequently held for sale. This Sucker rarely takes a hook; but, when ascending streams in the springtime for the purpose of spawning, it affords amusement to boys, who catch it by means of wire snares fastened to poles. This species and the 'Nub-nose' (*Erimyzon sucetta oblongus*) are also speared, at night, by torch light.

8. *Erimyzon sucetta oblongus* (Mitchill). NUB-NOSE; CREEK-FISH; CHUB SUCKER.—This species is common in our streams and larger ponds. I have never known it to take a hook.

¹ Mr. Gerrit S. Miller, Jr., informs me that it commonly feeds upon seeds of the yellow water lily (*Nymphaea advena*) in ponds on Oneida Creek, central New York.

Though it probably occurs in the Hudson River, I have never found it there, nor do I know of any getting into the fishermen's fyke-nets. In spring I have speared males, in Poplopen's Creek, whose heads were ornamented with three large horny tubercles upon each side. I have occasionally eaten this fish, but found it bony and flavorless.

9. *Cyprinus carpio* Linn. CARP; GERMAN CARP.—A few were put in Echo Lake in 1892. They were obtained from the United States Fish Commission, and increased rapidly until the pond was drained, several years ago.

10. *Crassius auratus* (Linn.) GOLDFISH.—This introduced species is abundant in the Hudson River and the saltmarsh creeks which border it. The red ones are utilized for aquaria, fountains and fish-ponds. Fishermen take enormous quantities of them in seines. They are usually used for fertilizing, or sold in winter at a small price for food; but they are rarely purchased twice by the same person, they are so exceedingly bony.

11. *Semotilus corporalis* (Mitchill) FALL-FISH; SILVER CHUB; WIND-FISH; CORPORAL.—The 'Wind-fish' is our largest Minnow. I have taken several from a deep hole in Poplopen's Creek, close to Poplopen's Pond, which weighed a pound apiece; and others have taken individuals from the same pool which weighed more than two pounds. In this region I have only found this beautiful fish in Poplopen's Creek and its branches. I have taken it at various points, from the sources of the stream to the estuary near the Hudson, where the water becomes brackish from the inflowing tides. It is voracious, but shy, and takes living grasshoppers in the same way that the Trout does. It is remarkably strong and swift, and affords excellent angling and tolerably good food. In Wappinger's Creek, Dutchess County, N. Y., this fish is quite numerous, grows to a large size, and is called 'Wind-fish,' as it also is in Orange County.

12. *Semotilus atromaculatus* (Mitchill) HORNED DACE; CREEK CHUB.—The 'Chub' is a common fish in all of our fresh-

water brooks. I have never heard of its capture in any of our larger mountain ponds or lakes ; and, in fact, the only pond where I have seen it is the small one owned by Messrs. John Denton and J. Pierpont Morgan, near Highland Falls. Pickerel were lately introduced into this little pond, and, owing to the abundance of food which this species afforded them, increased and grew rapidly. Some years ago only a few Brook Trout and the ubiquitous Eel inhabited the pond with the Chubs, which then grew to an unusually large size. I have caught upwards of two hundred of them in a day, among them one or two weighing about a pound apiece. Holes in rapid streams are the favorite abode of this species. It rises readily to a fly, and is so voracious that I have taken numbers of them with an unbaited hook. The best bait is a living grasshopper, but it readily bites at worms. The larger ones are excellent food. Males develop rosy tints in April and May, when they sometimes have horny spines on their heads.

13. *Abramus chrysoleucas* (Mitchill). GOLDEN SHINER ; ROACH ; BREAM.—This handsome species is sometimes abundant in the Hudson River, where it goes by the name of 'Roach.' In our inland ponds and lakes, in most of which it is abundant, it is called 'Shiner,' and, on account of its tenacity of life and showy colors, is highly valued as a bait-fish for taking Pickerel, Yellow Perch, Catfishes and Eels, all of which seize it with avidity. Occasionally the larger individuals may be induced to take a small hook baited with worm ; but meal, dough, or bread attract them much more readily, as they are not specially carnivorous. They swim in large schools, and rise to the surface frequently, from which circumstance, Dr. DeKay tells us, they are called 'Wind-fish,' as he states that they rise to the surface whenever a light flaw of wind ruffles the water ; but this I have not observed. I think, in fact, that they rise much more frequently when the surface is smooth. Small urchins catch them in the Hudson with small hooks, baited with dough. The fishermen use a bagging net fastened to an iron rim, which they lower in the water by means of cords attached to a stout pole. A handful of bread scattered upon the surface over the net will attract thousands of them, and hundreds may be taken in a short time. This species

is seldom found in rapid brooks, and only by accident. I have noted some variation in the average size and coloration of this species in different ponds which it inhabits. Seven or eight inches is about the maximum size, both in the Hudson and the ponds.

14. *Notropis hudsonius* (DeWitt Clinton). SPAWN-EATER; SPOT-TAILED MINNOW; SHINER.—Dr. DeKay says: "It is not uncommon in the Hudson River and its tributaries." Governor DeWitt Clinton, in the 'Annals' of the Lyceum of Natural History of New York, Vol. I, p. 49, pl. ii, fig. 2, 1824, gave the original description and figure of this interesting species, of which I have never seen more than a single specimen, which I caught, using a hook baited with worm, at the rocky point where Poplopen's Creek estuary joins the Hudson River, on the north side, on October 15, 1875.

15. *Notropis cornutus* (Mitchell). SHINER; RED-FIN; DACE; ROUGH-HEAD.—The 'Red-finned Shiner' or 'Horned Chub,' as this species is called in the Highlands, is a remarkably handsome fish when in spring breeding dress. At this season it is ornamented with prickly spines upon the upper surface of the head, in addition to the bright red fins and golden lateral bands. It is fairly common in most of our rapid brooks; but I have never heard of its occurrence in the Hudson River. It hides under stones, and is shy, but takes a worm or grasshopper bait with alacrity, and is a vigorous biter. I have seen a few specimens of this species, which were seven or eight inches in length, caught in the Bog Meadow Brook between Echo Lake and the Parry Pond. I have also found it in Morgan's Brook, and in Poplopen's Creek from the Hudson to its sources in the mountains.

16. *Rhinichthys atronasus* (Mitchell). BLACK-NOSED DACE.—This very small but beautiful Minnow is found in clear, rocky streams. In August the males develop red fins and a golden yellow color on the under surface. It is possible to catch only the largest specimens, on very small hooks, baited with worms. I have found it in waters that were strongly impregnated with sulphur.

17. *Anguilla chrysypa* *Rafinesque*. AMERICAN EEL; FRESH-WATER EEL.—The Eel is common in all our waters. Specimens weighing five pounds apiece are sometimes taken in mountain ponds and streams. Eels are sometimes found in damp meadows, under stones, usually near springs from which rivulets flow.

18. *Pomolobus pseudoharengus* (*Wilson*). ALEWIFE; BRANCH HERRING; SPRING HERRING; GASPHEREAU; WALL-EYED HERRING; BIG-EYED HERRING.—This species arrives in April and becomes abundant during May, when large numbers are taken in drift nets, and sold at a very moderate price per dozen. Though bony, they are tolerably good food.

19. *Pomolobus æstivalis* (*Mitchill*). GLUT HERRING; BLUE-BACK; SUMMER HERRING; KYACK; SAW-BELLY.—‘Shoals’ of the fry of this species are sometimes seen agitating the surface of the Hudson in late summer. When dozens of them are leaping out of the water it is not difficult to kill them with a shotgun.

20. *Alosa sapidissima* (*Wilson*). COMMON SHAD; AMERICAN SHAD; NORTH RIVER SHAD.—The Shad fishing is an important industry in this region. The Shad arrives about the first of April, and is abundant by the end of the month. I have not heard of its ascending any of our small streams.

21. *Brevoortia tyrannus* (*Latrobe*). MENHADEN; MOSS-BUNKER; BONY-FISH; WHITEFISH; BUG-FISH.—‘Mossbunkers’ are said to occur in the Highlands. In the autumn of 1877, I saw a number that had just been caught by a fisherman in the estuary where the Croton River empties into the Hudson, north of Sing Sing.

22. *Salvelinus fontinalis* (*Mitchill*). BROOK TROUT; SPECKLED TROUT.—This species is found in some of our ponds, many of our brooks, and in the Hudson River. In April, 1882, Mr. Jerome Denna caught a Trout weighing half a pound in a net set in the estuary of Poplopen’s Creek, near the Hudson, where the water is brackish; and one is occasionally taken in a fyke-net from the Hudson itself. When a small boy, I caught them in

Morgan's Brook, and well remember a huge fellow that lived under a projecting rooty bank of a shady hole in the brook, and which resisted all my angling efforts for more than one season. I caught a half-pound one in the Morgan Pond (then owned by Messrs. Baldwin and Denton), and shot a still larger one in the brook below the pond. During those years Mr. Denna and myself got some fine ones each year from streams in Rockland and Putnam Counties. Trout are now said to be very scarce in the Highlands.

23. *Umbra pygmæa* (DeKay). EASTERN MUD MINNOW.—This diminutive species is included on the authority of Dr. Theodore Gill, who took specimens in Rockland County, N. Y., in 1855. In the original description of this species (New York Fauna, Fishes, 1842, p. 214), Dr. James E. DeKay observes: "It is the smallest of the American Cyprinidæ, the above being the largest size.¹ It occurs in brooks near Tappan, Rockland County, from whence it was obtained by Mr. John G. Bell."

"A locality which, with the water perfectly clear, will appear destitute of fish will perhaps yield a number of mud-fish on stirring up the mud at the bottom and drawing a seine through it." (*Baird.*)

24. *Lucius reticulatus* (Le Sueur). COMMON EASTERN PICKEREL; GREEN PIKE; JACK.—The Pickerel is common in our ponds and streams, living under logs and stumps or jutting rocks, where it lies in wait for its prey, occasionally swimming out in a circle and then returning to its sheltered abode. This is the fish most sought for by amateur sportsmen, who take them by trolling a spoon-hook, or with live Minnow bait. It bites as well in winter, when the ponds are ice-bound, as during the summer. Pickerel are frequently taken in fykes set in the Hudson, and are abundant in some of the tide creeks in marshes bordering the river. A specimen weighing 3½ pounds was taken in Poplopen's Pond, in 1882, by Mr. Jerome Denna.

25. *Fundulus heteroclitus macrolepidotus* (Walbaum).—COMMON COBBLER; KILLIFISH.—Abundant in saltmarsh tide

¹ "Length one inch."

creeks along the Hudson, and commonly used for bait. Males, in the breeding season, are gorgeously colored.

26. *Fundulus diaphanus* (*Le Sueur*). SPRING MINNOW; SPRING MUMMICHOG.—I have found this Minnow in several ponds, among them Echo Lake and Long Pond, in this vicinity. Shoals of these semi-transparent Minnows may be seen apparently sunning themselves upon the sand along the shores of ponds, and occasionally in slow streams running from them. They are difficult to distinguish unless in motion. Sometimes a large one will bite at a worm bait.

27. *Tylosurus marinus* (*Walbaum*). GARFISH; BILLFISH; NEEDLE-FISH; AGUJON.—This species is seen swimming upon the surface of the Hudson River and its estuaries in autumn, at which season it is usually quite common.

28. *Apeltes quadracus* (*Mitchill*). FOUR-SPINED STICKLEBACK.—April 30, 1883, I preserved 100 specimens of this tiny fish, obtained from a tide-creek of the Hudson, and counted the number of dorsal spines on each. In 79 specimens there were 4 spines each; in 19 there were 5 each; and in 2 there were but 3 each.

29. *Hippocampus hudsonius* *DeKay*. COMMON AMERICAN SEA-HORSE.—During the summers of 1895 and 1896, a number of Sea-horses were taken by fishermen, when netting shrimp in the eel-grass bordering the saltmarshes near Consook Island, at low tide.

30. *Caranx hippos* (*Linn.*). CREVALLÉ; TORO; HORSE CREVALLÉ; CAVALLY; JACK; JIGNAGUA.—One was caught in a drift-net, and others in a fyke-net. Dr. DeKay wrote, in 1842: "This is perhaps one of the most gorgeously beautiful fishes to be found in our waters." In this assertion I heartily concur. It only occurs in the Hudson Highlands after severe and protracted droughts, when the water of the Hudson becomes quite salt. I have seen it only in August.

31. *Pomatomus saltatrix* (Linn.). BLUEFISH; SNAP MACKEREL; SKIPJACK.—This species swims in large shoals on the surface of the Hudson, and is so voracious that it can be taken with any sort of bait; but a short quill answers the purpose best. The tide current keeps the quill upon the surface, and the 'Snappers' strike at it just as other fishes do at a trolling-spoon. In this way it is often possible to fill a market-basket with them. Adults do not reach this portion of the Hudson. The largest one I ever saw in the Highlands weighed little more than a pound, and the average size is very much less. I have caught very small fry as early as June 22. The larger specimens are taken in autumn.

32. *Rhombus triacanthus* (Peck). DOLLAR-FISH; LAFAYETTE; BUTTER-FISH.—The 'Butter-fish' is abundant in the lowest part of the Hudson, but only reaches the Highlands during dry seasons when the river becomes unusually saline. It appeared in some numbers at West Point in the summers of 1882 and 1883. When crabs are abundant the Butter-fish is likely to occur.

33. *Ambloplites rupestris* (Rafinesque). COMMON ROCK BASS; RED-EYE; GOGGLE-EYE.—This pretty fish was abundant in Bog Meadow Pond, about twenty-five years ago, when I saw several individuals taken weighing about a pound apiece. A few are still to be found there; but I have never seen it in any other pond or stream of the region, except the Highland Lake and in the Hudson River, whence fishermen frequently take them in fyke-nets.

34. *Enneacanthus gloriosus* (Holbr.). BLUE-SPOTTED SUN-FISH.—The beautiful Blue-spotted 'Sun-fish' appears to be found, in this region, only in Long Pond, a sheet of deep water almost a mile in length, four miles west of the village of Highland Falls. I found them more than twenty years ago; and the species is still common there. Specimens were identified by Dr. Tarleton H. Bean.

35. *Lepomis auritus* (Linn.). LONG-EARED SUN-FISH; YELLOWBELLY; REDBREAST BREAM.—This Sun-fish is abundant in the Hudson; elsewhere I have found it only in Poplopen's Creek, which it ascends from the Hudson to the sources of the

stream, in the mountains twelve to fifteen miles distant. It is commonly sold in the market. Fishermen take them in fykes, and by angling, using dough, grasshoppers, angle-worms, etc., for bait. I have taken it in the most rapid portions of Poplopen's Creek when angling for Brook Trout. A large individual, taken from Highland Lake, September 15, 1883, measured 6.25 inches in length, exclusive of the caudal, and 2.75 inches in greatest depth.

36. *Eupomotis gibbosus* (Linn.). COMMON SUN-FISH; BREAM; PUMPKIN-SEED; SUNNY.—Abundant in the Hudson, and in all of our ponds and slow streams; but it is seldom found in rapid streams.

37. *Micropterus dolomieu* Lacépède. SMALL-MOUTHED BLACK BASS.—This is the common species with which our ponds and lakes abound, and which affords the best of sport to anglers. One or two individuals have been caught in Long Pond, which weighed five or six pounds apiece; but the weight seldom exceeds three or four pounds. In autumn it bites most readily at living crickets. At other seasons crawfishes and hellgrammites are most in favor, though it frequently takes a fly-hook. I have never seen any from the Hudson River.

38. *Micropterus salmoides* (Lacépède). LARGE-MOUTHED BLACK BASS; OSWEGO BASS.—In the autumn of 1882 these fishes were first brought to my notice by fishermen who caught them in fyke-nets during October and November. These fishermen had fished in the Hudson for many years, and never took this species before. It was supposed that they were introduced by the U. S. Fish Commission.

39. *Perca flavescens* (Mitchill). YELLOW PERCH.—This is our most abundant game-fish. It inhabits the Hudson River in large numbers, as well as all of our larger mountain lakes and ponds; but the only stream which I have known it to habitually frequent is Poplopen's Creek, where it occurs from its sources to its mouth. The fishermen inform me that it is very unusual to

take specimens from the Hudson weighing over a pound; but, in Poplopen's Pond, I have taken a number that weighed about two pounds apiece. Mr. Jerome Denna has taken two, in Poplopen's Pond, which weighed $2\frac{1}{2}$ to 3 pounds each; and a professional fisherman, named Samuel Runnels, assured me that he took a Yellow Perch there which weighed $4\frac{1}{4}$ pounds, by actual weight on the scales at the village store. The small individuals nibble at worms; but large ones seldom take any save a live bait. Minnows or grasshoppers are the best. At the former they will bite throughout the winter, at which season numbers are caught through holes cut in the ice.

40. *Roccus lineatus* (Bloch). STRIPED BASS; ROCKFISH; ROCK.—This, with us, is a valuable food-fish, which is taken in great numbers in nets set through the ice of the Hudson in winter, and in drift nets by shad-fishers in spring. The young take the hook readily, and afford excellent sport to anglers, who fish for them with drop-lines, upon reefs in the Hudson. They bite at worms, clams, shrimp, crabs, etc. Large individuals, weighing 60 pounds and upwards, are sometimes taken in nets through the ice, and in shad-nets in spring. It is found, in this region, only in the Hudson and its estuaries, though I once took one a little above the estuary of Poplopen's Creek, in fresh water.

41. *Morone americana* (Gmel.). WHITE PERCH.—This species supplies our table with an excellent article of food. It remains in the Hudson throughout the year, and affords amusement to the anglers, who take numbers of them upon rocky reefs in the Hudson. In winter they are taken in abundance in nets set through the ice. In the river, I have rarely seen specimens taken of a pound in weight; but in Oscawana Lake, a pond in Putnam County, individuals are said often to attain to the weight of two or even three pounds. I am not aware that the White Perch has been introduced into any other ponds of this region. It bites at worms, grasshoppers and clams; but the most successful anglers use shrimp or soft crab for bait.

42. *Leiostomus xanthurus* Lacépède. SPOT; GOODY; OLDWIFE; LAFAYETTE.—This beautiful species, locally known
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as the 'Sand Porgee,' is of frequent occurrence in summer in the Hudson River and its estuaries, where it frequents the sandy shores, and delights the schoolboy by biting at his worms. Besides being good to eat, it is one of the most exquisitely beautiful of living creatures.¹

43. *Microgadus tomcod* (Walbaum). TOMCOD; FROST-FISH. — This is the only species of Cod that I have found in the Hudson. The Tomcod is usually called 'Frost-fish' by the fishermen, who catch numbers of them in their fykes and ice-nets during fall and winter. It bites readily, and is esteemed as an article of food. I have found it during the entire year, and in August have seen young ones only an inch or two in length. For some reason which I have not discovered, this fish is very often found in eel-grass, along shore, half dead, but able to swim a little though floating on the surface. I noticed this for several years prior to 1883, and preserved specimens so found on August 11, 1879, and August 30 and September 10, 1881.

44. *Achirus fasciatus* Lacépède. AMERICAN SOLE; CALICO SOLE; HOG-CHOKER; COVERLIP; SPOTTED SOLE.—Common throughout the year in shallow water along the Hudson; often found in the gullets of our two Mergansers (*Merganser americanus* and *M. serrator*).

BATRACHIANS.

I. *Ambystoma opacum* (Gravenhorst). MARBLED SALAMANDER.—This species is generally dispersed throughout this region, though not very numerously. It is found in dry places, as a rule, and even basks in the sun. On October 21, 1875, I caught a large one, sunning itself on a rock. A very large one was found under a stone in our garden, April 26, 1880. Another was found under a stone, near the summit of Bear Mountain, at nearly 1,400 feet altitude, August 8, 1880. In digging a deep trench through dry ground, on our place at Highland Falls, one was obtained on April 10, 1880. One was found crawling on the ground in February, 1872.

¹ NOTE.—*Prionotus* sp.? SEA ROBIN; GURNARD.—An individual of this genus was caught in the Hudson, at Sing Sing, in the summer of 1875, by Mr. William Cole, who was fishing from a dock. It has not been known to reach the Highlands to my knowledge.

2. **Ambystoma punctatum** (*Linn.*). LARGE SPOTTED SALAMANDER.—On March 2, 1876, I caught one upon the snow near a little hole in the ice on a small stream. I saw no more until April 8, 1883, when a large one was found near Pell's Pond. In October, 1896, my son, Louis di Z. Mearns, caught two more in 'cyclone' traps, set for small mammals and baited with oat-meal; and he found a third beneath a stone, making, in all, five specimens from the region.

3. **Hemidactylium scutatum** (*Schlegel*). FOUR-TOED SALAMANDER.—A single specimen was obtained by my son in October, 1896.

4. **Plethodon cinereus** (*Green*). GRAY SALAMANDER.—I found a typical specimen of this form under a stone on the slope of Bear Mountain, west of Echo Lake, October 20, 1875.

5. **Plethodon erythronotus** (*Green*). RED-BACKED SALAMANDER.—This terrestrial species is common here, and is found under stones and logs in dry places.

6. **Plethodon glutinosus** (*Green*). VISCID SALAMANDER ; BLUE-SPOTTED SALAMANDER.—Fairly common. It is found under stones and logs, often on high ground, and in moist leaf-mould, through which it makes long tunnels, or else uses those of the Mole-shrew (*Blarina brevicauda*). I have found specimens of unusually large size, measuring five to six inches in length.

7. **Gyrinophilus porphyriticus** (*Green*). FIERCE SALAMANDER.—Quite rare. A fine adult example of this species was found in a spring, near Highland Falls, during the autumn of 1872. It was not again seen until 1875, when several were caught in a muddy brook, in company with the common species of *Desmognathus*.

8. **Spelerpes bilineatus** (*Green*). STRIPED-BACKED SALAMANDER.—This is common under mossy stones beside shaded brooks. It is exceedingly swift and nimble, and loves moist places, though the adults are seldom found either in the water or far from it.

9. *Spelerpes ruber* (Daudin). RED SALAMANDER.—The 'Red Triton,' as this Salamander is locally called, is only moderately common, and in autumn is usually found in cold springs with turfy margins. One was found in a path, during a rain storm, as early in the season as February 14, 1876.

10. *Desmognathus ochrophæa* Cope. ALLEGHANY MOUNTAIN SALAMANDER.—Taken at Highland Falls, near a brook, under stones, April 13, 1882. It is said to be abundant in the Catskill Mountains, though I failed to find it in the neighborhood of Schoharie Creek and Hunter Mountain.

11. *Desmognathus fusca* (Rafinesque). DUSKY SALAMANDER.—This is the common Salamander of our rapid, pebbly brooks. It often crawls out upon stones, but rarely wanders far from water. It is strong and agile.

12. *Diemyctylus viridescens* Rafinesque. SPOTTED TRITON; NEWT; EVET; EFT.—This is our commonest Salamander. The larval form is found in abundance in all our ponds and ditches throughout the year, and is active during severe winter weather, when the waters are frozen over. The aquatic form sometimes crawls out of water upon stones. It was seen copulating, in winter, under the ice, and also as late in the season as May 2. Boys frequently hook them when fishing, with angle-worms for bait. The terrestrial form is very common in wet woods after showers, but otherwise seeks concealment beneath stones and logs, though it is sometimes found in the water late in autumn.

13. *Bufo americanus* Le Conte. AMERICAN TOAD.—Very numerous; some specimens bright brick-red. About the beginning of May this species resorts in pairs to the edges of ponds, and spawning begins; during this period its voice—a long-drawn nasal snarl—fills the air incessantly during warm evenings.

14. *Hyla versicolor* J. Le Conte. COMMON TREE TOAD.—Abundant, ranging from the Hudson to the mountain tops.

15. *Hyla pickeringii* (Storer). PICKERING'S TREE TOAD; 'PEEPER.'—Abundant. Clamorous in spring, and again in autumn; also in winter during thaws. In spring it usually attunes its voice to 'peeping' early in March (1st to 25th, according to season), continuing until May. Ice is still lying on the north slopes of the mountains when its cheerful voice is first heard in the swamps to which it repairs to breed. During long warm rains it wanders away from the pools into the woods.

16. *Rana pipiens* Schreber. COMMON FROG; LEOPARD FROG.—Very common. Often found in tide creeks of the brackish marshes bordering the Hudson River, and common in all grassy, swampy places, even to the highest wet places on the mountains. Four specimens, mainly from the summit of the mountains, near Bog Meadow Pond, collected in 1896, were identified as this species by Dr. Leonhard Stejneger. Some of the earlier specimens may have been *Rana palustris* Le Conte.

17. *Rana septentrionalis* Baird. NORTHERN FROG.—Three specimens, identified as this species by Dr. Stejneger, were collected in the highest part of the Highlands, about Tamarack Swamp, during the last week of September, 1896.

18. *Rana sylvatica* Le Conte. WOOD FROG.—A terrestrial species, except during the breeding season in spring; fond of damp, shady woods, and noted for its prodigious leaps. In the spring it repairs to swamps and ditches to deposit its eggs, and sets up a mighty croaking; we therefore do not take the author of the 'Manual of Vertebrates' seriously when he says it is "an almost silent frog." About the middle of March (20, 1882; 25, 1883), unless the season is late, the first croaking of the nimble Wood Frog is heard in the Highlands. During April the racket is tremendous in the vicinity of the swamps in which it is spawning. The species is then to be seen all around the edges and islands of the shady, sphagnous pools in which it breeds. The female is about double the size of the male, and brown, whereas the male is blackish. Its voice ceases early in May, and thereafter it becomes 'an almost silent frog.' It is common in wet woods of this region, at all altitudes. Two specimens were taken as high as the Tamarack Swamp, September 30, 1896.

19. **Rana clamitans** *Latreille*. GREEN FROG.—This Frog is common in all our ponds, brooks and springs, up to the highest altitudes, and supplies our tables with a delicate and delicious dish. A specimen was collected at Tamarack Swamp, at the summit of the mountains, September 28, 1896, where the species was common.

20. **Rana catesbeiana** *Shaw*. BULL-FROG.—This is the common edible Frog, known for its nocturnal serenades. I shot a remarkably large one, more than a foot in length, about 1870, in Pell's Pond. Its color, above, was pale rusty brown. Smaller ones are abundant in our ponds, and are commonly angled for.

REPTILES.

1. **Eumeces fasciatus** (*Linn.*). BLUE-TAILED LIZARD.—Not common, but seen nearly every year at my old home, near Highland Falls. There are two specimens, male and female, in the American Museum collection, which I shot on May 13, 1880. They were together, sunning themselves on a rock. This beautiful and entertaining animal lives among rocks, under buildings, walls, etc. It is exceedingly swift, but often surprisingly gentle, coming out of its hole and close to an intruder as often as driven in, but usually so nimble as to elude capture.

2. **Sceloporus undulatus** (*Daudin*). COMMON TREE LIZARD.—There is a specimen in my collection, taken at Highland Falls, Orange County, N. Y., in 1877. It is, however, not common here.

3. **Lampropeltis doliatus triangulus** (*Boie*). MILK SNAKE.—A very uncommon species.

4. **Diadophis punctatus** (*Linn.*). RING-NECKED SNAKE.—Quite numerous.

5. **Liopeltis vernalis** (*De Kay*). GREEN SNAKE.—Still common in the Highlands.

6. **Bascanion constrictor** (*Linn.*). BLACK SNAKE.—Formerly extremely abundant; now fairly so. A specimen taken May 25, 1883, measured 58 inches in length.

7. *Callopeltis obsoletus* (Say). PILOT BLACK SNAKE.—Formerly quite common ; now rare.

8. *Heterodon platyrhinus* Latreille. SPREADING ADDER ; BLOWING VIPER ; HOG-NOSED SNAKE.—One of our common Snakes ; called 'Flat-headed Adder,' 'Blowing Adder,' and 'Hissing Adder.' It flattens out and expands its head when excited, and, though harmless, is universally believed to be poisonous.

9. *Thamnophis saurita* (Linn.). RIBBON SNAKE.—Common, especially in fields and meadows through which streams flow and frogs are abundant.

10. *Thamnophis sirtalis* (Linn.). GARTER SNAKE.—Abundant. Stout, with shorter tail, than the preceding. It ranges from the Hudson River to the highest altitudes in the Highlands.

11. *Natrix fasciata sipedon* (Linn.). WATER SNAKE.—One of our largest, handsomest and most abundant snakes. It lives beside water, in which it swims swiftly and gracefully, with only its head and a small extent of neck raised above the surface. It can remain under for a considerable length of time. In spring, climbing up into bushes—preferably those standing in shallow water—it twists itself about the branches and sleeps in the sunshine.

12. *Storeria occipitomaculata* (Storer). RED-BELLIED BROWN SNAKE.—Common under stones and leaves. I have seen many when searching for salamanders and terrestrial molluscs.

13. *Agkistrodon contortrix* (Linn.). COPPERHEAD.—Much more common than the 'Rattler.' Some are killed in hay-fields in this neighborhood each year.

14. *Crotalus horridus* Linn. BANDED RATTLESNAKE.—Formerly numerous about Highland Falls ; now extremely rare. One was killed on our place many years ago, and its rattles are still preserved. One was killed near Tamarack Swamp, on one of

the highest points in the Highlands, September 28, 1896. A specimen in the American Museum collection was killed near the old Highland Falls cemetery, August 6, 1881, and presented to me by Mr. Arthur Pell.

15. *Chelydra serpentina* (Linn.). SNAPPING TURTLE.—Abundant in ponds and streams. It often lays its numerous spherical eggs in ploughed fields. Its tenacity of life and snap-pishness are proverbial. It fights fiercely with others of its species. Its tracks are often mixed with those of the Muskrat and Great Blue Heron on the muddy margins of our ponds; and it not infrequently swallows a live minnow intended by the fisherman for the Reticulated Pickerel. Females are usually larger than males. The sex of two fine specimens, taken by the writer, and mounted in the American Museum collection, was determined by the taxidermist as masculine in each case; one weighed 23 and the other 26 pounds.

16. *Aromochelys odorata* (Latreille). MUSK TURTLE; STINK-POT.—This species is abundant in Oscawana Lake, Putnam County, where its shell is always densely covered with cryptogamic vegetation. On the west side of the Hudson it is less abundant. I obtained specimens from Poplopen's Pond and Long Pond, in Orange County. It takes a baited hook freely, and is often pulled out by juvenile anglers.

17. *Chrysemys picta* (Hermann). PAINTED TURTLE.—Common in ponds and along the Hudson. It only leaves the water to crawl out upon a rock, stump or sloping bank to sun itself, except when it goes to deposit its eggs. If confined in a dry place it soon dies. Like the Speckled Tortoise it sometimes wanders forth on warm days in winter. It regularly appears during March (6, 1880; 20, 1882), unless the season is late and cold weather unusually protracted. If the ice has melted sufficiently, it usually comes out about the time the mercury has risen to 70° Fahr. It follows the largest streams well up amongst the mountains.

18. Clemmys insculpta (*Le Conte*). WOOD TORTOISE.—Common on the margins of brooks; occasionally found beside the Hudson River. It is not infrequently met with on dry ground. In 1896 I caught one in the mountains near Bog Meadow Pond, at a considerable altitude, and forwarded it alive to the U. S. National Museum. Like many species of Turtles, it lives for a long time in confinement. I caught a large female in the estuary of Moodna Creek, at Cornwall-on-Hudson, May 3, 1882. An unusually large one was taken by Dr. Louis A. di Zéréga, in Poppen's Pond, in the mountains of Orange County, May 2, 1883.

19. Clemmys guttata (*Schneider*). SPECKLED TORTOISE.—Common in brooks, ponds and in the Hudson River. It often basks on rocks, logs and sunny banks, and comes out in winter during protracted thaws. In spring it generally makes its appearance early in March (6, 1880; 2, 1882; 15, 1883), and is first seen in little rills running from the swamps; or, if the ice has melted, it crawls out on rocks and stumps in the ponds, and beside small streams and ditches. I have seen them in such situations before the ice had broken up on the Hudson. Copulation occurs during April. In a swamp near my home, on June 13, 1883, I found a nest containing three eggs, which were white, equally rounded at both ends, and measured, respectively, 1.35 x .70; 1.29 x .68; 1.31 x .68 inches. The eggs were placed in mossy turf on a stone in a bog. A small, shallow excavation had been made by the parent, and the eggs were covered after oviposition. I have seen them copulating in tide creeks of the river marshes, and at the sources of the larger streams, high among the mountains. In the mountain streams the shell-markings were observed to be unusually clear and bright. On April 1, 1883, I obtained a good proof of its acuteness of hearing: While leaning against a wall and looking into a swamp-hole, a Turtle arose to the surface of the pool, but appeared not to see me or to be aware of my presence until I made a sharp sound, when it instantly turned its head and looked at me before disappearing.

20. Terrapene carolina (*Linn.*). COMMON BOX TURTLE.—Very common. I have found it eating wild strawberries; and,

when removed to a bed of cultivated strawberries, it remained there for several days, eating the ripe fruit. It is also very fond of mushroom fungi. When approached it produces a loud hissing sound and closes its shell. Though commonly found on high ground and in dry places, it seeks moist swamps during dry weather. It usually makes its appearance early in May (1 and 12, 1878; 7, 1883).

BIRDS.

Having already published a very fully annotated list of the Birds of the Hudson Highlands,¹ it seems sufficient to refer to this list in the present connection rather than to include even a nominal list of the species here. It may, therefore, suffice to say that the total number of species recorded from this region is 213, of which 100 are known to breed in the Hudson Highlands. Of the total number, 33 may be classified as permanent residents; 100 as summer residents, and 16 as casual summer visitors; 73 as winter residents and visitors (this includes the permanent residents); and 90 as spring and fall migrants.

MAMMALS.

1. *Didelphis virginiana* Kerr. VIRGINIAN OPOSSUM.—In the Highlands the Opossum has always been fairly common since my boyhood, and hence long before its too 'successful' introduction on Long Island, New York. As a lad, I sometimes caught them in my deadfalls set for rabbits and baited with pieces of sweet apple. About 1880 specimens were taken by Mr. Benjamin P. Keith as far up the Hudson as the neighborhood of the town of Catskill. I also heard of its capture at Newburgh, on the Hudson, about that time. On my recent visit to Highland Falls, I was pleased to learn that the new generation of 'coon-hunters' kill about as many Opossums as we used to twenty years ago; and one or two were brought in during my stay.

¹ 'A List of the Birds of the Hudson Highlands, with Annotations.' By Edgar A. Mearns. *Bulletin of the Essex Institute*, Vol. X, 1878, pp. 166-179; Vol. XI, 1879, pp. 43-52, 154-204; Vol. XII, 1880, pp. 11-25, 107-128; Vol. XIII, 1881, pp. 75-33. 'Addendum to "A List of the Birds of the Hudson Highlands, with Annotations."' By Dr. Edgar A. Mearns. *The Auk*, Vol. VII, Jan., 1890, pp. 55, 56.

It is certain that the Opossum sometimes roams abroad during cold winter weather. The night of January 13, 1882, was stormy and cold, and the snow lay deep on the ground; as I returned on horseback from visiting a patient and had nearly reached my house, the horse suddenly shied at something in the road that proved to be an Opossum. On another occasion, a specimen was killed in a henery, January 30, 1877. This was an adult male, and furnished the following measurements: length, 840 mm.; tail vertebræ, 330; ear from crown, 45; ear from notch, 52; width of ear, 63.5; distance from tip of nose to eye, 59; length of head, 148; length of hind foot, 76.

2. *Lepus sylvaticus* Bachman. WOOD HARE; EASTERN COTTONTAIL; GRAY RABBIT.—Fairly common throughout the Highlands, and found everywhere, from the brackish marshes besides the Hudson to the tops of the highest mountains. Some individuals—those from the highest localities—verge towards the subspecies *transitionalis* of Bangs, which is the only form of this species found about Fort Miller, about 150 miles higher up the Hudson, in Washington County, N. Y. It is quite probable that *Lepus sylvaticus transitionalis* also occurs in the mountains in the northeastern corner of Orange County, where the Varying Hare (*Lepus americanus virginianus*) is said to occur sparingly. In the Catskill Mountains, typical *Lepus sylvaticus transitionalis* is found; but its range does not extend to the highest elevations, where the Varying Hare alone occurs.

This Cottontail is more prolific than most of the western species. I once found no less than nine little ones in a nest—a shallow burrow, thickly lined with rabbit-hair, in an orchard. I have known the Black Snake (*Bascanion constrictor*) to feast on young Rabbits still in the nest. The young that are born in early spring, when the weather is cold, have a coating similar to that of adults in winter; those born in summer, however, at once acquire the coarse post-breeding pelage of adults.

Dimensions.—Average of three adults, taken at Highland Falls, in January and April, 1871: total length, 436 mm.; tail vertebræ, 50; ear from crown, 76; from tip of nose to eye, 48; length of head, 80; length of hind foot, 84.

3. **Zapus hudsonius** (*Zimmermann*). MEADOW JUMPING-MOUSE.—Common at Poplopen's Pond and on J. Pierpont Morgan's mountain farm, but not seen elsewhere in the Highlands.

4. **Fiber zibethicus** (*Linnæus*). MUSKRAT.—The Muskrat is abundant in all situations where there is sufficient water. It is most numerous in the brackish marshes that border the Hudson, but occurs at the highest altitudes wherever there are swamps, ponds or streams. In winter it builds houses regularly in all of the localities which it frequents. In the Hudson River it is very commonly taken in fyke-nets set by fishermen. Though living chiefly on vegetable food, it often eats fish, and its fondness for mussels of the genera *Unio* and *Anodonta* is evidenced by heaps of these shells on all the shores where it feeds. It often eats garden vegetables, and not infrequently enters houses and root-cellars in search of them. Where gardens and corn-fields are contiguous to its habitat, it does some damage by tearing open the ears of corn or carrying the vegetables into its burrows. It is especially fond of the sweet potato. It is easily taken by placing steel-traps in its well-beaten runways, which resemble those made by the Meadow-Mouse (*Microtus pennsylvanicus*).

If not molested, Muskrats become quite confiding. One spent the greater part of a winter in our storeroom; and they are usually numerous in the cellar of the Highland Falls Hotel, adjacent to Bog Meadow Brook, in the midst of the village of Highland Falls. Even in the woods they are sometimes quite fearless, as illustrated by the following incident copied from my journal: "May 11, 1883. Towards evening, after a rainy day, I walked to Echo Lake and saw a Muskrat swimming about and across the pond. After liberating some captive turtles, I seated myself beside the water, and immediately detected a strong scent of musk. Looking up, I saw a large Muskrat swimming in front of me. After swimming about for awhile, it came to the shore only a few feet away, and seated itself on a stone beneath the surface, so that only a portion of its head was above the water. After watching me for several minutes, it approached to within a yard or two of me, then passed on and came out upon the bank at a distance of only a few yards.

Measurements.—Average of three adult males: length, 575 mm.; tail vertebræ, 252; ear from crown, 15.6; ear from notch, 22.3; length of head, 75; length of hind foot, 86.3.

5. *Microtus pennsylvanicus* (Ord). COMMON MEADOW-MOUSE.—This species is abundant in the river marshes, woodland swamps, and wet meadows. Like the Muskrat it is most abundant in the salt marshes along the Hudson that are submerged by the tides. Among the mountains, a few were found in the wettest places in the forest; and several were trapped in Tamarack Swamp, in the highest part of the mountains (altitude about 1800 feet), where it associated with the Masked Shrew (*Sorex personatus*) and New Jersey Red-backed Mouse (*Evotomys gapperi rhoadsi*), living among wet sphagnum and pitcher-plants, in a forest growth of black spruce and tamarack. These specimens were not perceptibly different from those taken at the edge of the Hudson River. In the Hudson valley I have taken this Vole from Fort Miller, in Washington County (November, 1883), to Central Park, in New York City (April 17, 1881).

Measurements.—Average of eight adults (3 males and 5 females) from Consook Marsh, beside the Hudson River: length, 178 mm.; tail vertebræ, 49; ear from crown, 8.1; ear from notch, 12.8; length of head, 34.2; length of hind foot, 22.5. Average of two adults (male and female) from Tamarack Swamp, near the summit of the Highlands: length, 178; tail vertebræ, 54; ear from crown, 8; ear from notch, 12.8; length of head, 31.5; length of hind foot, 21.8.

6. *Evotomys gapperi rhoadsi* Stone. NEW JERSEY RED-BACKED MOUSE.—I have found this Mouse only in Tamarack Swamp, a boreal swamp near the summit of the Highlands. This tract is forested with white pine, tamarack and black spruce, with an undergrowth of rhododendron, Labrador tea, swamp huckleberry, sheep laurel and spice-bush. In it are numerous swampy openings, carpeted with sphagnum, cranberry, pitcher-plant, sundew and cotton-grass (*Eriophorum vaginatum*); while here and there are pools that float the golden-club, the buckbean, and other aquatic plants. This is the only spot in the region where I have found the small white lady's slipper (*Cypripedium candidum*). In September, 1896, four small mammals were trapped in these

sphagnous openings—the Meadow-Mouse (*Microtus pennsylvanicus*), Mole-Shrew (*Blarina brevicauda*), Masked Shrew (*Sorex personatus*), and the present species. Of these the Red-backed Mouse and Masked Shrew have not been found elsewhere in the region. I was surprised at finding no species of the genus *Peromyscus* near this locality.

7. *Peromyscus leucopus* (Rafinesque). COMMON DEER MOUSE.—This is, doubtless, the most abundant mammal of the region. It is common on the islands in the Hudson River, and beside the salt marshes. It sometimes inhabits barns and houses, and occurs in swamp bogs as well as on high ground. Its young are brought forth in nests built with materials similar to those used by the Red Squirrel, and placed in hollows of trees, or on old nests of the Catbird or Brown Thrasher in thickets of vines, cat-briers and underbrush. They often occupy such nests in winter. One found in the Fishkill Mountains was built on a Robin's nest, and contained five young mice. I have never found any species of *Peromyscus* on the highest mountains or about Tamarack Swamp.

Measurements.—Average of ten adult males: length, 176 mm.; tail vertebræ, 78.5; ear from crown, 12.8; ear from notch, 16.7; length of head, 29.5; length of hind foot, 20.7. Average of eight adult females: length, 185; tail vertebræ, 82.3; ear from crown, 12.5; ear from notch, 16.8; head, 30; hind foot, 21.1. Total average of eighteen adults (ten males and eight females): length, 180; tail vertebræ, 80.2; ear from crown, 12.7; ear from notch, 16.7; head, 29.7; hind foot, 20.9.

8. *Neotoma pennsylvanica* Stone. ALLEGHANY WOOD RAT.—Mr. Samuel N. Rhoads, in a paper entitled 'A Contribution to the Life History of the Alleghany Cave Rat, *Neotoma magister* Baird,' published in the 'Proceedings' of the Academy of Natural Sciences of Philadelphia for 1894, pages 213-221, claims that the recent species described by Mr. Witmer Stone,¹ under the name *Neotoma pennsylvanica*, is specifically identical

¹ Proc. Acad. Nat. Sci. Phila., 1893, p. 16.

with the subfossil cave species, named *Neotoma magister* by Baird.¹ I am unable to concur in this opinion, for the reason that a comparison of eight jaws—one upper and seven lower—belonging to Baird's type series of his *Neotoma magister* differ in important respects from a series of recent skulls, accompanied by skins, of *Neotoma pennsylvanica* Stone, for the use of which I am indebted to the kindness of Dr. C. Hart Merriam. In this comparison, *Neotoma magister* proves to have been a considerably larger and stouter animal than *N. pennsylvanica*; the skull is relatively shorter in proportion to its breadth, as best seen when the mandibles are articulated; the mandibles are deeper, wider, and with the notch between the condyloid and angular processes shallower; the upper incisor is larger; the lower molars have the cusps more condensed and the tooth-row broader and longer, with rounded instead of sharp angles, and with the salient angles of the middle lower molar opposite, not oblique—much as in *Baiomys* as compared with *Peromyscus*.

I therefore incline to the opinion that *Neotoma pennsylvanica* Stone is a distinct species from *N. magister* Baird, and that the latter will never more appear to us in the flesh, but belongs to a remote post-glacial epoch. One fragment of a lower jaw in Professor Baird's series looks very much like a young individual of *N. pennsylvanica*, which it probably is, since Mr. Rhoads informs us that bones of the Horse and Norway Rat have been found in the bone caves of Pennsylvania.

The only authentic record of the occurrence of this species in the Hudson Highlands is that of Dr. J. A. Allen, in his paper entitled 'Rediscovery of *Neotoma* in New York.'² This record is based on one specimen, obtained by Mr. Cleveland Allen (son of Dr. J. A. Allen), October 30, 1894, "on Storm King Mountain, Cornwall, Orange County, New York, about fifty miles north of

¹ In his *Mammals of North America*, 1857, page 486, Baird states: "One species (*N. magister*) occurs fossil in the caves of Pennsylvania"; and, on page 498, he describes it as follows:

"The bone caves of Pennsylvania have furnished me with several lower jaws of a fossil *Neotoma*, considerably larger than that of the largest specimen even of any recent species which I have seen. The body could not have been less than twelve inches in length; it differs from the others in the wider and more massive molars, the lobes of which are all more nearly equal than in the rest, and all rounded, not angular. The inner and outer sides of the molars are very nearly symmetrical, and the indentations or folds of nearly equal depth. The axis of the condyloid process is quite oblique, and the condyle below the level of the coronoid. The species may be called *N. magister*."

² *Bull. Am. Mus. Nat. Hist.*, VI, 1894, pp. 362-364.

New York City, and forty miles north of Piermont," Rockland County, New York, where Mr. John G. Bell took several specimens about 1850, one of which (No. 375) is still in the collection of the U. S. National Museum. In the paper cited, Dr. Allen also referred to "an early and rather indefinite record of the Wood Rat in Massachusetts"; also mentions the probable capture "of six specimens at Liberty Hill, in the northern part of New London County, Connecticut"; and concludes his article thus: "It hence seems probable that small colonies of Wood Rats may exist at various points in southern New York and southern New England, as well as in New Jersey, Pennsylvania, and in the mountains of Virginia, all probably referable to the recently described *N. pennsylvanica*."

Mr. Samuel N. Rhoads has recently discovered this Rat at Greenwood Mountain, at the south end of Greenwood Lake, in northern New Jersey.¹

Mr. Charles H. Townsend writes me: "I found a Wood Rat (*Neotoma*) near Latrobe, Westmoreland County, Pennsylvania, many years ago. The specimen was skinned and stuffed, and probably given away, as I do not know what became of it. The Wood Rat must be rare in that region as I never found another."

Recollecting that I had once seen a published record of the capture of a *Neotoma* in Connecticut by Dr. Robert T. Morris, I wrote to him for a reference to the publication. My letter elicited the following information: "I do not remember just the time when the *Neotoma* was killed in Connecticut, but am pretty sure that it was in the summer vacation late in the seventies or early eighties. I made a note of the capture in 'Forest and Stream,' I think; and the specimen is probably in a bottle of alcohol in the Peabody Museum at New Haven—very likely carrying the date of capture on the label of the bottle. The Rat was running through a ditch, newly dug, on Prospect Street, when I made a lucky shot with a stone, and collected the results."

9. *Mus decumanus* Linnaeus. RAT.—Too abundant.

Measurements.—An adult female (No. 20, collection of Louis di Zerega Mearns), taken at Highland Falls, September 28, 1896, gave the following

¹ See Proc. Acad. Nat. Sci. Phila., 1897, p. 28.

measurements: length, 396 mm.; tail vertebrae, 187; ear from crown, 16.5; ear from notch, 20; length of head, 51.5; length of hind foot, 41. Mammæ, 6 pairs (3 pectoral, 1 abdominal, and 2 inguinal).

10. *Mus musculus* Linnæus. HOUSE MOUSE.—Found in woods as well as houses.

Measurements.—Average of two adult males: length, 164 mm.; tail vertebrae, 79; ear from crown, 10.5; ear from notch, 13.2; head, 24; hind foot, 18.2.

11. *Arctomys monax* (Linnæus). WOODCHUCK; GROUND HOG.—Abundant in the Highlands, and sometimes found on the highest mountains. It is seldom seen out of its burrows before April, and retires for the winter in early autumn. One was seen out, at Fort Miller, about 200 miles up the Hudson, as late as November 20, 1883. The young are born about the first of May, and are seen frolicking around the entrance to their burrows a few weeks later. At the residence of Mr. Alfred Pell, a Woodchuck's tunnel terminated in a greenhouse. The animals sometimes came out during winter and devoured some of the plants. On the estate of E. P. Roe, at Cornwall-on-Hudson, they also became very gentle. We visited one on April 22, 1883, that had become quite a pet. When we chased it into its den in a rocky bank beside a garden, its head was seen repeatedly cropping out of one or another crevice among the rocks, until, after 'whistling' and stamping for awhile, it finally tumbled out altogether, and began digging and scratching amongst the leaves. Ordinarily they are shy, and often pause when feeding to sit up and look about them, dreading lest some enemy should come upon them by stealth.

On May 25, 1878, I caught two young Woodchucks no larger than House Rats. One was cross and had to be liberated; but the other became gentle and affectionate at once. Within a few hours it would sit on my knee and take clover from my hand, holding the stems clasped in its fingers as Chipmunks do. It slept under cotton batting in a closet, drank water freely, and usually searched my pockets for food when I entered the room. Like other youngsters, it was good while I was present, but mischievously destructive as soon as my back was turned; and it finally died of poisoning after eating some birdskins that were coated inside with arsenic.

The pertinacity of the Woodchuck in attempting to return to its burrow, when surprised away from home, has been frequently commented upon. Among my own notes I find the following: "Highland Falls, New York, September 5, 1882. As I was skirting a swampy meadow, searching for orchids, I came suddenly upon a Woodchuck that was feeding in the grass. I was standing beside its burrow. It ran towards me, at first, and then stopped. Not knowing the location of the burrow, I momentarily expected to see it pop into a hole in the ground; but, as it did not move, but crouched flat upon the grass, I knew that I must be in its path, and that it did not intend to run from me. Not seeing a suitable stick with which to arm myself, I selected a handful of large stones and started to advance upon it; but the moment I did so the Woodchuck came at me full tilt. I threw a stone, but the beast came on so swiftly that the stone went over it. In fact, the animal advanced with such celerity that I backed to one side, expecting that it would pass by me; but it followed me! I threw another stone feebly towards it, then dropped the rest, and took to my heels, whereupon the Woodchuck ran into a burrow that opened in a horizontal crevice of a ledge of rock some three feet above the ground."

12. *Tamias striatus* (Linnaeus). SOUTHERN CHIPMUNK.—The Chipmunk is by far the most abundant member of the Squirrel family in the Highlands. It lives everywhere, from the islands of the Hudson to the highest mountaintops, though it is least common on the high ground. The form found in the Highlands, though distinctly *striatus*, is not quite typical, but slightly approaches the northern form *lysteri*, which is the prevailing form in the high Catskills. I have seen perfect intergrades from the Hudson River slope of the Catskill Mountains near Palenville, New York.

This familiar and attractive little animal stores up food in autumn on which to subsist through the long winter; but on winter days, when the sun shines brightly, it sometimes comes out in sheltered spots and suns itself on the stone walls and ledges. I have seen it running about during every month of the year, but seldom every month of any one winter, as there are usually several

consecutive weeks of severely cold or stormy weather, during which none can be found. Thus, under date of March 15, 1883, I have noted the appearance of a pair on a wall—"the first seen since last fall." On April 23, 1877, I noted as follows: "Chipmunks have not shown themselves upon a single occasion during the past winter, although the weather has been unusually mild and pleasant. Last winter they were to be seen at any time, in favorable localities, when the sun was shining brightly." I shot one on the snow, in Lewis County, New York, in January, 1878; another at Circleville, Ohio, December 4, 1880, when the weather was coldest and a heavy snow lying on the ground. The cheek-pouches of the Chipmunk will accommodate a pignut or the ginsing groundnut without much stretching, though it makes the animal look as if it had the mumps. Breeding sometimes occurs early in the season, as I have seen young ones half as large as their parents by the beginning of May.

Measurements.—Average of 13 adults (4 males and 9 females): length, 245 mm.; tail vertebræ, 91.4; ear from crown, 11.6; ear from notch, 17.7; head, 44.6; hind foot, 34.1.

13. *Sciurus hudsonicus loquax* Bangs. RED SQUIRREL; SOUTHERN CHICKAREE.—The very audacity and impudence of this lively little Squirrel seem to have preserved it from extermination, though its small size and comparative worthlessness for food have no doubt contributed to its preservation. It is still abundant throughout the course of the Hudson, never having been exterminated even on Manhattan or New York Island. Though noisy, somewhat mischievous, and destructive to the eggs and young of birds, it is loved and appreciated where better-behaved animals have been destroyed. In this locality its nests are very commonly placed amid the protecting foliage of the red juniper, though hollow trees, bird houses, attics, steeples, bridges, observatories, and similar shelters are often utilized as nestingplaces, or for winter homes. They are commonly seen mating during February. The young are usually brought forth in the outside nests, which are more warmly built than the coarse leaf-nests of the Gray Squirrel, being composed outwardly of strips of bark, chiefly of the red juniper and grape, and lined with hair, feathers,

moss, finely-shredded inner bark, and other soft materials that are conveniently at hand. The young are usually born in May or June, though, as in the case of the Gray Squirrel, they may be found at any time during the warmer half of the year. Those born early in the season, during cold weather, are coated with the winter pelage, and have red backs and grayish limbs; but those born in hot weather are at once provided with the summer coating, which has the color pattern reversed, the back being grayest and the limbs reddest, and with a black list on the sides. On May 5, 1878, I examined a nest containing six young, in a hollow oak-tree that had been repeatedly used by Flickers for the same purpose. The young Red Squirrels were quite large for the season, and very lively, soft and pretty. Their coats, like their mother's, were of the winter style. On another occasion (April 19, 1882), a Red Squirrel was seen leaving a bird-house on a tall pole covered with climbing rose-vines. Supposing this meant mischief to a family of Bluebirds, I procured a ladder and made an investigation. One compartment was nearly filled with grasses, papers, and bits of rag. After pulling out a quantity of such materials, a large family of very young Squirrels, with unopen eyes, was found. I did not try to count them; but one or two bright-colored and nearly naked little ones that were drawn out of their nest, cried out lustily, and scrambled back with alacrity although not yet able to see. Their bodies were wrinkled, their tails were bare, and their heads seemed disproportionately large.

During the seventies, a race of perfect albinos of this species was perpetuated for several generations, on Constitution Island, in the Hudson River, and several of them were killed and preserved as specimens.

Measurements.—Average of seven adult males: length, 306 mm.; tail vertebræ, 125; tail to end of hairs, 173; ear from crown, 14; ear from notch, 22; distance from nose to eye, 20.9; head, 50.5; hind foot, 46.9. Average of seven adult females: length, 315 mm.; tail to end of vertebræ, 130; tail to end of hairs, 176; ear from crown, 14.5; ear from notch, 21.5; nose to eye, 20.5; head, 50.3; hind foot, 47.3.

14. *Sciurus carolinensis leucotis* (Gapper). NORTHERN GRAY SQUIRREL.—About a dozen Gray Squirrels are preserved in

my collection, and a great many others were bagged during the very early days of my gunning; but the species was never very abundant in my time. On the recent visit I saw but few nests, and none that were occupied. A few black ones were shot on Dunderberg Mountain in 1876. All the others were gray, although blacks and intermediates were comparatively numerous in the northern part of the State. In the Highlands, leaf-nests are usually occupied during the warm weather, but in winter the Gray Squirrel more commonly lives in hollows of old trees, though I believe that leaf-nests are sometimes used in winter. The young are sometimes born as early as April. On April 28, 1877, near Sugar Loaf Mountain, in Putnam County, a leaf-nest was found occupying the site and remains of an old Hawk's nest. Three young, still quite small, were in it. When I climbed up to the nest the parent chanced to be absent, but returned while I was examining the contents of her nest. She was a beautiful Squirrel, with an elegant tail, and, to my astonishment, seemed to be utterly and absolutely devoid of fear. Disregarding consequences, she came straight up to her progeny, took one of them in her mouth, and made off with it towards some safer spot. We then left her without further molestation.

I have seen Gray Squirrels eating the large fungi of which so many animals are fond. In winter they tear open pine cones and devour the seeds. On January 28, 1883, I watched a pair gathering the 'beans' from the pods of a thorny locust tree. They dispatched them rapidly, sometimes holding the pods in their arms in the manner of a performer on the harp. Though they displayed much dexterity in handling this clumsy provender, one Squirrel seemed to be in imminent danger of prying itself off the limb with a huge pod that it was manipulating. After extracting all the seeds it threw the pod down at me. It was flat, about a foot in length, and an inch in width.

Measurements.—Average of 7 adults (4 males and 3 females): length, 515 mm.; tail to end of vertebræ, 249; tail to end of hairs, 331; ear from crown, 26.4; distance from tip of nose to eye, 31.7; head, 67.4; hind foot, 63.5.

15. *Sciuropterus volans* (Linnaeus). SOUTHERN FLYING SQUIRREL.—Abundant throughout the Highlands. Its nest is

usually placed in a hollow tree. I have found nests in the tops of the tallest trees, and once in a stump within a foot of the ground. Not infrequently it builds outside nests, and even lives in them during the winter. Some resemble the leaf nests of the Gray Squirrel externally, though there is always a warm lining within; other nests are indistinguishable from those of Red Squirrels; and others still are deftly woven of the softest possible materials. A hemlock that has donated its top to the children for a Christmas-tree is the likeliest spot of all to search for a Flying Squirrel's nest; but it is sure to be at the point of decapitation and surrounded by such an outgrowth of succulent sprouts that it is hard to see. You will find the young ones in it if you go at the right time; one of them will make the softest, prettiest and most affectionate little pet that any boy or girl ever loved. If you fail to find the nest on the hemlock stub, tap with a heavy stone on the aspen-tree that the woodpeckers bored out a year or two ago, and you may see a head with a pair of bright black eyes looking out from one of the openings; tap again, harder, and off will sail the old Flying Squirrel, away down the hill, frequently turning to avoid tree-trunks, and winding about amongst them with perfect ease, at last alighting far below with a strong upward sweep that gives it an impetus that helps it to run swiftly up to the tree-top, again to take a slanting flight towards the foot of another distant tree.

As before remarked, I once found a nest in a stump at the root of a chestnut-tree, close to the ground. It contained a family of five very young Flying Squirrels, which, when disturbed, were removed by their mother to a distant tree. She carried them, one by one, to the top of the tree, and then 'flew,' with a little one in her mouth, and alighted without apparent injury to it.

On May 3, 1877, no less than seven Flying Squirrels were driven from an old dead pepperidge-tree. They left the tree singly, and all appeared to be of about the same size, from which circumstance I suppose they belonged to one family, the young having remained with their parents during their first winter. Flying Squirrels are more apt than Red Squirrels to select cupolas, pigeon-cotes, attics or outbuildings for their abode. Mr. A. T. Mosman, of the U. S. Coast Survey, told me that one of these

Squirrels took possession of an apartment at the summit of an observatory that had been erected to the height of more than eighty feet, in the State of Indiana.

Measurements.—An adult male, taken at Highland Falls, New York, May 3, 1877, measured as follows: length, 220 mm.; tail to end of vertebræ, 95; tail to end of hairs, 107; head, 37.8; hind foot, 26.9.

16. *Sorex personatus* Geoffroy Saint-Hilaire. MASKED SHREW.—This, the smallest known mammalian inhabitant of the Hudson Highlands, was not found until September 28, 1896, when I trapped a single adult male in a sphagnous opening in the midst of Tamarack Swamp, near the summit of the mountains. Its measurements are as follows: length, 104; tail vertebræ, 40; head, 20.7; hind foot, 12.

17. *Blarina brevicauda* (Say). MOLE-SHREW.—This is one of the most abundant mammals of the Hudson Highlands, and is found in almost all situations. During my recent visit I trapped it on Consook Island, in the Hudson River; in the sphagnum of Tamarack Swamp, near the mountaintops; and in a variety of intermediate localities. These animals are locally known as 'Ground-Moles.' Cats capture them easily, and often bring them into houses and barns, but seldom care to eat them.

Measurements.—Average of eight adults (four males and four females): length, 128 mm.; tail vertebræ, 28; head, 29.2; hind foot, 15.5. The largest specimen came from Tamarack Swamp, and measured as follows: length, 142 mm.; tail vertebræ, 31; tail to end of hairs, 39; head, 29; hind foot, 16.

18. *Scalops aquaticus* (Linnæus). EASTERN MOLE.—This species is not very common in the Highlands. It, apparently, is more numerous in cultivated lands than elsewhere, and seems to be less aquatic than the Star-nosed Mole.

Moles of this genus are frequently albinistic; and, in fact, such appears to be the case with Moles in general; of this the European genus *Talpa* affords a good illustration. Albino Moles usually exhibit a yellowish glandular discoloration.

19. *Parascalops breweri* (Bachman). BREWER'S MOLE; HAIRY-TAILED MOLE.—This Mole is probably rare in the Highlands, though common in the Catskill Mountains. I have exam-

ined only two specimens. The first was picked up under a hay-pole on a saltmarsh beside the Hudson, and identified by Dr. C. Hart Merriam. On June 28, 1878, Mr. William Church Osborn brought me a perfect albino specimen of this Mole, which a gardener had caught near Garrison's, in Putnam County.

20. *Condylura cristata* (Linnaeus). STAR-NOSED MOLE.—This singular-looking mammal is not uncommon. It sometimes enters ice-houses or damp cellars, but usually prefers marshy ground, and swims amongst the cat-tails of the river marshes when the tide is up. A nest was opened by a ploughman in our garden. It was nearly two feet below the surface, in dry ground, and contained several half-grown young in a nest of shredded grass and weeds.

21. *Myotis subulatus* (Say). LITTLE BROWN BAT.—This Bat is quite uncommon in the Hudson Highlands. It flies about from early spring (March 6, 1880) till late fall; and I have found it dormant, in hollow-trees, in the winter. Inasmuch as Dr. A. K. Fisher, who collected several hundred Bats at Sing Sing, on the Hudson, failed to find in his series even a single specimen of this species, it is worth remarking that one of my early specimens, taken at Highland Falls, in August, 1873 (No. 509, collection of American Museum of Natural History), has recently been examined by Mr. G. S. Miller, Jr., and by Doctors Harrison Allen, J. A. Allen, A. K. Fisher, and myself, and determined to be this species.

22. *Vespertilio fuscus* Beauvois. BROWN BAT.—The Big Brown Bat is very common, often entering houses, in pursuit of insects, after the lamps have been lighted. At Highland Falls, I have seen it flying about as early as April 22 (1877) and as late as November 3 (1876). In New York City I rescued one from a Chinese laundryman into whose shop it flew, on Sixth Avenue, on the night of February 9, 1881; another was seen in Central Park, April 17, 1881.

Measurements.—Average of four adults (one male and three females): total length, 122 mm.; length of head and body, 75; tail, 47; head, 22; ear from crown, 13.7; alar expanse, 325; length of longest finger, 81; forearm, 47; tibia, 20.3.

23. Pipistrellus subflavus (*F. Cuvier*). GEORGIA BAT.—This species is not abundant in the Highlands. At Sing Sing it is the most common Bat. Dr. Fisher says he has never taken *Myotis subulatus* at Sing Sing, but that it is entirely replaced there by this species, which is also the most common Bat of the District of Columbia. An adult male, taken at Highland Falls, New York, April 24, 1877 (No. 508, collection of the American Museum of Natural History) measured as follows: length of head and body, 40.1 mm.; tail, 26.4; nose to eye, 5.3; nose to ear, 10.2; nose to occiput, 14; height of ear, 10.2; alar expanse, 222.3.

24. Lasionycteris noctivagans (*Le Conte*). SILVERY BAT.—One specimen was taken from a hollow tree. Dr. A. K. Fisher found it "tolerably common" at Sing Sing, New York. Mr. George Marshall, of Washington, D. C., brought me for identification an adult female of this species, taken with one other from a hollow tree, at Laurel, Maryland, October 12, 1896.

25. Lasiurus borealis (*Müller*). RED BAT; NEW YORK BAT.—Very abundant in this region during the summer. Bats of several species are frequently discovered in chimneys, hollow trees, caves, mines and similar places of shelter during the winter; but I have never seen a Red Bat taken alive at that season. It is possible that the species migrates to the south in the autumn and returns in the spring. During the latter part of October and the first week of November, I have seen great flights of them during the whole day. In 1876 I noted that all of the individuals shot from any single flock were of the same sex, though another flock might yield all of the opposite sex. One year specimens are recorded on four days, on two days only males and on two only females. So far as they go, these observations suggest that the sexes perhaps separate during their autumnal flights, as birds commonly do. The alar expanse of five males, shot in an open field in broad daylight, November 2, 1876, averaged 295 mm.

26. Dorcelaphus virginianus (*Erxleben*). VIRGINIA DEER.—The 'Middletown Journal,' issue of January 13, 1878, contains

¹ The Mammals of Sing Sing, N. Y. < *The Observer*, Portland, Conn., Vol. VII., No. 5, May, 1896, p. 195.

a notice of the capture of a Deer, near Middletown, in Orange County, New York. This record brings the species within the limits of the Hudson Highlands, and is the only authentic one that I know of; but I am informed that Deer are still occasionally found in the extreme northwest corner of Orange County.

27. *Phoca vitulina* Linnæus. HARBOR SEAL.—The Seal has been seen several times, and once captured, in the Hudson Highlands. One was shot at New Hamburg, on the Hudson, by a Mr. Wood, for whom the specimen was mounted by Mr. James S. Buchanan, a taxidermist of Newburgh, who showed me the specimen and four large jars of oil which he took from it. It was shot on the ice near an air-hole in the river, in midwinter, 1877-78, and weighed sixty pounds. This species has been taken on Lake Champlain, as recorded by Zadock Thompson,¹ and by Dr. C. Hart Merriam,² who also says (*l. c.*, p. 105): "March 25, 1879, I saw one on a rock in the Hudson River, near Sing Sing." On page 200 of his excellent paper on 'The Mammals of Sing Sing, N. Y.,'³ Dr. A. K. Fisher further observes: "Almost every spring one or more Seals are seen about the time the ice is breaking up in the river. On March 11, 1884, an adult male was secured in the cove."

28. *Procyon lotor* (Linnæus). RACCOON.—The Raccoon is a common species of the region; 'Coon-hunting' is still a favorite sport; and 'Coons' are almost always brought home, if the dogs and hunters are of the right sort. It is an almost omnivorous animal, and eats frogs, fishes, and poultry with almost as keen a relish as it does sweet corn in the milk or the large summer grapes. It makes a handsome and affectionate pet, possessing many winning traits and interesting habits to commend it, but is as mischievous as a bear and much too lively after bedtime. I have never seen its tracks in the snow, as it spends the winter in a deep sleep; but Mr. William K. Lente once killed one upon the frozen Hudson, between West Point and Cold Spring, in the middle of winter.

¹ Natural and Civil History of Vermont, 1842, p. 38.

² The Mammals of the Adirondack Region, Northeastern New York, 1884, p. 205.

³ Published in 'The Observer,' Portland, Conn., Vol. VII, No. 5, May, 1896.

29. *Lutra hudsonica* Lacépède. AMERICAN OTTER.—Otters are still found in the Hudson, and in the streams and lakes of the Highlands, though the species has now become extremely scarce. Twenty years ago it was much more numerous. I knew of the capture of several Otters, during the years spent in making my collections in the Highlands. One was trapped in 1875, by Mr. John Redner, on a stream that flows into Poplopen's Pond. I have repeatedly seen signs of the Otter about the Hudson River, Poplopen's Creek, and Bog Meadow Pond, though I never succeeded in capturing them.

30. *Putorius (Lutreola) vison lutrecephalus* (Harlan). LARGE BROWN MINK.—Minks have 'always' been rather common in this vicinity. I have known several persons, at one time or another, who trapped them for profit. I have no specimens at hand, except one fine adult male that was trapped by my son, on our old place at Highland Falls, October 2, 1896. This specimen (No. 23, collection of Louis di Zerega Mearns) gave the following measurements: length, 645 mm.; tail vertebræ, 233; length of head, 85; length of hind foot, 73; ear from crown, 11; ear from notch, 24. It was taken in a steel-trap set in a Muskrat runway. When my son approached this Mink in the trap it was very fierce, and uttered a loud, shrill cry. In its efforts to get free it had dug a trench in the mucky soil at a chain's-length radius from the stake to which the trap was fastened.

On March 26, 1880, while I was standing beside Morgan's Pond, in the mountains, watching the movements and colors of some handsome Mallards and Geese that were swimming close to the spot, a head emerged from the water and was propelled to the nearest rock that projected out of the water; then the head, shoulders and body of a fine Mink successively appeared upon the edge of the sloping rock, and their owner peered cunningly and wickedly at the flock of Mallards that fed close by unconscious of its presence. I was standing with my gun upon my shoulder in plain view, and dared not move, lest the Mink should observe me; but, for the moment, it was too eagerly occupied with watching the ducks to pay any attention to other matters; though, at the first movement of my hand on the gun-stock, it dis-

appeared with a celerity of movement that could scarcely be matched by one of the Grebes. A moment later I could hear the Mink making its way amongst the stones beneath my feet, and it did not again appear, though I waited there a long time. On several occasions I have found dead Dusky Ducks (*Anas obscura*) lying upon the river marshes with a hole eaten beneath the wing, and some of the muscles of the breast devoured; this I attributed to the Mink.

31. *Putorius noveboracensis* DeKay. NEW YORK WEASEL.
—This is the common Weasel of this region, and quite abundant. There are six specimens in my collection, taken from 1877 to 1884; and many others were trapped or shot, in earlier years, that were not preserved. It regularly changes to white in winter, though this seasonal phenomenon always strikes the residents as a novelty, and never fails to excite their astonishment. We were frequent losers from the nocturnal attacks of this little animal upon our poultry. Once I shot one that had just killed a large hen. Farmers, however, often overlook such trespassing and allow the Weasel to stay about their barns because it is such a good ratter. While a guest at the home of Miss Mary Rutherford Garrettson, at 'Wildercliff,' near Rhinebeck, on the Hudson, in March, 1878, that good lady related to me the following interesting incident, which shows the fearless nature of the Weasel: When upon the stairs, in her house, Miss Garrettson met a Weasel that was carrying a large Rat. The Weasel advanced boldly, and she, having the fire-tongs in hand, seized the Rat with them and proceeded to carry it through the hall, when she observed that the Weasel was following; passing through the hall and across another apartment, she deposited the dead Rat in the library, where the Weasel at once repossessed itself of its prize. The lady then withdrew, and shut the door of the room, hoping to discover some of the habits of her plucky little guest; but the Weasel immediately disappeared and carried the Rat along, having, no doubt, discovered some hole large enough to allow its escape with the booty; but the good lady never discovered the opening, and thinks to this day that it must have gone up the chimney, though a fire of logs was burning in the fire-place at the time.

It is not at all uncommon for this Weasel to take to a tree when surprised in the woods. It does not hesitate to climb the largest tree, and sometimes ascends to the top, though it more often runs out towards the extremity of one of the larger limbs and crouches upon it until the danger is past. Several of my specimens were shot in trees. When wounded it sometimes utters loud cries.

While I was walking with my wife, near Highland Falls, April 17, 1883, a Weasel appeared from among some loose rocks around the base of a large granite boulder and approached us fearlessly. It came slowly up to within two yards of us, and then tossed its nose upwards and sniffed the air. A Crow cawed loudly in passing, and at once attracted the attention of the Weasel, for it instantly started and turned toward the sound. Then it ran under the boulder again, but continually darted in and out, appearing alternately at one opening and then another, keeping its bright eyes fixed upon us, and poising its head horizontally. After we had watched it for several minutes, it ran along a ledge of rock to a swamp, and for awhile disappeared; but later it appeared again amongst some broken rocks, where it was shot. Although so late in the season, white hairs were scattered through the entire pelage, and one foot was about half white.

Measurements.—Average of four adult males: length, 401 mm.; tail to end of vertebrae, 140; tail to end of hairs, 178; ear from anterior base, 23.2; nose to eye, 19.3; head, 57.2; hind foot, 43.2.

32. *Putorius cicognani* (*Bonaparte*). BONAPARTE'S WEASEL.

—About the year 1870 I trapped one or two of these little, short-tailed Weasels on our place at Highland Falls, and I have seen a few of them since. It is probably quite uncommon. I am unable to say whether or not, in this locality, it changes to white in winter, as I have seen them only in summer. When a boy, I once met one, carrying a Mouse in its mouth, coming toward me on a stone wall. I was carrying a string of fish, and with this struck the Weasel and dashed it several yards away from the wall, but it secured the Mouse and succeeded in passing on. When struck, it uttered a shrill cry of rage, but turned immediately to pick up the Mouse.

33. **Mephitis mephitica** (*Shaw*). EASTERN SKUNK.—The Skunk is common, though not very numerous.

34. **Vulpes pensylvanicus** (*Boddaert*). AMERICAN RED FOX.—This splendid animal is not numerous in the Highlands. It prefers more open country. Now that the Gray Timber Wolf has practically disappeared from the East the cunning Red Fox has only the hunter and the hounds to fear in the thickly settled places. I have watched it running before the dogs many times, and have seen some of its clever manœuvring; it always appeared to me as if the Fox was enjoying most of the sport, unless it came to a shot from one of the stands, an accident that seldom happened. One frosty December morning, at the age of eighteen, I unwittingly ambushed and shot the only Red Fox that ever fell to my gun, though numberless Saturdays and other holidays were spent in hunting with the hounds; and I certainly—perhaps rightly—considered myself the peer of any fox-hunter of the region.

35. **Urocyon cinereoargenteus** (*Müller*). EASTERN GRAY FOX.—This is the common Fox of the region, the Red Fox being comparatively scarce. It is very destructive to poultry. When I was a boy of perhaps a dozen summers we were much annoyed by the loss of our spring chickens, several of which daily disappeared with a regularity that was disheartening to young poultry-raisers; and one morning, when 'Biddie,' our pet Dorking, was gone, and her thirteen eggs were cold in the barrel of straw, it was understood that a climax had been reached, and that active measures for the suppression of the marauders must be instituted at once. Some of 'Biddie's' white feathers furnished a clew which led to the discovery of a trail through some dense brushwood, leading to a den in a thicket on a rocky hill at the back of our place. There I trapped a half-grown Gray Fox. In this den most of our missing poultry had disappeared, and it was forthwith effectually broken up by digging out the whole length of the burrow. The cavity in which the young had been reared was oval in shape, with about the capacity of a flour barrel. It was located under a large stone, and tunnels extended from it to the surface in two directions for distances of about three and five yards respectively.

Gray Foxes are not very shy. I sometimes came upon them unexpectedly about the ruins of old Fort Putnam, near the West Point Military Academy, and they usually trotted off without breaking into a gallop. When pursued by hounds they soon grow tired or frightened, and end the chase by entering a burrow or crevice among the rocks.

Measurements.—Average of three adult males, from Highland Falls, N. Y.: length of head and body, 642 mm.; tail to end of vertebræ, 333; to end of hairs, 437; breadth of expanded tail, 229; ear from crown, 77; from tip of nose to eye, 54; to ear, 117; length of head, 143; fore limb, from olecranon to end of longest claw, 190. Iris, grayish brown.

36. *Lynx ruffus* (Guldenstadt). WILDCAT; BAY LYNX.—On my last visit to the Highlands, in 1896, I saw no signs of the Wildcat; and I was told that none had been killed there for several years past. During the first twenty-five years of my life the Wildcat was at least as numerous as the Red Fox, and more frequently killed. In the early seventies, Wildcats, by their depredations, caused so much loss to the residents of Putnam County, across the Hudson from my home, that bounties were privately subscribed by landowners, amounting to \$25 for every one killed in that neighborhood. Mr. Henry Le Farge, still a hunter of local renown, killed a considerable number of them; but there were still some Wildcats remaining on Sugar Loaf Mountain, when I left the Highlands, in 1884.

Measurements.—A fine adult female (No. $\frac{3128}{3443}$ of the American Museum collection), killed on Black-top Mountain, near Highland Falls, Orange County, New York, on November 29, 1874, presented the following measurements: length of head and body, measured from end of nose to root of tail, 795 mm.; tail, measured from root to end of hairs, 185; ear from crown, 68.3; from tip of nose to eye, 51; from tip of nose to ear, 124; from tip of nose to end of outstretched hind limb, 1156; expanse of outspread fore limbs, 825; height of ear, 68. Iris, yellow.

RECENTLY EXTIRPATED MAMMALS.

1. *Castor canadensis* Kuhl. CANADA BEAVER.—When I was a boy, the remains of a Beaver-dam were plainly visible at Bog Meadow Pond, in Orange County. When this pond was

raised, a few years ago, to supply the town waterworks at Highland Falls, the dam was submerged, and with it disappeared the last vestige of the Beaver, long extinct in the Highlands.

2. ***Ursus americanus Pallas.*** BLACK BEAR.—Though still common in the Adirondack and Catskill Mountains, the Bear disappeared from the Highlands many years ago, though my father's mother saw them there.

3. ***Sciurus ludovicianus cinereus (Le Conte).*** NORTHERN FOX SQUIRREL.—Doctor Bachman wrote :¹ "In the northern part of New York it is exceedingly rare, as I only saw two pair during fifteen years of close observation. In the lower part of that State, however, it appears to be more common, as I recently received several specimens procured in the County of Orange." I never heard any allusion to the Fox Squirrel as an inhabitant, past or present, of Orange County ; and it is probably many years since it occurred there.

¹ Charlesworth's Magazine of Natural History, Vol. III, 1839, p. 161.

Article XVII.—DESCRIPTIVE CATALOGUE OF THE
BOMBYCINE MOTHS FOUND WITHIN FIFTY
MILES OF NEW YORK CITY.

By WILLIAM BEUTENMÜLLER.

The present paper constitutes the third part of my work on the Lepidoptera found within a radius of fifty miles of New York City, and relates to the species which have been classed as Bombycine Moths. It enumerates 182 species, and should be looked upon as an aggregation of species, rather than a strict classification; the object of the work being to place on record the species found in this region, for the benefit of those who are interested in the study of our local fauna. The first part of the catalogue, the Butterflies, was published in this Bulletin in 1893 (Vol. V, pp. 241-310), and the second part, the Hawk-moths, in 1895 (Vol. VII, pp. 275-320). For obvious reasons no descriptions of the genera have been given in this paper, but with the aid of the illustrations most of them can be readily identified. The measurements are given in millimeters (25 mm.= 1 inch), and the segments or joints of the caterpillars have been numbered separately, beginning with the one behind the head as the first, counting the head as a separate organ.

I am under obligation to Dr. H. G. Dyar, Dr. Otto Seifert, Messrs. L. H. Joutel and W. T. Davis for the assistance they have given.

***Scepsis fulvicollis* (Hübner).**

PLATE XV, FIG. 13. FEMALE.

Fore wings blackish brown. Hind wings somewhat more blackish and transparent at the middle. Head black, vertex, base of palpi and collar bright orange. Thorax and abdomen blue black. Expanse, 35 mm.

Larva.—A dark colored dorsal line, then a pale greenish stripe on which is a row of small warts; next to this stripe is a pink line, then a pale yellow line,

then a dark greenish slate-colored stripe on which is a row of small warts. The spiracles are situated on the lower part of this stripe, below the warts; below this stripe is a pale yellow line; between this line and the legs are two rows of small warts. From each of all the warts proceeds a thin cluster of whitish hairs. Under side pale greenish yellow. Head shining yellow. Length, 20 mm.

Food-plants.—Various kinds of grasses.

Rather common in swampy, grassy meadows from June to September. The larva spins a thin lemon-yellow cocoon. Double brooded.

***Ctenucha virginica* (Chap.).**

PLATE XV, FIG. 5. MALE.

Head black in front; vertex, base of palpi, anterior part of patagia and chest bright orange. Fore wings sooty brown, hind wings darker. Fringe of both wings white at the apex and before the hind angles. Thorax and abdomen blackish brown with a rather strong metallic blue reflection. Expanse, 40–54 mm.

Caterpillar.—Body blackish with six rows of tubercles on each side. There are four large warts on each abdominal segment. From the third to the eleventh segments inclusive, is a cluster of black hairs, the hairs forming these clusters not spreading; next to these is a row of pale yellowish or whitish spreading clusters, and below these the hair is black, in spreading clusters. The hair lowest down on each side of the body and that on each end of the body is sometimes mixed with whitish. Head red, face black. On each side of the body is a subdorsal and lateral yellow stripe, the former sometimes being almost obsolete. Length, 31 mm.

Food-plants.—Various species of grasses.

The insect is quite rare in the immediate vicinity of New York, but is common in the mountainous region towards the Catskills. It is found in July and early in August, and flies in the hottest sunshine, hovering over flowers. It is not difficult to capture, since its flight is not strong nor rapid. In cloudy days it clings to the stems of plants or flowers, and can be easily taken with the fingers. The species is single brooded, and hibernates in its larval state. When fully grown the larva spins a cocoon composed entirely of the hairs from the body, which are held together by the minute spinules with which they are beset. The larva may be found fully grown in June.

Lycomorpha pholus (*Drury*).

PLATE XV, FIG. 9. MALE.

Wings black with the basal half of the fore wings and basal third of the hind wings bright orange above and below. Head, abdomen and legs black. Thorax black with the patagia orange. Expanse, 25-30 mm.

Caterpillar.—Gray, dotted with pale green, with thin, very long, blackish hairs. Head bilobed, clypeus large, lower part pale; brown with two pale green, narrow, transverse irregular lines; hairs short, white. Body rather flattened, brown gray with many irregularly triangular, transversely streaked patches; a geminate, rather large, anterior segmental, dorsal, pale yellow one, present on segments 4-10, is most distinct; the other patches are whitish, smaller and confused. Legs pale, two setæ on the obscurely corneous plate.

Food-plants.—Lichens.

Not common in the immediate vicinity of New York, but frequent in certain districts on the flowers of goldenrod in August and early September. It flies in the hottest sunshine. The larva spins a cocoon, composed of a thin web, on one side of a stone or on a fence. In coloration closely resembles lichen-covered rocks.

Pyromorpha dimidiata *H.-S.*

PLATE XV, FIG. 10. FEMALE.

Fore wings with outer half semitranslucent black, basal half above the median vein ochreous. Hind wings semitranslucent black. Expanse, 20-25 mm.

Caterpillar.—Head pale brown, lighter in the suture and retracted under the hood of the first segment, which is large with a dark brown, divided cervical shield. Body thick and robust, not tapering, with dense, short hairs. Color dark velvety brown, reduced to a series of longitudinal and transverse lines by the large, rounded and slightly oblique pale gray areas which surround the upper parts of the warts. The warts are brown, forming dark centres to the pale patches, not so dark as the ground color. Hairs along the extreme sides conceal the subventral region. Feet pale. A circular pale area surrounds the spiracles on joints five and ten.

Food-plant.—Dead and decaying oak leaves, the larva living on the under sides of the fallen leaves.

Not common and quite local. The moth lives amongst grass, especially along the borders of wood. Its flight is short and soft, thus rendering it easy to capture. They appear about the middle of June and last only a few days. The larva lives solitary, becomes fully grown in September, and passes the winter in a cocoon.

Harrisina americana (*Guérin*).

PLATE XV, FIG. II. MALE.

Fore wings, hind wings, head and body black, with a very slight blue-green lustre. Collar broadly orange. Expanse, 20-25 mm.

Caterpillar.—Yellow with a transverse row of black spots or warts on each segment, bearing a tuft of velvety black hair. First segment entirely black with a yellow edge, while the spots on the last two segments run together. Head small, brown, retractile and usually hidden in the first segment. Length, 14 mm.

Food-plants.—Grape-vine, Virginia-creeper and Judas-tree (*Cercis canadensis*).

The larvæ may be found during July and August. They are gregarious, and when young they feed together, arranging themselves side by side, beginning at the edge of the leaf and eating the softer parts, leaving the small veins. When fully grown they disperse over the vine. They spin a small, tough, whitish, flattened cocoon. Some chrysalids produce the moth in a few weeks, but the majority are not evolved until the following spring. Another form of the larva occurs which is banded with purple and has a white lateral stripe.

Acolothus falsarius *Clem.*

Wings and body black, with greenish or bluish reflections. Collar reddish. Expanse, 13-14 mm.

Very rare in this neighborhood, but quite common in the Southern States. It may be readily known by its small size, uniform color and reddish collar. The larva is said to live solitary or not more than two together on a leaf, in which they eat small holes. It lives on grape-vine and Virginia-creeper.

Psychomorpha epimenis (*Drury*).

PLATE XV, FIG. 3. MALE.

Fore wings black with bluish scales, and a large pale yellowish white patch, from the costa to nearly the hind angle, indented on the inner side. Hind wings black, with a large subovate brick-red patch. Body entirely black. Expanse, 25 mm.

Caterpillar.—Ground color white, banded transversely with four black stripes on each segment. The contrast of the black and white gives it a bluish appearance. Third and fourth stripes are usually farther apart than the other two with two or more black dots at the sides. Eleventh segment has an elevation or hump, which with the cervical shield, anal plate, under side and legs, are dull orange. Head reddish yellow with black dots. Under side pale, mottled with dark and rows of dots on the legs. Length, 25 mm.

Food-plant.—Grape.

The moth is single brooded and comes forth from the pupa about the middle of April and flies for about two weeks. The larvæ fold together a leaf in a nest-like fashion in which they live, from one to about five or six individuals together. When about to transform they gnaw their way into soft wood and close up the entrance with silk and chips.

Alypia octomaculata (*Fabr.*).

PLATE XV, FIG. I. FEMALE.

Fore wings black with two large pale yellow spots. Hind wings with two white spots; the basal one in the male is very much enlarged. Thorax black with a broad yellow stripe on each side. Abdomen black. Legs black, fore and middle tibiæ orange. Expanse, 25-30 mm.

Caterpillar.—Head and cervical shield shining orange yellow, marked with black dots. Across the middle of each segment is a transverse orange band, with four alternating, bluish white and four black transverse stripes. Below the spiracles is a wavy white stripe interrupted by the orange bands. Over the body are also a number of small black, piliferous spots, each bearing a short white hair. Eleventh segment with a prominent elevation. Length, about 30-35 mm.

Food-plants.—Grape and Virginia-creeper.

Very common in yards and gardens about houses, especially in New York City. It flies during June and July, and the larvæ do considerable damage to grape-vines, sometimes completely defoliat-

ing them. It seems strange that this insect should prefer cultivated places about dwelling houses instead of the woods, where it is very rarely, if ever, found. The larva constructs a cocoon of chips or gnaws into wood to pupate. Single brooded.

Eudryas grata (*Fabr.*).

PLATE XV, FIG. 4. FEMALE.

Fore wings chalky white, with a broad, rich brown outer border, narrowly bordered within with olive green. Through the brown border is a wavy blue line composed of blue scales. Along the costa, from the base to about the middle, is a broad brown border, with bluish scales, beneath and at the end of which are two olive green connected patches. On the inner margin is a large olive green patch contiguous with the outer border. Hind wing light ochre yellow with a brown outer border, from below the apex to the anal angle. Head and thorax along the middle deep brown with raised bluish scales. Patagia white. Abdomen ochreous, with a few black spots along the back, under side white. Expanse, 40-45 mm.

Caterpillar.—On the middle of each segment is a transverse orange pink band, on each side of which are three black rings alternating with two bluish white ones. Each orange pink band has a number of black dots. Head orange, dotted with black. Eleventh segment with a prominent elevation. Length, 37 mm.

Food-plant.—Grape.

The larva, when fully grown, bores into decaying wood, excavating a cavity in which it transforms, and which it closes with chips fastened together with a glutinous secretion. It is single brooded. The moth emerges in June and the caterpillars may be found during July and August. Sometimes the moth escapes from the chrysalis late in the same season, and the species is therefore partly two-brooded.

Eudryas unio (*Hüb.*).

PLATE XV, FIG 8. MALE.

Fore wings chalk white with a broad rusty brown outer border which has a narrow, scalloped sepia brown inner margin. Through the rusty border is a broad scalloped line of bluish scales. Along the costa is a broad rusty brown band, scaled with blue, extending to the outer third of the wing. On the inner margin, contiguous to the outer border, is an olive brown patch, which sends a narrow ray of olive green towards the base of the wing. Hind wings pale

ocherous with a broad rusty brown outer border. Head and thorax along the middle with raised blackish scales. Patagia white. Abdomen ochreous with a row of black spots along the back and sides. Underneath white. Expanse, 30-35 mm.

Caterpillar.—Similar to that of *E. grata*, but smaller and more heavily marked with black, both in its bands and spots. The black bands are much wider than the white ones, while in *grata* they are about one-half the width. The spots on the head are larger than those of *grata*. The spots on the hump on the eleventh segment are connected by the black band to which they are united, while in *grata* the spots are isolated. The feature which seems to distinguish *unio*, is the blackish coloring above the prolegs and continued on the two following segments, the three piliferous spots above the prolegs being connected with it. Length, 30 mm.

Food-plants.—Evening Primrose and *Epilobium*.

Double brooded, from June to August. The larva when ready to pupate eats into decaying wood or other soft substances to transform, closing up the entrance of the channel or cavity with chips. It often forms its cocoon in the stems of its food-plant. Not common, in damp fields.

Nycteola lintneriana *Speyer*.

PLATE XV, FIG. 14. MALE.

Fore wings gray, more or less clouded with dark gray; before the middle is an irregular zigzag bigeminate transverse band, with indications of a transverse line beyond the middle. There is also present a subterminal indistinct band composed of dots. In the cell is a round blackish spot, and a black mark outside the basal band above the fold. Hind wings grayish, whitish at the base. Expanse, 22 mm.

Not common. The caterpillar lives on Willow. It spins an elongate, almost parallel cocoon, flattened below, bluntly rounded at the hind end, and flatly pinched together, at the part where the moth escapes.

Nola ovilla *Grote*.

Light gray, with indistinct, curved, transverse, blackish lines, more or less broken, the one beyond the middle composed of small dots. Hind wings whitish or dusky. Expanse, 16-18 mm.

Caterpillar.—Body broad and much flattened, rather short, with four pairs of well-developed abdominal legs, the first pair being situated on the seventh

segment. The body is dirty whitish, with a dark linear dorsal line, a dark dorsal discoloration behind the head, another in the middle of the body and another near the end. The body is hairy, but not densely so; on each segment are four dorsal tubercles from which radiate short dusky hairs; on the sides are larger and longer tubercles from which arise lateral very long hairs, being as long as the body is broad. The larger hairs are simple, not barbed, but the shortest are finely though slightly barbed. The tubercles are dirty white, concolorous with the rest of the body. Length, 12 mm.

Food-plant.—Oak.

Probably double brooded and not common. The moth may usually be found resting on the trunks of trees in May and June. The larvæ occur in September. The cocoon is boat-shaped, flattened, oval cylindrical, and closely attached to the surface of the leaves.

***Nola melanopa* Zeller.**

PLATE XV, FIG. 19. FEMALE.

Head black; thorax and abdomen chalky white. Fore wings chalky white; costa broadly black and with a broad, oblique, transverse band of the same color across the middle; outer margin grayish with black points. Hind wings grayish. Expanse, 19–20 mm.

Not common. The moth may be readily known from its congener, by its white color with black, oblique band and markings. The earlier stages are unknown.

***Nola trinotata* (Walker).**

PLATE XV, FIG. 17. MALE.

Light gray, with three wavy, blackish, transverse lines, more or less distinct; at the base of the costa is a short blackish dash, and about the middle a blackish patch. Hind wings gray. Expanse, 16–18 mm.

Caterpillar.—Head round, pale yellowish, and thickly marked with black; partly withdrawn within the first joint. Body somewhat flattened, robust and of almost uniform width; last segment smaller, pale yellow; a black dorsal shade line and a fainter subdorsal one, which is somewhat broken into oblique portions as seen under a lens. Three rows of warts, one per segment. First row above subdorsal line, second below it, third substigmatal and a fourth row below the subventral fold at the bases of the legs. All the warts bear a few white hairs. First and second rows of warts partly black and partly pale

brown. Third row ocher. Thoracic feet slender; abdominal legs only present on joints 7, 8, 9 and 12. Length, 12 mm.

Food-plant.—Witch-hazel.

Not common in this vicinity. Found in open woods and overgrown fields. There is only one brood a year. The larvæ form their cocoons late in June and early in July, and the moth appears the following spring. The cocoon is constructed on a piece of wood from little bits of bark. It is flat at the sides and narrow, tapers upward from the hind end, and is truncate anteriorly at the end where the moth emerges. Length, 12 mm.; width, 2 mm.

Argyrophyes cilicoides Grote.

Chalky white. Fore wings dusky beyond the middle and with a subterminal line of the same color; at the end of the cell is a raised patch of black metallic scales. Hind wings white, dusky outwardly. Expanse, 16–18 mm.

Not common. Earlier stages not known. The moth looks like an *Erastria*.

Argyrophyes pustulata (Walker).

White. Fore wings with a small black dot at the base, and on the costa a larger brown spot, with bluish scales; across the middle of the wing is a broad black band, which becomes narrower as it reaches the inner margin; on this band are metallic bluish scales; on the fold the transverse band is broken; beyond the band is a wavy dusky line; the terminal margin also lined with a dusky shade. Hind wings white, dusky outwardly. Expanse, 17 mm.

Not common. Earlier stages not known.

Clemensia albata Packard.

PLATE XV, FIG. 16. MALE.

Fore wings white, with numerous fine, brown scales. A transverse, anterior, median, posterior and terminal line composed of black spots, more or less distinct. The space between the median and posterior lines often filled with brown. On the disc is a rather large and distinct black spot. Hind wings dirty whitish, with a terminal row of black dots, often wanting. Expanse, 17–24 mm.

Not common. Found in woods in June. Early stages not known.

***Crambidia pallida* Packard.**

PLATE XV, FIG. 12. MALE.

Almost entirely uniform drab with the veins of the fore wings lined with a pale shade, and the hind wings basally somewhat paler. Expanse, 21 mm.

Rather rare in this neighborhood, being found in open meadows in August. Earlier stages not known. The moth resembles a *Crambus* in general appearance.

***Hypoprepia miniata* (Kirby).**

PLATE XV, FIG. 6. MALE.

Fore wings bright pinkish red with a broad longitudinal band beneath the costa, another similar band above the inner margin, and a short one from the outer margin to nearly the middle of the wing, all lead color. Hind wings with basal half red, outer half lead color. Abdomen pink in the male, and partly lead color above in the female. Expanse, 30-40 mm.

Found during July and August, and is common, though not abundant. Earlier stages not known. Possibly a variety of the following species.

***Hypoprepia fucosa* Hübner.**

Head and thorax yellow or pink; abdomen wholly pink in the male and lead color above in the female. Fore wings marked with broad lead-colored bands as in *H. miniata*, but the spaces between are yellow or partly pink outwardly. Hind wings largely pink with a narrow lead-colored outer border. Expanse, 25-30 mm.

Caterpillar.—Body dark reddish brown or brownish black, with a dorsal, stigmal and indistinct subdorsal yellow line; subdorsal space mottled with yellow; warts black, and from each proceeds one or two stiff black bristles; head brownish black with a few short whitish hairs on the face. Length, 16 mm.

Food-plants.—Mosses and Lichens growing on trees.

Not rare in July and August; sometimes quite common.

***Cisthene unifascia* (G. & R.).**

Head yellow; thorax yellow or partly lead color; abdomen pink. Fore wings slate gray, with a more or less broad yellow band across the outer third and a more or less broad yellow stripe along the inner margin from the base to

the cross band. Hind wings wholly pink or with the apex slate gray, or with a rather broad lead-colored outer border. Expanse, 14-19 mm.

Not common. Early stages not known.

***Cisthene subjecta* Walker.**

Head and abdomen pink; thorax yellowish. Fore wings lead colored with a yellow spot on the costa before the apex and a broad stripe of the same color along the inner margin. Hind wings pink with a lead-colored border. Expanse, 17 mm.

Caterpillar.—Form flattened and nearly the same width throughout. Pale cinereous, variegated with fine curved lines and dots of purple brown; medio-dorsal stripe pale, margined on each side with a distinct purple line, not continuous, but composed of very minute dashes and dots. Under side translucent buff. Head and legs colored similarly to the dorsum. Clothed with long, fine light hairs. Length, 10 mm.

Food-plant.—Lichens.

Not common in this vicinity. The species is probably double brooded. The moth appears in May and June, and young larvæ may be found late in fall and early in spring hibernating under bark; fully grown larvæ have been found in May. The pupa is formed in a thin web-like cocoon appressed to the under side of the bark.

***Lithosia casta* Sanborn.**

Body and wings pure white; under side of fore wings and costal half of hind wings cinereous. Expanse, 22 mm.

May be readily known by its pure white color. Found in dry sandy fields in August. The earlier stages are unknown.

***Lithosia bicolor* Grote.**

Head, thorax and abdomen slate gray; collar and tip of abdomen ochraceous. Wings above and below slate gray, with the costa of the fore wings ochraceous. Expanse, 25-33 mm.

A northern species possibly found in this vicinity. Earlier stages unknown.

Euphanessa mendica (*Walker*).

PLATE XV, FIG. 2. MALE.

Semitransparent, pale straw yellow with the borders deeper in color. Across the fore wings are two transverse rows of large and small spots and a single spot close to the outer border between veins three and four. Hind wings pale semitransparent yellowish. Body yellowish. Expanse, 22–30 mm.

Found in open woods in June and July. Early stages not known.

The species is placed by some authors in the Geometridæ, where it without much doubt belongs.

Euphanessa meridiana *Slosson*.

PLATE XV, FIG. 7. MALE.

Pale yellowish with two rows of small dots across the fore wings, one row before and one row beyond the middle. Hind wings yellowish. Expanse, 20 mm.

Very much resembles *E. mendica*, but it is smaller and yellower, and lacks the single spot between veins 3 and 4 close to the outer border. The rows of spots are also much smaller.

The early stages are not known. Placed by some authors in the Geometridæ. It appears in June and July.

Eubaphe læta (*Boisd.*).

Fore wings uniformly brown with the costa very narrowly brick-red. Hind wings with basal two-thirds bright brick-red, outer third black. Head, thorax and abdomen brown. Under side of all the wings with basal two-thirds brick-red, outer parts blackish brown. Expanse, 18–27 mm.

Found in dry woods in June. Early stages not known.

Eubaphe opella (*Grote*).

Fore wings tawny, sometimes shaded with more or less black. Hind wings reddish or partly so, with a discal spot. Expanse, 30–33 mm.

Var. **nigricans** *Reak.*—In this variety the whole insect is suffused with black, or the fore wings are tawny, with hind wings smoky brown.

Quite rare in this vicinity. It is found in dry hilly places, June-August. Early stages not known.

Eubaphe immaculata (*Rearkirt*).

Fore wings rosy red, or shaded over the entire surface with fawn color, or partly shaded with brown; sometimes there is a faint whitish spot below the middle of the wing. Hind wing rosy and without markings. Expanse, 20-30 mm.

Var. **trimaculosa** *Reak*.—Like *immaculata*, but with a subterminal row of three more or less distinct spots on the hind wings, and the two near the anal angle more or less connected.

Rather common, locally, in dry places, in overgrown fields. June-September. Early stages unknown.

Eubaphe aurantiaca *Hübner*.

Fore wings tawny brown to yellowish fawn color, sometimes with a decided rosy tinge, with a more or less obscure, distinct discal dot, and sometimes with one or more whitish spots. Across the outer part of the wing a more or less distinct transverse band. Hind wings rosy with a rather broad black outer border and discal dot; sometimes the border is more or less broken into spots and sometimes they are entirely absent. Expanse, 18-25 mm.

Var. **aurantiaca** *Hübner*.—Entirely immaculate. Fore wings pale, tawny yellowish. Hind wings rosy.

Var. **rubicundaria** *Hübner*.—Like *aurantiaca* but with a terminal black border on the hind wings.

Var. **ferruginosa** *Walk*.—Has the black terminal border on the hind wings broken into spots, and a discal dot.

Var. **brevicornis** *Walk*.—(Plate XV, Fig. 15.) Similar to *ferruginosa* but has the broad continuous terminal band on hind wing.

Var. **quinaria** *Grote*.—Fore wings brown with five whitish spots.

Var. **bimaculata** *Saund*.—Like *quinaria*, but has only one whitish spot on each of the fore wings.

Var. **choriona** *Reak*.—Like *quinaria*, but with two whitish spots on each of the fore wings.

Common in dry overgrown fields from June to September. The forms *ferruginosa* and *brevicornis* are most abundant. The form *aurantiaca* is more abundant southward, while *quinaria* and allied forms are quite scarce. Earlier stages not known.

Haploa clymene (*Brown*).

PLATE XV, FIG. 21. FEMALE.

Fore wings creamy white with a dark brown stripe along the costa, from the base nearly to the apex; another stripe along the outer border which is widest centrally, and another brown stripe along the inner margin, sending a blunt projection upwards to beneath the end of the cell. Hind wings yellowish ochereous, with a rounded dark brown spot beneath the middle. Head and abdomen ochereous; thorax creamy white with a broad dorsal band which runs to nearly the end of the abdomen. Expanse, 38-50 mm.

Caterpillar.—Bright yellow with white lateral stripe, mottled along its upper edge with bright red; anal end faced with red markings. Tubercles with brown hairs.

Not common. Found in July and August. More information is needed about the earlier stages and habits. The caterpillar lives on low plants.

Haploa lecontei (*Boisduval*).

Fore wings white; costa and inner margin broadly bordered with brown, and from a little below the apex to the outer fourth of the inner margin is an oblique transverse band, and two short transverse bands run from the costa to this oblique stripe, and one near the base of the wing from the costa to the stripe along the inner margin. The outer border is also rather narrowly bordered with brown. Sometimes the stripes are more or less broken, the white spaces between becoming confluent. Hind wings pure white. Head ochraceous. Thorax and abdomen white, with a brown stripe along the back. Expanse, 38-45 mm.

Var. **confinis** *Walker*.—White with costa and inner margin broadly striped with brown; an oblique band from the apex to the stripe on the inner margin near the hind end. It differs from the type form by the absence of the three short transverse bands. Sometimes there is a short projection from the costa in the white field, an indication of the middle band.

Var. **militaris** *Harris*.—White, costa, inner margin and outer border brown, as in the preceding form, but the oblique band from the apex is absent, being reduced to a short projection upwards from the stripe along the inner margin.

Var. **vestalis** *Clemens*.—This variety is white without any markings whatever. The head, legs and extreme edge of costa ochereous.

Caterpillar.—Black, with rich yellow dorsal and lateral lines.

Food-plant.—*Cynoglossum*.

Common in certain localities in New Jersey, especially near Plainfield. More information regarding the life history is needed.

Haploa contigua (*Packard*).

PLATE XV, FIG. 20. MALE.

Fore wings pure white, with a dark brown stripe along the costa to nearly the apex, and another stripe along the inner margin; from the costa, a little beyond the middle, is a transverse band running obliquely across the wing and joining the stripe along the inner margin at the hind angle; from a little below the apex is another stripe running downward and joining the oblique band at the middle. This latter stripe is sometimes absent. Hind wings pure white. Head ochereous; thorax and abdomen white with a brown stripe along the back. Expanse, 35-45 mm.

Rather scarce in this vicinity. Early stages not known.

Utetheisa bella (*Linn.*).

PLATE XV, FIG. 18. FEMALE.

Fore wings white with five broad orange or orange-ochereous transverse bands, between each of which is a transverse row of black dots in the white ground color. Hind wings bright pink with a black border and a subapical streak confluent with the border; before the anal angle is also a spot confluent with the border. Head and thorax white with black dots; abdomen white. Expanse, 32-45 mm.

Var. **terminalis** *N.* ♂ *D.*—Differs in having no pink on secondaries, being white with a black border. On fore wings the orange bands are indicated on costa and slightly near internal margin and subterminally. Black dots present only on costa, at base, and terminally.

Caterpillar.—Head chestnut brown, smooth, shining. Ground color of body deep buff, with orange tint. Each segment has a black transverse mark deeply notched before and behind, and edged broadly with white, bearing rather long hairs, those on the dorsal region black, of the lateral, white. Mouth parts white. Abdominal legs orange, banded with black and white. Length, 30 mm.

Food-plants.—Rattle-box (*Crotalaria*), *Lespedeza*, etc.

Very common in dry fields in June, and again more plentifully in August and September. Double brooded. The caterpillar spins a cocoon under stones and loose roots.

Cycnia egle (*Harris*).

PLATE XVI, FIG. 11. FEMALE.

Wings uniform leaden gray; fore wings sometimes sprinkled with paler shades. Head and thorax lead gray; abdomen ocherous above, with a row of black dots along the back and extreme sides, with the under side whitish. The abdomen of the female is blunt and tufted with whitish at the tip. Expanse, 33-44 mm.

Caterpillar.—Head glossy jet black. Body and legs blackish. Warts black, with bunches of rather long hairs along each side on the second, third, eleventh and last segments, those on the fourth and last two segments mixed with white. On each side of the back the tufts of hairs are orange and black along the middle. The hairs on the 2-4 and 11-12 segments are longer than the rest, and the hairs along the extreme sides are much shorter and mixed with white. Length, 30 mm.

Food-plants.—Various kinds of Milkweed.

Double brooded and common everywhere. The first brood of moths, which appears in June, is darker in color and without markings, while the second brood, which comes forth during the end of July to about the middle of August has a decided band and shades of whitish scales on the fore wings much paler than the ground color. The caterpillar lives socially, on the under sides of the leaves, and spins a cocoon, interwoven with thin hairs, on the ground under stones.

Cycnia tenera *Hübner*.

PLATE XVI, FIG. 10. MALE.

Wings pure white with the costa of the fore wings ocherous. Head, collar and anterior part of thorax ocherous, hind part of thorax paler. Abdomen ocherous, with a row of black dots along the back and sides. Under side whitish, with a row of obsolete black dots on each side. The costal region of the fore wings beneath is smoky brown. Expanse, 28-40 mm.

Caterpillar.—Head silvery gray. Body whitish, with all the warts concolorous, and the tufts of white hairs are spreading, forming an even coat and longer at the ends. Length, 28-30 mm.

Food-plants.—Dogbane (*Apocynum*).

Common wherever its food-plant occurs, and double brooded, occurring from June to the middle of August. The larva feeds

at night, usually hiding during the day at the foot of the food-plant. Spins a rude cocoon intermixed with its hair.

Cycnia eglensis (*Clemens*).

Wings uniform lead gray, with the costal edge of the fore wings to about the middle narrowly margined with orange ochereous. Head orange ochereous. Thorax lead gray, with an orange ochereous spot on each side in front in line with the stripe on the costa. Legs, and thorax beneath, mouse gray; coxæ of anterior legs orange ochereous. Abdomen ochereous above, with a row of black dots along the back and sides. Under side of wings lead gray. Expanse, 28-35 mm.

Summer form: inopinatus *Hy. Edwards*.—Wings almost pure white or leaden white, otherwise marked with ochereous like the lead-colored form.

Caterpillar.—Head small, shining, dull orange. Body orange, somewhat paler than the head, with small black warts, each of which bears a thick bunch of evenly cut, dark mouse gray hairs, those on the third segment longer, and those on the second segment still longer, and directed forwards over the head. Length, 25 mm.

Food-plants.—Different species of Milkweed.

The moths from the pupa which have over-wintered are lead gray, and the offspring from this brood are whitish lead color or almost pure white and resemble *C. tenera*, but differ in having the thorax light lead color, while in *tenera* the anterior portion of thorax is ochereous. The ochereous costal stripe is also narrower than in *tenera*.

The gray form appears in May and June, and the white form the middle of July. The larvæ live socially when young, but scatter as they grow older. They form their cocoons under loose stones or leaves. The cocoon is composed of the hairs of the larva held together by silken threads.

Cycnia oregonensis (*Stretch*).

Fore wings very light smoky brownish, with the veins whitish. Hind wings white. Under side of wings like the upper. Head orange ochereous. Thorax light in front, paler behind. Abdomen ochereous, with a row of black dots along the back and sides. Under side pale smoky brown. Expanse, 37 mm.

Very rare. More common in the Northern States, and found from the Atlantic to the Pacific coast. Earlier stages not known.

[*September, 1898.*]

***Halisidota tessellaris* (A. & S.).**

Pale straw color with fine darker transverse bands which are lined on each side with blackish brown. The middle band does not reach below the middle of the wing; at the extreme base is also a trace of a band. Sometimes the bands are more or less broken or confluent. Hind wings semitranslucent, pale straw yellow. Head and thorax straw yellow, the patagia lined with green inwardly. Abdomen ochereous yellow above, straw yellow beneath. Expanse, 38-48 mm.

Caterpillar.—Head polished black, mouth parts varied with white. Body black above, pale on the under side, covered above with dense hairs, proceeding from little warts in evenly-shorn brushes or tufts, which vary in color in different specimens from light gray to brownish gray and from yellow to ochre yellow and pale yellowish brown. On the second segment behind the head is a lateral black pencil and two white ones under it, the black pencils directed forwards. On the third segment one lateral black pencil and one white one under it. On the eleventh segment one lateral black and white pencil directed obliquely backwards, and one on the twelfth segment which is either whitish or the color of the tufts of the body. Length, 30 mm.

Var. *Living on Sycamore*.—Head pale orange brown, labrum and antennæ white. Body white with black warts; hairs pale straw yellow or whitish, with orange and white pencils.

Food-plants.—Oak, Chestnut, Hornbeam, Willow, Poplar, Elm, Beech, Juneberry, Locust, Maple, Sweet-gum, Tulip-tree, Hickory, Walnut, Witch-hazel, Ash, Huckleberry, Linden, Sycamore, etc.

Very common everywhere in this neighborhood. The larvæ are very variable in color in different individuals, which feed upon many kinds of plants, while those which feed on the Plane tree or Sycamore (*Platanus*) are always pale straw yellow or whitish with the head pale yellowish brown and the pencils orange. The moth makes its appearance during June and July, and is single brooded. The larva when fully grown spins an elongate oval cocoon chiefly composed of its hairs, which are held together by loose silk. While there is considerable variation in the caterpillars which feed upon mostly all kinds of plants from those which live on the Sycamore, the moths, however, are exactly the same in color and markings.

***Halisidota caryæ* (Harris).**

PLATE XVI, FIG. 13. MALE.

Fore wings pale straw yellow, heavily washed with ferruginous scales forming a shade beyond the cell to the apex; from near the base of the costa to

above the hind angle is a transverse ferruginous streak or line. Across the wing are five rows of rounded spots, the middle row not extending across the wing; the three outer rows are white and the two basal rows pale straw yellow. The veins are also marked with ferruginous. Hind wings pale straw yellow. Head, thorax and abdomen above straw yellow, the thorax with brown marks. Under side pale straw yellow. Expanse, 40-50 mm.

Caterpillar.—Head shining jet black. Body whitish with black spots and warts; junction of segments also black. Bunches of hairs from the warts white, and a row of eight black tufts along the back from the fourth to last segments; two long pencil-like black tufts on the fourth and tenth segments, and four white pencils on the second and third, and two on the eleventh and twelfth segments. Legs black outside. Under side of body transversely streaked with black. Length, 38 mm.

Food-plants.—Oak, Elm, Hickory, Walnut, Maple, Willow, Poplar, Chestnut, Ironwood, Hornbeam, Linden, Larch, Locust, Apple, Cherry, etc.

Very common everywhere in this neighborhood. The moth lays her eggs in a mass on the under side of a leaf, and the young larvæ live socially until they have reached their last moult, when they scatter over the tree. The cocoon is oval, much larger than that of *tessellaris*, and grayish with many fine spinules from the hairs of the larvæ protruding. It is single brooded, the moth appearing late in May and in June, and the larvæ in June to September.

***Halisidota maculata* (Harris).**

Fore wings light yellow with five or six more or less distinct confluent transverse bands of a rusty brown color. Hind wings pale straw yellow. Head, thorax and abdomen light yellow: the thorax sometimes having two brown streaks or shades. Expanse, 35-44 mm.

Caterpillar.—Head black with a faint white streak down the front as far as the middle, where it becomes forked. Body above black, with the hairs from the warts thick. On the second, third and fourth segments the hairs are mixed with yellow and black, those on the second and third segments overhanging the head. From the fourth to the eleventh segments, inclusive, is a row of black tufts along the back, the largest of which are on the tenth and eleventh segments. The fourth and eleventh segments have also a black pencil on each side. The hairs on the sides of the body, from the fifth to the tenth segments, are bright yellow, while those on the sides of the last segment are mixed with black. On the third, fourth, eleventh and twelfth segments are a few long, spreading hairs, much longer than the rest. Length, 38 mm.

Food-plants.—Willow, Alder, Oak, Poplar.

The moth appears early in June, and the larva may be found in August and September. The cocoon is yellowish gray, oval, and is constructed of silk, with the hairs of the caterpillar interwoven. Quite rare in this vicinity, but common in the Northern States, and westward.

Ecpantheria ocularia (*Fabr.*).

PLATE XVI, FIG. 12. FEMALE.

Fore wings white with transverse rows of black spots or rings more or less filled with black. Hind wings white with a black streak along the inner border, and in the female a terminal row of large and small black spots. Thorax with black rings in the female, and in the male these are usually spots with metallic blue reflections. Abdomen black with a metallic reflection; along the back a row of quadrate orange spots and a lateral irregular line. Expanse, male, 55-65 mm.; female, 75 mm.

Caterpillar.—Head black, polished, brown at sides and below. Cervical shield brown black. Body above black, inclining to brown laterally, bright red-brown between the segments, showing in strong contrast, especially between segments three to ten, when the larva curls up, but scarcely visible when straightened out and contracted. Warts with long, stiff, bristle-like black hairs. Under side purplish brown, as are also the legs. Length, 60 mm. or more.

Food-plants.—*Plantago*, and other low plants.

Not common. The moth comes forth in May and June, and the caterpillar becomes fully grown in August or early fall, in which state it over-winters. It feeds mostly at night, and during the day usually hides under loose stones or bark, especially the latter. In early spring the caterpillar feeds for a few days on low plants, and then forms a loose, thin cocoon, through which the pupa can be seen. The caterpillar when disturbed rolls up in a ball or hedgehog-like manner, and then the sutures of the joints are seen to be red, in strong contrast to the rest of the body.

Leucarctia acræa (*Drury*):

PLATE XVI, FIG. 7. FEMALE.

Fore wings white, with many small black spots, sometimes forming irregular transverse rows. Hind wings of the male ochereous, with a few black spots. Hind wings of female white with a few black spots. Head and thorax white. Abdomen ochereous above, last two segments and under side white; along the back and sides a row of black spots. Expanse, 45-63 mm.

Caterpillar.—Head glossy black, with the suture in front white. Body along the dorsal region dark sepia brown, minutely speckled with black. Along the sides there are indications of two very much broken stripes on a paler ground. Spiracles white and conspicuous. Warts along the back blackish with the long hairs sepia brown. Warts along the sides dull orange with the hairs orange brown. Sometimes the hairs on the back are the same as along the sides. Length, 60 mm.

Food-plants.—Clover, *Melilotis*, *Plantago*, Dock, and many other species of low plants.

Common everywhere and double brooded, the first brood of moths appearing in May and June, and the second in July and August.

Pyrrharctia isabella (A. & S.).

PLATE XVI, FIG. 5. FEMALE.

Fore wings ochereous yellow, with a small blackish spot at the end of the cell and traces of dusky, wavy transverse bands, these bands more or less distinct or wanting. Hind wings in the male pinkish; pale whitish ochereous in the female, with discal and submarginal spots. Head, thorax and abdomen ochereous, the latter with a dorsal and lateral row of black spots. Expanse, 45-55 mm.

Caterpillar.—Head jet black, shining. Body black. Warts and hairs on first four and last three segments wholly jet black, while those on the segments between are rusty brown, standing in strong contrast with the black ends of the body. Hairs strong and bristle-like, and very dense. Length, 40 mm.

Food-plants.—Almost all kinds of low plants.

Very common everywhere, especially in open fields and vegetable gardens. It is double brooded, the first brood appearing in June and the second in August. The caterpillar may be readily known by its reddish brown color with each of the ends black for some distance. It hibernates under loose stones, boards or bark of trees. Spins an oval cocoon.

Phragmatobia fuliginosa (Linn.).

PLATE XVI, FIG. 6. FEMALE.

Fore wings dark blackish brown with a reddish tinge, sometimes with one or two dark, wavy transverse lines, and with a dark spot at the end of the cell. Hind wings reddish with a black outer border which is sometimes broken; sometimes the entire outer half is black or with only a little red at base, or it is

entirely black. Head and thorax deep brown red. Abdomen red with a black line along the back and a lateral row of spots. Expanse, 30-35 mm.

Caterpillar.—Head small, polished, black. Body black or slate color, with pale yellowish dorsal and lateral lines, the space between them being closely covered with black waved lines formed of transverse specks. Spiracles clear white, sometimes with a broad yellowish line below. Under side of body black. Warts on body black, each with a dense bunch of chestnut colored or ochreous brown hairs, all of equal length. Length, 28 mm.

Food-plants.—Golden-rod, Skunk-cabbage, *Eupatorium*, Iron-weed (*Vernonia noveboracensis*), and other low plants.

The caterpillar when disturbed falls to the ground, concealing itself at the base of its food plant, and the moth has much the same habit. It is found in swampy meadows overgrown with low plants. The caterpillar hibernates and may be found fully grown in early June. It spins a very thin cocoon, lace-like, oval, and very regular in outline, attached to the under side of a leaf. Double brooded—May-June, and again in August.

***Spilosoma virginica* (Fabr.).**

PLATE XVI, FIG. 8. FEMALE.

Wings pure white, with a very small black dot on the fore wing at the end of the cell, and sometimes with one or two additional spots. Hind wings with two or three black spots. Sometimes all the spots are wanting. Head and thorax pure white, abdomen orange sublaterally, white along the back with a row of black spots and another row along the sides. Femora and tibiae of fore legs orange. Expanse, 35-50 mm.

Caterpillar.—Body and head varying from white to brown and even deep blackish brown. The warts each have a bunch of long, woolly hairs, of same color as the body, which readily drop off when the larva is handled. Spiracles white. Expanse, 40 mm.

Food-plants.—All kinds of low plants growing in gardens and fields.

Very common everywhere. The moth appears in May and June, and again in August. The caterpillar may be easily known by its woolly hairs varying from white to deep blackish brown. It is exceedingly abundant, and sometimes does considerable damage, especially to garden plants. When fully grown it spins an oval cocoon, composed of its hairs, interwoven with fine silk.

***Spilosoma antigone* Strecker.**

Wings pure white, fore wings more or less spotted with black, sometimes the spots are in the form of a subterminal row. Hind wings white. Head, thorax and abdomen white. Fore femora and coxæ orange. Expanse, 40-45 mm.

Caterpillar.—Head and legs black. Body along the dorsal area blackish; sides brownish, with a wine-red tinge. Along the sides above the spiracles is a row of reddish spots, one spot to each segment. The junctions of the segments on the back are dirty whitish. Warts deep black with the bunch of hairs on each jet black, stiff and bristle-like. Length, 40 mm.

Food-plants.—Various kinds of low plants.

The moth is found in May and June, and again late in July and early in August. The larva may be known by its bristly jet black hairs and row of red spots along each side. It often bores in the stems of large mushrooms. The cocoon is oval, composed of fine silk woven with the hairs of the caterpillar. Double brooded.

***Spilosoma latipennis* Stretch.**

Wings entirely pure glossy white. Head, thorax and abdomen white, above and below. Fore coxæ and femora red, very rarely yellow. Expanse, 35-40 mm.

Caterpillar.—Head yellow brown, median suture deep, mouth parts darker. Ground color of body dark slate gray, somewhat mottled; sometimes varying from light gray to slate, or to almost black, but always covered with black irrorations; pale individuals have the first segment almost colorless, whitish; under side dark slate to olive gray. Feet dirty white, especially so in pale individuals. Junctions of segments paler than ground color. Warts somewhat lighter than ground color with the hair foxy brown, somewhat darker at tip, giving them a chestnut appearance, paler on first segment and along sides. Length, 40 mm.

Food-plants.—Jack-in-the-pulpit (*Arisæma triphyllum*), Touch-me-not (*Impatiens*), *Plantago*, and other low plants, and Wild Cherry.

The moth makes its appearance during the latter part of May and in June, and the larvæ may be found fully grown in June to August. It is, as far as we are aware, single brooded, and is found in swampy meadows. The cocoon is oval and composed of fine silk and hairs of the larva, and is formed on the ground between leaves or under stones.

Hyphantria cunea (*Drury*).

PLATE XVI, FIG. 9. MALE.

Fore wings pure white, more or less covered with black spots, and when all are present they form six curved rows. Hind wings with one or more black spots. Femora of fore legs yellow.

Var. **budea** *Hübner*.—Entirely pure white without any spots whatever.

Expanse, 25-35 mm.

Caterpillar.—Head shining jet black. Dorsal region black, limited on each side by a wavy, broken, yellow line. Below the spiracles is a similar line; the space between these lines is very pale yellow and more or less sprinkled with minute black dots, giving the space a grayish appearance. The warts on the back are black, and orange in the light lateral area. Hairs from the warts white, with a few black ones. Under side black. The larva is subject to much variation, sometimes it is almost brown, with the sides but little paler, and the hairs tawny brown and whitish along the sides. Length, 30-35 mm.

Food-plants.—Oak, Chestnut, Birch, Maple, Elm, Locust, Poplar, Willow, Alder, Dogwood, Basswood, Apple, Cherry, Pear, Walnut, Hickory, and many other kinds of trees and shrubs.

The caterpillar, which is known as the "fall web worm," spins a large web over the branches of the tree, living in large colonies in the web. The eggs are laid in masses on the trunk or branch of a tree. The moth is double brooded, and makes its appearance late in April or early in May to June. The second brood appears in July and August. The caterpillars form their cocoons in masses under stones, fence rails or loose bark. The cocoon is oblong oval, and consists of loose silk and the hairs of the caterpillar. Very common everywhere.

Platarctia hyperborea (*Curtis*).

Fore wings coffee brown, with several light yellow spots along the costa and the submedian fold; sometimes these spots are connected, thus forming transverse bands. Hind wings ochre yellow with a black band beyond the middle, basal half black, with a band connected by rays with the black base, sometimes with a black discal spot. Head red; thorax brown with a light yellowish stripe on each side from the head to the end of the patagia. Abdomen black above, sides and tip ochreous. Expanse, 45-65 mm.

Exceedingly rare in this neighborhood; only a single specimen has been taken. It is more common in the northern parts of America.

Hypercompa caja var. **americana** (*Harris*).

Fore wings brown, with a transverse white band near the base, one beyond the middle and a subterminal one; the bands are angular and the outer two become joined at the middle, and the basal band is connected with the one beyond the middle by a band along the submedian fold; on the costa are also two white spots. Hind wings vary from red to yellow, with three or four large blue-black spots and one or more discal spots. Head and thorax brown; collar edged with red behind and broadly with white in front; patagia white at sides; sometimes this white line is almost absent. Abdomen red with a row of black spots along the back; under side brown. Expanse, 55-70 mm.

Caterpillar.—Body velvety black brown, with the hair on the first and fourth segments ochre brown; back with long black hairs; at the sides the hairs are also ochre brown; third row of bunches of hairs made up about equally of brown and gray hairs. Spiracles yellowish white. Feet and legs brown. Length, 45 mm.

Rare near New York City, but quite common in the northern part of the United States and Canada, and westward. The species is single brooded, and hibernates in the larval state. The cocoon is loosely woven together with hairs from the caterpillar.

The moth appears in June. The species is European, and several varieties occur in this country. Var. *opulenta* has the fore wings almost white. Var. *utahensis* has yellow hind wings, and broad white bands on the fore wings. Var. *transmontana* is more marked with white than *utahensis*, less so than *opulenta*. The form *caja* has red hind wings, and inhabits the Pacific Northwest.

Arctia virgo (*Linn.*).

PLATE XVI, FIG. 3. MALE.

Fore wings black with the veins, margins and markings pinkish buff, breaking the ground color into squares, triangles and streaks; on the outer part is a large Σ -shaped mark, the middle angle of which is connected with a transverse band which meets a longitudinal band running from the base of the wing; in the cell is also a short transverse band. Hind wings bright red with seven or nine large black spots. Head black, top pinkish cream color. Thorax black with four pinkish cream-colored stripes. Abdomen red with a black band composed of spots along the back. Under side of body black. Expanse, 40-60 mm.

Var. *citrinaria* *N. & D.*—Has the hind wings yellow instead of red.

Caterpillar.—Head dark brown, shining; legs and feet flesh-colored. Body deep rich blackish brown almost black, with a narrow dorsal dirty flesh-colored

stripe. Spiracles clear yellow. Body with six rows of prominent flesh-colored or yellow tubercles on each side of the dorsal line, each tubercle carrying a bunch of unequal stiff, black and brown hairs. Length, 43 mm.

Food-plants.—Different kinds of low plants.

Not common, inhabiting swampy meadows. The imago appears from May to August, and the larva hibernates when partly grown and completes its growth the following spring. Possibly double brooded.

***Arctia virguncula* (Kirby).**

Fore wings black heavily streaked with creamy white or yellow, and an outer Σ -shaped mark of the same color. Hind wings ochre yellow with black spots, which are sometimes more or less confluent. Expanse, 37-43 mm.

Caterpillar.—Body black with tubercles of the same color. Hairs along the spiracle region reddish brown, the rest black. Head shining black. Length, 37 mm.

Food-plants.—Various kinds of low plants.

May be readily known by its black color with yellow streaks and outer Σ -shaped mark. Rare in this vicinity, and single brooded. The imago appears in June, and the larva hibernates. It is more common in the Northern Atlantic States.

***Arctia persephone* Grote.**

Fore wings black with the streaks and Σ -shaped outer mark as in *A. virguncula*, but with two transverse bands preceding this mark. Hind wings ochre yellow with a broad outer black band occupying nearly half the wing, and one or two black discal spots. Sometimes the outer band is broken into spots or the wings are entirely black, and the discal spots are also sometimes wanting. Expanse, 40-45 mm.

Caterpillar.—Body and hairs black; warts shining black; ends of feet pale. Head with back and sides brownish, antennæ and line above the mouth pinkish. Length, about 40 mm.

Food-plants.—Various low plants.

Not common in this vicinity. The form with entirely black hind wings is called variety *anna*, and the yellow winged, *persephone*. Single brooded, the moth appearing in June, and the larva ceases

feeding late in August and early in September, and begins hibernation soon afterwards. Spins a cocoon.

Arctia parthenice (*Kirby*).

Color same as *virgo*, from which it differs by being smaller and having the transverse band before the Σ -shaped mark less angular, the median vein only narrowly lined with pale. Hind wings with a terminal row of black spots, sometimes more or less united and forming a border. A discal spot is also present, while in *virgo* there are several. Expanse, 30-40 mm.

Var. **approximata** *Stretch*.—Like the type form, but the outer transverse band is partly broken.

Quite scarce in this vicinity, but common northward. Single brooded. Larva unknown.

Arctia rectilinea *French*.

Color and markings very similar to those of *parthenice*, but the outer transverse band is straight instead of angulated at the median vein, and the inner band is less oblique, thus making the bands more parallel than in *parthenice*. Expanse, 30-40 mm.

This is possibly not distinct from *parthenice*. It is said to be rare in the Atlantic States; we have no record of its occurrence in this vicinity.

Arctia intermedia *Stretch*.

Similar in color and markings to *A. parthenice*, but differs in having three transverse bands on the fore wings, instead of two as in *parthenice*. It is also larger. Expanse, 45-50 mm.

Said to be found from New York to Texas, and possibly may occur in this vicinity. Probably nothing more than a variety of *parthenice*.

Arctia arge (*Drury*).

PLATE XVI, FIG. 4. FEMALE.

Pale pinkish cream color with the pale streaks all very broad, thus breaking up the black into small spots and streaks. The outer Σ mark, the transverse band, and two abbreviated bands in the cell are present. Hind wings pale

whitish in the male, pinkish in the female, with a narrow salmon-red margin before the fringes, a marginal row of black spots, and one or more discal spots. Costa of wings heavily marked beneath with orange red. Body pale pinkish cream color. Thorax with three black stripes, abdomen with a row of black spots along the back, a row at the sides, and another row at the sides beneath. Expanse, 33-45 mm.

Caterpillar.—Head black, shining. Body blackish brown with velvety black shades between the tubercles. Along the back is a broad pinkish white stripe, and one on each side of the subdorsum. Beneath the spiracles is a zigzag stripe, and between the tubercles on each side is a spot of the same color. Each tubercle has a bunch of brown hairs, those along the extreme sides with white hairs. Abdominal legs pale flesh-color. Thoracic feet black. Length, 43 mm.

Food-plants.—Corn, *Chenopodium*, *Plantago*, and various kinds of low plants.

Rather common, especially in open fields. Double brooded, June to August. The caterpillar hibernates and spins a loose cocoon.

Arctia michabo Grote.

Fore wings with the veins and margins pale pinkish, the streak along the median vein very broad. Outer Σ -shaped mark very broad, as is also the transverse band; two abbreviated bands in the cell. Hind wings salmon red with a terminal row of black spots and two or more discal spots. Under side of all the wings with the markings from above repeated, but the pale marks on the fore wings are salmon pink. Head and thorax pale pinkish; the latter with three black stripes. Abdomen salmon pink above and below, with a row of black spots along the back, a row along the sides, and another row on each side beneath. Expanse, 45 mm.

Found from Canada to Florida, and westward to Nebraska, and undoubtedly also found in this neighborhood. It looks like *arge*, but the black marks on the fore wings are twice as broad, and the light parts pinker. Hind wings above and below salmon pink, as are also the fore wings beneath, and with black spots. The larva is not known.

Arctia phyllira (Drury).

Fore wings deep brown black with a distinct cream-colored outer Σ -shaped mark and two straight, parallel, oblique bands from the costa to the straight broad band along the median vein; sometimes the inner band is abbreviated. Hind wings red with an outer row of black spots. Expanse, 32-40 mm.

Var. **figurata** *Drury*.—Fore wings brown black, with the outer Σ -shaped mark wanting, and the hind wings red with a broad brown black border and discal spot.

Var. **celea** *Saunders*.—Fore wings as in *phyllira*. Hind wings light brown, with two irregular yellow spots about the middle of the wing, and a stripe of the same color extending from the base along the submedian vein to within a third of the hind margin; inner margin yellow.

Var. **excelsa** *Neum.*—Hind wings black with a large bright red discal spot of irregular shape.

Very rare in this vicinity, but more common in the Southern States. Double brooded, the first brood appearing in May and the second in July. The caterpillar is said to be jet black. The figure given by Abbot and Smith has a row of yellow spots along the back and sides.

Arctia nais (*Drury*).

PLATE XVI, FIGS. 1 AND 2. MALE AND FEMALE.

Fore wings black with a broad pale ochereous costal stripe, the costal edge black and connected at the end with a short oblique transverse band, which unites the broad stripe along the middle of the wing with the outer Σ -shaped mark. The central band sends out a branch from the middle to the hind angle, connecting with the lower limb of the Σ -shaped mark, leaving a small triangular black space at the angle. Often the outer mark is broken or is obsolete. Inner margin of wing ochereous. Hind wings ochereous, sometimes pink with an outer black border sometimes more or less broken into spots. Abdomen ochereous above with a black stripe; under side wholly black. Σ panse, 25-35 mm.

Caterpillar.—Head black, shining. Body black with a flesh-colored or reddish dorsal stripe. Warts with hairs, black. Length, 25-28 mm.

Food-plants.—Various kinds of low plants.

Common in open fields and vegetable gardens. Double brooded. May-August.

Arctia vittata (*Fabr.*).

Allied to *nais*, but the hind wings are usually pink. Markings on fore wings as in *nais*, but the costa lacks the black edge, and in the female the outer Σ -shaped mark is usually wanting; the hind wings have a very broad black border, which is sometimes broken into spots, and with a distinct discal spot,

when not confluent with the border. Stripe on abdomen of male very broad; in the female the abdomen from the fourth to last segment is wholly black. Expanse, 30-42 mm.

Caterpillar.—More robust than *nais* and *vittata*. Black, with tubercles also black, from which arise tufts of black hairs. Length, about 25 mm. or more.

Food-plants.—Various kinds of low plants.

Common in open fields. Double brooded; May to August. Sometimes partly three brooded. The caterpillar hibernates and spins a cocoon in early spring.

Arctia phalerata Harris.

Allied to *vittata*, but less robust, and as in this species the pale costal stripe touches the costa, and lacks the black edge which is present in *nais*. The markings are similar, but the outer Σ -shaped mark is nearly always present, being very rarely absent. Hind wings of male usually buff pink or buff, with pink inner margin; costa black, outer row of spots usually small and often absent. Abdomen buff or pink in both sexes, with a black stripe along the back as in *nais*, and the female has never the last four segments wholly black, as in *vittata*. Hind wings of female rosy pink, with larger spots, which are sometimes confluent. Expanse, 30-37 mm.

Caterpillar.—Head and body black; tubercles black with black hairs along the back and foxy brown hairs along the sides. Length, 25-28 mm.

Common in open fields and double brooded. The caterpillar hibernates.

Notolophus definita (Packard).

Dark gray, more or less heavily shaded with black between the transverse lines, and sometimes clouded with dark ochereous. The black shades are sometimes in form of transverse bands. White spot near hind angle more or less distinct. Hind wings uniform fuscous. Expanse, 25-35 mm. The female is wingless.

Caterpillar.—Head yellow. Body pale yellow, almost colorless, dorsal band, replaced on joints,—on joint 1 by the yellow cervical shield, becoming narrow and greenish on joints 2 and 3, widening and enclosing the yellow dorsal brush-like tufts on the fourth to seventh segments, and narrowing on the eighth to eleventh segments. A narrow subdorsal and stigmatal, similarly colored lines. Sometimes these bands are more or less black, gray or brown, and there is a velvety black spot between the dorsal tufts on segments 5, 6 and 7. Warts all yellow. Pencils on first segment long, plumed, black; that on the eleventh seg-

ment light brown with a few black plumes. Other hairs long, thin and white. Length, 40 mm.

Food-plants.—Willow, Oak, Linden, Witch-hazel, Maple, etc.

Very rare in this vicinity, but quite common in certain parts of Connecticut and New York State (Catskills). It is double brooded, May to September. The cocoon is pale yellow, and in structure it is like that of *N. leucostigma*. The pupa is pale yellow, with thin silky hairs, and the larva does not differ structurally from that of *leucostigma*, but differs markedly from it in color, especially by the yellow head, cervical shield and tufts.

Notolophus leucostigma (*A. & S.*).

PLATE XVII, FIG. 16. MALE.

Fore wings with basal and outer third mouse gray; middle third suffused with gray, limited outwardly by a narrow, transverse dark line; a more or less distinct reniform spot in the cell. Through the outer third is a narrow, wavy, grayish line; before the hind angle a distinct white spot, and on the costa an irregular white spot. Across the basal third is a wavy grayish line, sometimes almost wanting. Hind wings uniform mouse gray. Expanse, 25-35 mm. The female is wingless.

Caterpillar.—Head and cervical shield bright coral red. Along the back is a velvety-black stripe broken on the 4th-7th segments by the four bunches of white brush-like tufts. Body yellow, sometimes grayish or blackish along the side. On each side of the first segment is a long black pencil, and one on the top of the eleventh segment. Tubercles yellow, with the hairs white. Length, 40 mm.

Food-plants.—Oak, Elm, Horse-chestnut, Beech, Chestnut, Maple, Willow, Hickory, Pear, Apple, Plum, Quince, Larch, Spruce, and a variety of other plants.

Exceedingly common everywhere, but especially in city parks and on the shade trees lining the streets. It sometimes does considerable injury to the trees by stripping them of all their leaves. It is double brooded, from May to September.

Notolophus antiqua (*Linn.*).

Fore wings rusty brown with darker transverse lines and shades, and a bright white spot before the hind angle. Hind wings bright, uniform rusty brown. Expanse, 25-35 mm. Female wingless.

Caterpillar.—Head black, shining. Body deep smoky black with a velvety black stripe along the back, which is broken on the fourth-seventh segments by four bunches of buff-colored brush-like bunches of hairs. Pencils on first and eleventh segments black; cervical shield and tubercles red. Hairs white along sides, brownish on the back. Along each side, below the spiracles, is a broken yellow stripe, and on the last three segments are two yellow stripes on each side of the velvety black dorsal band. Length, 25–30 mm.

Food-plants.—Pear, Apple, Rose and other plants of the family Rosaceæ; also various other kinds of deciduous trees.

This European species is found in Canada and Northern United States, from the Atlantic to the Pacific. It is found as far south as Albany, N. Y., and possibly may also occur in this vicinity. The moth may be readily known by its rusty brown color.

Olene achatina (A. ♂ S.).

Fore wings dark brownish gray, with a pale shade between the two irregular black transverse lines; sometimes the wings are more or less washed over with a rusty brown shade between the lines, and have an ill-defined dark terminal line. Hind wings uniform brown gray, showing traces of a median band and discal spot. Expanse, male, 35 mm.; female, 45–50 mm.

Var. *parallela* G. ♂ R. (Plate XVII, Fig. 18).—Like the preceding, but with a black dash along the median vein to the outer transverse line.

Caterpillar.—Head shining, dark brown, rather hairy, mouth parts lighter. Body dark slate gray, almost black, velvety; stigmatal region light yellowish gray, almost the color of the vestiture; this color spreads in fine lines across the segments. Spiracles white. Under side black; legs whitish. The hair of the larva is mouse gray, feathered and soft. On the second and third, but far more so on the fourth, fifth, sixth and seventh segments, the dorsal warts are ridge-like, enlarged but low, with the hair tufts arising from them covering the entire dorsal region. On the sides, above the spiracles, the warts on the first segment are without feathery hairs, the small warts bearing some spreading hairs; on all the other segments these warts are provided with bushy, rounded tufts of feathery hairs. The warts below the spiracles have longer, bushy, fringe-like, spreading hairs. On each side of the first segment is a black pencil, and there is a similar one on top of the last segment. The black dense tuft on the dorsal warts on the fourth segment slightly longer than the surrounding hairs; dorsal tufts on the fifth, sixth and seventh segments mixed with dark hairs. On the eleventh segment the rounded black tuft arising from the two warts is still higher. The vestiture on the ninth and tenth segments is more scant and the larva skin always visible. The amber-colored, cylindrical excrescences between the dorsal

warts are scarcely one-third the length of the adjoining hair. Length, 30-34 mm.

Food-plants.—Plum, Pear, Oak, Hickory, Chestnut, Cherry, etc.

Not common, and single brooded. The moth may be found in July; the larva stops feeding when about half grown, and winters over. Rarely part of the brood become fully fed and emerge during the same season. They may be found again in early spring when the leaves are just coming forth. The caterpillar, when at rest, bends the head down, and as the vestiture on the next segment is richest and longest, it presents an almost humped appearance.

Olene leucophæa (A. & S.).

Fore wings with two irregular transverse black lines. Space between the lines white, powdered with black scales and shaded with ochreous. Basal area ochreous, shaded with dark brown; terminal area dark brown and ochreous in the male; female has a series of dark dashes on an ochreous or brown ground, sometimes mixed with whitish. Expanse, male, 35 mm.; female, 45-50 mm.

Caterpillar.—Head black, whitish above the mouth. Body pale whitish with a yellowish tinge, shaded and marked diffusely with black; a dorsal and stigmatal band indicated. On joints 4, 5, 6, 7 and 11, the warts have large, square, brown tufts, mixed at the sides with white, plumed hairs, the tuft on joint 11 black and contrasting with the others. Hairs along the sides dirty white mixed with a few black ones. First joint with a long black pencil on each side, and a similar one on the last segment; segments 9 and 10 with a whitish retractile tubercle. Length, about 30 mm.

Food-plants.—Hickory, Oak.

Not common, and single brooded. The larva hibernates when nearly full grown, and becomes fully fed the following spring. The moth is found in July.

Olene plagiata (Walker).

Fore wings dark gray, irrorated with black, pulverulent scales, obscuring the markings, especially in the female; two transverse, dark, wavy lines, between which is a large whitish area on the costa. Outer part of wing with black dashes. Hind wings uniform fuscous. Expanse, male, 30-35 mm.; female, 40-45 mm.

[September, 1898.]

Caterpillar.—Body dark gray, with a bunch of evenly cut hairs on top of joints 4, 5, 6 and 7, mouse colored, sprinkled with white; on each side of the first and last segments, and on top of eleventh segment is a pencil of long black hairs which are knobbed at the outer end; on top of segments 9 and 10 is a small reddish retractile tubercle; hairs on sides of body quite long, mouse colored. Head shining black. Length, 30 mm.

Food-plant.—Oak.

Quite scarce, and single brooded. The larva hibernates, and may be found in May to July the following year. The moth comes forth in July and August.

***Olene cinnamomea* (G. & R.).**

Fore wings with basal and outer third dull cinnamon brown, median space brownish gray, limited on each side by a narrow undulating, brown transverse line. Reniform spot ill-defined, with the broken outline black. Across the outer third is a transverse whitish shade. Body dull cinnamon brown. Expanse of male, 35 mm.; of female, 45 mm.

As far as we are aware, this insect, like its congeners, is single brooded, the moth appearing during the latter part of July and early in August. The caterpillar hibernates before it is fully grown, and may be found again the following spring. It spins a loose cocoon, mixed with its hairs.

***Porthetria dispar* (Linn.).**

Male.—Dark smoky brown. Fore wings crossed by four dentate, dark lines, one on basal third, one on the middle, and two subterminal ones. Two discal dots, the outer one lunate. Fringe spotted with dusky. Expanse, 25-37 mm.

Female.—Much larger and heavier than the male. White, with tip of abdomen brown. Fore wings with four transverse dentate lines, placed as in the male, but heavier on the costa. Discal spots also present. Antennæ black. Expanse, 45-55 mm.

Caterpillar.—Head dull yellowish sprinkled with black or brown, and with two vertical stripes in front. Body dull yellow, thickly sprinkled with black dots and irrorations, giving a general dark gray appearance, and leaving a narrow dorsal line of another color. The tubercles on the back of the first, fourth or fifth segments are bluish, and those on the remaining segments red. Tubercles along sides reddish. Length, about 50 mm.

This is the well-known Gipsy Moth, which is doing so much damage in Massachusetts. It is not found in this neighborhood, but has been inserted here on account of its interest. Possibly the pest may increase its range of distribution so as to reach this neighborhood.

***Eudeilinia herminiata* (Guenée).**

Pure white with two transverse bands on both wings, composed of indistinct smoky spots on the veins, the outer band broadly sinuate. Two discal spots on the under side of both wings. Expanse, 28 mm.

Caterpillar.—Head bilobed, rounded, whitish, yellow in front below the apex of each lobe; two transverse bands connected by a strong band on each side of the head behind the ocelli. Body flattened, smooth, translucent whitish with a green shade dorsally; cervical shield hemispherical, whitish, shining, a gray shade at the lateral corners. Above and before the spiracle on the second segment is a shining black elliptical spot, bearing two setæ. Thoracic feet small, colorless. Abdominal legs on segments six to nine. No anal legs; the fleshy plate is produced into a short conic process.

Food-plant.—Dogwood.

Quite rare in this vicinity, but commonly found in the Adirondacks and northward. The pupa is formed between leaves on the ground, with a few silken threads. The larva when mature becomes suffused with reddish pink on the back. It lives singly, spinning two leaves together, within which it remains concealed.

***Oreta rosea* (Walker).**

PLATE XIX, FIG. 14. FEMALE.

Fore wings largely pale brownish rose; outer margin narrowly brownish rose, with a narrow lemon yellow space between. The outer border sometimes darker, with two black spots near the hind angle and one at the apex. Across the wings are also fine brownish rose striæ, more or less distinct. Hind wings with basal half brownish rose, outer half yellow, with a brownish rose-spot at the apex, with fine striæ across the wing. Expanse, 24–28 mm.

Var. *marginata* Packard.—The basal parts of the wings in this variety are almost yellow, with fine striæ, and have the outer border brownish rose.

Caterpillar.—Head dark rust red, small, narrow, the vertex ending in two high conical lobes, each bearing a large rounded, tuberculated knob; surface densely covered with coarse, prominent, piliferous warts. Body olivaceous

brown, pale dorsally; a triangular dark patch on each side of the body, commencing on the fourth segment and bordered above the feet with pink. On the middle of the back of the third segment is a large, fleshy, round, knob-like projection, covered with minute piliferous warts. Tenth segment conical, merging into a remarkably developed suranal plate, which is drawn out into a long thick appendage, blunt at the end, and with two constrictions, dividing it into three segments, and covered with coarse spinules. Length, 21 mm.

Food-plant.—*Viburnum*.

Not common, and easily recognized by its yellow and brownish rose markings and excavate wings. The caterpillar is found in the beginning of July, and again in September, on the leaves and stems of its food-plant. In resting it elevates the terminal segment. When fully developed it forms a light close web cocoon, of pale brown silk, between leaves. The moth appears in May–June, and again in July–August.

***Oreta irrorata* (Packard).**

Wings uniform rosy brown with a darker transverse line on the fore wings from the apex to the inner margin before the angle; across the basal third is also a faint trace of an irregularly curved transverse line. Hind wings with two very faint transverse lines. Across the wings are also fine irrorations. Body uniform rosy brown. Expanse, 24–28 mm.

This species is supposed to be the second brood of *Oreta rosea*, and the larva is said to be exactly the same in markings, shape and habits. It feeds on birch and *Viburnum*.

***Platypteryx arcuata* (Walker).**

PLATE XIX, FIG. 12. MALE.

Fore wings pale ochreous or straw color with four narrow, undulating brown transverse lines, and a conspicuous rusty brown stripe running from the apex to the outer third of the inner margin; sometimes shaded with dark between the lines; apex purplish. Two small blackish dots in the cell. Hind wings with the lines running from the inner margin to about the middle of the wings. Body uniform straw color. Expanse, 25–35 mm.

Var. *genicula* Grote.—Wings darker than in *arcuata*, with the markings less distinct. The color is almost uniform ochreous.

Caterpillar.—Head small, yellowish green, with two curved, transverse brown bands. Body light green, red along the dorsal region, mottled with yellow; along the subdorsum is a deep brown, broken stripe, which is sometimes obsolete or wanting. Second and third segments each with two prominent yellow tubercles, tipped with red, and at the base on the outer side of each is a small black wart. On the fifth segment are two similar prominent tubercles. Along the back and sides are yellow piliferous warts. Last segment elongated into a pointed spine, with short bristles. Under side of body sordid white. Legs green. Length, 23 mm.

Food-plant.—Birch.

Double brooded. The first brood produces the form *genicula*, and the second *arcuata*. The larva lives singly on the upper surface of a leaf, under a silken web, slightly drawing the leaf together. Spins a cocoon between leaves. The moth appears in the first week of June and again late in July. Rather common.

Falcaria bilineata (*Packard*).

PLATE XIX, FIG. 10. MALE.

Fore wings pale ochereous, covered with fine transverse striæ and crossed by two parallel brown stripes, which are almost straight. On the disc is a small brown dot. Hind wings very pale, almost whitish, and without striæ. Expanse, 25-30 mm.

Var. *levis* *Hudson*.—This form lacks the transverse striæ.

Caterpillar.—Head rather square, higher than the first segment, and distinctly bilobed. Pale, whitish, thickly mottled with pale reddish brown, the mottling cut into several areas by narrow lines of the ground color, forming a distinct blotch below the vertex of each lobe. Body marked in an undefined, creamy white, varied with vinous brown, and traces of broken dark brown dorsal and subdorsal lines; sides of joint 5 and abdominal legs yellowish white; the dark shades predominate on joints 6 and 7. The markings suggest oblique lateral lines. The general appearance varies in different individuals from creamy yellowish with slight marks to dark rusty brown. Tubercles distinct, button-like, with short pale setæ; on the second and third segments are two pairs of tubercles, which form a partly consolidated process producing a short horn-like structure. Anal legs absent; a short upturned rounded anal process. Length, 22 mm.

Food-plant.—White Birch.

The moths come forth from hibernating pupæ early in June, and there are two broods annually. The larva when in its last

stage of growth usually rests on a twig or branch. In its usual position the head and tail are held up at an angle of 45 degrees, the larva being supported on its abdominal legs. When fully developed it forms a slight cocoon of yellow silk between leaves, and the pupa is covered with white bloom.

Euclea delphinii (*Boisd.*).

Deep velvety, deep reddish brown, with a triangular green patch near the base beneath the median vein, separated from a rusty brown patch by a silvery white line; before the apex is also a small green patch, with sometimes one or two more smaller ones. In the cell is a deep black dot. Hind wings uniform brown. Sometimes the discal dot on the fore wings is absent. Body uniform brown. Expanse, 17-22 mm.

Var. **querceti** *H.-S.*—The green patch at the base on the fore wings sends out a fine green line over the ferruginous patch.

Var. **interjecta** *Dyar.*—In this form the basal green patch is connected with the apical spots by a row of contiguous dots.

Var. **viridiclava** *Walk.* (Plate XVII, Fig. 3.)—The green basal mark is fused into a continuous band, which is deeply notched beneath and irregularly concave above.

Var. **elliottii** *Pears.*—Like *viridiclava*, but the green band is much broader, the upper part straight and contains the brown discal spot.

Var. **pænulata** *Clem.*—Similar to *elliottii*, but the green field is larger, and lacks the brown discal spot.

Caterpillar.—Elliptical, dorsal region flat, bordered on each side by a slight ridge on which are placed a row of ten spiny horns, the three at each end being longer and stouter. Sides sloping outward and having a series of rough pit-like depressions in which are placed the spiracles; below these there is another ridge, on which are placed nine spined horns, projecting laterally, and stouter than the upper row. Flesh-colored, horns and ridges bright red shading to pinkish, black lines present, waved, forming irregular areas about the glandular dots along the sides and back; sometimes sordid purplish, or with sides green; the black lines shaded, horns and ridge broadly bright ferruginous, broken by dark quadrate spots; sometimes green, with black lines faint; horns and ridge yellow, broken by black spots, or with horns and ridge red broken by brown spots. Length, 23 mm.

Food-plants.—Oak, Chestnut, Beech, Sour-gum, Blackberry, Cherry, *Myrica*, *Andromeda*, etc.

A common species and very variable in marking of both moths and caterpillars. Single brooded. Moth in June and July, and mature caterpillars in August and September. The cocoon is formed on the ground and is oval, very hard and brittle; the caterpillar changes to a pupa the following year.

***Euclea indetermina* (Boisd.).**

PLATE XVII, FIG. 1. FEMALE.

Fore wings largely bright green, with a subtriangular, wood-brown space on the costa at the base and a broad outer border of the same color. Hind wings ochereous. Thorax above bright green, abdomen ochereous. Under side of wings yellowish ochereous, body darker. Expanse, 25-30 mm.

Caterpillar.—Elongate, dorsal space broad, flattened, narrowing slightly at the ends and curving down. Sides nearly perpendicular, lateral and subventral areas almost continuous. On segments 2, 3, 4, 7, 10 and 11 are six well-developed horns on each side, armed with strongly stinging spines; intervening segments with short bunches of spines, and a row of spines along each of the sides. Body bright scarlet red, with yellow longitudinal bands; dorsal region with stripes of bright purple and white; lateral area with two pairs of purplish lines in the yellow bands, and a pair in the yellow of the subventral area. Horns scarlet red with yellow spines; bunches of spines yellow. Sometimes the body is bright sulphur yellow instead of scarlet. Length, 20 mm.

Food-plants.—Apple, Cherry, Rose, Blackberry, Oak, Hickory, *Myrica*, etc.

Not common everywhere, but quite common in certain places. The moth appears in July and mature larvæ may be found in August and September; they may be known by their bright scarlet color and long horns with yellow spines. Cocoon like that of the preceding species.

***Monoleuca semifascia* (Walker).**

PLATE XVII, FIG. 5. MALE.

Fore wings uniform rusty brown with an irregularly waved white band running from the middle of the inner margin upwards to the middle of the wing. Hind wings somewhat paler. Body brown. Expanse, 19-22 mm.

Very rare in this vicinity, but more common in the Southern States. The caterpillar is unknown.

Sisyrosea textula (*H.-S.*).

PLATE XVII, FIG. 9. MALE.

Fore wings pale cinnamon brown with a paler shade of a silky lustre along the costal region, and running obliquely across the wing, forming a triangular space between this and the apical pale shade. Across the wings are also many wavy creases, formed of raised scales. Hind wings pale cinnamon brown, as are also the under side and the body. Female paler in color, and the lighter shade is hardly or not at all discernible. It is also larger. Expanse, 15-22 mm.

Caterpillar.—Form very much flattened, dorsal space narrow, lateral space broad and very oblique. On each of the dorsal ridges is a row of very short and flattened horns. Lateral horns large, flattened, armed with long spines and looking like the antennæ of a Bombycid. The first three horns are shorter than the others. Body green, dorsal ridges yellow. First three spines along sides orange, and a small mark of the same color on the dorsum of the ninth and eleventh segments. Head hidden by the overlapping of the other segments, smooth, pitchy. Length, about 15 mm. ; width, 10 mm. (including spines).

Food-plants.—Oak, Hickory, Cherry, Chestnut, Elm, Beech, Maple, Linden, Hornbeam, etc.

Single brooded. The moth emerges in July and lays her eggs singly. The flounder-shaped caterpillars live on the under side of the leaves and spin their cocoons on the ground late in August and in September. The larva hibernates in the cocoon, forming a chrysalis the following spring.

Natada nasoni (*Grote*).

Fore wings pale brown, sparsely sprinkled with black. An oblique brown line crosses the wings from the apical third of the costa to the basal third of the inner margin, and a second subterminal dark brown line crosses the wings transversely. Both lines are faintly pale, bordered outwardly. Thorax slightly brighter reddish brown. Expanse, 25-32 mm.

Caterpillar.—Body bright green, elongate, square, high in front, tapering somewhat towards the end of the body; dorsal space wide, subdorsal ridge prominent, lateral space high and sloping; subventral space narrow; a series of red warts in the subdorsal ridge more prominent on the third and fourth segments, with black setæ. Anal segment with two rather long, pointed appendages, spined. A series of minute warts along the subventral ridge. Length, 16 mm.

Food-plant.—Oak, Chestnut, Beech, etc.

Quite rare, but somewhat common locally. It is quite common near Lake Ronkonkoma, Long Island.

Phobetron pithecium (A. & S.).

PLATE XVII, FIGS. 7 AND 8. MALE AND FEMALE.

Male.—Fore wings transparent, with very few scales, and the margins dull brown black; fringes on outer margin with whitish spots. A blackish discal spot also present. Hind wings transparent with the costal and inner border broadly black. Head black, face, breast, middle tibiæ pale. Thorax above black, tufted with deep blackish brown; abdomen black, anal segment beneath straw yellow. Expanse, 15–20 mm.

Female.—Very different in color and markings. Fore wings ochreous, with dense dark blackish brown shades and three transverse black lines, the outer one curved outwardly, scolloped, with the indentations pointing inwardly. A rusty brown spot in the disc. Fringes deep brown, cut by whitish spots. Hind wings blackish, with narrow ochreous outer margin. Body deep brown. Face, thorax beneath, middle tibia and anal tuft ochreous. Expanse, 19–25 mm.

Caterpillar.—Rounded, quadrangular, dorsal space broad, even, flat; lateral space broad, subventral space broad and continuous with the lateral space. Ridges absent. Warts on subdorsum attached by broad bases and produced laterally into fleshy appendages of variable length. Lateral row of warts forms small, rounded, button-like structures. The rows of warts are composed of a soft spongy tissue and readily become detached. On each side are also four very long, fleshy appendages. Warts and appendages all covered with feathery, brown hairs, giving the larva a woolly appearance and a curious shape. Length, 20 mm.

Food-plants.—Plum, Cherry, Apple, Oak, Chestnut, Hazel, Buttonbush (*Cephalanthus*), Dogwood, Ash, Sassafras, etc.

Quite rare and local. The moth appears in July. The caterpillar mimics a dead dry leaf, and with its curious shape and appendages assumes a very striking and remarkable appearance. The cocoon is oval, hard, and the tubercles of the caterpillar remain on the outside of the structure, giving it a characteristic appearance. Single brooded.

Adoneta spinuloides (H.-S.).

PLATE XVII, FIG. 4. FEMALE.

Fore wings chocolate brown with a black discal patch or spot, a short dentate white line before the apex and one on the inner margin; these two lines are

more or less connected by a light grayish brown shade and a curved row of minute black dots. Fringes grayish brown with a row of black dots. Head and body cinnamon brown; collar grayish brown. Hind wings paler brown, fringes edged with black at the hind angle. Expanse, 13-18 mm.

Caterpillar.—Elongate, sides slightly rounded. Dorsal space rather broad, narrowing at each end. Lateral space bright green, dorsal space with a narrowing and expanding bright purple mark, sometimes more or less broken, and edged with yellow; sometimes edged with crimson inside the yellow and with a red lateral band. Tubercles on segments 2, 3, 4, 7, 11 and 12 longest, red; the rest yellow, or sometimes red. Length, 10 mm.

Food-plants.—Cherry, Plum, Juneberry, Birch, Oak, Chestnut, Linden, Willow, Witch-hazel, Beech, Sour-gum, *Myrica*, etc.

The moth emerges during July, and the caterpillar matures during the latter part of August and in September. Common and single brooded.

***Parasa chloris* (H.-S.).**

PLATE XVII, FIG. 2. MALE.

Fore wings largely bright green with the terminal space and a subtriangular space at the base on the costa brown. Hind wings ochereous, with the outer third brown. Head and thorax above green. Abdomen brown. Expanse, 18-24 mm.

Caterpillar.—Dorsal space broad, and almost of uniform width. The dorsum rises abruptly from the first to the fifth segment, then slopes backward, and terminates in a tail-like process at the last segment. Lateral space broad, nearly perpendicular and continuous with the subventral space. Subdorsal ridge well indicated. Horns reduced to small spinose buttons. Color fleshy brown, with many wavy salmon-colored lines; tubercles with whitish spines. Subventral edge broadly pink, edged above by a deep red line. Length, 11-20 mm.

Food-plants.—Hickory, Oak, Chestnut, Wild-cherry, *Myrica*, etc.

Rather common and single brooded. The moth appears in July and the caterpillar in August and September. They rest on the under side of the leaves, feeding singly.

***Sibine stimulea* (Clemens).**

PLATE XVII, FIG. 6. FEMALE.

Fore wings deep velvety seal brown with a silky lustre if held in certain lights. Before the apex are two or three minute white dots and sometimes one

below the median vein near the base. Hind wings and abdomen chocolate brown; thorax like the fore wings. Expanse, 22-34 mm.

Caterpillar.—Velvety brown on the first four and last three segments and extreme sides, with a large, square, saddle-like green patch, edged with white, on the rest of the body above, containing a conspicuous, round velvety brown spot in the middle of the back. On the fourth and tenth segments are two long stout horns with stinging spines, and along the sides is a row of bunches beset with bristly spines, and around the last segment are four thick bunches of hair-like spines. Between the anterior and posterior pairs of horns is a small yellow spot, and two larger ones on the eleventh segment. Length, 23 mm.

Food-plants.—Oak, Sweet-gum, Viburnum, Rose, Apple, Cherry, Raspberry, Blackberry, Juneberry, Corn, Asters, Sumac, Catbriar (*Smilax*), Huckleberry, Spice-bush, etc.

Common everywhere and single brooded. The moth appears in July, and the larvæ may be found fully grown in September. The eggs are laid in masses on the upper side of a leaf, and the larvæ live socially, but scatter over the plant when in the last stage.

Apoda scapha (Harris).

PLATE XVII, FIG. II. FEMALE.

Fore wings pale wood brown, with a very large subtriangular reddish brown patch on the costal region, which covers a large portion of the wing and is narrowly connected with the base on the costa, thus forming a deep notch beneath. The patch is separated from the rest of the wing by a narrow silvery white line which expands in the notch at the base of the wing. A small black discal spot present. Hind wings and body chocolate brown. Expanse, 22-32 mm.

Caterpillar.—Form elliptical, dorsal space very broad and terminating in a point on the last segment. Subdorsal ridges prominent, sides almost perpendicular, giving the larva a boat-shaped appearance. Color bright green, variably patched and spotted with yellow and brown, especially on the dorsum, which is sometimes yellow. Length, 12-18 mm.

Food-plants.—Oak, Chestnut, Cherry, Hickory, Sweet-gum, Linden, Hornbeam, Juneberry, Apple, Walnut, *Myrica*, Huckleberry, etc.

The moths fly in July and the larvæ mature in August and September. The eggs are laid singly, and the larvæ often live on the upper side of the leaves.

Apoda biguttata (*Packard*).

PLATE XVII, FIG. 12. FEMALE.

Fore wings pale wood brown with an oblique, paler transverse line from the middle of the costa to the basal third of the inner margin, and a short line from a little before the apex to the middle of the outer margin; beyond this line the apex is rusty brown, as well as a triangular spot before the hind angle, this spot surrounded by a light shade. Fringes pale wood brown, as are also the hind wings. Body, and wings beneath, wholly pale wood brown. Expanse, 20-25 mm.

Caterpillar.—Elliptical, dorsal space broad, narrowing slightly towards the extremities; last segment broadly quadrate. Lateral area oblique. Skin uniformly covered with granules, frosted. Subdorsal ridge not prominent, formed only by the change in slope between the back and sides. Pale green with a broad pale yellow subdorsal, edged with dark green above and less distinctly so below. Subventral line obscure whitish. Length, 10-12 mm.

Food-plant.—Oak.

Quite rare and local. The moth emerges during the latter part of June and early in July. The species is single brooded, lays its eggs singly, and the larvæ mature from the middle of August into September.

Apoda y-inversa (*Packard*).

PLATE XVII, FIG. 13. FEMALE.

Fore wings light ochereous, with an oblique brown line from the middle of the costa to the basal third of the inner margin, and another line from the apical third of the costa to above the hind angle. From the middle of this last line is another line running to the inner margin before the angle. Hind wings pale. Body entirely ochereous, as are also the wings beneath. Expanse, 20-27 mm.

Caterpillar.—Same as that of *S. biguttata*, in structure and color, but differs from it by the presence of a transverse yellow line on the second segment. Length, 10-15 mm.

Food-plant.—Oak.

Rare and single brooded. The moth appears in July and larvæ mature in August and September.

Apoda rectilinea (*G. & R.*).

Fore wings with a very broad inverted V-shaped mark across the wings, bordered narrowly with white and blackish. This mark is grayish brown, while the basal part and apex is ochereous brown. Hind wings testaceous. Expanse, 20-25 mm.

This species is very rare in this neighborhood, but is more common in the Southern States. The earlier stages are not known.

Lithacodes fasciola (*H.-S.*).

PLATE XVII, FIG. 10. FEMALE.

Fore wings ochereous brown with a dentate white band running across the middle, followed by a blackish shade. From the white band on the costa to the hind angle is a curved black line. Hind wings blackish or pale testaceous. Expanse, 15-20 mm.

Var. **laticlavia** *Clem.*—Like *fasciola*, but wants the blackish shade behind the white transverse band on the fore wings, thus giving it a much paler appearance. The ground color is also paler.

Caterpillar.—Elliptical, posterior end quadrate. Dorsal space broad, flat; lateral space broad, oblique. Subdorsal ridge slight, smooth, yellowish green, subdorsal and lateral lines yellow, the latter broken. Depressed spaces pale yellow, with green centres. Length, 7-13 mm.

Food-plants.—Cherry, Apple, Birch, Dogwood, Chestnut, Oak, Linden, Maple, Beech, Hickory, Hornbeam, Huckleberry, *Myrica*, etc.

Generally distributed and not rare in this neighborhood. The moth lays her eggs in July and the larvæ mature in August and September. Single brooded.

Tortricidia flexuosa (*H.-S.*).

Fore wings deep ochereous with a narrow dark brown line from the middle of the inner margin running upwards to nearly the costa, forming a rounded loop, then running downwards and curving inwardly before reaching the inner margin on the outer third. This loop is more or less distinct or entirely wanting. Expanse, 12-25 mm.

Var. **caesonia** *Grote.*—In this form the space between the loop is more or less filled with dark brown.

Caterpillar.—Elliptical; dorsal space of almost uniform width, scarcely narrowing at the ends. Lateral space broad and oblique. Dorsal ridge very slight. Color pale yellowish green, clearer green at the sides. Subdorsal line yellow, as are also all the depressed spaces in the bottom, the largest with glandular green centres. On the anterior edge of the second joint is a red mark, widened along the edge and produced backwards more or less in the dorsal space. The central dorsal red mark is very variable, sometimes absent or represented by a yellow bridge, slightly tinted with red. The usual form is a rounded cross; sometimes enlarged to a hexagon or extended in a dorsal band the whole length. The color is crimson, marked with purplish brown or blackish on the ridges. Length, 6–10 mm.

Food-plants.—Cherry, Plum, Apple, Oak, Chestnut, Hickory.

Not rare and local in this vicinity. The moth appears during the latter part of June and early in July. Single brooded.

Tortricidia pallida (H.-S.).

Similar to *T. flexuosa*, but pale ochereous instead of dark ochereous, with the hind wings pale straw yellow and slightly darker outwardly. Fore wings uniform, pale ochereous without any markings whatever, with a silken lustre. The dark shade is also always wanting. Expanse, 12–20 mm.

Var. *flavula* (H.-S.).—Like *pallida*, but a loop on the fore wings, otherwise the same.

Caterpillar.—Oval, elliptical. Dorsal space rather broad, subdorsal ridge rounded, lateral space gently sloping, giving the larva a flattened appearance; lateral ridge acute, subventral space narrow. Head whitish green, mouth parts black. Body bright green or yellowish green, second segment edged in front with bright red, and continuous with the narrow red dorsal band; on the second and third segments, this band connects with the very large arrowhead-shaped mark on the back. This patch begins on the fourth segment, then suddenly expands, being broadest at the sides of the sixth, seventh and eighth segments; at the end of the eighth segment it abruptly and acutely contracts and runs to the end of the body. Purplish red, scarlet in the center, bordered with crimson and yellow outside; depressed spaces yellowish. Length, 10 mm.

Food-plants.—Willow, Oak, Sycamore, *Myrica*, etc.

Common locally. The moth appears in June, and fully developed larvæ may be found in August and early in September. Single brooded.

***Tortricidia testacea* Packard.**

Fore wings pale ochereous with the outer half of the wings rusty ochereous, the veins somewhat darker. Hind wings very pale. Expanse, 17-25 mm.

Caterpillar.—Shape as in *flavula*, as are also the depressed spaces. Color green, depressed spaces pale with dark centres. Dorsal mark reaching the extremities and lateral margins in the form of a cross with four projections from the center, or filled out to a larger diamond-shaped mark, produced narrowly forward to joint two. Patch reddish or purplish, usually darker around the edge, bordered with crimson and yellow. The exact shape and size is variable. Length, 6-9 mm.

Food-plants.—Oak, Wild-cherry, Birch, Hickory, Chestnut, Witch-hazel, Sour-gum.

Common locally. The moth is found late in June, but mostly in July, and the caterpillars are found fully grown in August and September.

***Tortricidia minuta* (Rearkirt).**

Fore wings and body clay colored, with a silky look; hind wings blackish or brownish. Expanse, 10-12 mm.

Recorded from the Atlantic States, and probably found in this vicinity. Early stages not known.

***Heterogenea shurtleffi* Packard.**

Male.—Deep brown, with two darker lines, beginning on inner margin, running upwards and meeting in a curve around the discal area. A curved line from the apical third to the hind margin. Hind wings uniform smoky brown black. Expanse, 12 mm.

Female.—Larger, wings more pointed and very much paler than in the male, almost uniform ochereous, lines similar. Hind wings fuscous testaceous. Expanse, 15 mm.

Caterpillar.—Elliptical, tail rounded, slightly notched at the sides. Dorsal space as broad as the lateral one, flat; lateral space steep above, slightly concave; subventral space retracted; the larva is therefore flattened; subdorsal ridge slight; lateral ridge prominent. Pale yellowish green, shading to nearly colorless on the lateral ridge; the dorsum and upper part of lateral area on segments five to ten distinctly spotted with emerald green pigment. A narrow yellow subdorsal line, slightly unevenly edged on joints three to twelve, the

pair free and uniform or partly or wholly connected by a yellow bridge, usually with a small red spot, or rarely by a large one, covering joints six to eight, and widened on joint seven. The red spot varies in color from vermilion red to light blue or dark slaty blue edged with crimson. On joint two in front is a transverse yellow line, edged with crimson below. A series of red spots usually appears, beginning on the collar in front and extending to joint four, the spots dull and diffuse. Length, 5-8 mm.

Food-plants.—Oak, Chestnut, Beech.

The moth emerges during the first week in July, and the larvæ may be found fully grown early in August, but a few last into September. The larva does not leave the tree, but spins its cocoon in the crevices of the bark.

Packardia geminata (*Packard*).

Fore wings whitish with a large triangular brown patch and two white spots at the hind angle. The patch is composed of three brown lines, with the spaces between filled with brown. Hind wings whitish, as is also the body. Expanse, 20-24 mm.

Var. **albipuncta** *Pack.*—Uniform gray brown with the triangular patch somewhat darker or concolorous, and with the two white spots at hind angle present. Hind wing concolorous.

Var. **ocellata** *Grote.*—The whitish ground color dusted with ferruginous scales, especially at base, and in the spaces of the darker lines forming the triangular patch, apex whitish. Hind wings gray brown.

Var. **goodellii** *Grote.*—Fore wings almost uniform seal brown with the lines slightly darker and hardly visible, apex paler. Two white spots at angle. Hind wings concolorous, deep seal brown.

Caterpillar.—Body elongated, sides subparallel, rounded towards the anterior end and sloping backwards, the last segment produced into a slender tail. Dorsal space broad, flat, and narrowing at both ends; lateral space broad, oblique; subventral space two thirds as wide as the lateral one. Whitish green, opaque, with a yellowish white straight line along the subdorsal ridge, with upper dark green clear border. Depressed spaces very small, the dorsal ones smooth, whitish with green centers. A row of white dashes on the lateral ridge and a dorsal green line, interrupted by the impressed spots. Length, 7-11 mm.

Food-plants.—Wild-cherry, White-birch, Black-birch, Oak, Sour-gum, Hickory, *Myrica* and *Clethra alnifolia*.

The moth makes its appearance in June and the eggs are deposited singly on the under side of the leaves. The caterpillars

frequent dry woods and bushes on the edges of fields. They are low feeders and are often found on small plants, only a few inches from the ground. Not common and single brooded.

Packardia elegans (*Packard*).

PLATE XVII, FIG. 14. MALE.

Fore wings grayish black or brownish to pale buff, with three white lines, one from the middle of the costa to the basal third of inner margin, one from the costa to nearly the hind angle, and the third from the middle of this last line to the inner margin before the angle and parallel to the basal line. Two black spots at the angle. Hind wings grayish. Expanse, 14-18 mm.

Var. *fusca* *Pack.*—This form has the ground color brownish instead of grayish black, with the lines the same as in *elegans*.

Caterpillar.—Shape as in *geminata*. Light yellowish green, lateral edge clearer, dorsal space darker. A wavy, narrow, yellow subdorsal line composed of a series of intersegmental, inwardly lunate, jointed yellow marks; tail reddish brown above. Six of the depressed dorsal spaces are visible as white rings, around which more or less light green pigment forms in rings, transverse bands, or filling all the dorsal space. A broken subventral line. Lateral space with depressed spaces, large pale rings with dark centers. Length, 7-11 mm.

Food-plants.—Cherry, Linden, Witch-hazel, Hornbeam, Beech, Oak, Chestnut, Maple, Birch, Sour-gum, Hickory and *Leucothoë racemosa*.

Not common in this neighborhood except locally. The moth appears late in June and early in July. The caterpillars live on low plants and frequent dark woods. Single brooded.

Lagoa crispata *Packard*.

PLATE XVII, FIG. 19. MALE.

Very woolly. Pale straw yellow. On the fore wings the long woolly scales are arranged in transverse wavy wrinkles. On the costa, above the middle, the wool is blackish and beneath brownish. Head, below base of fore legs and tarsi, blackish. On the costa of the fore wings beneath is a broad blackish streak. Expanse, 25-35 mm.

Caterpillar.—Body thick, short and fleshy. Head retractile. On each side of the body are rows of spherical tubercles from which arise dense bunches of tawny brown, soft hairs, meeting over the dorsum in form of a ridge; the hairs along the sides and on the first two segments are smoky black. Seven pairs of abdominal legs and three pairs of thoracic feet. Length, 20 mm.

[*October, 1898.*]

Food-plants.—Blackberry, Apple, Pear, Plum, Cherry, Basswood, Sassafras, Alder, Willow, Oak, Hazel, Sycamore, Birch, *Myrica*, etc.

The caterpillar is common along the edges of woods or overgrown fields. In its earlier stages, up to the moult before the last, it is densely covered with long flossy, pure white hairs, looking very much like a piece of wool. The cocoon is formed on the ground of tough silk, elongate in shape, and when the moth emerges, it cuts out a circular piece which remains on the cocoon, in shape of a lid, with the pupa sticking half way out. The species is single brooded and the moth emerges in June. The caterpillar hibernates in the cocoon and forms a pupa the following spring.

Lagoa opercularis (*A. & S.*).

A single specimen of this southern species was taken in Prospect Park, Brooklyn, N. Y. City, and its occurrence there was probably accidental.

Apatelodes torrefacta (*A. & S.*).

PLATE XVIII, FIG. 3. MALE.

Fore wings ash gray, clouded outwardly with smoky brown. Across the basal third are two brown, parallel, wavy, narrow, transverse lines and two similar ones across the outer third. On the inner margin near the base is a deep brown patch, and a small white spot beneath the apex. Hind wings dull reddish, sometimes washed with ashen gray, and with two ill-defined transverse lines, the outer one whitish and marked at the inner angle with two deep brown dashes. Head and thorax ashen gray, the latter with a deep brown band across the posterior part. Abdomen gray, and tuft tipped with deep brown. Expanse, male, 36-40 mm.; female, 50 mm.

Caterpillar.—Head dirty white. Body creamy white with a broken black dorsal stripe on which are tufts of hairs of the same color. A black spot on each segment along the sides. Body covered with long, white, flossy hairs directed backwards, except those on the anterior segments, which are directed forwards. On the back of each of the second, third and eleventh segments is a long mouse-colored pencil, tipped with white at the ends. Abdominal legs black, the extremities pinkish. Thoracic feet black. Sometimes the body is pale yellow with the hairs bright sulphur yellow, with the pencils ferruginous, tipped with black. Sometimes the body is black with the hairs maltese gray. Length, 45 mm.

Food-plants.—Wild-cherry, Willow, Alder, Blackberry, Bayberry (*Myrica*), Azalea, Sassafras, Hazel, Viburnum, Ash, Ironwood and Spice-bush.

Rather common in certain localities. The moth appears during June and again in August, and the larvæ are found during July, August, and in September. They enter the earth for pupation.

***Apatelodes angelica* (Grote).**

Fore wings pale ashen gray with two darker transverse shades, one before and one beyond the middle. Beyond the outer one is a transverse row of small black dots and another row before the first band. In the apical area are two semitransparent white spots. Hind wings darker and of a brownish shade with two narrow, ill-defined, transverse lines. Head, thorax and body ashen gray. Thorax with a pale brown line along the middle and the abdomen is finely scaled with brown along the back. Expanse, male, 40-45 mm.; female, 45-59 mm.

Caterpillar.—Head dark brown, with two lighter brown lines in front. Body color gray, with numerous fine black lines. On the first segment anteriorly are four dorsal white lines, posteriorly black; second and third segments anteriorly black, behind which are irregular black lines; on segments five and ten the dorsal black lines assume a V-shape, the apex resting on the suture and enclosing centrally two yellow, subelliptical spots, with a similar spot exterior to each within the superior lateral stripe. First segment with long whitish brown hairs extending over the head, nearly concealing it; from the middle of the second and third segments whitish hairs project forward. The whitish hairs at the sides straight, those on the back directed backwards. Last segment with white and brown hairs. Along the back a row of tufts of black hairs. Length, 45 mm.

Food-plants.—Lilac, Ash.

Scarce in this neighborhood, and probably double brooded. The moth emerges early in June, and fully-grown caterpillars may be found in September.

***Gluphisia septentrionis* Walker.**

PLATE XVIII, FIG. 10. MALE.

Fore wings dark gray, with three narrow wavy black lines, with the basal and median spaces dull ochreous, more or less dusted with blackish scales. Hind wings gray. Body somewhat darker. Expanse, 20-30 mm.

Caterpillar.—Head smooth, polished, darker green than the body, with two black stripes on each side, not meeting on the vertex. Body green, tapering at the end, smooth, with a few scattered minute hairs and a conspicuous yellow subdorsal line on each side, between which is a pink red blotch on each of the first three segments, and a square spot of the same color on the seventh to twelfth segments, with the space between the spots more or less yellow. Sometimes the red markings are absent, sides of body and under side green. Length, 30 mm.

Food-plants.—Willow, Poplar, Yellow-birch, Sweet-gum.

Not common, and double brooded. The caterpillar spins a cocoon composed of a very light web of silk between leaves. The moth occurs from about the middle of May to the middle of August.

Gluphisia severa Hy. Edw.

Fore wings gray with three transverse lines, the outer one white and composed of small waves. The space between the two outer lines dark blackish, with an ochereous patch beneath the median vein. Outer part of the wing broad, blackish or grayish, through which runs an ochereous shade. The space between the first two lines light gray sprinkled with black, and at the base is an ochereous patch. Discal mark angular, ochereous. Hind wings blackish or grayish, with two indistinct broken lines. Head and thorax gray, abdomen paler. Expanse, 40-45 mm.

Var. *danbyi* Neum.—In this form the markings are obscured.

Var. *avimacula* Hudson.—Fore wings gray, lines black, with the spaces between gray instead of blackish as in *severa*, and it also lacks the ochereous patch beneath the median vein. Discal mark black, reniform, with two ochereous spots.

Var. *slossoniæ* Packard.—Fore wings pale ash gray, basal fifth brown black, sending out five sharp, tooth-like projections and a broad median oblique band enclosing a white triangular discal spot, the apex pointing upwards.

Caterpillar.—Head very slightly bilobed, pale uniform green, with a yellow line on each side; mouth parts paler, jaws black. Body green, dorsal region whitish green, almost white; along the spiracles is a yellow line, bordered above very narrowly with crimson on the first three segments. Subventral region clear green with yellow dots. Spiracles orange. Length, 41 mm.

Food-plant.—Poplar.

Very rare in this neighborhood. It has been found on the Palisades in New Jersey, and will probably also be found in other

localities. The moth appears in April and the larva in May and early in June. Single brooded. *Severa* and *danbyi* are the Pacific Coast forms, while *avimacula* is the form found in this neighborhood, and *slossonia* occurs in New Hampshire. Spins a cocoon between leaves.

Gluphisia lintneri (Grote).

Fore wings dark gray, scaled with black, shaded with ochreous at base and at the median space and along the subterminal line. Transverse lines black, outer one faintly white. Discal mark faint, linear. Hind wings gray, with a mesial shade line followed by whitish and shaded with blackish on external margin at angle, where a second line is indicated. Expanse, 40 mm.

This species is found in the northern parts of New York and in the New England States. It flies from early in April until early in May. It has not as yet been taken in this vicinity, but may possibly occur here. The larva is not known.

Datana ministra (Drury).

PLATE XVIII, FIG. 2. FEMALE.

Fore wings ochreous brown to dark russet brown, with five transverse, darker lines. The basal one is curved. The remaining lines are beyond the middle, of which the first is abruptly curved at the end of the cell, while the others are but slightly curved or almost straight. In the cell are one or two dark spots. Hind wings much paler than the fore wings. Thorax with a large, deep velvety ferruginous brown patch. Expanse, 35-50 mm.

Caterpillar.—Head jet black, sometimes chestnut red, but very rarely so, shining. Neck bright yellow, cervical shield dull orange. Body pitchy black with four sulphur yellow equidistant longitudinal stripes on each side, all being much narrower than the intervening spaces, the dorsal space the widest; anal plates jet black, roughly punctured. Under side with three yellow stripes. Thoracic feet jet black, with their bases yellow; abdominal legs bright yellow, banded with jet black outside. A few sordid white hairs are scattered over the body, most numerous along the sides. Length, 55 mm.

Food-plants.—Cherry, Pear, Apple, Quince, Linden, Oak, Chestnut, Beech, Hazel, Hornbeam, Birch, Walnut, Hickory, etc.

The moths emerge from late in June until early in July, and are single brooded. The caterpillars live socially, in clusters of about fifty or more individuals. They mature in August and in

September, and enter the earth to pupate. The characteristic attitude of this, as of the other species, when disturbed, is to raise the head and tail, bending the body in a semicircle till both ends meet over the back.

Datana drexelii Hy. Edw.

Allied to *D. ministra*, with the lines the same. It differs from *ministra* by having the costal area for nearly one-third the width of the wing bright ochereous and the discal spots more distinct. Hind wings darker, on an average. Thoracic patch more ochereous. Expanse, 35-50 mm.

Caterpillar.—Head jet black, shining. Neck and cervical shield golden yellow. Body black with four equidistant citron yellow stripes on each side, and three on the under side. Abdominal legs and bases of thoracic feet golden yellow. The stripes all become confluent at the posterior extremity. Anal plate jet black and very shining. Hairs over the body sordid white. Length, 55 mm.

Food-plants.—Huckleberry and Witch-hazel.

Single brooded. The moth emerges early in June, and earlier in the season than *ministra*. The caterpillars are fully fed in July and August. They live socially like *ministra*, but usually there are fewer individuals in each cluster. They differ from *ministra* by the citron yellow stripes being confluent at the posterior extremity.

Datana major G. & R.

Fore wings somewhat as in *drexelii* in color, as are also the transverse lines. The second line, however, is more oblique, and runs more inwardly in its downward course, meeting or almost touching the basal line on the inner margin. Discal spots conspicuous, the second spot usually beyond or on the second line. The outer border is almost even, and not so much scalloped as in *drexelii* and *ministra*. A slight ochereous shade along the costal area. Hind wings and thoracic patch as in *drexelii*. Expanse, 25-55 mm.

Caterpillar.—Head bright mahogany red. Cervical shield, anal plate, abdominal legs, thoracic feet and corresponding spots on legless segments, mahogany red. Body black with the stripes broken into a series of irregular square white or lemon yellow spots, sparsely covered with white hairs, and with very short black ones, which are only visible under a lens. Length, 60 mm.

Food-plants.—*Andromeda ligustrina*, Witch-hazel and Sumac (*Rhus glabra*).

Not common, except locally. The moth comes forth in June and July, and the larvæ mature in August and early in September. They live in clusters, as in the other species, and before the last moult are beautifully striped with white or lemon yellow. Pupate in the earth. Single brooded.

***Datana angusii* G. & R.**

Fore wings varying from chocolate to deep smoky brown, differing in this respect from all the other species of this genus. Along the costal region the color is of a shade darker than the rest of the wing. Lines like those of *D. minima*. Hind wings paler. Thoracic patch very deep brown. Expanse, 35-45 mm.

Caterpillar.—Head and cervical shield jet black, shining. Body black with three equidistant, very narrow, pale yellow or whitish stripes on each side, very much narrower than the intervening spaces. Under side with three yellow stripes,—one along the middle, which is the broader, and one on each side, broken by the legs. Abdominal legs and spots on the legless segments reddish. Thoracic feet black. Hairs on body dirty white. Length, 55 mm.

Food-plants.—Hickory, Walnut, Butternut.

Rather common in this vicinity. It is single brooded, the moths appearing in June and the larvæ maturing in August. They live in colonies of about thirty individuals, and enter the ground to pupate.

***Datana palmii* Beuten.**

Head and thoracic patch deep velvety brown, remaining parts of thorax cinnamon brown, mixed with whitish scales. Fore wings cinnamon brown, thickly covered with whitish scales, so as to almost obscure the ground color. Across the wings are four narrow, transverse lines, same as the ground color. The first is oblique, the second slightly curved; the third a little beyond the middle and the fourth across the apical fourth, both the latter curved outwardly. Hind wings pale cinnamon brown. Expanse, 40-50 mm.

Caterpillar.—Head light orange red, with a brownish tinge. Body black, with four pale yellow stripes, narrower than the intervening spaces, the lateral ones becoming white or canary yellow in some specimens. Cervical shield, anal plate and abdominal legs, except an outward blackish band on the latter, same color as the head. Bases of legs and corresponding spots on legless segments, darker red. Thoracic feet black. Hairs sordid white. Length, 50 mm.

Food-plant.—Huckleberry (*Vaccinium stamineum*).

Very rare in the vicinity of New York, but more common in the Catskills and at Delaware Water Gap. The moth emerges in June, and is single brooded.

***Datana integerrima* G. & R.**

Fore wings light brown with five transverse lines followed by light shades. Over the wings are fine darker irrorations. Outer margin even, in the male, very slightly scalloped in the female, which is of a paler shade. Two discal spots. Thoracic patch dark ochereous. Hind wings paler. Expanse, 35-45 mm.

Caterpillar.—Body wholly black, covered with long floss-like, white hairs. Sometimes there are visible a subdorsal, ill-defined, white stripe, a rather broad wavy, lateral stripe and one along the middle of the under side. Head jet black, shining, rarely chestnut red. Abdominal legs black outside and reddish brown inside. Length, 55 mm.

Food-plants.—Walnut, Hickory, also Beech and Oak, but very rarely.

Very common, and single brooded. The caterpillars live in large colonies, and when about to shed their skins they leave the branch upon which they have been feeding and select some convenient place where they can perform this operation. They usually select the trunk of the tree, sometimes descending nearly to the base, where they congregate in form of a thick ball-like cluster, held together by silken threads. As they march along they spin a path of silk, so as to insure their safe return to the tree top. The moth hatches out in July, and the caterpillars become fully grown in the latter part of August and in September.

***Datana contracta* Walker.**

Pale tawny luteous, with numerous dark brown or blackish irrorations. Lines as in *integerrima*. Discal spots present. Hind wings and body pale luteous. Thoracic patch dark ochereous. Expanse, 35-45 mm.

Caterpillar.—Head black. Cervical shield orange. Body black with four creamy white stripes along each side, as wide as the intervening spaces, and three stripes beneath. Abdominal legs yellowish brown, extremities black, and with yellowish brown spots on the legless segments. Thoracic feet black, bases yellow brown. Length, 55 mm.

Food-plants.—Oak, Chestnut, and rarely Hickory.

Common in this vicinity, and single brooded. The moths come forth early in July, and the larvæ are fully grown in August and September.

Datana perspicua G. & R.

Fore wings clear yellow buff with the transverse lines, apical streak and narrow outer border bright ferruginous. Usually there are only four lines instead of five. Discal spots large, conspicuous, ferruginous, the outer one being the largest. Hind wings paler. Body yellow buff, with the thoracic patch rusty ochereous. The lines are sometimes more or less distinct or partly broken before they reach the costa. Expanse, 40-55 mm.

Caterpillar.—Head and cervical shield black or red. Body black or red, with very broad canary yellow stripes as wide or wider than the intervening spaces. Thoracic feet black or red. Abdominal legs red or blackish. Length, 55 mm.

Food-plants.—Sumac (*Rhus glabra* and *R. typhina*).

Common in this neighborhood. The moths appear late in June and early in July, and the caterpillars in August and September. Single brooded.

Melalopha inclusa (Hübner).

PLATE XVIII, FIG. 5. MALE.

Fore wings cinereous with ochereous tints and shaded with brown scales. At the base is a transverse line dislocated about the middle, and beyond is a short line meeting an oblique line which runs from the costal third to the outer third of the inner margin, where it meets another line which runs upwards to the costa, and forms a V-shaped mark. This last line is bent at the costa and followed by a rusty patch. A submarginal row of black spots also present. Hind wings uniform in color with a median paler line. Body same color as wings with a broad median umber brown band from the top of the head to the summit of the crest on the thorax. Expanse, male, 30-35 mm. ; female, 35 mm.

Caterpillar.—Head and cervical shield black, shining. Body cylindrical with a double tubercle on the top of the fourth and eleventh segments. Along the back are four narrow yellow lines alternating with black ones, and on the subdorsal space are irregular alternations of blackish and dusky lines. Below the spiracles is a yellow line, and below this, on the substigmatal space, the body is flesh colored. A few gray hairs are scattered over the body. Length, 30 mm.

Food-plants.—Different kinds of Willow and Poplar.

Very common and double brooded. The caterpillars live in colonies of ten to twenty or more individuals, in a tent made of folded leaves lined with silk. The first brood appears from May to July, and the second brood from August to October. Spins a loose cocoon between leaves, usually on the ground.

Melalopa apicalis (*Walker*).

Fore wings light ashen gray, with a lilaceous tint, and shaded with dark ashen gray lines similar to those of *M. inclusa*, whitish, the fourth line widened and white at the costa, and more obliquely bent outward than in *inclusa*. At the costa the white mark is followed by a reddish shade. Subterminal row of spots dark. Hind wings mouse gray, with a median lighter line-like shade. The brown thoracic line as in *inclusa*. Expanse, 22-28 mm.

Caterpillar.—Head brown, cervical shield widely divided into two transversely oval brown black plates. Body along the back ash gray or greenish white, traversed by three pale reddish brown lines, more or less broken. Sides of body darker and containing two darker irregular lines, giving it a marbled appearance. Four yellow tubercles on each segment from the second to eleventh. There are no humps nor warts on the fourth and eleventh segments, thus differing from the larva of *inclusa*. Thoracic feet black; abdominal legs livid ash. Length, 27 mm.

Food-plants.—Willow and Poplar.

Not common. Little is known about the habits of this species, which are said to be similar to those of *inclusa*. The larva may be found fully grown in August and September, and the species seems to be double brooded. Spins a rude cocoon like that of *inclusa*.

Melalopa albosigma (*Fitch*).

Fore wings varying from light to dark ochereous brown with a large, conspicuous, rusty brown apical patch, limited inside by the fourth transverse line which forms a prominent, clear white angle at the costa. First and second lines oblique, third line slightly bent and almost touching the fourth line before it reaches the inner margin. Across the outer part of the wing is a subterminal dark shade. Thoracic mark broader than in *inclusa* and *apicalis*. Hind wings light brown. Expanse, 30-34 mm.

Caterpillar.—Head black, with a Y-shaped pale brown line in front, densely covered with grayish hairs. Body straw yellow, with three dorsal, more or less

interrupted grayish or pearly pale brown lines, and a broad lateral stripe, below which the tubercles are yellow. The first three segments bear each six rather large yellowish warts, the lowest being the largest, each having a number of unequal hairs. On the fourth segment is a high finger-shaped fleshy-black tubercle, bent backwards and bearing a number of hairs. On the eleventh segment is a smaller and paler tubercle. Thoracic feet black. Abdominal legs dark. Length, 30 mm.

Food-plants.—Willow and Poplar.

Several caterpillars commonly live together in a kind of nest they construct by drawing two or more leaves together with silk, forming a hollow ball-like cavity, within which they repose when not feeding. Double brooded; the moths appear in May and again in July and August. Not common in this vicinity.

Nadata gibbosa *Walker.*

PLATE XVIII, FIG. 1. MALE.

Fore wings uniform light buff with a rusty tinge. Across the wings are two transverse rusty brown lines, the basal one straight or curved; the outer one oblique and straight. In the cell are two white discal spots. Hind wings pale buff, as is also the body. Expanse, male, 40-45 mm.; female, 45-55 mm.

Var. **rubipennis** *Neum. & Dyar.*—Has the wings tinted with deep orange brown.

Var. **oregonensis** *Bull.*—Differs by having a distinct grayer tint and greater predominance of markings.

Caterpillar.—Head large, smooth, rounded; whitish green; mandibles bright yellow tipped with black. Body smooth, whitish green along the back and darker along the sides; without tubercles or humps, cylindrical, surface with minute, raised, flattened, more or less confluent granulations and with a narrow, yellow subdorsal stripe along each side. Spiracles orange brown. Anal plate edged with yellow. Legs and feet green. Length, 35 mm.

Food-plants.—Maple, Oak, White Birch and Sugar Plum.

Double brooded. The moths appear in May and again late in June and July, and the larvæ in June and September. It enters the ground, where it spins a loose, soft cocoon, composed of only a few silken threads. Common. Var. *oregonensis* is a western form and does not occur here.

Lophodonta angulosa (*A. & S.*).

PLATE XVIII, FIG. 12. FEMALE.

Fore wings mouse gray, with a large, rounded, whitish area at the middle on the costa; this patch is sometimes absent or is more or less distinct. At the extreme base is a short angulated ferruginous line followed by a small tawny patch. Across the basal third is an angulated ferruginous line, and across the outer third is a line composed of small teeth which are tipped with white outwardly. A subterminal diffuse, paler shade also present. Hind wings dirty whitish or gray, costal margin broadly mouse gray, broken by two whitish bands. Expanse, 35-45 mm.

Caterpillar.—Somewhat like that of *Nadata gibbosa*. Head rounded, deep pea green, with a pink line on each side, edged above with white. Mandibles green at base, with an orange red line along the upper edge, tips black. Body noctuiform, tapering towards the anal legs, pea green, slightly darker below than along the back. On each side is a yellow stigmatal line, edged above narrowly and irregularly with red brown; a faint double whitish, somewhat broken median line, uniting on the anal plate, where it is pinkish, and a faint, narrow, broken one along the subdorsum. Thoracic feet greenish amber, spotted with black outside. Length, 40 mm.

Food-plant.—Oak.

The moth issues from the pupa in June and July, and the species is single brooded. The caterpillar closely resembles that of *Nadata*, but differs from it in habits, for it rests on the edge of the leaf instead of on the back, as *Nadata* does. It forms a cocoon, composed of silk mixed with grains of dirt, beneath the surface of the earth.

Lophodonta ferruginea *Packard*.

Fore wings ferruginous, median space paler. Across the basal third is a transverse line, straighter and less angulated than in *L. angulosa*; outer line curved outwardly and bending inwardly at the middle. In the disc is a large whitish spot, preceded by whitish confluent spots. The lines are shaded with whitish and the veins on the outer part of the wing are blackish with a minute white point on each at the margin. Hind wings whitish; costa mouse gray with two short white bands; outer margin narrow, blackish. Expanse, 45 mm.

Caterpillar.—Head rounded, broad, flattened in front; light green with a white line on each side of the clypeus and another from the palpi converging slightly on the vertex of each lobe; lateral band smoky purplish red fading to yellowish on its lower side, and continuous with the line on the first, second and

third segments. Body soft, yellowish leaf green, cylindrical, tapering posteriorly, with a broad yellowish white, double dorsal band, the space filled with red on the last segment. Faint traces of a broken subdorsal line and two or three round yellow dots laterally. Dorsum faintly shaded with white. Thoracic feet reddish, tipped with black. Length, 40 mm.

Food-plant.—Birch (*Betula papyrifera*).

Not common in this vicinity. It is double brooded, the moth appearing in May-June, and again in July-August. The caterpillar eats an irregular hole out of the side of the leaf and forms a loose cocoon in the ground.

Lophodonta basitriens (*Walker*):

Fore wings ash gray with an oblique dark line from the costal third to the outer fourth, slightly dentate. Outer line dentate. Basal space ochreous, with a darker streak. Veins on outer part black. Hind wings grayish with a paler median line. Head gray, thorax gray mixed with ferruginous. Expanse, 46-49 mm.

Not common. The larva is not known.

Notodonta simplaria *Graef*.

Fore wings uniform dark gray, finely scaled with lighter gray, and with two transverse darker, wavy lines. Discal spot linear, in a paler ring. Subterminal row of dots dusky. Hind wings whitish gray. Head and thorax gray. Expanse, 45-50 mm.

Has been found in the Catskills in August, and possibly also occurs in this vicinity. The larva is not known.

Notodonta stragula *Grote*.

Fore wings slate gray, ochreous and chestnut brown along the inner margin and subterminally, where the color is in the form of a scalloped band. Basal space of wing beneath the slate gray costal area ochreous and chestnut brown with two dark brown streaks. Transverse anterior line scalloped, ochreous. Transverse posterior line obsolete except at inner margin. Discal spot linear. Hind wings white in the male, gray in the female. Expanse, 40-45 mm.

Caterpillar.—Head large, oval, narrowing near the vertex, which is slightly bilobed, of color of body, and mottled with brown. The body is thickest on

the fifth and sixth segments, on each of which is a thick, fleshy, conical, soft tubercle, the apex falling over backward; they may be elevated and somewhat enlarged or depressed, the anterior tubercle the larger of the two; the body is humped on the last segment. Color pearly whitish blue or lilac white, somewhat marbled with brown, except the last two segments, which are golden brown mottled with darker brown. Laterally there are some oblique, pale streaks, somewhat similar to those of many Sphingidæ. A brown dorsal line extends from behind the head to the apex of the second tubercle on the sixth segment; thence extends a faint vascular line to the end of the body. Last segment humped. A pinkish stigmatal line. Length, 40 mm.

Food-plants.—Willow and Poplar.

Not common in this neighborhood, and double brooded. The moth appears in May and June, and again in July and August. The singular caterpillar often rests on the edge of a leaf, and its oblique markings and tubercles bear a striking resemblance to a twisted, partly dead and dry portion of the leaf.

Drymonia georgica (*H.-S.*)

Fore wings ochreous gray, with two black transverse lines edged with white; the first line dentate, outer line curved outwardly, and bending inward beneath the middle, where it is connected with the first line by a black dash. At the base and in outer part of the wings are several black dashes. Thorax grayish, collar edged with black, on each side of which is a white spot which sends a white dash obliquely into the wing. Hind wings whitish or grayish. Expanse, 40-45 mm.

Caterpillar.—Very similar to *Lophodonta angulosa* in color, shape and markings, but has a red button on top of the eleventh segment.

Food-plants.—Various kinds of Oak.

Not common, and double brooded.

Ellida caniplaga (*Walk.*)

Fore wings uniform ash gray; no distinct transverse line at the base, but just before the middle of the wing are three vandyke brown parallel, close-set lines which begin on the costa, but are most distinct and heavy between the subcostal vein and above the median fold; the outermost and innermost of the three lines extend to the inner edge of the wing, but the inner one is obsolete. On the outer of the three lines is situated the dark vandyke brown, distinct, curvilinear discal spot, and this distinguishes the species from any other Notodontian. On

the outer fourth of the wing are two faint scolloped dark lines, represented by venular spots; a marginal row of irregular brown spots. Hind wings and abdomen ash gray. Expanse, 37-42 mm.

This species has been taken at Poughkeepsie, N. Y., and is undoubtedly also found in this neighborhood. The larva is not known. The moth may be found late in April and in May.

Lophopteryx camelina (*Lin.*).

Fore wings bright wood brown, with the nervules interruptedly marked with black brown. Transverse anterior line forming two approximate teeth in the cell and dentate beneath. Transverse posterior line obliterated, with a paler shade a little beyond. Hind wings ochereous with a blackish patch at the hind angle. Expanse, 36-40 mm.

Caterpillar.—Body whitish green along the back, with the dorsal vessel forming a blue thread; a subdorsal line of a faint bluish tinge; sides green; sometimes the back is pinkish. Spiracular line yellow, edged above with violet and bearing a red spot behind each spiracle; spiracles black. Under side green with a plum-colored tinge, showing ventral spots of pale yellow. Head smooth, green, mouth parts yellow with a black line. Thoracic legs pink; abdominal legs green, tips red. Last segment with a double, high, conical tubercle on the top of the last segment. Length, 33 mm.

Food-plants.—Poplar, Oak, Alder, Hazel.

Very rare in this neighborhood. It is also found in Europe and northern Asia. The caterpillar is allied to that of *Phcosia*, but differs from it by having a double twined, conical tubercle on the last segment, whereas in *Phcosia* the horn is single.

Pheosia dimidiata (*H.-S.*).

PLATE XIX, FIG. 7. MALE.

Fore wings whitish brown at the apical third on the costa, with two dark brown streaks. Middle of the wing white, brown along the inner margin, with deep brown and white streaks. Sometimes the brown along the inner margin extends nearly to the apex. Hind wings white, with a blackish patch at anal angle. Head and thorax cinereous. Expanse, 50-60 mm.

Caterpillar.—Head reddish, mottled with lighter color. Body of a peculiar pearly hue, with a porcelain-like polish; segments swollen. Last segment provided with a rather stiff, well-developed black horn. Thoracic feet deep amber

red or salmon color. Abdominal legs large, thick, blackish in the middle; anal pair with a rusty red spot outside. On the under side of the body is an irregular greenish median line. Spiracles black ringed with yellowish white.

Food-plants.—Willow and Poplar.

Not common, and double brooded. May–June and August. The remarkable caterpillar recalls those of the Sphingidæ on account of the horn on the last segment.

***Nerice bidentata* Walker.**

PLATE XVIII, FIG. 9. MALE.

Fore wings rich dark sable brown along the middle and shading into lighter brown at the costa. The brown part sends two prominent teeth into the light gray brown part along the inner margin, which is separated from the brown part by silvery white. Hind wings gray brown. Thorax gray brown with a sable brown patch in front. Expanse, 36–40 mm.

Caterpillar.—Head polished bluish green, narrower above than below, with four perpendicular silvery green lines; first, second and third segments above pale silvery green, interrupted by a straight dorsal and subdorsal line of dark bluish green. On the back of each of the fourth to eleventh segments inclusive is a high prominence, directed forward and ending in a bifid ridge. The upper half of the body, including the prominences, is silvery green with a series of oblique, dark lines, running from the anterior base of the prominence to the posterior part of the following segment. Thoracic segments with a lilac line, bordered above with yellow, above the legs. Summit of prominences yellowish with the extreme edges brown. Spiracles yellow with a lilaceous ring. Length, 30 mm.

Food-plant.—Elm.

Not common. The moth is found in May and June, and again in August. The caterpillar, when resting on the edge of a leaf, very much resembles a part of the leaf. It spins a rude cocoon on the surface of the ground between leaves.

***Dasylophia anguina* (A. & S.).**

PLATE XVIII, FIG. 8. MALE.

Fore wings ashen gray shaded with darker gray. Veins marked with black, and across the outer third is a slightly curved, transverse black line. Near the

hind angle are two black spots, and at the base of the wings is a black longitudinal streak. The female has the basal part of the wing largely ochreous. Hind wings uniform grayish. Expanse, 30-40 mm.

Caterpillar.—Head rounded, greenish amber. Body smooth, shining, with a jet black button or hump on top of the twelfth segment. Purplish red, with seven longitudinal black lines, one dorsal and three on each side, the lateral ones confluent on the eleventh segment, leaving the ground color light blue between them. This color also edges narrowly the dorsal line on each side. Below the lateral lines is a broad yellow stripe, white in the center, and below this a row of large black spots, one on each segment. Dorsum shaded with reddish and a little yellow just above the lateral black lines. The lines do not extend beyond joint eleven. On each side of the twelfth segment is a black spot, and one on each side of the fifth segment. Under side with traces of a black line. Thoracic feet red, claspers of legs reddish. Length, 45 mm.

Food-plants.—Locust, False Indigo (*Baptisia*), Clover.

Not common and double brooded, the first brood appearing in June and the second in August. The larva spins a thin, somewhat tough cocoon, on the surface of the ground between leaves or chips.

***Dasylophia thyatiroides* (Walker).**

Fore wings light mouse gray, middle part grayish, dusted coarsely with brown. Differs from *anguina* in having a zig-zag or scalloped cross line on the basal third of the wing, within which the wing is tawny brown; also a double scalloped line ending just within the inner angle. Costa towards the apex interrupted by gray spots, which are more distinct on the under side. A submarginal row of very oblique, dark linear spots between the veins, succeeded by lighter streaks of light tawny white. Fringes gray, with dark spots. Pectinations of antennæ a little longer than in *anguina*. Hind wings mouse brown. Expanse, 36 mm.

A northern species, very rarely found in this neighborhood. The larva is not known, but is said to live on Hickory. The moth is found in July.

***Symmerista albifrons* (A. & S.).**

PLATE XVIII, FIG. 7. MALE.

Fore wings cinereous, with darker shadings and two double transverse lines within the middle, an obsolete line beyond, and a subterminal, dentate, black line. The costa from the middle to the apex is broadly white, with a rounded

tooth projecting inwards. Discal mark linear. Thorax cinereous, ochereous in front. Head ochereous. Hind wings gray. Expanse, 30-40 mm.

Caterpillar.—Head bright orange testaceous. Ground color of body flesh-colored or pink, with five equidistant black lines on the back, and broken at the junctions of the segments. On segments one to three are only three lines, following which lines is a rather broad orange yellow stripe, and another of the same color along the spiracles; between the two orange stripes are three narrow black lines. All these lines terminate on the eleventh segment, which has a coral red hump, the color uniting with the lateral orange stripe. Last segment spotted with black; extreme sides also spotted with black in form of broken patches. Legs pinkish flesh-color. Length, 40 mm.

Food-plants.—Various kinds of Oak and Beech.

Quite common everywhere, and single brooded. The moth makes its appearance during June and early in July, and the caterpillars may be found until late in September. They live in swarms and spin a cocoon on the ground when fully fed. The caterpillar may be easily known by its conspicuous colors and the coral red hump on the eleventh segment.

***Hyparpax aurora* (A. & S.).**

PLATE XVIII, FIG. II. FEMALE.

Fore wings light yellow, with the terminal space broadly pink, as is also the costa and basal part of the wings. Hind wings white, tipped with pink at the anal angle. Head pink; thorax yellow, anterior half pink. Discal mark linear, pink. Expanse, 30 mm.

Caterpillar.—Head rounded, ground color white with a yellow tint, reticulated with mottled bands of purple brown, a broad one running from the antennæ to the top of each lobe. The fourth and eleventh segments each with a prominent elevated tubercular hump. Body whitish green at the sides, finely dotted with white and brown, and shading into brighter green on segments one to three. On the first three segments is a purple brown dorsal band, dotted with white and bordered with yellow. Beginning at the tubercle on the hump on the fourth segment is a white subdorsal band, marked with five irregular purple brown lines, ending on the last segment. Dorsal space bright yellowish leaf-green, dotted with white, with indications of a narrow white dorsal line. Under side and legs purple brown, dotted with white. Tubercle on sixth segment marked by a small white patch, and there is an enlargement of the subdorsal line on the seventh segment. Length, 35 mm.

Food-plant.—Oak.

The moth appears in the latter part of May and early in June ; the second brood comes forth in August. The caterpillar enters the ground, forming a thin cocoon of silk and dirt.

Ianassa lignicolor Walker.

PLATE XVIII, FIG. 4. MALE.

Fore wings light gray with darker longitudinal shades and streaks. At the base is a blackish dash. Discal spot obscure. Hind wings whitish with a grayish patch at the anal angle. Expanse, 35-45 mm.

Caterpillar.—Head not very large, with a depression at the summit, smooth ; whitish ash, with two mottled yellowish and dark ash bands, dentate inwardly, dividing the ground color in front into spots. Similar markings occur on the sides of the head, giving it a marbled appearance. First three segments pea green with a triangular dorsal patch, light brown, widest and forked on the first segment ; at the sides is a narrow brown border. Fourth segment provided with a large brown, pointed tubercle, curved forward ; on the eleventh segment is a small tubercle ; fourth to sixth segments pale gray and reddish brown, the fourth less marbled than the fifth and sixth, and watered with gray ; the back from the seventh to the last segments is clear deep pea green, with the green running into the seventh segment, and the brown and gray running along the sides to the end of the body. On the top of the ninth segment is an ashen brown spot. Length, 35 mm.

Food-plants.—Different kinds of Oak ; Beech and White Birch.

Not common, and possibly two-brooded. The larva is found from July until late in September. It spins a tough cocoon between leaves on the ground.

Schizura ipomææ Doubleday.

PLATE XIX, FIG. 8. MALE.

Fore wings brown, sometimes with a reddish tinge in the male ; costal region grayish ; nervures blackish. Transverse lines indicated by black dots. Discal spot reddish brown, linear, surrounded by gray, in a black cloud. On the outer part of the wings are two obsolete rows of black dots. Hind wings whitish, with dark margin in the male ; smoky brown in the female. Expanse, 35-43 mm.

Var. *telifer* Grote.—Has the fore wings as in *ipomææ*, but with two black, longitudinal dashes, one at the base on the middle, and one above and beyond, reaching almost to the outer margin.

Var. *cinereofrons* Packard.—Fore wings from the base to the outer edge along the middle very dark smoky brown, obscuring all the markings except the discal spot. Costal region from a little beyond the base light gray; inner margin brown.

Caterpillar.—Head small, high, pale bright purplish, darker down the front, with two parallel black brown lines on each side, bordered with paler and enclosing a clear purplish band. First segment mottled with reddish and pale flesh color at the sides, and a dorsal band, divided in the middle by a pale yellow line, which narrows to half as wide on the second segment, and passes back to the horn on the fourth segment; the rest of the second and third segments are green; the fourth to last segments are faded, dull blood red, due to fine, flesh-red lines and mottlings on a carneous ground. On the fourth segment is a high, fleshy, soft tubercle or horn, which is bent a little backward; the basal half is mottled and lined like the segment from which it rises, but above becomes bright, clear, blood red, forked at the end, each fork bearing a black bristle; a black median line passes along the tubercle, becoming forked in front and behind at the base. Two large, high twin tubercles on the eighth segment are not so high as the two similar ones on the eleventh segment; both are blood red. The small dorsal tubercles on the fifth and sixth segments are minute and yellow, those on the seventh are partly blood red. On the fourth to eighth segments is a porcelain white band, bordered with faint yellow, and containing deep pink, irregular, broken lines, the part on the fourth segment behind the tubercle being triangular and that on the fourth round. On the ninth segment is a white, V-shaped mark, acute in front. Thoracic feet pale flesh color. Beneath the first three segments are green, and the rest much as above, as are also the legs. Length, 18–33 mm.

Food-plants.—Oak, Maple, Birch, Blackberry, Elm, Huckleberry, Honeylocust, and *Ceanothus*.

The moth may be found in June and again in July–August. Double brooded. The larva wonderfully mimics a dull blood red portion of a leaf which has been cut partly off and become somewhat twisted. The red on the larva is somewhat variable in tint. Found until late in September. Spins a cocoon covered with dirt on the surface of the ground.

Schizura leptinoides (Grote).

Fore wings ash gray with a brownish tint, slashed with narrow, black, broken lines or streaks; discal spot small, black; apex whitish; transverse lines blackish, geminate, undulate, obsolete, especially in the female. Hind wings whitish in the male, dark gray in the female. Expanse, 35–40 mm.

Caterpillar.—Head somewhat notched above, clay yellow, with two broad dark brown bands in front, which are made up of irregular, wavy, dark lines and spots; labrum carneous. Body uniformly pale brown, with a broad dark brown dorsal stripe along the first three segments, and continued upon the base of the head in form of a triangular spot. On the fourth segment is a large, high, fleshy cylindrical tubercle of the same color as the body, which nods back and forth as the creature walks; it bears two piliferous tubercles at the end; on the eighth segment is another large fleshy hump bearing two small tubercles, and on the last segment is a prominent fleshy hump bearing two small piliferous warts. Behind the first hump is a long triangular flesh-colored dorsal band; on the sixth segment is a similar band, and a similar flesh-colored one on the seventh segment, which breaks up into three diverging stripes ending at the suture. The V-shaped dorsal mark on the ninth and tenth segments is faded pink edged with clay yellow and dark brown. Along the sides is a narrow dark line. Length, 25–30 mm.

Food-plants.—Oak, Hornbeam, Beech, Chestnut, Hickory, Walnut and Butternut.

The caterpillar is subject to variation in depth of coloration from pale to dark brown or almost black in different examples. It mimics a part of a dead leaf. The moth appears in June and again in August.

Schizura unicornis (*A. ♂ S.*).

Purplish gray, tinged with sea-green at base and along costa of the fore wings; frequently with a buff-colored apical patch in the male. Discal spot black, linear, and followed by a blackish shade. Transverse lines faint, blackish, wavy, the outer lines succeeded by a reddish brown shade. A series of subterminal dashes, and a few white marks. Hind wings whitish in the male, dark gray in the female. Expanse, 30 mm.

Caterpillar.—Body pale rust red, with a pea green patch on each side of the first three segments. Fourth segment with a large, high, acute tubercle, with two small tubercles at the tips. On the eighth is a slight hump with two small warts, and on the last segment is a rather large dorsal hump, supporting two warts, in front of which is a long, broken, silver V-shaped mark, the apex pointing forward. At the sides are three oblique lines connecting with a dark line above the spiracles. Ground color variable, from red brown to grayish brown. Length, 30 mm.

Food-plants.—Blackberry, Apple, Plum, Thorn, Elm, Birch, Hazel, Alder, Locust, Cherry, Dogwood, Oak, Ilex, Rose, Willow and Hickory.

The moth appears in May and June, and is double brooded. The larva may be found until late in September. It spins a cocoon on the ground between leaves. Common everywhere, but not abundant.

Schizura apicalis (*G. & R.*)

Purplish ash gray; discal spot on fore wings large, lunate, followed by a black cloud. Transverse lines obscurely geminate, black, coarsely waved, the outer one curved outward opposite the cell; lower half of wing clouded with brownish; middle of wing whitish, frosted over with white scales; a narrow black basal streak. Veins outwardly lined with black. Discal mark distinct. Hind wings white in the male, with a black spot at the anal angle; blackish in the female, with a central pale band. Expanse, 30 mm.

Very rare in this vicinity, and the larva is not known. It may be recognized by the large, heavy, discal mark, the distinct black submedian streak, the fawn brown fore wings, and by the white bands in the middle of the wing.

Schizura badia (*Packard*).

PLATE XVIII, FIG. 6. MALE.

Fore wings reddish brown at base. Transverse bands geminate, sinuous, reddish brown, narrow, space between these lines ashen gray brown, sometimes flushed with purplish gray; discal spot black, linear, and followed by a conspicuous black shade, giving it the appearance of a large prominent patch. Outer part, beyond the lines, largely reddish brown at angle, and a black sub-apical patch; apical parts of wings sometimes slashed with white and black in the male. Hind wings grayish brown in the male, uniformly brown in the female. Expanse, 30 mm.

Caterpillar.—Head white, with a faint yellow tinge, and with two purplish brown bands in front, extending to the vertex and mottled with round dots of the ground color; a fainter similar band behind the ocelli. Body green on the sides of the first to third segments inclusive, with a purple brown dorsal band mottled with white and tapering on the fourth segment. A white subdorsal shade from the fourth to the last segment, diffuse downward and cut by oblique lines of the ground color, broken on joint ten, the posterior part continued forward from joints ten to nine and becoming yellow, forms a V-shaped mark supplemented by a few dots on joints eight and ten. A distinct yellow dorsal mark, composed of spots from the fourth to the seventh segments, the spots on joint seven separated by a brown Y-shaped mark. Sometimes the sides of joints

four to seven are more or less covered with dark brown mottled with white, and the brown usually prevails in a band on the fourth segment back to the abdominal legs. Sixth segment sometimes brown, with the yellow dorsal marks present. Thoracic feet pinkish, abdominal and anal legs brown. A very slight prominence on the fourth and last segments. Length, 35 mm.

Food-plants.—Different kinds of *Viburnum*.

Not common, and double brooded. The moth may be easily known by its purplish brown color and conspicuous, large discal spot and shade.

Schizura eximia (*Grote*).

Fore wings ashen gray, with dashes of ochreous brown; transverse lines absent; inner margin for two-thirds of the width of the wing purplish brown. Discal dot very small, round, black. At the base of the wing is a short black dash. Hind wings gray brown, darker in the female. Expanse, 42–50 mm.

Caterpillar.—Head dirty white, with a band on each side, composed of spots of brown black, dotted with red. Body pale brown, with a mossy olivaceous brown shade along the dorsum, distinct on the last four segments, and often quite greenish. Segments six to eight diffused with pink dorsally. V-shaped mark distinct, pinkish, with centering red lines, but remaining narrow and diffuse. First three segments dirty whitish, dotted with brown reticulations and a dorsal shade. An oblique olive brown line runs from the base of the long fleshy tubercle on the fourth segment, backwards to the anterior part of the leg on the sixth segment. The movable tubercle on the fourth segment is long, with the distal half slender. On the eighth segment is a slight hump, and a larger one on the twelfth segment. Length, 35 mm.

Food-plants.—Willow, Poplar, White Birch, Maple, Beech, Apple.

Not common; probably double brooded. The moth resembles *S. concinna*, but the wings are longer and more produced, with the outer margin more oblique. It is also larger. More information regarding the life-history is needed. The larva lives singly on the edge of a leaf.

Schizura concinna (*A. & S.*).

Fore wings pale tawny, cinereous along the costa and broadly purplish brown along the inner margin; the light part with ochreous dashes. Discal spot minute, black; base with a short black dash. Hind wings white with a blackish patch at hind angle. *Female*, almost uniform purplish brown, gradually fading

into dark cinereous towards the costa and apical region with a few black dashes. Hind wings uniform brown. Expanse, 30-33 mm.

Caterpillar.—Head deep coral red, as is also the transverse hump or elevation on the fourth segment. Body black, with four dull yellow, narrow, wavy dorsal lines and three white subdorsal lines. Sides with two dull yellow lines, below which is a white line. Under side with dull yellow broken lines. On the first three segments all the lines are broken into small spots. On the back of each segment are two long spine-like tubercles, the pair on the red hump being the longest and the following ones gradually decreasing in size towards the end of the body; the other tubercles on the segments much shorter and wart-like. Length, 30 mm.

Food-plants.—Apple, Cherry, Plum, Rose, Thorn, Pear, White Birch, Willow, Poplar, Blackberry, Huckleberry, Dog-wood, Sweet-gum, Persimmon, Bayberry, Hickory, Wistaria, Oak, and Locust.

The moth appears during the end of May and in June, and again in August. The caterpillars feed in clusters and spin their cocoons between leaves on the ground. Rather common, and double brooded.

***Seirodonta bilineata* (Packard).**

PLATE XIX, FIG. 4. FEMALE.

Fore wings mouse gray, sometimes with a lighter shade; two transverse, angular, double, narrow gray brown lines, and a subterminal pale, line-like shade; fringes notched with black. Discal spot small. Sometimes the wings are suffused with black brown. Costa towards the apex sometimes streaked with black. Hind wings gray brown. Expanse, 35-40 mm.

Caterpillar.—Cylindrical, slender, with two warty elevations on the dorsum of the fourth and twelfth segments. Body green; a pale yellow dorsal line, bordered on each side of joints three and four by a purple line; outside this is a pale yellow stripe that diverges on joint two, and gradually diverging again on joints four, five and six, where it reaches below the subdorsum and extends back to joint eleven, uniting again on the last segment. These stripes send more or less prominent deflections down the sides on joints seven and ten. In some examples the space between these stripes and the dorsal line contain a pale whitish stripe on each side of the dorsal; the deflections, a little space on joint five, and the elevations are reddish purple. In other examples the whole space between the lines, except four or five greenish patches, is reddish purple. The sides are speckled with purple; stigmal line yellow. Head green, with a dark purple line each side, outside of which is a yellowish line. Length, 30 mm.

Food-plants.—Elm, Beech.

Not common and double brooded, the first brood appearing late in May and early in June, and the second brood in July and August. The larva forms a rude cocoon on the ground.

Heterocampa manteo (*Doub.*).

Fore wings ash gray, varying from light to dark gray, with three scalloped, darker, transverse lines, the scallops filled with light gray. A large discal pale gray spot containing two small black dots; costa before apex with short black dashes. Terminal edge notched with black dots. Hind wings uniform mouse color, fringes paler. Expanse, 40-50 mm.

Caterpillar.—Head dull opaque amber, with a broad lateral brown line edged with white, on each side, meeting on the vertex. Body green with a broad subdorsal and two narrow yellow lines. The sides of the first three segments dotted with reddish pink, and there is a reddish streak on the outside of the anal legs. The subdorsal lines diverge on the first segment, and on the next two segments are edged within with pinkish red lines. The space between the dorsal lines is more or less filled with pinkish red, and with a narrow yellow line along the back, beginning on the fourth segment. Body elongate, with slight traces of a hump on the last segment, otherwise smooth. Length, 35 mm.

Food-plants.—Oak, Basswood, Persimmon, Walnut, Apple, Birch, Hawthorn.

Double brooded and not common. The caterpillar is subject to variation, especially in the red markings along the back; sometimes the space between the subdorsal stripes is filled in solidly with deep red, and only interrupted by the yellow dorsal line. It spins a rude cocoon on the ground, or under the surface.

Heterocampa guttivitta (*Walker*).

PLATE XVIII, FIG. 13. FEMALE.

Fore wings whitish gray, with darker shades; the markings are like those of *H. biundata*, but the subterminal row of spots is straight, and not bent as in the latter species; hind wings gray. Expanse, 40-50 mm.

Caterpillar.—Head large with a short, lateral four-colored stripe, of black, white and pink, with the outside yellowish. Body green, finely speckled with dark red brown along the sides. Dorsal line snow white, fading into yellowish on the sides, where there is a series of fine dark red black dots; the line is widest on the fifth and sixth segments, and at the suture of the seventh and eighth segments connects by a narrow neck with the posterior division of the band, which contains a whitish line in the middle, bearing reddish dots on each side. Sides of

the tenth to twelfth segments white, including the upper part of the anal legs, which are marked with a red line. Thoracic feet green, with a black dot in the middle. Length, 35 mm.

Food-plants.—Maple, Oak, Chestnut, Beech.

Not common, and possibly double brooded. The very young caterpillar is reddish brown with nine pairs of long horns like the antlers of a deer. The first pair are much longer than the rest, each with four very long branches.

Heterocampa biundata Walker.

Fore wings olive green gray, with two transverse, scolloped blackish lines and a subterminal row of dusky spots, sometimes quite conspicuous. Hind wings mouse gray. Expanse, 40-44 mm.

Caterpillar.—Head high, conical, extending on the vertex into two rounded tubercles which are blackish; sides of head reddish brown, with a white median band in front, extending over the top to the white dorsal band beginning on the first segment. Body delicate pea green, with the characteristic white dorsal band, and on the sides of the third and fourth segments is an oblique leaf brown patch. A second large leaf brown patch on the side of the sixth segment, extending forward upon the fifth, and backward, forming a larger spot on the seventh. A third oblique leaf brown patch is situated on the side of the ninth segment, edged irregularly with a reddish brown tint. The white dorsal band is broad, gradually widening and again rather suddenly decreasing and contracting to a narrow point on the hinder edge of the seventh segment, where a second white band begins, which gradually widens and becomes forked on the last four segments. It is also edged with reddish brown. Over the sides are fine concolorous dots. Thoracic feet reddish; abdominal legs reddish flesh color. Length, 35-40 mm.

Food-plants.—Maple, Yellow Birch, White Birch, Willow, Dogwood, Witch-hazel, Beech, Hickory, Cherry, etc.

Not common. The moths have been captured in May and August, which would indicate that the species is double brooded.

Heterocampa obliqua Packard.

Fore wings dark gray, transverse lines obscured, varied more or less with ochreous, ferruginous and white patches. Of the patches the subapical one is most conspicuous. Discal mark black, linear. Hind wings white in the male, smoky outwardly in the female. Expanse, 40-50 mm.

Var. *trouvelotii* Pack.—In this form the white patches are absent, with the large subapical area filled with ferruginous, limited inwardly by a narrow black margin, part of which is the discal mark.

Caterpillar.—Head rounded, luteous, with a flesh-colored tint and slightly purplish; an ashy irregular stripe on each side, with scattered spots between. Body thickened in the middle, pale flesh color, marked with numerous irregular reddish pink wavy hair lines. Dorsal band reddish, bordered with yellow and enclosing a pale, almost white stripe. From the first segment the two lines unite, spreading again on the second and becoming widest apart on the fifth and sixth segments, narrowing again between the seventh and eighth segments, and again widely separated on the tenth segment. The two lozenge-shaped marks thus formed inclose two parallel median pink lines. On the end of the last segment the two lines unite to form a median leaf brown band. Sometimes the body is green, with a faint double, rather narrow dorsal line, green on joints four to six, eight and nine, and forming a green wedge-shaped patch on joints ten to twelve, edged with brown and yellow, tapering posteriorly and ending in a line on the last segment. A pale yellow stigmal line. Length, 40 mm.

Food-plant.—Oak.

Not common. Fully grown larvæ may be found in July and August, and possibly the species is double brooded. The moth is found late in June and early in July.

Heterocampa umbrata Walker.

Fore wings pale gray, with a greenish tinge; a double basal black scolioped line at the insertion of the wings; a double scolloped black line across the basal fourth, followed by a broad, clear olive ash space. Discal mark curved, continued by a broad, oblique, black shade in the female, which is absent in the male. Across the apical fourth of the wings is a double scolloped, black line, more or less distinct, and beyond which is a subterminal row of black connected spots. Wings in female more or less clouded with black. In the female the apical area is filled with pale whitish or greenish in form of a lunate patch. Hind wings alike in both sexes, whitish gray, with a diffuse whitish median band. Expanse, 40-53 mm.

Caterpillar.—Body green, sparsely dotted with white. On the first segment are two purplish black warts. From these warts runs backward a bright brownish purple line, dividing on the middle of the third segment and reaching the subdorsum on the posterior end of the fourth segment; then running along the subdorsum to the end of the sixth segment; they there unite and cover the whole of the back of the seventh and part of the eighth segments, where it again separates and runs as two lines to the end of the ninth segment. The space on the back of segments three, four, five and six, between the purple

lines, is filled with orange. On joint four a spur is given off from the purple line to the third thoracic leg, another runs from joint six to the first abdominal leg, and there is another short spur on joint nine; both of the last with oblique lines of lighter shade. On joint nine the orange is outside the purple, extending down the lateral spurs. Joint ten has no purple nor orange, except a little below the stigmata, but it has faint subdorsal lines. Joint eleven has purple subdorsal lines which unite on the anterior part of the twelfth segment and continue backward as a broad dorsal line, darkest on anal plate. The space on joint eleven between the subdorsal is filled with orange. Feet and legs purple, but rest of under side green. Length, about 32 mm.

Food-plant.—Various kinds of Oak.

Not common and double brooded. The moth appears in May-June, and August.

Heterocampa unicolor (*Packard*).

Fore wings pale gray, often of a faded clay brown, without any lines, or lines are only very slightly indicated. Thorax tufted with clay brown on the middle at the posterior end. Hind wings almost like the fore wings in color, somewhat paler at the base, and with a dusky transverse shade. Expanse, 42-52 mm.

Caterpillar.—Head small, rounded, with no trace of warts, but slightly bilobed. Body smooth, cylindrical, with no piliferous tubercles or warts. Anal legs long and slender. Leaf green, of the hue of the leaf it feeds on; along the back is a broad whitish yellow band, edged with reddish. There are no subdorsal lines or other marks.

Food-plant.—Sycamore.

Not common and double brooded. The moth emerges late in May and early in June, and again in July and early August.

Heterocampa marthesia (*Cramer*).

PLATE XIX, FIG. I. FEMALE.

Fore wings whitish, with light green and gray shades. Across the basal third is a black, double, wavy, transverse line, before which the wings are dark gray black or almost black. Beyond this line the wings are pale or obscured with blackish marks. The double transverse, bent, scolloped line is more or less distinct, broken, and filled with whitish. A subterminal line-like shade also present, and a black dash-like mark above the hind angle. Fringes grayish, with black marks. Hind wings whitish with a paler transverse band in the male; smoky gray, with the light band, in the female. Expanse, 40-58 mm.

Caterpillar.—Large-bodied, pale green, thicker in the middle, somewhat spindle-shaped, with two tails at the end of the body. A small, double, reddish tubercle on top of the first segment, from which a median white or yellow stripe, marked here and there with red, passes back to the end of the body. Along each side are seven pairs of faint, yellowish, slender stripes, the last extending to the sides of the anal filaments or tails. Legs green. Head large with the vertex light and conical, edged irregularly with pink on each side. Length, 40-42 mm.

Food-plants.—Oak and Beech.

This species may be easily known by its light green color, with darker marks and shadings, and the caterpillar by its two anal filaments or tail-like appendages. It lives singly and forms a cocoon on the ground between leaves or under stones. Double brooded. Not common in this district.

***Cerura borealis* (Boisduval).**

PLATE XIX, FIG. 9. MALE.

Head and thorax white, the latter largely blue black in the center. Fore wings white, with a very broad, gray black median band with irregular edges, and contracting about the middle. Outer blackish shade running narrowly across the wing. Space between the band shades white, with two distinct black spots on the costa, followed by two rows, each consisting of four small black spots. Outer and basal parts of wing white, the former with a terminal row of black spots and the latter with a row of four black spots and one spot near the base of the wing. Hind wings of male whitish with a small black discal spot, a terminal row of spots and a dusky patch at hind angle. In the female the hind wings are dusky. Expanse, 38-43 mm.

Caterpillar.—Head pale reddish or mahogany brown. First segment very broad, square in front on the sides, and ending in a low projection. Body pale yellowish green, with a dorsal median reddish brown band beginning at each angle on the first segment, and narrowing on the second and third segments; it begins to widen again on the fourth segment, becoming widest on the seventh and extending down each side to near the base of the abdominal legs, and contracting and becoming narrowest on the end of the tenth segment, and widening a little on the last. The red patch is sometimes more or less broken, dorsally, by the ground color. Anal plate triangular, rounded at end; tails long, brown, with three pale rings on the outer half. Thoracic feet deep red; abdominal legs pale, tips reddish. Length, 45 mm.

Food-plants.—Wild Cherry (*Prunus serotina*) and other allied plants.

Not rare ; double brooded. Fully grown caterpillars may be found in August and September and the moth in July. The caterpillar constructs an oval, flattened cocoon, mixed with bark or wood spun over a hollow in the wood bitten out by the larva.

Cerura occidentalis *Lintner.*

Head and thorax gray, the latter with a black transverse band in front and with orange spots. Fore wings light gray, the basal broad band deeper in color edged with black and orange ; beyond the middle are two or three dentate, black transverse lines, the outer one shaded with orange, and followed by a dark gray, triangular, subapical patch. Discal spot linear, black. Base of wings in the light gray area with black spots. A terminal row of black spots. Hind wings light gray, with a terminal row of black spots. Expanse, 30-35 mm.

Caterpillar.—Shape as in *borealis*. Body bright clear green, sides spotted with purple brown. The spots around the spiracles and base of thoracic feet the largest. The back is marked with lilac or whitish, varying in shade. From the double tubercle at the end of the second segment to the head is a somewhat diamond-shaped space, broadest in front on the first segment, bordered by bright brownish with a white line. From the tubercle on the second joint to the end of the body is another whitish space, somewhat paler than the first. This space gradually expands to the base of the abdominal leg on the seventh segment and then again gradually decreases in width to the posterior end of the eleventh segment, slightly expanding and contracting again. The lilac-white of this large patch, like the first, is suffused with green on the back, and is bordered with brownish purple and white. The two patches are separated by a small green patch. Anal filaments or tails brownish purple, with somewhat greenish annulations, and a white ring near the extremity. Head dark lilac. Length, 30 mm.

Food-plants.—Different kinds of Willow and Poplar.

Double brooded, and somewhat common. The moth appears in May and June, and again in July and August. The larva is sometimes found until late in September. The larva may be distinguished by its white color along the back and the double tubercle on the end of the second segment.

Cerura aquilonaris *Lintner.*

Fore wings white with a median transverse band, very broad and black, almost straight on the inside and scalloped on the outside, followed by three faint,

scolloped transverse lines ; subapical patch large, black. Terminal row of spots small, basal row small, four in number, and one at base of wing beneath costa. Hind wings white, with discal spot, and terminal row of black spots, but with no dusky patch at hind angle, as in *borealis*. Expanse, 40-45 mm.

Rare in this vicinity, but more common in the Northern States.

***Cerura cinerea* Walker.**

Fore wings almost uniform gray, the median and outer transverse shade a little darker than the ground color, and not standing in contrast as in the other species of *Cerura*. The median band is marked with an orange mark, which is also present on the inside of the outer band. The transverse lines on middle part of wings are in shape of spots. Terminal row of black spots distinct ; basal ones also present. Hind wings whitish with a discal spot and a terminal row of black spots. Thorax gray, with orange marks. Expanse, 30-40 mm.

Caterpillar.—Head deep brown black. Body green with a triangular, deep brown black patch on the first and second segments, the hinder edge resting on the posterior part of the second segment. Another large patch of the same color begins on the fourth segment, gradually widens, and then suddenly contracts on the ninth segment, and forming a dumb-bell shaped patch which extends to the end of the body. Tails or filaments blackish, with two greenish annulations. The two patches are very narrowly connected by a fine blackish line on the back of the third segment. Length of body, 35 mm.

Food-plants.—Willow and Poplar.

Double brooded, from May to August. The caterpillar differs from that of *C. borealis* and *C. occidentalis* in the less connected and narrower dorsal patches and in the end of the suranal plate being squarer, that of *occidentalis* being somewhat rounder behind. The cocoon is formed on a piece of wood, and is composed of gunmy silk, strengthened by small bits of wood, making it difficult to detect on the bark or wood on which it is made.

***Cerura multscripta* Riley.**

PLATE XIX, FIG. II. FEMALE.

Fore wings pure white with many narrow, transverse, scolloped black lines, the pair across the basal fourth filled with creamy white, with fine black scales. Discal mark in form of a small black ring. The outer line is more intense for some distance beneath the costa, and again at the inner margin. Terminal

row of spots black. Veins on outer part of wings usually black. Thorax white, with transverse black bands and spots. Hind wings blackish. Expanse, male, 25 mm.; female, 30 mm.

Caterpillar.—Head with a broad black band in front on each side, extreme sides brownish. First segment narrowly edged with bright red; under the fold between the head and the segment a black spot on each side at the angles; first and second segments with a whitish triangular patch, greenish in front on the large cervical shield and with lilacine lines. Third segment with a black tubercular hump which connects with the large, elongate, diamond-shaped dorsal patch, which is whitish with green striae and a purplish line on each side of the widest part. Both triangular patches are bordered with pale yellow. A yellow line on each side along the spiracles, bordered with red beneath. Sides of body bright green, dotted with pale yellow. Spiracles black. Anal filaments or tails bluish with black spinules. Last segment with two short spines between the tails. Abdominal legs banded outside with black. Length, 35 mm.

Food-plants.—Willow and Poplar.

This species may be known by its white fore wings with the many fine wavy transverse lines, and blackish hind wings. Double brooded. May-June and July-August.

Thyridopteryx ephemeraeformis *Haworth.*

PLATE XVII, FIG. 17. MALE.

Male.—Head, thorax and abdomen wooly, black. Wings transparent, veins black. *Female* wingless. Expanse, 20 mm.

Caterpillar.—Head dirty white, spotted with brown black. Body brown black, first three segments each with a white, transverse, plate-like band marked with black, the last one divided in the middle. Thoracic feet well developed, black, bases marked with white; remaining legs rudimentary. Body stout, and tapering towards the end. Length, 30-40 mm.

Food-plants.—Oak, Elm, Willow, Chestnut, Larch, Pine, and many other trees and plants.

This is the well-known Bag-worm, which often does considerable damage to trees and other plants. The caterpillar lives within the bag, which is made of silk and pieces of sticks, twigs or leaves outside. The female moth never leaves the bag. Double brooded.

***Psyche confederata* G. & R.**

Wings and body wholly black, without any markings whatever. Expanse, 10-12 mm.

Caterpillar.—Head, and first to third segments, pitch black; fourth segment yellowish with two black, triangular spots on each side; fifth segment whitish with two brown points; rest of body yellowish white, except the last segment, which has a triangular, brown patch above. Body rather flattened, narrowed at each end. Length, 11 mm.

Rather common locally. The larva lives in a small silken bag, similar to that of the preceding species, and fastened outside are many pieces of bark or short sticks. It lives on the bark of Oak, Chestnut and other trees. Double brooded.

***Lacosoma chiridota* Grote.**

PLATE XVII, FIG. 15. FEMALE.

Ocherous brown, fringe marked with black on the veins. A black discal spot on both wings, and an undulating, smoky brown line across each wing. This line is more or less distinct, sometimes almost absent. Expanse, 25 mm.

Caterpillar.—Head ocher yellow, heavily mottled with chestnut brown, especially along the middle in front. First segment ocher yellow with brown stripes, which are continuous on the remaining segments. The first four or five segments are pinkish, which gradually fades out along the dorsal region towards the end of the body. Sides yellowish. A dorsal line, one on each side on the subdorsum, and indications of three broken lines along the sides. Spiracles black with light centres. Under side yellowish with a brown line along the base of the thoracic feet, outside. Thoracic feet brownish and yellow inside. Head small, and the segments of the body gradually thicken towards the end of the body. Anal plate on top flat and rounded at end. Length, 23 mm.

Food-plant.—Oak.

The caterpillar constructs a flattened case, open at each end between leaves. In shape it is very much like that of the following species. Fully grown caterpillars may be found in September, and the species is probably double brooded.

***Perophora melsheimeri* Harris.**

PLATE XIX, FIG. 2. MALE.

Wings pale brownish gray, more or less tinted with pink and dotted minutely with black; across the fore wings, beyond the middle, is an oblique, narrow

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blackish line, forming an angle below the costa. Hind wings with a straight line across the middle. Expanse, 30-45 mm.

Caterpillar.—Head shining, blackish, with white bristles, and with two obsolete reddish spots on each side. First three segments blackish brown, slightly tinged with reddish, and with small tubercles, from which arise long brown hairs; segments four, five and six black, polished, and each furnished with a broad hump; segments seven, eight and nine polished white, veined with black above; tenth segment shining black, veined with white and tuberculated; eleventh segment black, with a large, flat-topped hump, studded with black tubercles. Last segment black, veined with white. An obsolete white dorsal line; thoracic feet reddish brown, marked with black; abdominal legs long, blackish, laterally white with black lines. Body beneath blackish varied with reddish. Length, 30 mm.

Food-plants.—Oak, Winterberry (*Prinos*).

The larva lives in a flattened case, open at each end. It has long appendages on the head, and the body is very narrow but gradually swells towards the end, which is provided with a corneous flat plate which is used to close up the end of the case when the larva is at rest.

***Samia cynthia* (*Drury*).**

PLATE XXI, FIG. 2. FEMALE.

Olive green, finely sprinkled with blackish scales on the outer parts of all the wings. A broad transverse pink band beyond the middle, limited inwardly, narrowly with white and black; basal bands white and black, slightly pink inwardly. Lunate mark semitransparent, and partly yellow. Apical area on fore wings purplish with a black, eye-like spot. Expanse, 100-125 mm.

Caterpillar.—Body pale green covered with a whitish, flour-like powder; tubercles bright blue with yellowish green bases; the row of tubercles along the sides black. Head and cervical shield yellowish green, also the anal plates, which are margined with blue. Thoracic feet yellowish green; abdominal legs with a bright blue patch at the base on the outer side of each. Length, 61-65 mm.

Food-plants.—Ailanthus, Hop-tree (*Ptelea*), Tulip-tree, Linden, Wild Cherry, Plum, Sycamore, Sweet-gum, Dogwood, Sassafras, Spicebush, Nannyberry, Holly, Castor-oil plant, etc.

Common everywhere, especially in the cities and towns on the Ailanthus trees, which are its native and favorite food-plant. It is partly double brooded, and the caterpillar spins an oval, compact, elongate cocoon, fastened to the twigs by a long silken band. It is an importation from China.

Platysamia cecropia (Linn.).

PLATE XXI, FIG. I. FEMALE.

Head and thorax red, collar broadly white. Abdomen red, banded with black and white. Wings blackish brown with light irrorations, each with a large crescent-shaped mark, part red and white, or white bordered with red and black, or wholly red bordered with black. Beyond the middle a black and white band broadly shaded with red outwardly. Basal band on fore wings black and white. The wings are also shaded more or less with red. Outer part of wings clay brown, light and dark, with wavy black lines. Apical patch on fore wings purplish with a large black eye-like spot. Expanse, 120-150 mm.

Caterpillar.—Bright green along sides, paler along the back. Head and feet brighter green, abdominal and anal legs with blue extremities; along each side are two rows of blue tubercles and on the back are two rows (one on each side) of yellow tubercles; the second, third and fourth segments have each two prominent bulb-like tubercles, the first two pairs coral red, and the last yellow, all beset with short black spines; eleventh segment with a large yellow tubercle on top. Spiracles blue. Length, 75 to 100 mm.

Food-plants.—Elder, Willow, Apple, Pear, Thorn, Poplar, and a variety of other plants.

Common everywhere. The caterpillar spins a large, conspicuous, double cocoon, on the branches of trees. Its favorite food seems to be the Elder, on which they thrive best. Single brooded.

Callosamia promethea (Drury).

PLATE XXII, FIGS. I AND 3. MALE AND FEMALE.

Male.—Wings black, outer border clay brown, with a fine wavy line and with black spots on hind wings. Across the wings, near the middle, is a narrow grayish, wavy line. Apical area of fore wings purplish, with a black eye-like spot.

Female.—Reddish, wings with lighter irrorations; transverse lines more prominent than in the male, and usually followed by a lighter shade. A light triangular spot on each wing. Borders of wings as in the male, but the lines and spots are reddish. Expanse, 75-100 mm.

Caterpillar.—Pale whitish green, darker along the sides. On each of the second and third segments is a pair of coral red, cone-like tubercles, with a black ring at the base and a similar single, yellow one on top of the eleventh segment. On each side are three rows of polished black dots. Length, 55 mm.

Food-plants.—Sassafras, Tulip-tree, Sweet-gum, Viburnum, Wild Cherry, etc.

Common everywhere. The caterpillar spins a cocoon attached by a long silken band to a twig.

Callosamia angulifera (Walker).

PLATE XXII, FIG. 2. MALE.

Male and female similar. Markings like those of *promethea*, but the triangular spots on the wings are much larger, and conspicuous. The general color of the male is wood brown, tinged with ochreous. The female is much brighter in color, reddish and much suffused with ochreous, and with the angular spots usually larger than in the male. Expanse, 80-100 mm.

Caterpillar.—Resembles that of *promethea*, but may be readily distinguished by the lateral yellow stripe, which forms a ridge, and the less prominent tubercles on the second and third segments, and also by the smaller black dots, which in some individuals are quite obsolete. It is also stouter, and more tapering towards the end of the body. Length, 60-65 mm.

Food-plants.—Tulip-tree, Sassafras, Wild Cherry.

The caterpillar spins its cocoon on the tree, and it drops off with the falling leaves in autumn; sometimes the cocoon is fastened to a twig by means of a silken band. The cocoons should be looked for on the ground under Tulip-trees, which is the favorite food of the caterpillar.

Telea polyphemus (Cramer).

PLATE XXIII, FIG. 2. MALE.

Wings ochreous brown, varying from light to dark, and sometimes with a reddish tinge. Costa of fore wings and collar gray. Basal transverse band on fore wings dislocated, reddish outside and whitish inside. Outer band lilac, as is also the one on the hind wings, and marked with black inside. On the fore wings is an oval, transparent, glass-like spot, bordered with yellow, those on the hind wings in a large black, oval, eye-like patch, clouded with blue. Expanse, 100-125 mm.

Caterpillar.—Head purplish brown. Body stout, bright green, with three rows of scarlet tubercles, metallic or pearly on each side, from each of which

arise two or three bristles. On each side is a narrow, yellow, oblique stripe, extending from the fifth to eleventh segments, connecting the lateral with the subdorsal row of tubercles. Anal plate bordered with purple. Spiracles red. Thoracic feet ochre brown.

Food-plants.—Oak, Elm, Willow, Poplar, Walnut, Hickory, Chestnut, Beech, Linden, Maple, Hazel, Rose, Quince, Apple, Pear, Birch, Cherry, etc.

Common everywhere, and single brooded. The caterpillar forms an oval cocoon, closed at each end. It is dense, compact, and generally fastened to a leaf or leaves, with which it falls to the ground, though often it is fastened to the twig. The caterpillar resembles that of *A. luna*, but may be easily distinguished from it by the metallic tubercles.

Actias luna (*Linn.*).

PLATE XXIII, FIG. I. MALE.

Bright pale green, fringe sometimes reddish or yellow. Costa of fore wings with purplish, this color being continuous with the band of the same color on the thorax. Each wing with a rounded yellow spot marked with white, black, and sometimes with red, and transparent centrally. Expanse, 75-100 mm.

Caterpillar.—Head purplish, sometimes tinged with greenish. Body bright yellow green, somewhat dark at sides and beneath. Along each side is a narrow yellow line beneath the spiracles, and a transverse yellow line on the hind edge of the fourth to tenth segments inclusive. On each side are three rows of bright red tubercles, each with a few bristles. Spiracles deep reddish brown. The whole body is sparsely covered with evenly cut, short, yellowish hairs. Length, about 60 mm.

Food-plants.—Sweet-gum, Hickory, Walnut, Butternut, Birch, etc.

This beautiful species is rather common everywhere in this vicinity. It is double brooded, and sometimes partly three brooded. The moth appears in April and May, and the second brood in July. The cocoon is oval, thin, and closed at each end, and is spun between leaves on the ground. The favorite food of the caterpillar is walnut and sweet-gum.

Automeris io (*Fabr.*)

PLATE XX, FIG. 1. MALE.

Male.—Body and wings bright yellow. Fore wings with two or three more or less distinct wavy transverse, scalloped shades, and a patch about the middle. Hind wings with a large eye-like black spot, whitish centrally; a round black line, followed by a reddish one, the inner part of which is heavily scaled with reddish. Expanse, 60–70 mm.

Female.—Fore wings purplish brown with the transverse lines whitish, and the patch on the middle composed of raised scales surrounded with white. Expanse, 70–80 mm.

Caterpillar.—Body pea green, with a distinct white line edged above with lilac or red, below the spiracles. Spiracles yellow with brown rings. The body is covered with bunches of long, stinging spines, some of which are branched, giving the creature a spiny appearance. Length, 50 mm.

Food-plants.—Willow, Elm, Maple, Sassafras, Apple, Pear, Currant, Clover, Locust, Ash, Poplar, Dogwood, Cherry, Cotton, Corn, Birch, and many other plants.

Common everywhere. The eggs are laid in masses, and the young larvæ live socially, but scatter as they grow older; they spin a tough, but rather thin cocoon on the ground under stones, wood or leaves. Single brooded. The moth appears early in July.

Hemileuca maia (*Drury*).

PLATE XX, FIG. 2. MALE.

Thorax black, tufted with white; abdomen black, anal part orange in the male, scaled with white in the female, and the thorax has two red tufts behind. Wings black, each with a yellowish transverse band, that on the hind wings broadest, and containing a black mark; fore wings with a linear, white, discal mark. Expanse, 50–75 mm.

Caterpillar.—Brown black, with numerous white irrorations or small rounded dots, and with three rows of spines on each side; those on the dorsum consist of bunches of spines, except those on the first and second segments, which are long spines with branches. The two rows on each side are somewhat longer, and have short black bristly branches. Head, cervical shield, thoracic feet and anal plates mahogany red. Abdominal legs similarly colored. Length, 60 mm.

Food-plants.—Various kinds of Oak.

The moth appears late in September and early in October, and deposits her eggs in regular rows around the twig of a plant. The eggs hatch during the latter part of May the following year. The caterpillar pupates in moss, under leaves, or partly enters the earth. The caterpillars live socially.

Anisota stigma (*A. ♂ S.*).

PLATE XX, FIG. 4. MALE.

Bright ochereous brown with a slight purplish tinge. Fore wings with many blackish dots, an oblique purplish line from the apex to the middle of the inner margin, and one across the basal part, which is more or less distinct or absent. A rather large white discal spot. Hind wings with only a few dots and a purplish transverse band. Male and female similar in color and markings. Expanse, 40–60 mm.

Caterpillar.—Head ocher yellow. Body light leather brown, dotted over with white granules; a narrow dusky dorsal line and a wider one on each side along the spiracles; on each side are three rows of black spines and a long movable spine on each side of the second segment. Spiracles black. Length, 55 mm.

Food-plants.—Oak, Chestnut, Hazel.

Rather common everywhere in this vicinity. The moth emerges early in July, and is single brooded. The caterpillars live in colonies, and may be found fully grown late in August and early in September. They enter the ground to pupate.

Anisota senatoria (*A. ♂ S.*).

PLATE XX, FIG. 3. MALE.

Male.—Wings ochereous brown, sometimes with a purplish tinge; fore wings semitransparent in the middle. A conspicuous white, round discal spot and a dark oblique line, from a little before the apex across the wing, parallel with the outer margin. Hind wings opaque. Expanse, 30–38 mm.

Female.—Very dissimilar from the male. It is very much like *stigma*, but is very much paler in color, and usually less spotted. Expanse, 45–60 mm.

Caterpillar.—Head jet black. Body dull black, with four dull orange stripes along each side, and traces of a fifth stripe along the base of the legs; all the stripes run to the end of the eleventh segment; last segment black. Under side with a broad yellow stripe along the middle. On each side of the second

segment is a slender, long, slightly curved horn, and along each side of the body three rows of short spines. Length, 45 mm.

Food-plants.—Oak, Chestnut.

Common, and often quite injurious to oaks, which is the favorite food of the caterpillars. They live in large swarms, and sometimes defoliate the entire tree. The insect is single brooded, and the moth is found early in July.

***Anisota virginiensis* (Drury).**

Male.—Similar to *senatoria*. Purplish brown, fore wings largely transparent, much more so than in *senatoria*, and this part breaking the oblique, transverse line. Hind wings opaque, with an ill-defined, darker transverse line. Discal spot round, white. Expanse, 30-35 mm.

Female.—Wings opaque, ochreous brown, without dots; outer part beyond the line purplish, as is also the base before the basal line. Hind wings with outer part purplish. Discal spot large and conspicuous. Expanse, 45-55 mm.

Caterpillar.—Body obscure green with a subdorsal purplish red stripe, and another on each side below the spiracles; on each side are three rows of black spines, and two long, black movable horns on the second segment. Body also covered with white granules, and sometimes blackish instead of green. Head dull greenish or brownish yellow. Length, 50 mm.

Food-plants.—Different kinds of Oak.

Not as common as *stigma* and *senatoria*. The moth comes first during the latter part of June, and the caterpillars live in clusters and are fully grown about the middle of August. It is single brooded, and the caterpillars enter the earth to form their pupæ.

***Anisota rubicunda* (Fabr.).**

Body pale yellow, legs rose colored. Fore wings with the outer and basal parts largely rose colored, leaving a triangular yellow space about the middle. Hind wings yellow, washed with rose outwardly. Expanse, 40-55 mm.

Caterpillar.—Light green with longitudinal stripes of darker green. Spines very short, the row beneath the spiracles and those on the last two segments longest. Along the sides is a rose red stripe, sometimes only present on the

last few segments. On the second segment are two long black horns. Head ochereous brown. Length, 45 mm.

Food-plants.—Maple and Oak.

This beautiful insect may be easily known by its rose colored and yellow wings. It is quite common, and the caterpillar lives socially, usually on Red Maple (*Acer rubrum*), which is its favorite food. It rarely feeds on Oak.

Citheronia regalis (*Fabr.*)

PLATE XX, FIG. 6. MALE.

Head and thorax bright red above, with a double yellow edge on the collar, and two divergent lines of the same color on the thorax. Anterior edges of abdomen yellow. Fore wings slaty gray, veins broadly marked with red. Spots yellow. Hind wings largely red marked with yellow, and sometimes with slaty gray dashes between the veins. Expanse, 100–145 mm.

Var. *infernalis* *Strecker*.—Head, thorax and abdomen entirely red. Fore wings slaty gray, veins marked with red. A subapical red patch and a smaller one at base of wings.

Var. *sængerii* *Neum.*—Body and markings on wings entirely yellow instead of red.

Caterpillar.—Head orange. Body green, smooth, paler along the back. On the first segment are two orange and four black horns with yellow bases, all short and spined; on each of the second and third segments are four very long and prominent spined horns, and a shorter one outside of each, orange, tipped with black. Along each side of the remaining segments are three rows of short-spined horns and a rather long one on the back of the eleventh segment. Anal plates orange, as are also the thoracic feet. Along each side of the body are oblique black and white band-like dashes, and between the second and third segments is a transverse black mark and a much narrower one between the third and fourth segments. Sometimes the body is black with the oblique bands obscure, ferruginous. Length, about 125 mm.

Food-plants.—Walnut, Butternut, Hickory, Sumac, Sycamore, Persimmon, Sweet-gum, Ash.

The moth is commonly known as the 'Regal Walnut Moth,' and the caterpillar as the 'Hickory Horned Devil,' so called from its ferocious aspect produced by the very long spiny horns. The moth comes out in June and early in July, and the larva may be found fully developed in August. Enters the ground to pupate, and is single brooded.

Eacles imperialis (*Drury*).

PLATE XX, FIG. 5. MALE.

Bright yellow with chocolate colored markings, and sprinkled with black dots on the wings. The female is less marked with chocolate, and as a rule is more heavily sprinkled with black dots. Expanse, 85-135 mm.

Var. *punctatissima* *Neum.*—Wings very heavily covered with black dots, giving them a very black appearance.

Var. *nobilis* *Neum.*—Almost or entirely chocolate colored.

Caterpillar.—Very variable in color, from light creamy brown to ferruginous or black, but usually green, with four short spiny horns on the second and third segments and a shorter one on each side of them. On each side are three rows of short yellow spines, those along the back being longest, the others much reduced. On the middle of eleventh segment a short, spiny horn. Anal plates black, spotted and bordered with yellow. Head yellow with a double black line in front and a short one on each side. Length, about 90 mm.

Food-plants.—Pine, Spruce, Hemlock, Oak, Elm, Hickory, Sycamore, Sweet-gum, Sumac, Maple, Beech, Chestnut, Sassafras, Birch, Alder, Cherry.

Common everywhere, but especially so in the city parks. The variety *nobilis* is found in Texas, and the variety *punctatissima* is an aberration, probably produced by cold. It is single brooded, and the caterpillar enters the ground to pupate.

Clisiocampa americana (*Fabr.*).

PLATE XIX, FIG. 13. MALE.

Cinnamon brown. On the fore wings are two whitish, oblique transverse lines with the space between them often dusted with white. Fringes marked with whitish. Hind wings uniform cinnamon brown, fringes marked with whitish. Expanse, 28-42 mm.

Caterpillar.—Head velvety black. Body with a rather broad bluish white dorsal stripe followed by fine orange, wavy striæ on a velvety black ground, broken by a row of rather large spots, containing blue spots and marks; lateral parts blue, irrorated with minute black dots. Under side black, irrorated with white; over the body are scattered, rather thickly, sordid white hairs. Neck creamy white. Length, 50 mm.

Food-plants.—Cherry, Apple, Pear, Plum.

Common everywhere, especially in orchards, where the caterpillars often strip the apple trees of their leaves. The eggs are laid late in June and early in July around a twig, and are covered with a gummy substance; they do not hatch until the following April. The caterpillars construct a large silken tent in the forks of branches, and come forth at night to feed. They spin an oblong, white, silken cocoon.

Clisiocampa distria (*Hübner*).

Pale ochreous brown, the female paler; fore wings with two dark brown, oblique bands; fringes marked with white. Hind wings crossed by a darker shade-like band. Expanse, 18-35 mm.

Var. *sylvatica* *Harris*.—In this variety the space between the lines on the fore wings is uniformly filled with brown.

Var. *thoracicoides* *N.* ♂ *D.*—The lines in this variety are very obscure.

Caterpillar.—Head slaty black. Body velvety black along the dorsal region, irregularly sprinkled with blue and with a row of creamy white spots along the back; then a narrow orange subdorsal line, followed by a broad blue space, sprinkled minutely with black, and a lateral orange and black line, beneath which the body is slaty gray to the base of legs. Under side blackish. Hairs along the sides grayish. Length, 55 mm.

Food-plants.—Apple, Pear, June-berry, Plum, Cherry, Ash, Oak, Beech, Poplar, Walnut, Hornbeam, Hickory.

The eggs are laid around a twig, and are not covered with a gummy substance as in *C. americana*. They are laid late in June and early in July, and hatch the following April. The caterpillars do not spin a tent like *americana*, but when at rest they sit side by side on a branch or the trunk of the tree. It spins an oblong, white cocoon.

Gastropacha americana (*Harris*).

PLATE XIX, FIG. 3. FEMALE.

Rusty brown, covered with whitish scales and shades, giving it a frosty appearance; two transverse lines on the fore wings, and indications of one on the hind wing. Expanse, 35-45 mm.

Var. *ferruginea* *Pack*.—Almost or quite uniform rusty brown, with the transverse lines present.

Caterpillar.—Body slate gray, mottled with black, beneath flattened and greenish; on the sides beneath the spiracles, a series of tufts of reddish hairs; on the junction of the second and third segments, a bright scarlet band, divided by a black line, and black at each end, only to be seen when the larva is in motion; on the first segment are two small tubercles on each side and one on each side of the following segments; from the tubercles arise tufts of gray hairs mixed with white ones, which are club-shaped at the tips; lateral fringes with many white hairs. Thoracic feet black; abdominal legs gray, with a black spot between each pair. Head ashen gray. Length, 50 mm.

Food-plants.—Apple, Birch, Poplar, Maple.

The moth comes forth in May and again in July, and the larva may be found from June until late in September. It spins a slight cocoon between leaves. The moth when at rest mimics a dead leaf. The variety *ferruginea* is the second brood.

Arctace punctistriga *Walker.*

PLATE XIX, FIG. 5.

Fore wings pure white with three rows of black dots, those on the costa being the largest, and a row of spots on the outer border. Hind wings and body white. Expanse, 30-45 mm.

Caterpillar.—Resembles that of *Tolyte vellea* but is more yellow, with the anterior segments somewhat reddish. The transverse mark on the third segment is orange instead of black.

Food-plants.—Oak, Wild-cherry, Peach.

Very rare in this neighborhood; only a few specimens have been found. It is more common in the Southern States.

Tolyte vellea (*Stoll.*)

PLATE XVII, FIG. 6. FEMALE.

Head and thorax white, the latter with an elongate, triangular brown patch, composed of loose, fluffy scales. Abdomen grayish above, white beneath. Fore wings gray, with two transverse, curved basal lines, a double slightly wavy oblique band, and a double one on the outer part; veins white; fringes white, with a row of gray spots. Hind wings grayish, margin narrowly lined with white, preceded by a whitish shade-like band. Expanse, 35-58 mm.

Caterpillar.—Body dull rusty gray, flattened beneath, rounded above; sides of segments produced into a long, blunt tubercle, from which spring out a

series of very long, light gray and a few black hairs, like a fan. On the third segment is a velvety black transverse black mark, and on the back are two rows of short warts, those on the third segment largest. Under side reddish flesh color, with a black spot between the legs. Length, 60 mm.

Food-plants.—Cherry, Poplar, Elm, Lilac, Oak.

Double brooded, and not common. The caterpillar, when at rest, is closely appressed to the limb, which it resembles very much in color.

***Tolyte laricis* (Fitch).**

Male.—Black, head and fore legs white. Fore wings black, with three narrow, whitish transverse lines, the two outer ones wavy; outer margin and tips of fringes sometimes with a very narrow whitish line. Hind wings uniform black or with the fringes narrowly pale edged. Expanse, 26–28 mm.

Female.—Head and thorax white, the latter with a patch of raised, brown scales along the middle. Abdomen whitish. Fore wings gray with a double basal white band; a wavy double band across the middle, and a single outer one; space between the basal and middle bands whitish gray, sometimes white and obscuring the bands; the space between the two outer bands dark gray. Fringes cut with white. Hind wings smoky gray, narrowly lined with white at the base of fringe, and sometimes preceded by a lighter shade-like band. Expanse, 35–44 mm.

Caterpillar.—Shape of *T. vellela*, but much paler in color. Dull umber brown, extremities ashen gray, and a tinge of this color on the fifth segment. Tubercles minute, those upon the ninth segment larger and of a paler color, with a small yellow spot in front of their bases. Hairs along the sides white. Length, 35 mm.

Food-plant.—Larch (*Larix americana*).

Rare in this vicinity, but more common northward. The moth appears in May and again in July. Allied to *T. vellela*, but smaller, with a middle band much more wavy; the female is also whiter, while the male is smoky black.

***Zeuzera pyrina* (Fabr.).**

PLATE XX, FIG. 8. MALE.

Wings white, with numerous blue black spots, those on the hind wings smaller; thorax with six prominent blue black spots. Female larger and much heavier than the male. Expanse, male, 35–50 mm.; female, 60–70 mm.

Caterpillar.—Head black. Body yellowish white, with a large blackish cervical shield and with black piliferous spots, each bearing a short hair; anal plates marked with black. Length, 45–50 mm.

Food-plants.—Elm, Maple, Ash, Poplar, Willow, Oak, Hackberry, Sweet-gum, Linden, Apple, Pear, etc. (boring in branches).

Very common in the immediate vicinity of New York City, especially in the parks, where the caterpillar does much harm to the trees. The species is an importation from Europe, and made its appearance here about 1887. The caterpillar lives in the trunk or branch for two or three years before it reaches maturity.

***Cossus centerensis* Lintner.**

Body blackish with whitish scales on the thorax. Fore wings with basal two-thirds blackish, outer third grayish, crossed by numerous black reticulations. Hind wings semitranslucent, with slight indications of reticulations. Expanse, 50–60 mm.

Caterpillar.—Body pale flesh color, with a dark dorsal line; on top of segments two and three is a dark spot; on each side of each segment above the spiracles are three brown piliferous spots arranged in the form of a triangle; spiracles reddish; cervical shield blackish brown, edged with dull yellow. Head dark reddish brown, slightly roughened; a few hairs on the face; jaws black. Length, 50 mm.

Food-plants.—Lives in trunks of poplar, and possibly also other trees.

Very rare in this vicinity, and only a few examples have been taken. The moth is found early in June.

***Cossus macmurtrei* Guérin.**

Male.—Very small. Wings semitransparent gray, with fine, black, transverse reticulations. Hind wings semitransparent gray, with a narrow black border, broader on the inner margin. Expanse, 35 mm.

Female.—Very large. Fore wings gray, semitransparent, with numerous black transverse reticulations, darker and heavier on the costa. Hind wings without reticulations. Expanse, 60 mm.

Very rare in this vicinity. The larva is unknown. It bores in trunks of oak trees.

Prionoxystus robiniaæ (*Peck*).

Male.—Head, collar and patagia black, remaining part of thorax finely dotted with gray. Fore wings grayish, very densely reticulated with black, forming a broad irregular black band across the middle, and also sometimes another from the apex downward; this outer one is more or less indistinct, the outlines of the band irregularly defined. Hind wings golden yellow, basal half and margins black. Expanse, 50-60 mm.

Female.—Much heavier than the male. Fore wings usually grayer with the reticulations more distinct and the black diffuse bands very often reduced to patches. Hind wings gray black, with indications of darker reticulations. Expanse, 70-80 mm.

Caterpillar.—Body whitish, usually tinged with pink; sometimes a reddish pink band on the anterior part of each segment, except the third or fourth and the last one. Second and third segments with a transverse brown, corneous patch on top. On each side above the spiracles are three pink or brown piliferous spots. Head chestnut, paler in front, mouth parts pithy. Length, 60 mm.

Food-plants.—Bores in trunks of Locust, Willow, Oak, Chestnut, etc.

Very common. The larva lives in the trunk about three years before coming to maturity. The moth comes out late in June and early in July.

Hepialus argenteomaculatus *Harris*.

PLATE XX, FIG. 7. MALE.

Male.—Fore wings sable brown, with a deeper brown band from the base of the costa to the middle of the inner margin, and two rather prominent tooth-like projections, each containing a silvery white spot; another slightly curved band runs obliquely from beneath the costa to the inner margin, and connected with this at the ends is another band on the outer margin; about the middle of the wing is an oblong mark, sometimes touching the costa, and often containing a silvery white spot; on the costa before the apex is a hook-like mark, and also two or three other marks. All the bands and marks narrowly bordered with a paler color. Hind wings sable brown with a few marks at the apex. Expanse, about 75 mm.

Female.—Usually pinkish, with the markings ocherous.

Caterpillar.—Head light yellowish brown above, black at the mouth parts. Body white, with rows of black piliferous spots. Second and third segments paler than the head. Legs yellowish. Length, 30 mm.

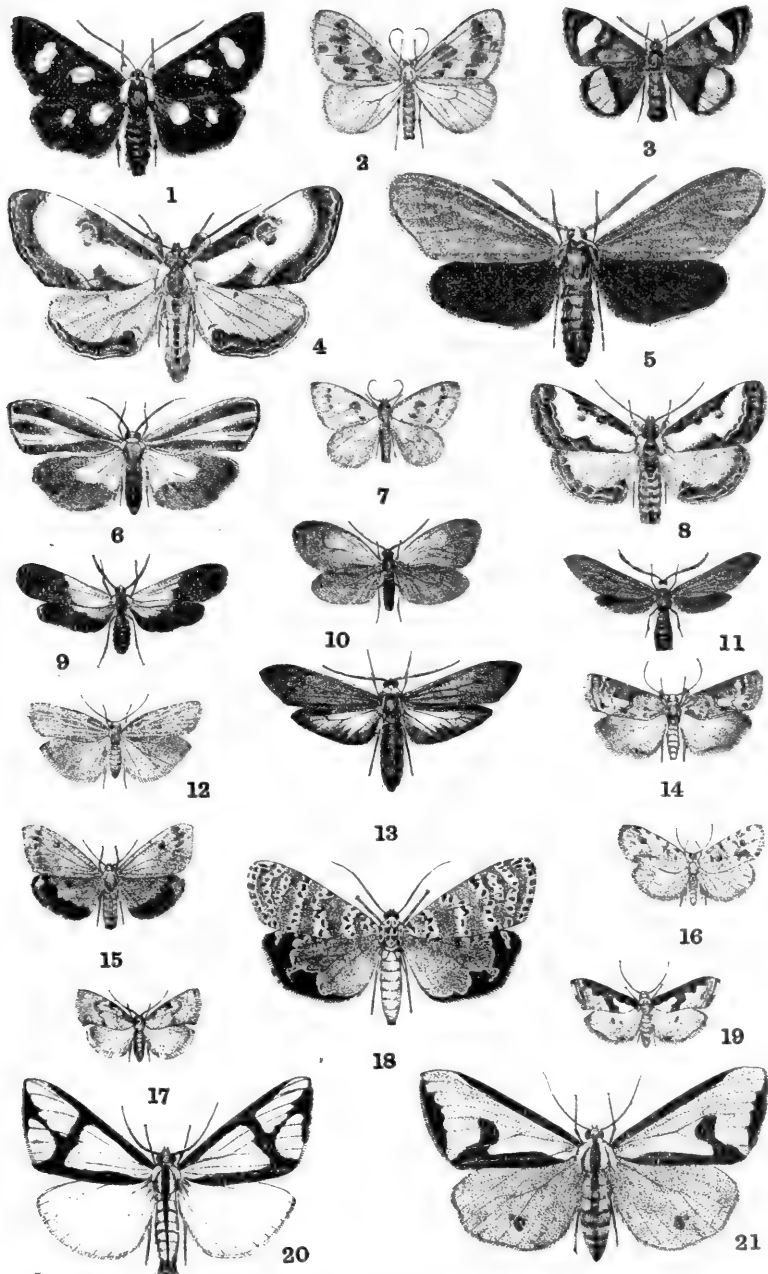
Food-plant.—Lives in roots of Alder.

This is a variable species, the spots and markings being more or less broken. The moth emerges early in June and the caterpillar lives two years in the roots; as the third year advances it works upwards more or less into the stems. In the spring of the third year it bores out to the surface, partially or loosely plugging the opening with chips, and transforms.

***Hepialus auratus* Grote.**

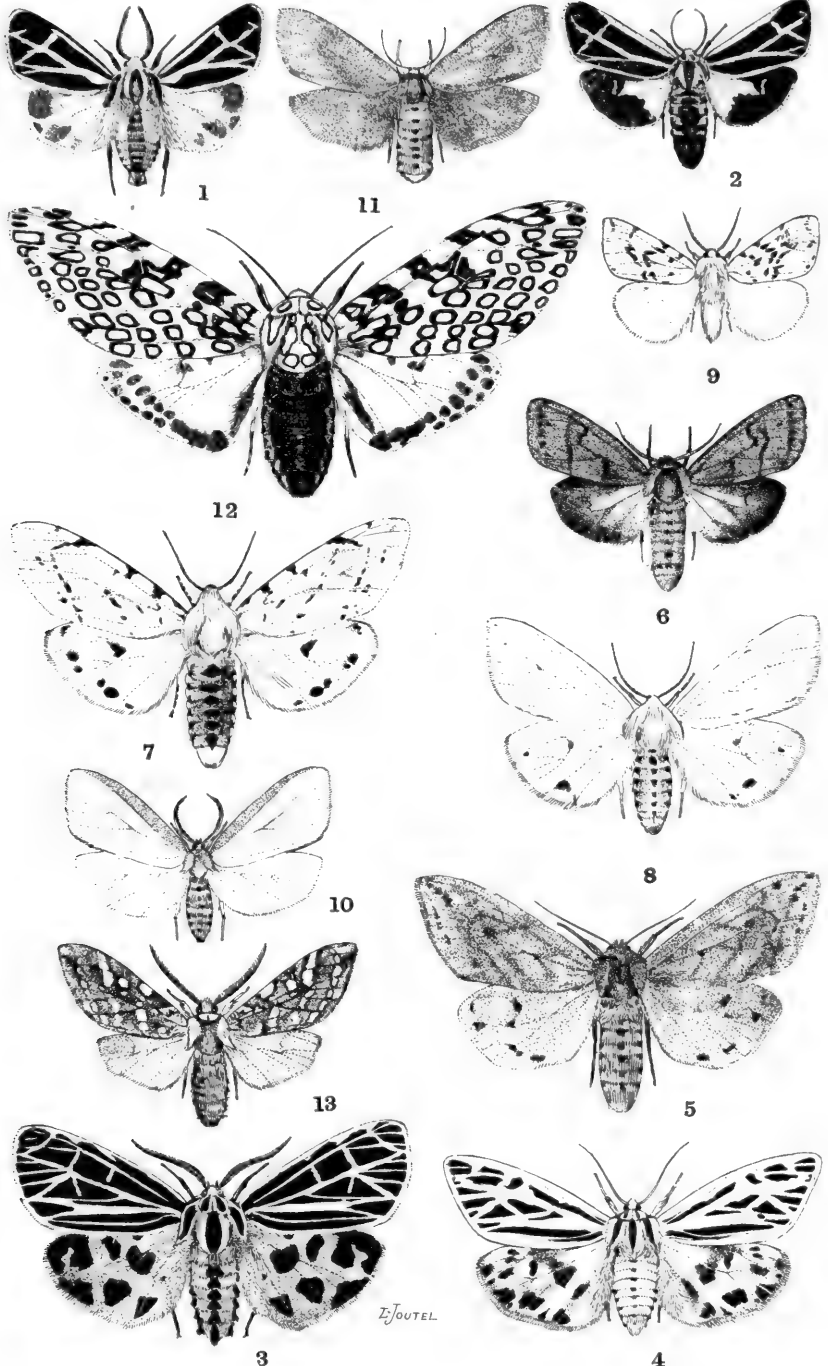
Yellowish brown with a metallic brassy lustre, and whitish ill-defined marks appearing most strongly on the two parallel transverse bands, a transverse posterior line and a subterminal one, the latter marked subapically with two or three silvery white triangular spots. Expanse, 48 mm.

Exceedingly rare in this vicinity. It has been recorded from Newark, New Jersey, and also from New York and New Hampshire.



J. F. J. DEL.

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|-----------------------------------|-----------------------------------|------------------------------------|
| 1. <i>Alysia octomaculata</i> . | 8. <i>Eudryas unio</i> . | 15. <i>Eubaphe aurantiaca</i> var. |
| 2. <i>Euphanessa mendica</i> . | 9. <i>Lycomorpha pholus</i> . | 16. <i>Clemensia albata</i> . |
| 3. <i>Psychomorpha epemenis</i> . | 10. <i>Pyromorpha dimidiata</i> . | 17. <i>Nola trinotata</i> . |
| 4. <i>Eudryas grata</i> . | 11. <i>Harrisina americana</i> . | 18. <i>Utetheisa bella</i> . |
| 5. <i>Ctenucha virginica</i> . | 12. <i>Crambida pallida</i> . | 19. <i>Nola melanopa</i> . |
| 6. <i>Hypoprepia miniata</i> . | 13. <i>Scopsis fulvicollis</i> . | 20. <i>Haploa contigua</i> . |
| 7. <i>Euphanessa meridiana</i> . | 14. <i>Nycteola lintneriana</i> . | 21. <i>Haploa clymene</i> . |



1. *Arctia nais*.
2. " *vittata* var. *phalerata*.
3. " *virgo*.
4. " *arge*.
5. *Pyrrharcia isabella*.
6. *Phragmatobia fuliginosa*.

7. *Leucarcctia acraea*.
8. *Spilosoma virginica*.
9. *Hyphantria cunea*.
10. *Cynia tenera*.
11. " *egle*.
12. *Ecpantheria ocularia*.





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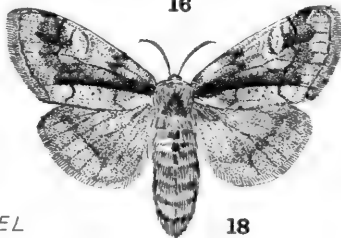


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EJOUTEL



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1. *Euclea indeterminata*.
2. *Parasa chloris*.
3. *Euclea delphinii*, var.
4. *Adoneta spinuloides*.
5. *Monoleuca semifascia*.
6. *Sibine stimulea*.

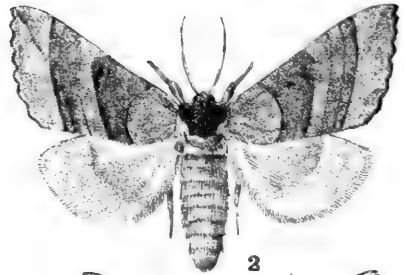
7. *Phobetron pitheceum* (male).
8. " " (female).
9. *Sisyrosea textula*.
10. *Lithacodes fasciola*.
11. *Apoda scapha*.
12. " " *biguttata*.

13. *Aboda y-inversa*.
14. *Packardia elegans*.
15. *Lacosoma chiridota*.
16. *Notolophus leucostigma*.
17. *Thyridopteryx ephermeræformis*.
18. *Olene achatina* var. *parallela*.

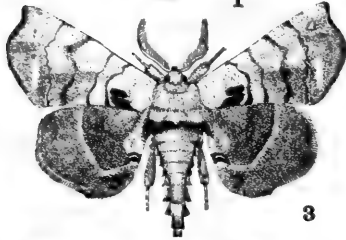




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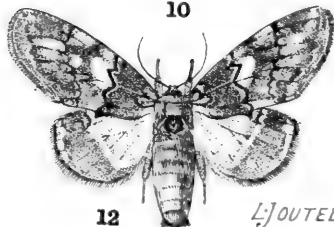
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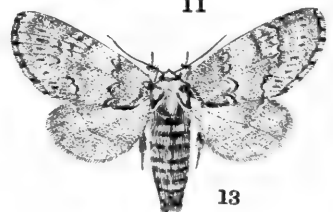


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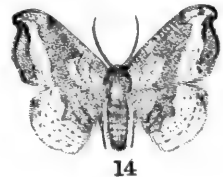
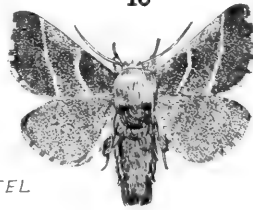
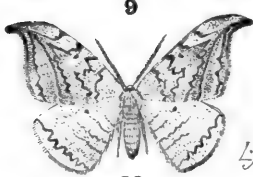
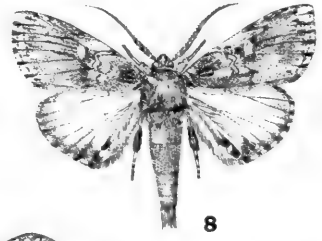
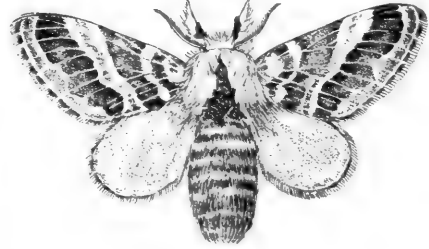
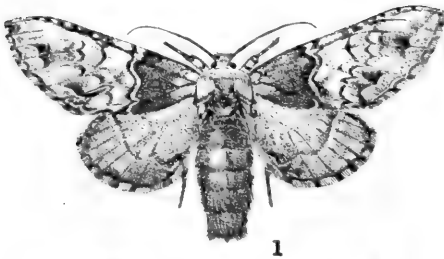


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1. *Nadata gibbosa*.
2. *Datana ministra*.
3. *Apatelodes torrefacta*.
4. *Ianassa lignicolor*.
5. *Melalopha inclusa*.

6. *Schizura badia*.
7. *Symmerista albifrons*.
8. *Dasylophia anguina*.
9. *Nerice bidentata*.

10. *Gluphisia septentrionalis*.
11. *Hyparpax aurora*.
12. *Lophodonta angulosa*.
13. *Heterocampa guttivitta*.



LOUTEL

- 1. *Heterocampa marthesia*.
- 2. *Cicinnus melshheimeri*.
- 3. *Gastropacha americana*.
- 4. *Seirodonta bilineata*.
- 5. *Arctace punctistriga*.

- 6. *Tolype velleda*.
- 7. *Pheosia dimidiata*.
- 8. *Schizura ipomoeæ*.
- 9. *Cerura borealis*.
- 10. *Falcaria bilineata*.

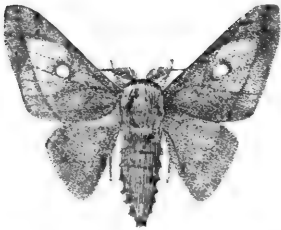
- 11. *Cerura multiscripta*.
- 12. *Platypteryx arcuata*.
- 13. *Clisiocampa americana*.
- 14. *Oreta rosea*.



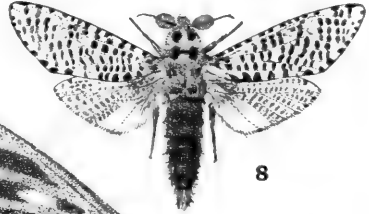
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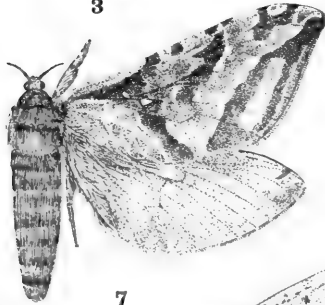
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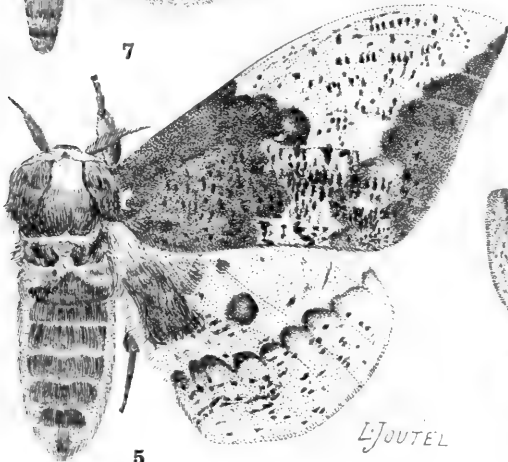
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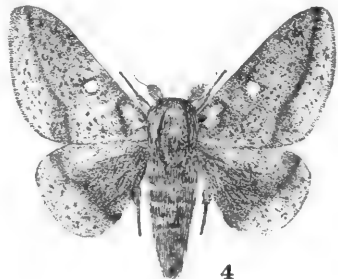
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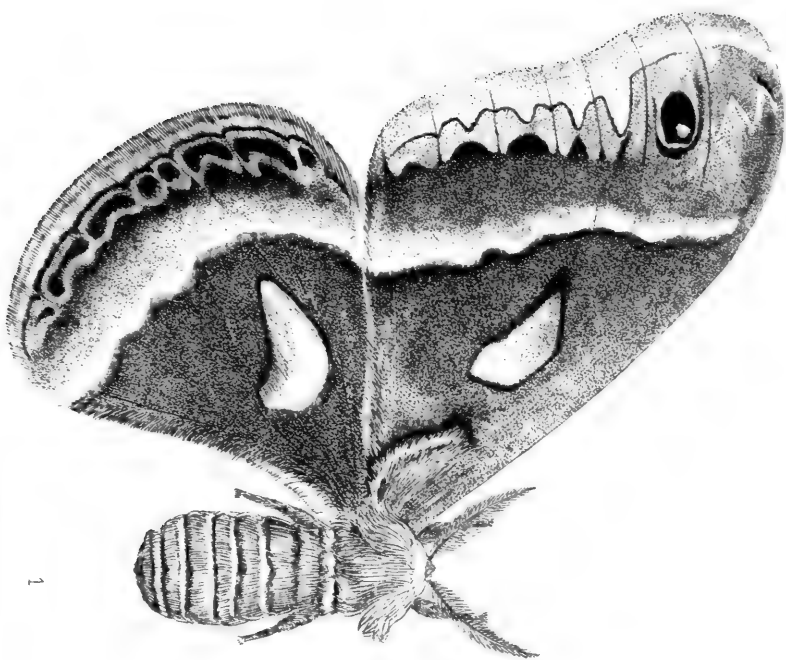


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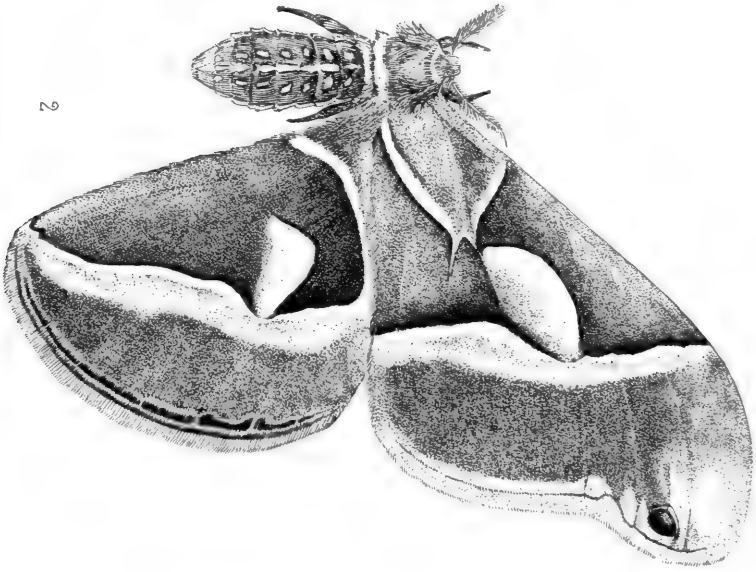
- 1. *Automeris io* (male).
- 2. *Hemileuca maia*.
- 3. *Anisota senatoria* (male).
- 4. " *stigma* (male).

- 5. *Eacles imperialis*.
- 6. *Citheronia regalis*.
- 7. *Hepialus argenteomaculatus*.
- 8. *Zeuzera pyrina*.



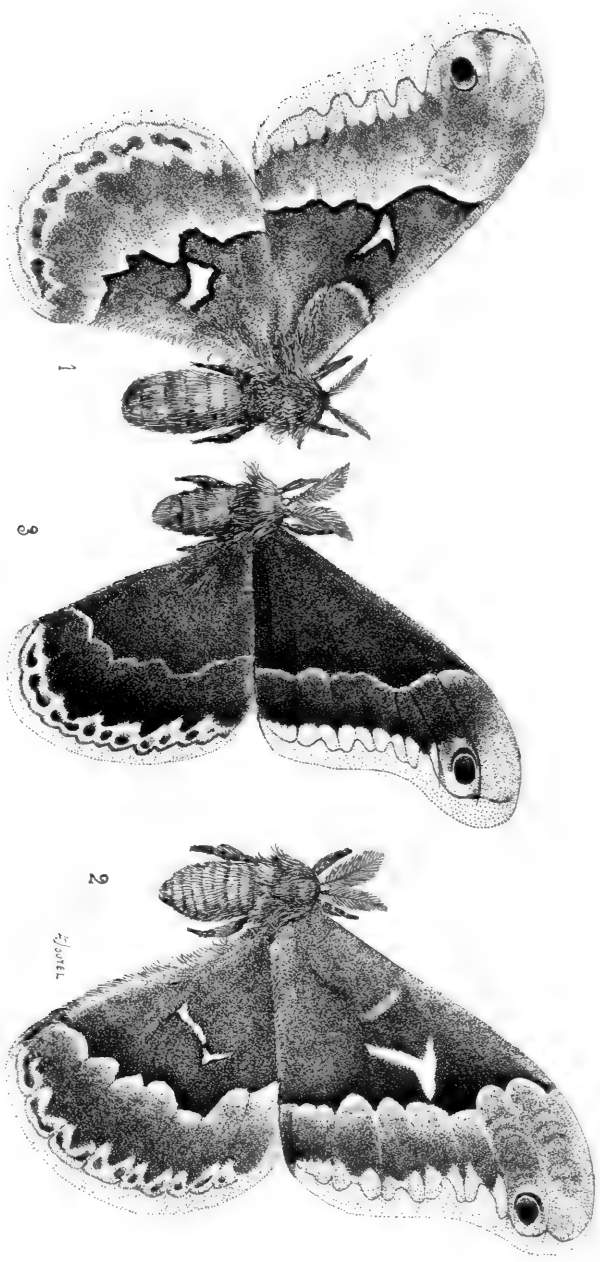
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1. *Platysamia cecropia*.



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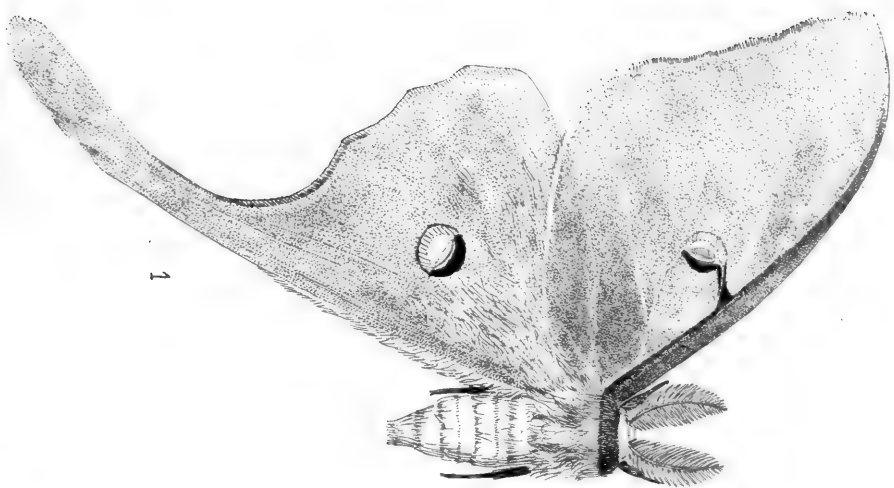
2. *Samia Cynthia*.



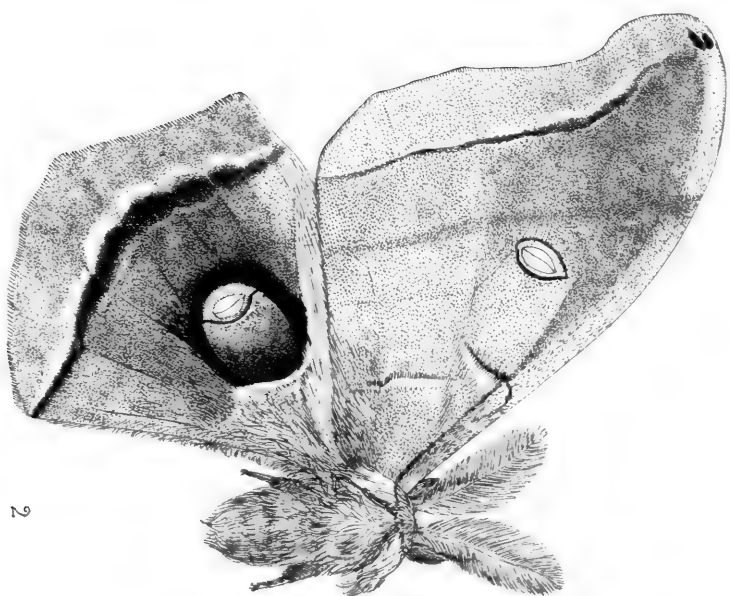
1. *Callosamia promethea* (female).

2. *Callosamia angulifera* (female).

3. *Callosamia promethea* (male).



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1. *Actias luna*.

2. *Telen polyphemus*.

Article XVIII.—NOMENCLATORIAL NOTES ON CERTAIN NORTH AMERICAN MAMMALS.

By J. A. ALLEN.

In revising a manuscript list of the described genera and species, etc., of North American Rodentia, prepared for the use of the Department of Vertebrate Zoölogy, a few points of interest have arisen which form the basis of the present 'Notes.' They relate mainly to certain early names given to various species of Sciuridæ, but include one Vole, and incidentally reference is made to recent proposed changes in the names of the Otter and Fisher.

Sciurus rubricatus Ord.

Sciurus rubricatus ORD, Journ. de Phys. LXXXVII, 1818, 152. Based on the "small gray squirrel" of Lewis & Clark, Hist. Exped. (Paul Allen ed.) 1814, II, 273. Not "small brown squirrel" of Lewis & Clark (*ibid.* p. 274), as claimed by RHOADS, Ord's Zoöl. 1894, 21.

In 1877 (Mon. N. Am. Roden., p. 673) I identified Lewis and Clark's "Small Brown Squirrel" with *Sciurus douglasii* Bachman, the correctness of which identification there is no reason to question. That it is not the "Red-breasted Squirrel, *Sciurus rubricatus* Ord" (*l. c.*), as claimed by Mr. Rhoads (*l. c.*), seems equally certain, the latter having evident reference to Lewis and Clark's "Small Gray Squirrel." This may also belong to the *S. douglasii* group, but if its geographical range, said to be "every part of the Rocky mountains where timber abounds," is to be regarded, it cannot be true *S. douglasii*. This view is supported by three good reasons: (1) There is nothing in Lewis and Clark's description of their "Small Brown Squirrel" to suggest the name *rubricatus*; (2) in the description of their "Small Gray Squirrel" they say it has "a narrow strip of black, commencing behind each shoulder, and entering longitudinally about three inches, between the colours of the sides and belly,"—this being of course the so-

called 'lateral line' of the summer pelage, and evidently is the feature which suggested to Ord the name *rubricatus*; (3) Ord refers, somewhat doubtfully, Lewis and Clark's "Brown Squirrel" to "*Sciurus hudsonius*," thus showing it is almost certainly not what he later called *Sciurus rubricatus*.

Ord, in his list of Squirrels in 'Guthrie's Geography' (1814, p. 292), gives four species as based on Lewis and Clark, mentioning them in practically the same order as they are described in the 'History' of Lewis and Clark's expedition, the last two alone being transposed. In this list Ord's "Columbian Gray Squirrel, *Sciurus* —," is evidently Lewis and Clark's "Large Gray Squirrel"; his "Red-breasted Squirrel, *Sciurus* —," is Lewis and Clark's "Small Gray Squirrel"; his "Rocky mountain Ground Squirrel, *Sciurus* —," is Lewis and Clark's "Ground Squirrel" (quite undeterminable); and his "Brown Squirrel, *Sciurus* —," is Lewis and Clark's "Small Brown Squirrel," concerning which Ord adds in a foot-note: "but we suspect that the Brown Squirrel is no other than the *Sciurus Hudsonius*, No. 48 of Pennant, Arct. Zool., sometimes called the Pine Squirrel, from the circumstance of its being found in Pine Woods"; Lewis and Clark stating that their Small Brown Squirrel "subsists on the seeds of various species of pine, and is always found in the pine country." There is no reference to pines in their account of the "Small Gray Squirrel."

From a letter published in Vol. LXXXVII of the 'Journal de Physique,' in 1818, sent by Mr. Ord to M. de Blainville, editor of the 'Journal,' it appears that Mr. Ord then contemplated publishing an illustrated work on the Zoölogy of the Lewis and Clark Expedition. In this letter occurs a paragraph, here literally transcribed, referring to the Squirrels of Lewis and Clark, of which an English rendering has already been given by Mr. Rhoads (*l. c.*): "Mon ami Leseuer a figuré pour moi la plus grande partie des quadrupèdes rapportés par Lewis, ou du moins ceux dont les peaux étoient dans un parfait état de conservation, comme le *Bagger* [Badger], *Ursus lubradoricus* de Linnæus; la Marmotte de la Louisiane, *Arctomys Ludoviciana*; le *Viverra alba*; le *Columbia grey Squirrel*; *sciurus griseus*; le *Red Breasted Squirrel*, *S. rubricatus*; le *Rocky mountain ground Squirrel*, *S. troglodytus*; le

Great grizzly Bear, Ursus horribilis; j'ai de ce dernier deux figures d'après deux beaux individus existant dans le Muséum [qui appartient à M. C. W. Peale]."¹

Here again there is no page reference to the 'History' of the Lewis and Clark Expedition, nor are Lewis and Clark's names of the Squirrels described by them mentioned. His proposed work on the Zoölogy of Lewis and Clark's Expedition was never published, and no further account of these new species of Squirrels ever appeared from Ord's pen.

As Lewis and Clark speak of their "Small Gray Squirrel" as "common in every part of the Rocky mountains where timber abounds" (meaning of course the portions they traversed), it seems not to be referable, as already said, to *Sciurus douglasii*; nor does it seem referable to any known species of *Sciurus* from the Rocky Mountain region, as their description says: "the throat, breast, belly, and inner parts of the legs are of the colour of a tanner's ooze," thus implying a ruddy or fulvous color of the under parts. Dr. Coues (Hist. Lewis and Clark's Exped., III, 1893, p. 855) has identified this animal with *Sciurus richardsoni* Bachman, apparently on the ground of locality, but the color of the lower parts, as given by Lewis and Clark, seems to preclude this identification. On the other hand, their account of their "Small Brown Squirrel" shows that this is certainly *Sciurus douglasii*. It is also evident from what they say of these two Squirrels that the animals they had in mind, and attempted to describe (perhaps from memory), were really quite different. The "tanner's ooze" tint of their "Small Gray Squirrel," however, is incongruous with the assigned locality.

While it is evident enough that Ord's "Columbia Gray Squirrel" is Lewis and Clark's "Large Gray Squirrel" of the Columbia River, it is equally evident that Ord's "Red-breasted Squirrel, *Sciurus rubricatus*" is their undeterminable "Small Gray Squirrel" of the Rocky Mountains. It therefore follows that Ord's *Sciurus rubricatus* does not "legitimately antedate Bachman's name [*Sci-*

¹ Sur plusieurs Animaux de l'Amérique septentrionale, et entre autres sur le *Rupicapra americana*, l'*Antilope americana*, le *Cervus major* ou Wapiti, etc. Par Georges Ord. Dans une lettre au Rédacteur du journal.—*Journal de Physique, de Chimie, d'Histoire naturelle, et des Arts*, par M. H.-M. Ducrotay de Blainville, Vol. LXXXVII, pp. 146-154, Aout, 1818. The paragraph above quoted occurs at the top of p. 152. Ord's letter is dated "Philadelphie, le 21 juin 1818."

urus douglasii] for the Red Squirrel of the West Cascade region of Oregon and Washington," as stated by Mr. Rhoads (*l. c.*).

Another name relating to the *Sciurus douglasii* group, which may be discussed in this connection, is

Sciurus bottæ Lesson.

Sciurus bottæ LESSON, Cent. Zool. 1830, 221, pl. lxxvi (1831). Text dated "Janvier, 1831."

As stated in my monograph of the North American Sciuridæ (Mon. N. Am. Roden., 1877, pp. 775, 776), *Sciurus bottæ* Lesson, from "Californie," in many points recalls *Sciurus douglasii* Bachman, agreeing with it very well in size and proportions, and also in having a yellowish belly and a yellowish-fringed tail; it differs, however, in its narrow, somewhat rounded, pointed tail, and in having the hairs of the upper surface of the body ringed about equally with white, brown, yellowish white and red, a coloration that does not fit any member of the subgenus *Tamiasciurus*. The locality, "California," might seem to point to either *Sciurus douglasii californicus* (Allen, 1898) or to *S. d. mollipilosus* (Aud. & Bach.), but the yellow-fringed tail is not pertinent in this connection. While in all probability *Sciurus bottæ* was based on a specimen of the *douglasii* group, the description is inapplicable at so many points, and the type locality is so vague that the name may well be left, as I have heretofore left it, in abeyance.

Sciurus californicus Lesson.

Sciurus (Macroxus) californicus LESSON, Descrip. de Mamm. et d'Ois. récemment découverts, etc., 1847, 143-145.

Lesson's *Sciurus (Macroxus) californicus*, described in 1847, is undoubtedly referable to the *Spermophilus beecheyi* of Richardson (*cf.* Baird, Mam. N. Am., 1857, p. 282; Allen, Mon. N. Am. Roden., 1877, pp. 827, 832). Its interest in the present connection lies in the fact that Lesson's *Sciurus californicus* renders the later use of the name *californicus* by myself for a subspecies of *Sciurus* (*Sciurus hudsonius californicus* Allen, 1890) untenable.

As it becomes necessary to supply a new name for the latter, it may be called **Sciurus douglasii albolimbatus**, in allusion to its conspicuously white-fringed tail, as compared with other members of the group.

Sciurus griseus *Ord.*

Sciurus griseus ORD, Journ. de Phys. LXXXVII, 1818, 152. Based on the "large gray squirrel" of Lewis & Clark, Hist. Exped. 1814, 273. Cf. RHOADS, Am. Nat. June, 1894, 525; *ibid.* Ord's Zoöl. 1894, App. 21.

As stated above (p. 451), I agree with Mr. Rhoads (*l. c.*) that *Sciurus griseus* Ord is beyond doubt the proper name for the much later *Sciurus fossor* Peale, so that this group will stand as follows :

1. *Sciurus griseus* Ord, Journ. de Phys. LXXXVII, 1818, 152 (*cf.* Rhoads, *l. c.*)=*Sciurus fossor* Peale, 1848.
2. *Sciurus griseus nigripes* Bryant (*cf.* Rhoads, *l. c.*)=*S. fossor nigripes* Bryant.
3. *Sciurus griseus anthonyi* (Mearns)=*S. fossor anthonyi* Mearns.

Sciurus albipes et varius *Wagner.*

Sciurus albipes WAGNER, Abh. der Math. Phys. Klasse der K. Bayer. Akad. d. Wissensch. II, 1837, 501. Mountains of State of Oaxaca, Mexico. Not *Sciurus albipes* KERR, 1792, from Ceylon.

Sciurus varius WAGNER, Schreber's Säugt. Suppl. III, 1843, 168, pl. ccxiiiid. (*Sciurus albipes* on the plate.) New name for *Sciurus albipes* WAGNER, 1837, preoccupied. Not *Sciurus varius* PALLAS, 1831 (or 1811)=*Sciurus vulgaris* LINN., or *S. vulgaris varius* (PALLAS).

As shown by the citations given above, *Sciurus albipes* Wagner, 1837, is untenable, being preoccupied. It was replaced by Wagner himself in 1843 by *Sciurus varius*, but unfortunately this name is also preoccupied by *Sciurus varius* Pallas (Zool. Rosso-Asiaticus, I, 1831, p. 183)=*Sciurus vulgaris* Linn. There being apparently no later available synonym for *Sciurus albipes* Wagner, the species may be again renamed **Sciurus wagneri**, in honor of its original describer, Johann Andreas Wagner, the eminent author of the 'Supplement' to Schreber's 'Säugthiere.' The species, with its subspecies recently described by Mr. Nelson (Proc. Biol. Soc. Washington, XII, pp. 150-152, June 3, 1898), may stand as follows :

1. *Sciurus wagneri* Allen=*S. albipes* Wagner, preoccupied.
2. *Sciurus wagneri quercinus* (Nelson)=*S. albipes quercinus* Nelson.

3. *Sciurus wagneri nemoralis* (Nelson)=*S. albipes nemoralis* Nelson.
4. *Sciurus wagneri colimensis* (Nelson)=*S. albipes colimensis* Nelson.
5. *Sciurus wagneri effugius* (Nelson)=*S. albipes effugius* Nelson.
6. *Sciurus wagneri cervicalis* (Allen)=*S. albipes cervicalis* (Allen) Nelson MS.

Mus empetra Pallas.

Mus empetra PALLAS, Nov. Sp. Glires, 1778, 74.

A careful reëxamination of the case of *Mus empetra* Pallas vs. *Arctomys parryi* Richardson, has confirmed me in the view I took in 1877 (Mon. N. Am. Roden., 1877, pp. 839, 842, 843), namely, that the two species are one and the same. Pallas's description, based on a specimen in the Leyden Museum, is not wholly satisfactory, but agrees well with Parry's Marmot, so far as it goes,—as regards size, form, and color, except that the chestnut brown on the front of the head is not mentioned. Schreber's Plate CCX, based on a drawing received by him from Pallas, shows the chestnut color on the head, somewhat exaggerated, it is true, but fails to show the grayish-white mottling called for by the text. But Pallas identifies with his *M. empetra* Forster's Quebec Marmot, which is unquestionably the *Arctomys parryi* of Richardson, as Richardson himself states (Faun. Bor.-Am., I, p. 147). Pennant's Quebec Marmot, also cited by Pallas under *Mus empetra*, is, of course, a wholly different animal, but it does not enter into Pallas's diagnosis of *Mus empetra*.

As shown by Dr. Merriam (N. Am. Fauna, No. 5, July, 1891, pp. 39-42), Richardson's *Arctomys* (*Spermophilus*) *parryi*, β *erythrogluteia* is *Spermophilus columbianus* (Ord). Richardson's *Arctomys parryi* and its varieties should henceforth stand as follows :

1. *Spermophilus empetra* (Pallas)=*Arctomys parryi* Richardson. Type locality, banks of the Mackenzie River.
2. *Spermophilus empetra columbianus* (Ord)=*Arctomys parryi* var. β *erythrogluteia* Richardson. Type locality, sources of Elk River, Rocky Mountains, lat. 57°.
3. *Spermophilus empetra phœognathus* (Richardson)=*Arctomys parryi* var. γ *phœognatha* Richardson. Type locality, Hudson Bay, precise district unknown. I have seen specimens I refer to this form from Depot Island, Hudson Bay.
4. *Spermophilus empetra kodiacensis* (Allen)=*S. parryi* var. *kodiacensis* Allen (1874).

Arctomys lewisii Aud. & Bach.

Arctomys lewisii AUD. & BACH. Quad. N. Am. III, 1853, 32, pl. cvii.

In 1857 Professor Baird (Mam. N. Am., p. 347) discussed the relationship of *Arctomys lewisii* Aud. & Bach., reaching the conclusion that, from the characters given, it could not be an *Arctomys* but might be a *Cynomys*, concluding his remarks as follows: "For the above reasons I am inclined to consider the *Arctomys lewisii* rather as a *Cynomys*, and quite probably the same with the burrowing squirrel of Lewis and Clark, called *Arctomys columbianus*, by Ord, and *Anisonyx brachyura*, by Rafinesque."

In 1877 I referred *Arctomys lewisii* not only to *Cynomys*, but placed it as a synonym of my *Cynomys columbianus* (Ord), accepting *Arctomys columbianus* Ord as the earliest name for *Cynomys gunnisoni* Baird. Since that date Dr. Merriam (North Am. Fauna, No. 5, July, 1891, pp. 39-42) has conclusively shown that the "Burrowing Squirrel" of Lewis and Clark, the basis of Ord's *Arctomys columbianus*, was not a *Cynomys* but a Spermophile, the *Arctomys (Spermophilus) parryi*, var. β *erythrogluteia* of Richardson.

Granting that the *Arctomys lewisii* is a *Cynomys*, of which there seems no reasonable doubt, its distinctive feature among the species of *Cynomys* is its half white tail, described by Audubon and Bachman as "tail, from the root for half its length, reddish-brown, the other half to the tip soiled white." This agrees strikingly with the tail of Dr. Merriam's *Cynomys leucurus* (N. Am. Fauna, No. 4, Oct., 1890, p. 33), which he describes as "Tail, basal half concolor with upper and lower surfaces of body respectively; terminal half whitish all round without trace of dark bar."

Arctomys lewisii was described from a specimen in the collection of the Zoölogical Society of London, unfortunately from an unknown locality, labeled "*Arctomys brachyura?* Harlan" (= *Anisonyx brachiura* Raf.). The supposed locality was given as "Oregon" (= Oregon of fifty years ago). The specimen, according to Audubon and Bachman, was sent to the Zoölogical Society by "the British fur-traders, who are in the habit of annually carrying their peltry down the Columbia river to the Pacific." The type locality of *Cynomys leucurus* is Fort Bridger, Wyoming,

the species ranging, however, considerably to the westward. There seems therefore good reason for supposing that in all probability the *Arctomys lewisii* (= *Cynomys lewisii*) and *Cynomys leucurus* are one and the same animal, there being as yet only one white-tailed *Cynomys* known.

***Glis canadensis* Erxleben.**

Glis canadensis ERXLEBEN, Syst. Anim. 1777, 363. Based primarily on the Quebec Marmot of Pennant (Syn. Quad. 1771, 270, No. 199)=*Arctomys monax melanopus* Kuhl.

Both the Quebec Marmot of Pennant and the *Glis canadensis* of Erxleben were referred by Baird (Mam. N. Am., 1877, pp. 339, 340) without question to *Arctomys monax* (Linn.). Under *Glis canadensis* Erxleben gives two references, first, to the Quebec Marmot of Pennant; secondly, to the Quebec Marmot of Forster (Phil. Trans., LXII, p. 378), an entirely different species (= *Spermophilus parryi phæognathus*), which he considered to be probably the young of Pennant's Quebec Marmot. But his diagnosis is almost a literal translation into Latin of Pennant's description of the Quebec Marmot, his incidental allusions, *passim*, to Forster's animal, in no way vitiating his diagnosis. Pennant's Quebec Marmot is, beyond reasonable doubt, the northern form of *Arctomys monax* (Linn.), which later was named by Kuhl *Arctomys monax melanopus*, under which designation it has been lately recognized by Rhoads (Proc. Acad. Nat. Sci. Phila., 1897, p. 30), Miller (Proc. Bost. Soc. Nat. Hist., XXVIII, 1897, p. 26), and Bangs (Am. Nat., July, 1898, p. 496). It should, however, evidently stand as

Arctomys monax canadensis (Erxleben)=*Arctomys monax melanopus* Kuhl.

***Arctomys pruinosus* Gmelin.**

Arctomys pruinosus GMELIN, Syst. Nat. 1788, 144. Based on the Hoary Marmot of Pennant, Hist. Quad. II, 1781, 398.
Arctomys caligatus ESCHSCHOLTZ, Zool. Atlas, Zweites Heft, 1829, I, pl. vi. "Nördlichsten Theile der Westküste Amerika's, häufig an der Bristolbai."

Gmelin's *Arctomys pruinosus* was based solely on the Hoary Marmot of Pennant; Pennant's very good description was taken from a specimen in the Leverian Museum; the habitat is given

as "the northern parts of North America." *Arctomys pruinosus* Gmelin was the currently accepted name for the Hoary Marmot until 1888, when Mr. J. B. Tyrrell, in his 'Catalogue of the Mammalia of Canada, exclusive of the Cetacea' (Proc. Canadian Inst., 3d Ser., VI, 1887-88, p. 88), adopted for it the name *Arctomys caligatus* Eschscholtz, stating that "Pennant's description on which Gmelin's name *pruinosus* was founded. . . . agrees so well with a specimen of *A. monax* from Hudson's Bay, the original locality, now in the Geological and Natural History Museum, that I have very little hesitation in placing Gmelin's species as a synonym of *A. monax*." In 1877 I had not only a specimen from the Hudson Bay region, but *several*, and others from as far north and west as the Athabasca country; so that this point was considered in the light of much pertinent material. Besides, it is not known that the type locality of *A. pruinosus* is "Hudson's Bay." Richardson, who identified Pennant's 'Hoary Marmot' with the 'Whistler' of Harmon, which is the true Hoary Marmot, states (Fauna Bor.-Am., I, p. 150) that Pennant's specimen (at that time lost) was "said to have been brought from Hudson's Bay," but Pennant does not so state.

Eschscholtz himself noticed the close resemblance of *A. pruinosus* to his *A. caligatus*; and Wagner says, under *A. caligatus* (Suppl. Schreber's Säugt., III, p. 260), that the resemblance of *A. caligatus* to *A. pruinosus* is striking, and that it seemed to him very doubtful whether *A. caligatus* was a distinct species. In view of this statement it seems strange that he should have placed *A. pruinosus* among the synonyms of *A. monax*, even under the separate subdivision " β *Totus pruinosus*," although thus indicating that he considered it something different from *A. monax* proper. Eschscholtz's *A. caligatus* was based on specimens from the coast of Alaska, apparently Bristol Bay, where, he states, it is abundant.

Some writers have given both *A. pruinosus* and *A. caligatus* the rank of distinct species, but most recent authors agree in referring, more or less confidently, *A. caligatus* to *A. pruinosus*. The case would not now be taken up were it not that there seems to be a tendency in some quarters to follow Mr. Tyrrell's dictum, which seems to me quite unwarranted.

In case the form from the Alaskan coast should prove to be separable from that found in the Liard River district, the name *pruinus* might appropriately be restricted to the latter and *caligatus* retained for the former; the British Columbia animal has already a name, in case it proves separable, in the *Arctomys okanaganus* King (Narr. Back's Journ., II, 1836, p. 236).

Hypudæus ochrogaster Wagner.

Hypudæus ochrogaster WAGNER, Suppl. Schreber's Säugt. III, 1843, 592.

In 1877 Prof. Baird said of this species (Mam. N. Am., p. 551): "I have never seen nor heard of any authentic American *Arvicola* of an ochery yellow beneath." In the same work he describes the color beneath of his *Arvicola* (*Pedomys*) *austerus* as "pale pure cinnamon, brighter than above," which he describes as "pale cinnamon rufous, variegated with black." Nine of his series of 12 specimens, however, were 'alcoholics.'

Coues described the upper parts in this species as "an intimate 'grizzle' of black, brown, yellowish-brown, and grayish-brown." The belly, he continues, in an average case, "shows a background of plumbeous, strongly washed over with a dirty cinnamon, or muddy rust color" which, "in the lightest-colored specimens" is "so bright as to approach a fawn-color or tawny brown."

Wagner describes his *Hypudæus ochrogaster* as being markedly smaller than *H. riparius* (= *Microtus pennsylvanicus*), but states that the chief difference from this species lies in the light ochery-yellowish of the underparts ("licht ockergelblichen Unterleib"), by which it is easily distinguished from *riparius*. He describes the upper parts as yellowish brown mixed with black. His Latin diagnosis is: "H. supra fuscus, subtus pallide bruno-ochraceus, gutture cinereo, auriculis tectis, cauda dense pilosa, supra fusca, infra abrupte et sordide ochracea." This is slightly amplified in the description in German which follows, the essential parts of which are quoted above. But he adds: "Der Schwanz ist oben dunkelbraun, unten licht ockergelblich, was von der obern Farbe scharf abschneidet." The description as a whole so admirably fits strongly colored examples of *Microtus austerus* that it seems surprising that the fact has not been previously

pointed out. Unfortunately there is no definite type locality; Wagner's two specimens were received from a dealer, "unter dem Namen *Hypudaeus riparius* und *novoboracensis*," and were said to have come from America.

If this identification of Wagner's *Hypudaeus ochrogaster* is accepted, the appropriate name *ochrogaster* will take precedence by ten years over *austerus*, for the animal now commonly known as *Microtus (Pedomys) austerus* (Le Conte), which should doubtless stand as *Microtus (Pedomys) ochrogaster* (Wagner).

***Mustela lutra canadensis* Schreber.**

Mustela lutra Linn, *canadensis* SCHREBER, Säugt. III, 1778, pl. cxxviii.
Plate issued in 1776.

Die americanischen Fischotter SCHREBER, *ibid.* 1778, 458, in text.

Mustela lutra canadensis SCHREBER, *ibid.* 588.

Mustela hudsonica DESMAREST (ex Lacépède, MS.), Nouv. Dict. d'Hist. Nat. XIII, 1803, 384.

The name currently adopted for the common Otter of North America throughout the present century has been *Lutra canadensis*, but the authority for the same has been carried back from Sabine, 1823 (Baird, 1857), to Turton, 1806 (Coues, 1877), to Kerr (1792), and finally to Schreber, 1778 (Rhoads, 1894). The latter is the correct authority for the name *canadensis*, as shown by Rhoads in 1894 (Ord's Zoöl., App., p. 12). It is therefore strange and surprising to find that in 1898 (Trans. Am. Phil. Soc., N. S., XIX, pp. 424-426) he abandons the name *canadensis* Schreber for the untenable *hudsonica* Desmarest (*ex* Lacépède, MS.), apparently to overturn the equally long accepted name *pennanti* Erxleben for the Fisher. Were it not for his intelligent discussion of the case in 1894, one would be justified in inferring, from his latest exposition of the matter, that he was quite unacquainted with Schreber's work, and dependent on second-hand references. He says: "*Mustela lutra canadensis* Schreber is a plate name, published (*vide* Sherborn) in 1776, and is the earliest applied to this Otter. It would stand . . . were it not unquestionably applied and intended by Schreber merely as a geographic name without reference to its specific relations to '*Mustela lutra* Linn.' For this reason alone it should be discarded. Furthermore, the name

Mustela canadensis was used by Schreber on a previous plate in the same volume (Pl. No. 126) in the specific sense for the fisher."

Here are two radical errors which defeat Mr. Rhoad's whole contention. First, the name *canadensis* was not used by Schreber "merely as a geographic name without reference to its specific relations to '*Mustela lutra* Linn.," but just in the same sense as on other plates in his work he employs such varietal names as *Felis catus ferus* (Pl. cviii and cviiia), *Felis catus domesticus* and *Felis catus angorensis* (Pl. cviii), *Ursus arctus fuscus* (Pl. cxxxix), *Ursus arctus niger* (Pl. cxi), etc., both on the plates and in the lists of plates at the end of each part. Secondly, the plate name *Mustela canadensis* for the Fisher does not occur "on a previous plate (Pl. No. 126)," but on a subsequent plate (No. cxxxiv)! Therefore the name *Mustela canadensis* Schreber, Pl. cxxxiv, becomes, contrary to Mr. Rhoad's contention, untenable for the Fisher, being preceded in the same work by a *Mustela lutra canadensis* on Pl. cxxvii. Furthermore, Schreber gives (*J. c.*, p. 458) a very good description of the distinctive external characters of the "americanischen Fischotter," as compared with the European species, adding at the close "S. Tab. cxxvii." Hence the group of North American Otters should evidently stand as follows:

1. CANADIAN OTTER. *Lutra canadensis* Schreber=*Mustela lutra canadensis* Schreber, Säugt., pl. cxxvii, 1776.
2. CAROLINIAN OTTER. *Lutra canadensis lataxina* (F. Cuvier)=*Lutra lataxina* F. Cuvier, Dict. des Sci. Nat. XXVII, 1823, 242.
3. FLORIDA OTTER. *Lutra canadensis vaga* (Bangs)=*Lutra hudsonica vaga* Bangs, Proc. Boston Soc. Nat. Hist. XXVIII, 1898, 224.
4. PACIFIC OTTER. *Lutra canadensis pacifica* (Rhoads)=*Lutra hudsonica pacifica* Rhoads, Trans. Am. Phil. Soc. N. S. XIX, 1898, 429.
5. SONORA OTTER. *Lutra canadensis sonora* (Rhoads)=*Lutra hudsonica sonora* Rhoads, Trans. Am. Phil. Soc. N. S. XIX, 1898, 431.
6. NEWFOUNDLAND OTTER. *Lutra degener* Bangs, Proc. Biol. Soc. Washington, XII, 1898, 35.

***Mustela pennanti* Erxleben.**

Mustela pennanti ERXLEBEN, Syst. Anim. 1777, 470. Based solely on the "Fisher Weasel" of Pennant, Syn. Quad. 1771, 223, No. 157.

As stated above, Mr. Rhoads, in his recent paper entitled 'Contributions to a Revision of the North American Beavers, Otters

and Fishers' (Trans. Am. Phil. Soc., XIX, 1898, pp. 417-439, Pl. xxi-xxv), rejects the name *Mustela pennanti* Erxl. (1777) for the Fisher for the plate name *Mustela canadensis* Schreber, distributed in 1776, about two years in advance of the text to which the plate belongs. But, as already shown (p. 460), this name appears on Schreber's Plate cxxxiv, and is preceded in the same work by a *Mustela lutris canadensis* on Pl. cxxvii, given to the North American Otter, which, on the ground that plate names are available, preoccupied the name *Mustela canadensis* as applied by Schreber to the Fisher.

We therefore agree entirely on this question with Mr. Rhoads's conclusion published in 1894 (Ord's Zoöl., p. 12), where he says: "The '*Mustela canadensis*' of Schreber (1778) [1776] is the same animal as '*M. pennantii*' of Erxleben (1777). Erxleben's *M. canadensis* is the Mink, *Lutreola vison*. Owing to its page sequence in the Säugthiere, the name '*canadensis*' is applicable to only one member of the genus *Mustela* as Schreber defines it, and that (if recognized as a tenable form) is the trinomial '*M. Lutra canadensis*.' The other, in such an event, is a synonym [=homonym]." The name of the Fisher should, therefore, still be ***Mustela pennanti* ERXLEBEN.**

Article XIX.—NOTICE OF A REMARKABLE SPECIMEN OF THE WEST INDIA CORAL MADREPORA PALMATA.

By R. P. WHITFIELD.

PLATE XXIV.

During March of the present year (1898) I spent my vacation in the Bahama Islands. While searching among the Keys about Nassau, N. P., in company with the Brown Brothers of that place, I chanced upon a comparatively young reef of the beautiful coral *Madrepora palmata*. After examining many individual colonies of large size, all of which had more or less dead and blackened fronds, we discovered one large colony that was entirely alive. I at once concluded that this must be obtained for the American Museum of Natural History in New York City.

After making an examination of the reef and its surroundings, we concluded that, with great care and additional help, and with the tide and wind at an advantageous stage, the specimen might be obtained.

Accordingly at the first favorable opportunity, with two good-sized boats and four trusty helpers, the attempt was successfully made and the specimen secured and carried into shallow water. A boat was then sunk and the specimen gotten into it, after which the boat was righted and bailed out and towed behind the larger boat to a suitable place for cleaning, near Mr. Brown's store on East Bay Street, Nassau, whence it was shipped to the Museum in New York, and is now on exhibition there. Experts who have visited all European and American museums pronounce this to be by far the finest specimen of this kind of coral in any existing collection.

The colony was rooted on the solid rock by its broad spreading base, and stands about three feet high; it is six feet two inches in the longest diameter by five feet four inches in the other diameter, the whole being of a very broadly oval outline with broad spreading and branching fronds so characteristic of the species.

There are a few features about the colony that are well worthy of special notice. On the unsymmetrical side, just above the letter *A* in the figure, there is a small frond which has at some time been broken from a point just below *B*, and has turned upside down, but has continued to live and grown fast to the part below it, the peculiar features of the basal polyps being retained in spite of its reversed position. The frond marked *B* has also been broken from the spot immediately over its small end, but, being caught by a small frond below, retained its upright position and continued to grow and became attached permanently to the fronds on which it rests. A little further to the right of *B*, at *C*, can be seen a narrow dark scar; at this point the large frond *C* with its four divisions was broken in life, but, being caught by the fronds below, has healed almost across the neck, leaving only a narrow space unhealed.

Another feature worthy of mention is seen over all the larger spreading fronds in the form of broad undulations. These mark periods of growth, being thicker and thinner in substance, and are undoubtedly annual growths of the coral, as at the time it was collected the outer thin edges of all these fronds were young growing polyps and of a very delicate texture and lighter color. Eleven of these undulations may be detected on the upper fronds outside of the thickening of the basal parts. It may, therefore, be supposed that the thin spreading fronds are of eleven years' growth, while the thick parts below may have taken an equal time before these thin fronds were thrown out. The difference in the temperature of the water at Nassau between the winter and summer months would probably account for this change in growth.

The specimen, when living, was of a light brown color over the entire colony, including the living portion of the thickened root. The growing edges were of a whitish yellow, and extremely tender and fragile. When first taken from the water and exposed to the air it emits a disagreeable sickening odor that is very repulsive, and probably may be distinguished in the water by fishes or other animal forms, and may act as a means of defense against parasitic growths, from which these Madreporae are generally particularly free.

VALPHERUS
PAMMIA. I.C.



PLATE 1

PLATE 1

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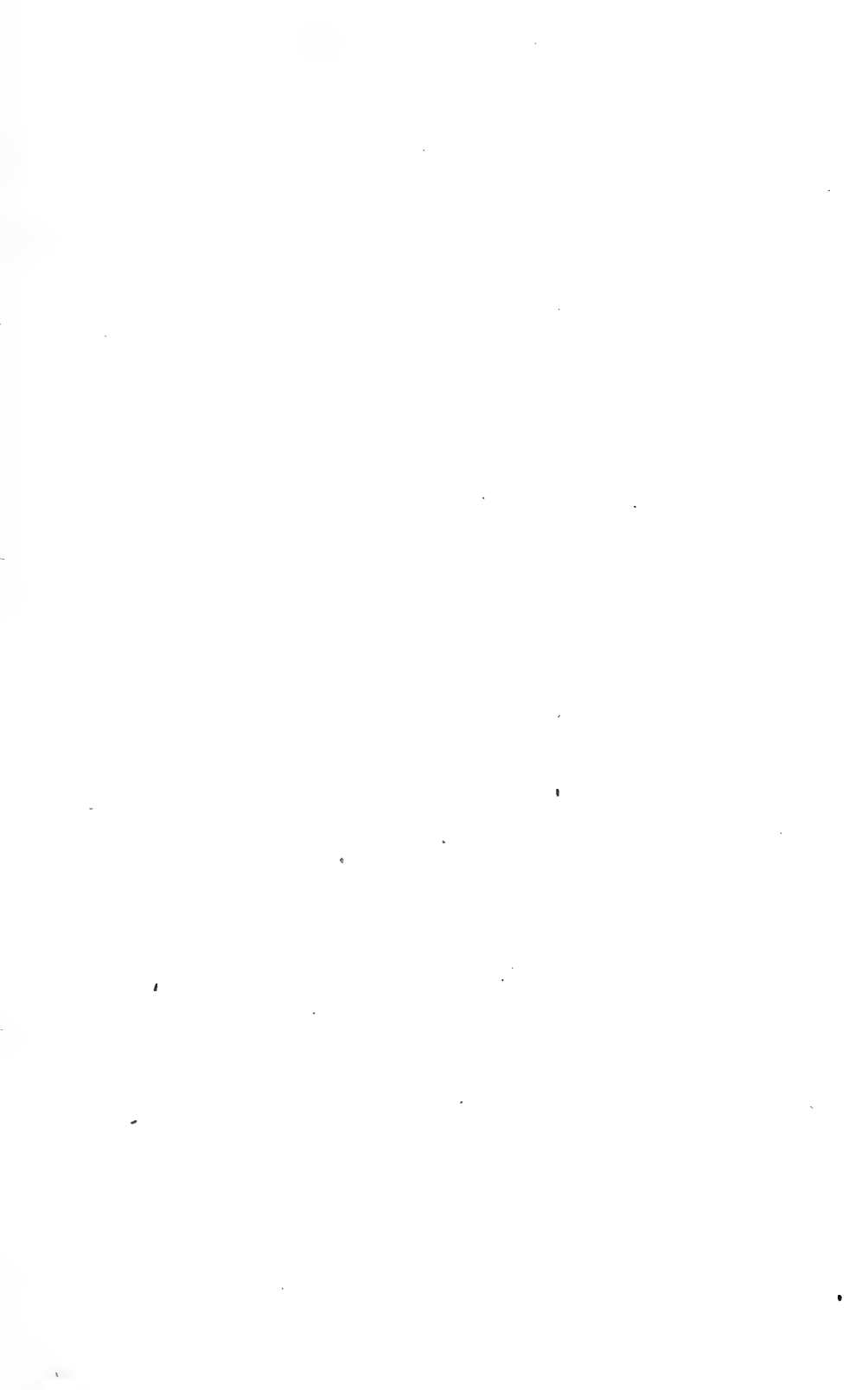
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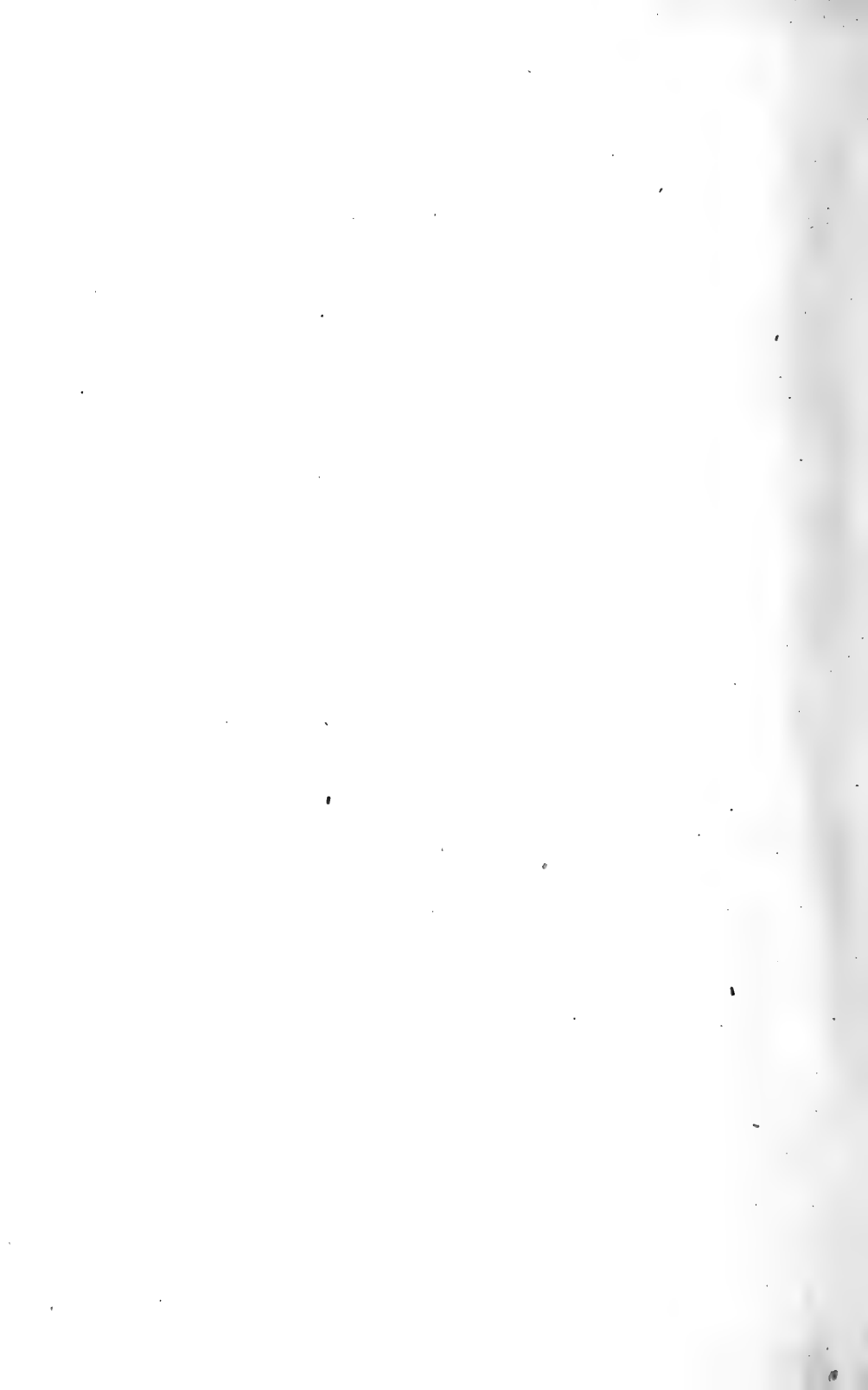
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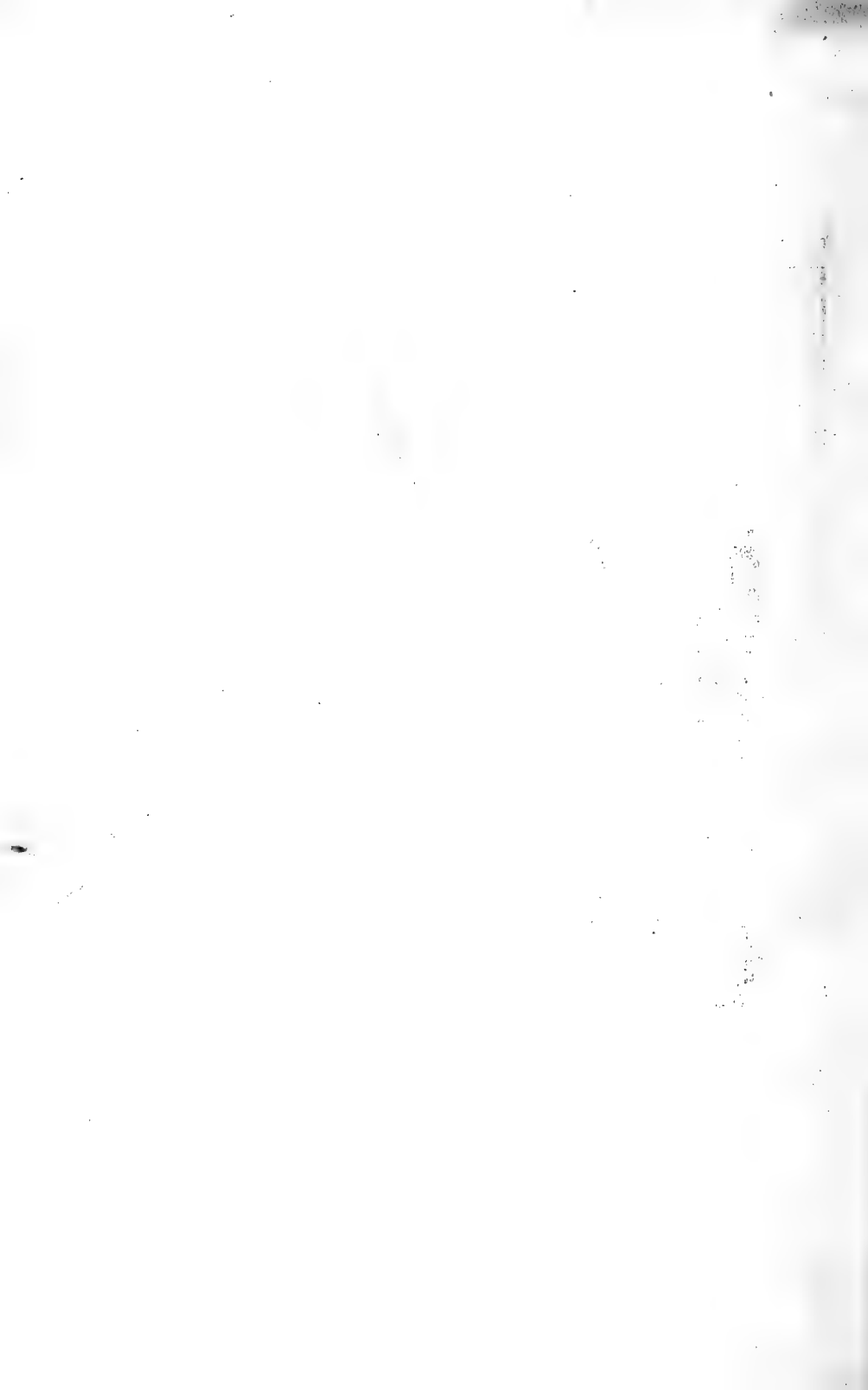
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