THE GENUS NEOTOMA IN THE SANTA CRUZ MOUNTAINS

By Harold E. Parks

Wherever he goes in the hills and woods of the Santa Cruz Mountains, California, sooner or later will the camper become acquainted with the little rodent commonly known as the woodrat. Not so much will he see of the animals themselves as of their astounding activities. To the camper, the woodsman, and the rancher the woodrat becomes a nuisance and a serious pest. Destructive to a high degree, versatile in its habits, adaptable to all conditions, it is an animal of considerable economic importance.

The prevailing idea is that there are two distinct species in this region but after lengthy observation I am inclined to recognize but one. This is *Neotoma fuscipes annectens*. Its varied activities have brought into common use the names "bushrat" and "traderat." The destructive activities are attributed to the bush or woodrat. The name traderat comes from the habit of replacing stolen articles with others, such as sticks, stones, dry bones, or pieces of dry cow manure. Variations in environment may account for these diverse habits but there is no apparent difference in the animals.

In the woods on all sides will be seen the nests of these rodents. Beyond recognition of the nests as the homes of the animals very little seems to be known of the inhabitants themselves. They are very shy and are seldom seen in daylight. On rare occasions one may be driven from a nest or seen wandering aimlessly in the trees during the day, but the activities are mainly nocturnal.

Several years ago in a camp in the mountains these animals became a source of annoyance. This camp was made in a steep little side canyon away from the travelled road and under some spreading live oaks. On the adjacent hills was a dense forest of mixed oaks, together with some madrone, redwood, laurel and the usual poison oak and hazel underbrush. The camp soon became the recipient of all kinds of attention, most of it very undesirable, from the rodents.

In the immediate vicinity of the camp there did not appear to be any of the nests of these animals. Within a few days however many articles of food began to disappear. Potatoes and pieces of bread vanished overnight. Very soon the entire supply of potatoes was gone. Then other things went. One evening a large piece of cold boiled meat was taken. Another night a large roll of jelly cake was taken.

I returned to my camp after an evening's absence just in time to see the roll of cake going under the rear flap of the tent. It had been rolled, pushed and dragged about considerably but showed few teeth marks. Several rats participated in this raid.

The so-called traderats carry away many very unweildy things, often to points high up in trees where nests have been made. They have a fondness for dried prunes, crackers, bits of glass, bright metal and sometimes pieces of brightly colored cloth and will carry such things to the nests for storage. In exchange they leave a chip, a small stone or anything that may happen to be handy and such things were frequently left in place of my bread and potatoes.

I have a record of a nest built at a considerable height in a pine tree that contained the bright inner lid of a lard pail stolen from the camp table, an old fashioned perfume bottle with a little mirror on one side, and many musty prunes and crackers. The perfume bottle contained gun oil and was rescued without the contents having been spilled. I have seen many other dexterous performances by these animals.

I watched many days with a little rifle handy to destroy my visitors before seeing one of them. In the meantime I went in search of the nests and found a colony established in a dense thicket of hazel brush in an almost impenetrable side gulch three hundred yards from camp. In this thicket were a dozen large conical nests of the type most commonly seen. These were built in such a way as to receive considerable support from the large stalks of the hazel which was very rank in growth. These piles of dry sticks were like so much tinder so I fired them, the surrounding vegetation being wet and green enough to prevent fire from spreading. Fire was applied at the top and burned rapidly downward. As they were fired one at a time I watched for the fleeing rats but saw none. The occupants took to underground passages and later came forth and proceeded to rebuild. In a few days the nests were well under way and assuming good size. Had a general fire run through the brush they would have deserted the locality for an unburned site. I have recently (1919–20) witnessed extensive burnings of brushy areas to rid a neighborhood of rats and within a month many new nests were in process of construction a very short distance from the burned area.

One morning while at an early breakfast under the trees at my camp I noted considerable commotion in the branches overhead. A half dozen small animals were running back and forth at play, unconscious of or unconcerned at my presence. I did not attempt to destroy them at this time and in several days they became quite tame showing

no fear of any one around the camp. They appeared regularly morning and evening and quite frequently came down to the ground for bits of food.

To me they appeared quite stupid and rather sluggish in movement. They did not move with any great speed and such of them as I have seen at distances from the nests did not take alarm very easily. It may be that their great curosity overcomes fear to a certain degree.

Eventually these little visitors became such a nuisance that the rifle was brought into use. Sitting at my table I shot six of them as they sat in the branches of the tree above me. They made no effort to get away, simply squealing a little at the noise but otherwise appearing unafraid. They presented a ludicrous and helpless appearance.

They were all apparently dwellers in a nest located in a large oak at some little distance from the camp. I could trace their course of travel through the trees from that vicinity. I have since seen regular courses travelled by rats through the madrone thickets, regular paths being worn in the tender young green bark early in the fall. These six rats were of an even size and were always seen together and I have thought they were all of one litter. They were four to five inches long with a tail a trifle longer than the body. The fur was of fine texture and condition although it was the middle of May. It was clean, soft gray on the sides and back and pure clean white on the belly. The head was short and rather heavy in appearance with a blunt nose and short, rounded, erect ears. They had the look of rats approaching maturity.

I have since found stray animals about a third larger than those mentioned. These latter were probably old as they had dirty gray fur and a more rat-like appearance. On the ground they were slow of movement but were much speedier in the trees. Aloft in the trees they were not inclined to run far or escape when observed. They would stretch their bodies lengthwise along a limb without much attempt at concealment and then follow every movement of a person on the ground with their eyes. Unlike the squirrels they do not seek to keep the tree between themselves and an observer. When shot at with a rifle they would sit up on their haunches and squeal but make no attempt to run away.

On occasion I have disturbed rats and forced them into the trees where I have thrown sticks at them with the intention of making them move rather than to injure them. If the missile passed close enough the rat would move a short distance and wait for another missile to be thrown. The result almost invariably was that the rat would travel

in a circle that kept it in close touch with the nest. If the nest was destroyed the rat could then be driven away immediately, usually to a small refuge nest high up in the trees.

NESTS

The dwelling of this woodrat and the methods used in its building are of much interest, even though these nests appear to the casual observer to be nothing more than piles of dry sticks and trash. The animals are versatile in their adaptability to their surroundings, in the methods of construction, and in the utilization of materials; and are exceedingly dextrous in the handling of large and unweildy objects.

Before going into details of the structure it is necessary to know something of the requirements of the animals. They appear to be sociable by nature. In one case I found evidence of two families occupying one large nest. Frequently hard and well worn paths will be found leading from one nest to another, indicating intercourse between them. Usually the nests are to be found in colonies, isolated nests being exceptions.

In certain localities where I have collected botanical specimens the nests are built in every thicket, against trees and around stumps, and in the branches of the trees, in fact in every conceivable place that affords the needed support and protection. The methods of utilizing these facilities are often unique and ingenious. The preferred places are in the dense forest but sometimes the nests are built on open rocky ledges. In the latter case they are solitary and small.

Conditions to be met in the selection of sites for individual nests and for colonies are the sources and abundance of food supply, the general safety and security of the nests, and the ease in securing the needed building materials. Proximity to water is not essential and the animals often travel considerable distances to it. The presence of humans is not taken into consideration, although they delight in raiding habitations and belongings.

I have on occasion come upon rats beginning the construction of a nest. One pair began at the base of an oak and made an excavation on the downhill side that ran back at an angle a foot in the hard, finely pulverized, rocky soil and was so placed as to receive the greatest amount of protection from the base of the tree. They next gathered a large number of small twigs, most of them freshly cut, which they piled in such a way around the opening as to form a chamber above it. This fine material they then covered with larger and coarser material

until they had a considerable pile of sticks. Into this upper mass they wove many long, green boughs of freshly cut laurel and vines of different kinds with some long sword ferns and filled the interstices with dry cow manure brought from an adjacent pasture. In the course of several weeks this nest became a structure of considerable size and strength.

Apparently this mass was piled more or less aimlessly around the base of the tree but the effect was to bind the nest securely together. The entrance, as in many others, was at the base on the lower or downhill side. The amount of debris that accumulated around the base of this nest seemed to indicate considerable extension of the original cavity and the running of some small lateral tunnels.

The material used in these buildings is subject to rapid decay. Most of the woods used are soft and light and yield readily to the gnawing of the rodents. When manure, vines, and ferns are used the process of decay is accelerated. This decay necessitates a constant renewal. At the edge of a forest I have found nests that were built around fallen oak logs and stumps and the material used in the construction was such that little renewal was required. In the fall months all nests are gone over to some extent. This work begins at the approach of wet weather and frequently continues until the long dry season sets in. During the summer season there is a general appearance of dilapidation.

A nest on the edge of the forest will show some signs of freshening up and a considerable amount of debris will be removed from the interior, while nests in the dense forest will frequently be buried under masses of manzanita and toyon. Neither wet nor cold seems to influence the amount of this rebuilding. In the spring there is a season of cleaning house and large amounts of filth, dirt, droppings, and decomposed material is dumped in heaps around the entrances. The nests are again covered with long laurel withes or branches clipped from redwood or manzanita and vines like the wild cucumber and with ferns.

A large house is not necessarily an indication of a large community occupying the nest. Size is attained by the constant addition of material required for the protection of the nest and its occupants. There is very little evidence in many of the nests which have been dismantled, to show that the upper portions of the structure are used for any purpose at all and only in a very few have any open chambers been found above the main quarters. Where these chambers have been found there is nothing to indicate the purpose for which they were made. The breeding nests are in the lower chambers close to the under-

ground passages and there is an absence of filth around them. The living quarters are generally filthy.

The larger a nest becomes the greater is the amount of work required to maintain it. Its length of life extends over a number of years of slow growth followed by a comparatively rapid decay when the forces of nature have become too great to overcome. In wet weather the nests absorb a large amount of moisture which is held for a long period and adds very materially to the rapidity of the decay. Then there comes the long, dry, desiccating summer weather when the soft materials crumble to dust.

The rats are not satisfied with the underground retreats for they build small refuge nests high up in the trees in the vicinity of the ground nest. When driven from the safety of the latter they will take to the trees and finally seek the shelter of the tree nests. A sudden sharp blow upon the ground nest will frequently scare a rat into the trees and on rare occasions one will go directly to the tree nest. More often the rat will remain in the vicinity of the main nest until compelled by force to leave it. If a person begins to dismantle a nest at the top the rats will seek the underground passages and none will be seen on the surface. I have succeeded in driving out one rat but have not been able to get sight of a second in any nest.

I once dismantled a nest that had reached its maximum development in an exceptionally favorable location. One side of a huge redwood stump had been burned in a fire and then broken off leaving a stub on one side while the fire continued to eat its way down the other into the roots. The side exposed to the heavy weather remained standing and the inner portion of it formed the bracing side for the nest. Against this upstanding slab there was piled an enormous amount of trash.

Beginning carefully at the top I removed a considerable pile of coarse sticks and rubbish, finding only a few small open chambers. When I had reduced the pile by fully three-quarters of its original bulk I came to a large chamber. This chamber was larger than usual but had not been cleaned out at the end of the rainy season and was very filthy. In one corner there was a small nest such as some bird might build. This nest was carefully woven of fine long grass and wood chewed into a resemblance to excelsior. The center was perfectly hollowed out and lined with soft fur. It was some five inches in diameter and four inches deep. This nest had been recently occupied and the young I think had been removed to some underground passage.

There was an entrance to an underground passage on the opposite side of the chamber to this breeding nest. This underground passage was an old burnt out root about ten inches in diameter and four or five feet below the level of the ground and extended laterally to a river bank some few feet distant. I ascertained this by starting a smudge. I forced some smoke into the hole and drove a rat out into the open on the bank. This nest was not rebuilt.

Unusual forms of construction are frequently met with and are often a puzzle. I found several along the rocky ledges at the Guadaloupe Mines which were but little more than heaps of sticks piled around deep holes or crevices in the rocks, the material in which must have been secured with difficulty. I endeavored to interview the occupants of one such nest with some unexpected success. One of the occupants was a very long slender snake, probably a California striped racer, which proceeded to race back and forth through some brush but I could not make it leave the vicinity of the nest. It is said that rattlers sometimes use these nests but although I have had some painful experiences in trying to prove it I have never found the rattler in the nest. If the rattler occupies the nest he also eats the rats.

I have observed many strange nests this last season or two, but none of them illustrates the ingenuity and dexterity of these animals more than one which was found on the site of an abandoned farm near Los Gatos. The nest was built in the crotch of an ancient laurel which had partly decayed as these trees frequently do. The usual brush and rubbish was piled loosely around on the ground. Above this was an immense pile of shingles built into the crotch of the tree to a height of five feet or more, all laid flat one upon another and securely braced to prevent falling. These rats had carried shingles a hundred feet or more from an old fallen roof and piled them with an infinite amount of labor.

In the Guadaloupe Mine region where there are some very large coast live oaks (*Quercus agrifolia*) the rats have taken advantage of heavy crossing branches in a unique way. Two nests were located close together in adjacent trees where the outer limbs crossed and braced each other and formed a solid base to build upon. The builders used three crossing limbs as the foundation and then drew in the smaller branches as the nests grew until the whole nest had attained a height of five feet or more and the base an area of nine or ten square feet. Although these nests swayed back and forth with the heavy winds they were very solid and difficult to take apart. These nests were two

seasons in the building. Each contained a large central chamber. In each nest I found a single old rat and signs that young had been in the nests recently. One of the curious features of these nests was the amount of dry manure used in the construction. Fully one-third of their bulk was made up of this material brought from an adjacent pasture.

FOOD AND FEEDING HABITS

There is plenty of evidence that the woodrat is a gross and destructive feeder. The animals are wanton in their ravages, destroying great quantities of things for which they have no use. It seems to be their special delight to enter cabins and ranch houses or other buildings and chew up papers, books, clothing, and whatever else they may find and such debris is left in heaps wherever it has been destroyed.

I have never seen papers or kindred articles in the nests or signs that they have been taken any great distance from dwellings. Bits of bright cloth like other bright things may be carried to some distance. At the cabin of a friend the food supplies were regularly raided and the salt and soap seemed to be favorite articles. One spring my friend missed some silk socks and a bright necktie. In the fall we found both in remnants together with some soap in a nest a quarter of a mile away. The rats seemed to develop a streak of mischief with a bit of humor and persistence in it. Every night the woodbox in the cook shack was a center of attention. This building being more or less open the rats had easy access at night. In the morning the wood was to be found on the floor, the pieces being laid out in rows and placed neatly end to end. This was repeated many times.

The season of 1919 produced an abundance of wild berries and fruits. The madrone trees bore enormous crops of the bright red berries which are known as the favorite food of the robins and wild pigeons of this region. In the vicinity of my friend's cabin the madrones are very abundant and the woodrats are also present in very large numbers. When we were opening some of the nests in search of young we found great numbers of madrone berries, which had been cut from the trees in clusters and taken to the nests as needed. This fruit must have been used to feed the young since the old rats eat what they require where it grows. It is a significant fact that the berries were placed conveniently near the little breeding nests that had contained young very recently. The berries are not eaten for the pulp that surrounds the large seeds but in the nests they are cracked open and the kernel is eaten as we would eat a nut.

No permanent food supply seems to be laid up regularly for winter use as is the case with the northern rodents. The climate is such that there is a constant supply of food of some kind available the year round. The conclusion is that when food is found in the nest it is there for the feeding of the young. During many months of the year when there are acorns to be found the rats are industrious in gathering them for food, but they are in the greater number of cases consumed where found. On two occasions in the fall of 1919 when examining nests I found acorns of live oaks stored for use directly in front of the breeding nests. The little nests had contained young within a short time of my visit and fragments of freshly eaten acorns seemed to indicate that the young had eaten of them within an hour of my opening the nests. In these piles I counted over five hundred acorns without taking more than half of them.

In one nest after removing the acorns I found a peculiar arrangement of the underground passage in which the young probably took refuge. The central chamber was quite large, the breeding nest was at one side with a passage beside it, and the acorns were piled on the opposite side with a mat made of the fine, long, tough twigs of a species of wild cherry beneath them. The main passage way passed directly beneath this mat and furnished the rats access to the pile of acorns without coming to the main chamber.

Fungi form one of the most important foods of the rodents here, if not the most important. One variety or another is to be found through a very long season if the rains are sufficient. It is in those winters when the rainfall is light that the rats make the greatest use of acorns and other foods. The botanical field work that I am doing relates to the groups of fungi which grow under the surface of the ground or are buried under the leaves of the forest, and are practically unknown in this country to any but a few scientists.

The collector of this kind of fungi in America is handicapped to a very great extent as he must choose his working place at random or by instinct. In Europe where truffles as well as others of this class are abundant, the fungi are strongly aromatic and certain animals are trained to search for the hidden plants. Unfortunately, while truffles in California are abundant, they are not in any sense aromatic. The plants give no evidence of their presence and must be located by some other means than by smell. We have another group of plants which may be called false truffles (i.e. *Hymenogastrales*), since they grow after the manner of the real truffles and some of the many species

are exceedingly aromatic. It is this latter group which is closely associated with the woodrats. To the woodrats or to the signs they leave, credit is due for many important discoveries. These signs and the reading of them are most important to the collector who desires to secure specimens of this kind.

There is a district within easy reach of San Jose which I visit frequently in following up the life cycle of the various species of fungi. This is the region of the New Almaden Mines and the Guadaloupe Mines. The rats are or have been assembled there literally by the thousands. It is a region well favored with all kinds of fungi. It is wooded densely with a second growth of liveoak interspersed with the usual underbrush of manzanita, *Baccharis* and poison oak. The soil is largely pulverized rock and quartz. For a long time I got very poor results in the collecting of fungi but occasionally I found large specimens of the Agaricaceæ and Boletaceæ which had been partly consumed by some small animals. At the same time my attention was frequently called to many excavations in the leaves and hard soil. These excavations were very puzzling but I had in mind the fact that some animals fed on truffles in Europe and that there might be a similar occurrence here.

The mystery of these holes in the ground induced me to return many times to this region long after it seemed that search for the truffles was useless. Persistence in following up these signs led to the finding and developing a district wonderfully rich in these strange forms of fungi. Months were spent in learning the meaning of these signs and excavations made by rodents but now they are read with as much certainty as a printed page. The form of the excavation often serves to identify the various genera of fungi present. But it is important to note that these signs do not reveal all that is undergound. The woodrat is the mushroom hunter par excellence.

Late in March of 1917 I was in the Guadaloupe Mine region following up some discoveries of a few days before. I became involved in a dense thicket of manzanita where progress was made only on hands and knees. I shortly brought up before a rat's nest of large size and disturbed a rat working in a hole at the base. Examination revealed several other holes in process of excavation and one large hole about four inches in diameter at the top and nearly a foot deep. At the bottom of this hole was a large fungus, strongly but not unpleasantly aromatic, which was partly eaten.

I completed excavation of the other holes and secured seven fine specimens of this fungus, all strongly aromatic. I assumed that these plants were desirable for food for the rats and associated the many excavations which I had been finding with the work of the woodrats. I also assumed that there must be some relationship between the location of nests and the location of desirable fungi. The conclusion arrived at after considerable study, was that where the woodrats were numerous the fungi must likewise be abundant. This is well borne out by subsequent discoveries. This particular fungus, genus *Gautieria*, I have never found at any great distance from rat nests. The plants of this genus are, in this locality, rarely found less than six inches and frequently nearly a foot below the surface. They are seldom found in any but very dry ground which is firmly packed. This condition requires a great amount of digging. When a mature fungus is located by a woodrat a hole is excavated until the plant is visible. It is then eaten in the hole. I have found many of them partly eaten in the holes but have never seen one removed from the hole. It is some feat for the rat to stand upon its head and consume such an article of food.

The genus *Gautieria* is found in abundance in normal moist seasons in this region from November to July. It is perhaps the most powerfully aromatic of all the species without being so foul as some are; beyond doubt it is one of the most esteemed of all the fungi and forms one of the most important foods for the woodrat.

In one place the rats opened up a series of holes around the sides of a steep, wooded ridge very much as a miner would sink test shafts in developing a vein of ore. In this way they followed for considerable distances parallel veins of mycelium, opening up holes at intervals of two or three feet and consuming the matured fungus at the bottom of each. By opening up the exposed veins between these holes a large number of plants were collected in their immature stages and which had not yet developed an odor. The woodrats seem to ignore the plants that have not yet developed to this state of maturity. It is solely by the sense of smell that the plants are found. I have seen other plants cast aside in the excavations because they lacked an odor.

There are several other species scattered through these hills in more or less abundance which have not been described scientifically and which form a very considerable item in the food supply of the rodents. These are all strong-odored varieties. They are all more or less buried in the soil and humus and are to be found by digging in appropriate places. Some are found among the leaves, others beneath the leaves

but on the surface of the soil, and still others at various depths beneath the surface. Occasionally they are found uncovered on the surface of bare soil but always beneath various trees.

One of these plants of somewhat common occurrence (genus *Melanogaster*) possesses an exceedingly powerful, spreading odor and is to be found growing among the leaves. It has the appearance of a small puffball of a reddish or brownish color. The rats range far and wide for these plants during the season and when they find them they turn over the leaves and humus sifting it into a fine mulch in their efforts to secure the fungus. These, as in the previous cases, are eaten on the spot. Being of the consistency of a rubber ball they make a rather tough bite. In spite of the very strong odor, the plants are, to the human taste, rather sweet and pleasant.

Some of the species serving the purpose of food for the rats are very malodorous, others somewhat pleasant. There are two species widely divergent in size, appearance and genera (*Hymenogaster* and *Hydnangium*) which have the same relative odor resembling that of witch hazel. Both are much sought after in season.

One of the remarkable facts established is that in each genus there is one species which stands out from the others in this matter of odor. It might be said that there is one species which represents the type of the genus because of its marked characteristic odor. This one species seems to be the most abundant one of the genus. The other species seem to have this character modified until the odor becomes almost negligible. Correspondingly their use by the rats decreases.

There is one fungus (genus *Hysterangium*) which seems to stand above all others in some respects in its relation to the rats and I might add, to the person collecting it. It is in appearance like a little white puffball with a tough rubbery gleba usually of a green color. Its predominant character is its exceedingly vile odor when mature. It is almost impossible to carry the plants in a collection, so offensive is this odor. Its habitat is among the leaves or slightly buried in the ground where it is easily accessible to the rodents. Where it is to be found the rats will pass by all other fungi to get it. I have seen the fragments of the white peridium scattered over considerable areas of the forest and excavations are to be found everywhere. The peridium seems to be rejected for the tough gristly interior portion. It is frequently to be noticed that many young plants are left, the rats taking only those which have fully matured.

At Guadaloupe Mines I found an exceptional location where the humus beneath the oaks had accumulated to a depth of a foot or more.

In this bed of leaves were signs of rat excavations showing the trend of a vein of mycelium of this offensive fungus. I uncovered a considerable area and secured some specimens. Along this vein I opened up another vein of mycelium belonging to another species of the same genus. This latter species is very different from the offensive one, particularly in the matter of odor. This odorless species was rejected. To the human taste there is no perceptible difference. This latter plant is larger and more attractive but not so common. Enlarging the excavation to the base of a very large rat nest I encountered still another genus (*Octaviania*) with a number of fine large plants. These were all mature but not odorous and some of them lay alongside of the offensive species. Many of them had been uncovered by the rats but all were ignored.

In many of these excavations I have found many different species of the real truffles but only once have I found one that appeared to have been eaten by a rodent and this I think had been bitten by a gopher. The truffles are all very finely flavored but apparently few of them have any perceptible odor which I think is the cause of their rejection for food. I have found in several places however a species in a genus very closely related to the truffles which has a very strong odor and was much sought for by the rats. This one (genus *Elaphomyces*) is abundant in the center of a large rat colony in the vicinity of Saratoga. In excavating for this species the rats opened up a trench exposing the mycelium for several feet at a time. This mycelium is found at a depth of four to six inches and the fungus is imbedded all through it.

In time of scarcity in the winter when a cold snap has destroyed most of the fungi the rats are frequently put to it very hard to secure the necessary food supplies. At such times they resort to the remnants of common fungi remaining above ground. Wanting these they go to extremes to satisfy their appetites. I have found half gnawed buckeyes, large galls from certain oaks, and other things within the nests. Twice this last season (1921) have I seen the thick bark of live oaks girdled by rats. They are persistent in their search for newly sprouted acorns.

All of the fungi mentioned are to be found in the collections filed in the Herbarium of the Department of Botany of the University of California at Berkeley. Acknowledgments are due to Dr. W. A. Setchell of the Department of Botany and to Mr. Tracy I. Storer of the Museum of Vertebrate Zoölogy who have been more than helpful in the preparation of this paper and in many other ways.

Berkeley, California.

Parks, Harold E. 1922. "The Genus Neotoma in the Santa Cruz Mountains." *Journal of mammalogy* 3, 241–253. https://doi.org/10.2307/1373256.

View This Item Online: https://www.biodiversitylibrary.org/item/220041
DOI: https://doi.org/10.2307/1373256
Permalink: https://www.biodiversitylibrary.org/partpdf/90567

Holding Institution
Smithsonian Libraries and Archives

Sponsored by
Biodiversity Heritage Library

Copyright & Reuse
Copyright Status: Not in copyright. The BHL knows of no copyright restrictions on this item.

This document was created from content at the **Biodiversity Heritage Library**, the world's largest open access digital library for biodiversity literature and archives. Visit BHL at https://www.biodiversitylibrary.org.

This file was generated 22 September 2023 at 05:41 UTC