NUMBER 193 APRIL 2, 1928

OCCASIONAL PAPERS OF THE MUSEUM OF ZOOLOGY

UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN PUBLISHED BY THE UNIVERSITY

MEXICAN MOLLUSKS COLLECTED FOR DR. BRYANT WALKER IN 1926, I

BY H. BURRINGTON BAKER

INTRODUCTION

This is the first of a proposed series of papers on a collection of Mexican land and freshwater mollusks made for Dr. Bryant Walker during the summer of 1926. As that season is the period of greatest rainfall in eastern Mexico, and the year was a notably wet one, the material contains very few aquatic forms.

June 17th, the writer arrived in Vera Cruz and the first week was spent in the vicinity of Córdoba, Estado Vera Cruz. From July 3rd to 31st, collections were made in the neighborhood of Necaxa, Estado Puebla. After three weeks of quiescence, enforced by sickness, I returned to Mexico City and obtained some material in the Distrito Federal and Estado Mexico and also around Córdoba. Progreso, Yucatan, was visited for a few hours on the return trip. Thus, practically all the mollusks discussed came from the eastern slope of the Anahuac plateau at altitudes over 2,000 feet.

The collections were made possible by the generosity of Dr. Bryant Walker and by letters of introduction to Messrs. Conway and Hutton, of the Mexican Light and Power Company (Companía Mexicana de Luz y Fuerza Motriz), procured by Dr. Walker from Mr. Edward D. Trowbridge. Mr. Conway took an especial interest in the work, obtained a pass on the private railroad from Carmen (the Company's terminal near Beristain) to Necaxa, and secured the hospitality of the Company's comfortable clubhouse at the last place. Mr. Oscar Proamer, the superintendent at Necaxa, gave me every facility for my work from this base, and I am especially indebted to him for his many kindnesses during my sickness.

I am also very deeply in debt to most of the officials and engineers at Necaxa, who were very helpful in advice and descriptions of the region and whose friendly visits and assistance during my illness carried me successfully through a rather trying period. I wish also to thank the Vera Cruz agents of the Ward Line and the customs officials at that port for their valuable assistance, and Mr. Antonio Luis, of the Hacienda de San Francisco, near Córdoba, for permission to visit the Cerro de las Palmas.

The trip was made under the auspices of the University of Michigan Museum of Zoology. The study and identification of the material collected were made possible by the collections and library of the Academy of Natural Sciences of Philadelphia, where Dr. Pilsbry's intimate knowledge of Mexican mollusks was a constant source of inspiration and assistance. The dissections and drawings were made in the Zoological Laboratory of the University of Pennsylvania.

Habitats

In order to obviate unnecessary repetition in the systematic discussions, the following symbols are used to denote roughly the various types of ecological environment:

A. Rocky Summits, with heavy rainfall but very rapid drainage, due to steep slopes and previous soils or substrata. Vegetation often appears somewhat xerophytic; trees small, vines and aerophytes abundant; agave and small palms often present; tree ferns commonly developed when in fog zones. Humus usually very much leached, often consisting largely of intertwined roots; with scattered deposits of decaying leaves in sheltered places. Rarely cultivated. Included in stations 3, 4, 32, 33 and 41.

B, I. Alder Forests. Alnus arguta,[1] in wet places at altitudes between 1,400 and 1,800 meters near Necaxa. Trees slender but often 25 meters in height; shade dense. Soil clayey, water-soaked; layer of decaying leaves usually thick. Included in stations 21, 31, 34, and 41. *B, II. Second Growth,* with drier soil and leaf humus; vegetation scrubby and of mixed content. Included in stations 33 and 34.

C, I. Pine and Oak Forests. See discussions of Necaxa and El Desierto de los Leónes. Included in stations 11, 12, 23, 35, 36, 37, and 51. *C. II. Second Growth,* of rapidly growing brush and tall weeds; "mala mujer" (*Urera* sp.) often present. Included in stations 22, 23, 33, 34, 35, 37, 38, and 51.

D, I. Tropical and Subtropical Jungles. Trees of varying heights and sizes, usually a few very large; floral composition very complex. Soil deeper, richer in humus; usually with well-developed layer of decaying leaves. Included in stations 1, 3, 4, 5, 6, 24, 52, 53, 54, and 55. *D. II. Second Growth,* of luxuriant thickets of rapidly-growing brush; manioc, Cecropia and "mala mujer" often present. Round-leaved, semi-climbing arums are usually present in moist situations, while heliconids form clumps in still damper places. Soil usually thinner as is also layer of rotting leaves. Coffee plantations (very poor molluscan fauna) around Córdoba also included. Parts of stations 2, 3, 4, 5, 24, 53, and 55.

E. Semidesert. The two localities visited, San Juan Teotihuacán (station 13)) and San Ignacio (station 61) are very different in appearance and molluscan fauna.

[1] I am indebted to Dr. Francis W. Pennell for this and some of the following identifications.

F, II. Cypress Woods. See station 14.

G. Rapidly-flowing Streams. Those around Necaxa appear devoid of molluscan life. Stations 7 and 8.

H. Spring. Station 42.

As indicated under certain of the habitats, an attempt is also made to differentiate between natural and artificial conditions.

I. Natural Forests. In a country where agricultural development is as ancient as that of Mexico, primeval forests are probably absent, although habitats of type A have probably always formed comparatively permanent islands of refuge. However, the term ''natural'' may be loosely applied to those forests in which the leaf humus as well as the trees themselves show no obvious signs of recent disturbance. Such forests are either climax formations or are in temporary equilibrium with their physiographic environments.

As a state of comparative equilibrium in any biotic complex means that only those forms with equal and maximum survival values have escaped elimination, climax associations are usually characterized by the relatively small number of species which compose them. Heavy depositions of leaf humus, a characteristic of well-established forests, produces a condition which, in the humid tropics, is the very antithesis of that ideal for molluscan life, although the relatively constant moisture in well-shaded areas would appear to be favorable to its development. In addition, mollusks are relatively inconspicuous members of any communty, except open forests and semi-deserts on calcareous rock, and never dominate their habitat to any marked extent. For these reasons, natural forests usually contain a few large species, in which the arboreal forms are quite conspicuous, together with a sparse and poor fauna of smaller snails.

However, the tropical and subtropical forests (type D) are remarkable for the variety in their composition, both as regards species of trees and in vegetative form. Widespread associations of a few dominant species, such as are commonly found in temperate regions, are notably absent. Life, death and decay in the tropics seem relatively rapid, and the number of competing forms render the forest development peculiarly chaotic. After a sojourn in such surroundings, even a primeval forest landscape, as developed in northern United States, gives the initial impression of a well-planned park.

This variety in the tropical forests is reflected in the mollusks which inhabit them. Although any given locality in the natural forest usually contains only a few species, another nearby area, even under similar conditions, may have developed a quite different series. For instance, during my first week's stay in Córdoba, excursions over considerable territory did not reveal a single specimen of *Leptarionta guillarmodi,* although, on the first day of my second visit, I accidentally stumbled on a "colony" where dead shells, at least, of this arboreal species were fairly frequent over a limited area.

II. Second Growth. Any disturbance, which releases an area from the comparatively static conditions of natural forest, sets in motion the dynamic forces of ecologic succession. A rapidly changing environment usually supports a more diverse fauna than does a static climax. In addition, many species appear to be practically restricted to these temporary phases in the life of an association-series.

In eastern Mexico, as in most tropical American rainforests, the usual method of clearing for cultivation is to cut and burn the smaller trees and brush. The giant trees are often left standing and the wet and deep humus is often only superficially affected by the fires. Such areas, if left to themselves for even a short time, develop a thick growth of brush and weeds; the return to "natural" conditions is of course much more rapid in the tropical regions with heavy rainfall than in the temperate and drier ones.

On account of the method of clearing, the burrowing mollusks, especially the smaller ones, and the strictly arboreal forms, like Drymaeus, are most apt to survive. Especially in or near limestone talus slopes, the thin and relatively fresh and dry layers of dead leaves, which rapidly accumulate in second growth, appear to offer ideal conditions for many of the terrestrial species, so that the fauna is often very much richer than in the older forests. In addition, the active arboreal and subarboreal species rapidly invade the young brush within their reach, and also often appear to be considerably more numerous than in undisturbed places, although this apparent increase in abundance may be partly due to the fact that the tops of the vegetation are within range of vision of the collector.

III. Combination of I and II. For practical reasons, this third symbol is used for cases where the mollusks were collected along the strand line between natural forest and second growth, or were found in both types of habitat.

In addition, the following smaller societies and strata are recognized:

a. Ground Stratum. Mollusks usually in or under layer of decaying leaves though a few species burrow more deeply.

b. Rock Faces, of cliffs and ledges.

c. Trunks, of living or dead (standing) trees; usually not more than two meters above the ground.

d. Shrub Stratum. Mollusks on leaves and stems of undergrowth during wet weather, usually less than two meters above ground.

e. Arboreal Stratum. Mollusks on leaves and branches of trees, mainly at greater heights than *d.* Practically all the species in *d,* and some of those in *e,* aestivate on the ground but climb up into the brush and trees when it is actually raining. On the other hand, it is probable that some of the smaller species usually found in *d* are able to aestivate in the epiphytic gardens of the larger trees.

Córdoba, Vera Cruz

(June 19 to 26, September 7 to 9)

The broad, roughly triangular valley, near the left side of which Córdoba (L 18° 50′, 96° 54′; altitude 827 meters or

2713 feet)[2] lies, appears to be a large outwash plain, surrounded by limestone hills. The soil of the plain itself is often reddish in color and its lower strata are cemented into conglomerates. The major portion of this valley plain is drained by the Rio Atoyac, the southernmost branch of the Rio Medellin; this stress breaks through the damming foothills near the town of Atoyac, just below which it has formed a beautiful falls and gorge (stations 1 and 7). However, the upper region of the valley is drained by the Rio Metlac, a tributary of the Rio Blanco, which forms the canyon east of Sumidero (station 6) and another which appears to rise on the sides of Mount Orizaba itself. The limestone hills east of Sumidero form the upper barrier and constitute the second steep rise on the Mexican Railroad between Vera Cruz and Mexico. Along this barrier, the valley sends a long arm northward towards Coscomatepec and Huatusco (L 19° 9′, 96° 54′). Eastward from the lower end of this arm, a broken series of higher hills forms the northern boundary of the main Córdoba Valley and seems to be composed of quite resistant and uniform limestone as the slopes are regular and even; this is apparently what earlier writers have called the Sierra de Matlaquihahuitl, although the name does not appear to be known locally at present. Between these higher hills and the valley-plain, a series of very broken foot-hills of rather uniform height are formed of complexly and weirdly eroded, soft limestone; these develop numerous sink-holes in their roughly conical valleys. The outwash valley itself is drained by numerous small creeks which have usually carved deep, steep-sided valleys, but the porous limestone of the foothills appears to entirely lack small surface streams, while one is constantly confronted by proofs of a rather extensive subterranean water system.

[2] In the following discussion, the altitudes of Atoyac, Córdoba, Fortín and Orizaba were taken from the signboards of the stations on the Mexican Railroad. All the others are simply estimates made from these data while in the field, except that of Cerro Peñuela, which is from the Carta de la Republica Mexicana á la 100000ª.

Opposite the eastern end of the town of Córdoba (i. e., north of the railroad station), the foothills form a relatively broad and low belt (Las Tortolas, station 4). East of this (i. e., towards Atoyac), they form a relatively narrower but increasingly higher zone, so that opposite Potrero (station 2), they merge into the still higher, but less rugged and more uniform slopes of the principal ridges. Northeast of the central portion of Córdoba, this belt of foothills is truncated abruptly so that the valley-plain near Hacienda Toxpam extends to the base of the Sierra de Matlaquihahuitl itself; this truncation forms a series of steep-sided, west-facing slopes, which are known as the Cerro de las Palmas (station 5).

The valley-plain around Córdoba has been cleared and planted to sugar cane, corn and coffee; the same is true of most of the regular and uniform slopes of the higher hills, and the lower regions in the foothills. However, the most rugged portions of the last, where the limestone blocks outcrop in a series of vertical faces, retain in many places their natural cover of brush and aerophytes (type A). Thus, the heavy forest with its fauna has been largely obliterated, although a few of the more inaccessible valleys of the foothills retain small pockets which give some idea of the richness of the original tree-cover of the plains (type D).

Station 1. Atoyac Gorge. Left side, just below falls; altitude about 400 to 450 meters (1300 to 1415 feet). The town of Atoyac (alt. 461 meters or 1513 feet) is on the Mexican Railroad, 20 kilometers out from Córdoba in the direction of Vera Cruz; the falls of the Rio Atoyac are a few hundred meters downstream from the town. The places studied are on the very steep, well-wooded slopes of the gorge below the falls, where outcropping ledges of limestone form numerous small cliffs with steep talus slopes below them. The layer of decaying leaves is rather scanty and well-drained, with a quite firm underlying humus. Despite the steepness of the slope, the conditions approach those of heavy lowland forests (type D, I).

Station 2. Potrero. Hills across Rio Atoyac; altitude probably between 650 and 850 meters (2150 and 2800 feet). The town of Potrero is also on the Mexican Railroad in the direction of Vera Cruz and lies 15.2 kilometers from Córdoba. As mentioned in the preliminary discussion, the hills north of Potrero extend quite high above the valley-plain, but have rather uniform slopes with little of the rugged erosion features that characterize the foothills near Córdoba. As a result, they are now almost entirely covered with coffee plantations (type D, II), although the very large cover-trees give the impression, from a distance, of heavy natural forest. Near the river iself, a lane, which leads northward into one of the valleys, is bordered by oranges, bananas and pollarded shade trees. Also, the coffee plantations in this locality appear to have been under cultivation for a long period, so that the cover-trees are enormous and support an abundance of epiphytes and vines. On this account, arboreal mollusks are quite frequent, while certain of the burrowing and rock-loving species occur sporadically, although the coffee-plants themselves and the repeatedly cleared ground beneath them support very few snails.

Station 3. Peñuela. East slope of Cerro Peñuela, between town and Rio Seco; altitude between 800 and 900 meters (2625 to 2950 feet). The town of Peñuela is 5.2 kilometers east of Córdoba on the Mexican Railroad. The lower slopes of the hill studied have been planted to coffee (type D, II); the collections come from the strand line between this and the brush that partially covers the deeply-eroded summit (type I). This station is similar to the next but is considerably drier and more disturbed; it shows the prevalence of small snails and burrowing forms which is quite typical of the edges of second growth.

Station 4. Las Tortolas. Limestone foothills about two kilometers north of eastern end of Córdoba, on opposite side of Rio Seco; altitude around 800 to 900 meters (2625 to 3000 feet). This is the region of the broad belt of quite low hills mentioned in the preliminary discussion. The lower slopes and level places near the river are mainly planted to coffee (type D, II), so that the original fauna is largely destroyed, although some of the arboreal species are exceptionally abundant in the shade-trees of the older portions. The summits and steeper slopes are very much dissected by erosion so as to form complexly carved, small cliffs and shallow caves; the humus in such places is thin and badly leached, while the vegetation consists of brush, small palms, numerous vines and aerophytes (type A). The valleys inside of the first ridges often develop into sink holes, drained by apertures a few meters across but apparently thirty or more in depth. Some of the more inaccessible of these conical depressions apparently approximate natural conditions; those which have a relatively level floor may support large, epiphyte-covered trees and form small pockets that must retain more or less the appearance of the original heavy forest of the more nearly level areas of the region (type D, I). Such pockets develop a relatively rich and firm humus, covered by a thin layer of rotting leaves.

Station 5. Cerro de las Palmas. Altitude about 850 to 950 meters (2800 to 3125 feet). The Hacienda Toxpam (or Toxpán), which figures quite prominently in the descriptions of the earlier conchologists, lies about four kilometers north and slightly east of the center of Córdoba; it is now a part of the large sugar plantation known as the Hacienda de San Francisco. The Cerro de las Palmas is simply a name applied to the region of the foothills east and north of Toxpam (i. e., along their abrupt truncation); it is not a separate ridge and is quite continuous with the Sierra de Matlaquihahuitl. However, as viewed from the valley-plain, it does present a series of west-facing slopes which run more or less at right angles to the south-facing ones of the higher ridges. All the lower slopes and even approximately level portions of the valleys and summits are now cultivated so that a large portion of the rich molluscan fauna described in the earlier works is undoubtedly exterminated. Only the steeper slopes with their maze of limestone blocks and crevices, which are exceptionally bold in this locality, remain comparatively undisturbed and retain the type of fauna that goes with these relatively barren habitats (type A). This station does not differ markedly from the steeper slopes of the preceding one, with which it is continuous; it is kept separate on account of its historic interest as the remnants of the type locality of so many of the mollusks described from the collections of Sallé.

Station 6. Sumidero. Hills southeast of town, on opposite side of canyon; altitude about 1100 meters (3400 feet). The town of Sumidero is on the Mexican Railroad 14 kilometers out of Córdoba in the direction of Orizaba (alt. 1227 meters or 4049 feet). The place mainly collected is on a quite steep, west-facing slope with heavy natural forest (type D, I) and numerous ledges and small cliffs of limestone (approaching type A). Along the creek, big ferns and sycamores are conspicuous. This locality is in the fog zone.

Station 7. Rio Atoyac. Stream in limestone gorge about two kilometers below Atoyac and one kilometer below falls; altitude about 350 meters (1150 feet). In the place collected, the small river is very swift, with rocky shores and many boulders; just below, it receives the Rio San Alejo, while outlets of several subterranean streams are also in the vicinity.

Station 8. Rio Seco. Stream at ford about two kilometers northeast of Córdoba railroad station; altitude about 800 meters (2625 feet). Just east of the town of Peñuela, two streams of almost equal size join to form a fork; the right (southern) one is known by the same name as the resultant stream, Rio Atoyac, while the left (northern) one is called the Rio Seco. The latter runs between Córdoba and the slopes of the foothills which form the northern boundary of the valley-plain. At the place where collections were made, it was a steep-valleyed, boulder-strewn, small river, that was in flood at the time studied, so the water was milky in color and only mollusks in very shallow water could be seen. The name would seem to indicate that it sometimes becomes dry.

MEXICO, DISTRITO FEDERAL

July 1; August 28 to September 5)

Mexico City (alt. 2227 meters or 7308 feet) lies near the west side of a basin which is almost completely surrounded by mountains of varying height. The almost level floor of the basin is formed by outwash and lacustrine deposits, while its rim appears largely igneous. At the altitude studied, four rather distinct types of vegetation may be recognized; these are more or less zonal in arrangement, but their development is very evidently much more affected by rainfall and humidity than by altitude or temperature. In addition it must be remembered that this valley has developed some of the oldest civilizations in America, and is largely under cultivation at present.

The lowest of these four types occurs around the large lakes of the basin and extends up into some of the stream valleys. In most places, it has been very much disturbed, but, in those where a forest is retained, the giant bald-cypresses (*Taxodium mucronatum*) are especially prominent (station 14). This is truly an edaphic formation, largely dependent on an abundance of ground water near the surface of the soil.

The second type is developed at slightly greater altitudes, but its upper limit is very irregular, as it extends high on the west-facing slopes and more exposed areas of the larger ranges and practically covers the smaller mountains even at still higher altitudes, but is largely absent from the stream valleys. Characteristically, it consists of grassy plains (Bouteloua) or prairies (bunch-grasses), with mesquite and arborescent Yuccae and Opuntiae as conspicuous features (station 13).

The third type is developed principally on the higher outwash fans of the larger ranges; in valleys and arroyos, it reaches much lower levels and may almost come in contact with the first type. Among the more prominent of the sparsely scattered trees are dwarf pines and oaks (station 12). This formation is greatly reduced by maguey and corn plantations, but, on the other hand, I suspect it has been considerably increased by the removal of the pine forests.

The fourth type in which collections were made is only developed in the larger ranges, in places where the rainfall is quite heavy. It usually consists of open pine forests or much denser ones in which Douglas spruces are prominent (station 11).

Station 11. El Desierto to La Venta. Coniferous forests between La Venta (terminal of suburban line from Tacubaya) and El Desierto de los Leónes (ruins of monastery, four kilometers away): altitudes between 2954 and 3000 meters (9700 to 9850 feet)[3]; about 20 kilometers southwest of Mexico City. Just outside of La Venta (L 19° 20′, 99° 12′), the open pine forests begin, although they extend to considerably lower altitudes in the valley of the nearby Rio Santa Borja, and in addition, appear to have been reduced considerably by man. At first, they consist mainly of *Pinus montezumae* with less numerous trees of *P. patula, P. leiophylla,* and Douglas spruce (*Pseudotsuga mucronata*). Especially along the arroyos and watercourses, they may develop rather thick but quite scrubby growths of oaks and other deciduous trees and shrubs, among which a Bossekia is quite prominent. Towards El Desierto, the Douglas spruces increase in abundance and size, until, in the high sheltered valley around the monastery, they form rather dense, wet woods with many very large trees; a juniper (*Juniperus mexicana?*) is also present but may be an artificial introduction. The valleys of the mountains near Desierto have steep slopes which in some places expose small cliffs of the underlying rock. Near La Venta, the soil is reddish, as are the outcrops, but, near the monastery, the humus is much thicker and the rocks are grayer in color. The walls of the old monastery are built of brick and cement; numerous cracks and fallen debris make admirable hiding places for land snails. The rainfall of these mountains appears to be very heavy, and fogs are frequent; the permanent residents of El Desierto, which is a National Park, informed me that snow is common in the winter and often lasts for a month at a time.

Station 12. Guajimalpa[4] to Santa Rosa. Oak brush and fields of maguey and corn, near suburban line to La Venta; altitudes between 2600 and 2800 meters (8525 to 9200 feet.) A great part of the region at the borders of the pine forests is under cultivation, but the sides of the arroyos and the valley

[3] Altitudes around Mexico City taken from the Carta de la Republica Mexicana á la 100000a.

[4] Also spelled Guajimalpam and Coaximalpán de San Pedro.

of Rio Santa Borja retain low and usually quite open growths of oak and other deciduous trees and shrubs, with a considerable intermixture of *Pinus leiophylla* in some places. The borders of the watercourses themselves often support a narrow but quite dense zone of small alders. The molluscan fauna on the ground in the more natural areas is usually very poor, but the older rosettes of maguey occasionally harbor an intermixture of native and introduced forms.

Station 13. San Juan Teotihuacán (Pirámides, Estado Mexico). High plains in the vicinity of ancient pyramids of sun and moon; altitude around 2290 meters (7510 feet). The pyramids of Teotihuacán lie in the eastern gateway to the valley of Mexico, about 60 kilometers from the city itself. Inside of the reservation, where the plains have been allowed to revert to approximately natural conditions, they support a rich growth of short grass (Bouteloua dominant), with clumps of higher perennials, which closely resembles the richer plains along the Rocky Mountain front in Colorado. Along and over the undisturbed ruins and near fences or piles of stone, rather dense growths of arborescent Opuntia, mesquite, some pipe-organ cacti and a few tree-like yuccas furnish some refuge for a sparse molluscan fauna.

Station 14. Chapultepec Park. Environs of the base of the Heights; altitude around 2270 meters (7450 feet). The more undisturbed places in the park are largely dominated by huge bald-cypresses. Around the base of the Heights, damp ledges and clumps of broad-leaf trees support a rather rich population of a few species; on a somewhat drier slope, a clump of arborescent Opuntia and organ-pipe cactus harbor a number of the larger snails.

Necaxa, Estado Puebla

(July 3 to 31)

The valley of Huachinango and Necaxa (L 20° 14′, 97° 52′; alt. 1360 meters or 4462 feet)[5] is a relatively flat-topped,

[5] Altitudes of Beristain and town to west from signboards on railroad stations; most of others from topographic surveys made by Mexican Light and Power Company.

although considerably dissected tongue of basalt, which slopes at first steeply and then gradually down from the edge of the Anahuac plateau at Beristain (L 20° 11′, 98°; alt. 2185 meters or 7170 feet) between steep hills of metamorphosed, crushed, sedimentary rocks, mainly shales (approaching slate and schist in places) and dirty limestones. At Tlalchichila (1250 meters or 4100 feet; see plate I, P), the edge of the igneous rock, with the underlying, highly-metamorphosed, sedimentary ones, form a series of cliffs and talus slopes, which drop down rapidly to the valley of Rio Necaxa[6] at Tepexic (687 meters or 2254 feet; plate I, U). Along the contact between the igneous valley-plain and the sedimentary hills on the north side, the Rio Necaxa (plate I, R) has carved its valley, now dammed (F) to form the Vaso de Necaxa (C), which is about 4½ kilometers long (alt. 1338 meters or 4390 feet). Opposite the Mesa de Necaxa (G), the river drops in two falls, Salto Chico (H) and Salto Grande (I), into a deep canyon, that in many places becomes a gorge with vertical walls. The Necaxa Power Plant (K), near the head of this canyon and at the foot of Salto Grande, is at an altitude of 894 meters (2933 feet). The Rio Tenango (O) has formed a similar valley, which is now dammed as the Vaso de Tenango (L), along the right contact, but later cuts across the basalt to empty by a series of falls into the Necaxa gorge.

Practically all the region below Beristain is in the fog zone; although the mornings are sometimes bright, even in the slightly wetter season of the summer months, the afternoons and evenings are usually taken up by a succession of fogs, showers and heavy rains. The vegetation around Necaxa shows no marked zonation, but exhibits peculiar intermixtures of tropical and temperate elements. The crests of the Anahuac plateau and of the hills, the plains of the igneous tongue, and the barer southern and eastern slopes of the valley sides, down at least to an altitude of 850 meters (2800 feet), have de-

[6] On the Carta de la Republica Mexicana á la 100000ª, this is spelled Rio Necatza, which is closer to its local pronunciation. It is a tributary of the Rio Tecolutla.

veloped an open pine forest (type C). Near Beristain, this apparently contains three species of pines, *Pinus patula,* which is by far the most prominent at the edge of the plateau, a short needled species (*P. leiophylla?*) and *P. montezumae.* Near the town of Huachinango at an altitude of about 1400 meters (4590 feet), the first and last species are present in about equal numbers, but around Necaxa, even at an altitude of 1725 meters (5650 feet), *Pinus montezumae*[7] appears to be the only pine. Burnt-over areas of this forest soon become covered with dense growths of bracken (*Pteris aquilina*) and raspberries. In slightly damper situations, the pine woods intergrade very gradually into oak groves, which consist of a number of species, some with dripping points; near the edge of the Anahuac plateau, walnuts and Crataegus are also quite prominent. In still more humid valleys, the fairly steep slopes are covered by close forests (type B, 1) of giant alders (*Alnus arguta*), which deposit a rich humus. The steepest slopes, with numerous rock outcrops, develop a mixed jungle (type A), with numerous vines, aerophytes and some small palms; this type of forest becomes dominated by tree ferns in disturbed and in especially wet places. Peculiarly enough, this mixed jungle, even at high altitudes (1725 meters), has a distinct resemblance to the brush in the truly tropical forests below the fall-line. Both above and below the falls, the principal streams usually have a border of sycamores (*Platanus* sp.) and sweet gum (Liquidambar); the last tree may form small groves under conditions apparently intermediate, as regards humidity, between the oak and alder forests.

The marked differences between the pine-oak-alder forests just below Beristain and the truly tropical jungles (type D) below Tepexic, show that differences in altitude and temperature do play a considerable role in the determination of flora (and fauna). However, the intermediate regions display such a complex of formations, almost regardless of elevation, that one is forced to conclude that such local factors as direction and amount of slope, depth of soil, and height of ground-water

[7] Possibly *P. pseudostrobus* is included in this identification.

level are the most dominant factors in control of the association. As a result, any attempt to draw strict lines of demarcation between "biotic zones" would have to be quite artificial; in any case, the wildest imagination could not make the boundary lines between such hypothetical zones even approximate the actual topographic contours of the terraine.

Considering the western slope of the Anahuac plateau as a whole, three rather vague regions may be recognized, although these are not strictly dependent on altitude, but on rainfall. These may be considered as: 1) the tropical and subtropical, below the fog zone, 2) the region of frequent fog and 3) the portions above the zone of greatest humidity. The fog zone becomes increasingly higher in position towards the west, so that at Beristain its upper limit practically coincides with the edge of the plateau, while at Necaxa its lower limit is below the fall line. However, its width and altitude are so largely dependent on direction and amount of slope that no fixed limits can be given.

This variability in the altitudinal location of the zone of heavy rainfall is even more clearly seen as one travels west of Beristain on the Hidalgo Railroad. Near the edge of the plateau, the dense and damp, pine and alder forests of the higher slopes soon change into open, park-like woods, which appear from the car window to consist largely of some short-needled species (*Pinus leiophylla?*). This open type of forest goes high up (at least to 2500 meters or 8200 feet, 14 kilometers from Beristain) on the east-facing slopes of the first series of rounded hills, but it is possible that a more mesophytic forest again occupies their summits. Quite high on the west-facing slopes of this same ridge-complex, and in the valley around Ventoquipa (2220 meters or 7284 feet; 34 kilometers from Beristain) and Tulancingo, the facies of the vegetation approaches that of a grassy semidesert, with arborescent Opuntia a prominent feature of the landscape; in other words, the "Lower Austral" occurs at considerably higher altitudes than either the "Upper Austral" or "Transition" zones! Still farther east, on the west-facing slopes of the next series of hills, the zonation repeats itself to a certain extent, with a region of scrubby oaks and juniper around Los Romeros (2355 meters or 7725 feet; 43 kilometers from Beristain), and one dominated again by short-needled pines at San Joaquin (2467 meters or 8094 feet; 57 kilometers from Beristain) and Somorriel (2600 meters or 8530 feet; 61 kilometers from Beristain).

While certain more or less variable effects of altitude are also visible in the distribution of the mollusks, the main factor in their abundance within the humid zone appears to be the relative degree of acidity and alkalinity of the soil. Thus, the basaltic outcrops are very much less favorable then those of dirty limestone or even shale. In a similar manner, the pine forests have a very decidedly poorer snail fauna than do the broad-leaved woods. Also, the places with a deep, damp layer of rotten and mouldy leaf-humus, as for instance those in the vicinity of tree-ferns, are almost completely without terrestrial mollusks of any kind. The most favorable locations in the natural forest appear to be the strandlines of talus between the mixed jungle of steep slopes (type A) and the almost pure alder-forest (type B, I) or tropical jungle (type D, I). However, the richest localities, especially as regards the smaller species, are the second-growth thickets over limestone talus slopes (types B, II and D. II).

The stations in the vicinity of Necaxa may be divided into four groups: 1) those on igneous rocks and reddish soil between Beristain and Tlalchichila (stations 21 to 24); 2) those on the hills of metamorphosed sedimentary rocks to the left of Rio Necaxa (stations 31 to 38); 3) those on similar hills to the right of Rio Tenango (stations 41 and 42); and 4) those on very highly metamorphosed, sedimentary rocks below the fall-line, that is, in the canyons which have been excavated through the igneous cap (stations 51 to 55).

Station 21. Kilometer 13. Valley in pine country five kilometers out from Huachinango on the company railroad to Carmen (Beristain); altitude about 1575 meters (5175 feet).

This valley has a very wet alder forest (type B, I) with some tree ferns along the brook. The deep rotten humus is very barren collecting, and the scanty molluscan fauna is mainly on the barer portions of the moss-grown tree-trunks, up to about five feet above the ground.

Station 22. Huachinango. Introduced slugs from the gardens in town; altitude about 1400 meters (4590 feet); 8 kilometers from Necaxa.

Station 23. Mesa de Necaxa (plate I). Wet basalt cliffs on south side of mesa; altitude around 1300 meters (4265 feet). These cliffs are partly natural and partly railroad cuts; the steep slopes are mainly covered with small oak trees. The collections were made during rainstorms. Under this station are also included a number of specimens of *Practicolella ampla,* which were obtained during wet weather from the cement curbing along the lawns of the mesa itself (alt. 1360 meters or 4462 feet).

Station 24. Salto Chico. Short gorge between upper and lower falls at Necaxa; altitude around 1160 meters (3800 feet). The humidity of this gorge is very oppressive, as seepage water from the cliffs is abundant and the steep sides cut off the breeze. A sparse molluscan fauna occurs in leaf humus near the creek (seepage water in channel of dammed river) and on heliconoids, which form dense thickets at the base of the steep talus slopes (type D, III).

Station 31. West Twin Peak. Steep southwest slope with alder and oak; altitude about 1650 meters (5400 feet). Just northwest of the Mesa de Necaxa, across the north overflow of the Necaxa storage-basin, the range which forms the north boundary of the valley culminates (1725 meters or 5650 feet) in two peaklets with a slight saddle between them; these are called here Twin Peaks, as I was unable to learn any local name. Although the major portion of the higher, south-facing slopes is covered by pine forest, patches of alders (type B, I) and oaks, the leaves of which develop dripping points, are developed at altitudes where fog is very prevalent.

Station 32. Ridge East of Twin Peaks. Steep, east-facing slopes about a kilometer northeast of Twin Peaks; altitudes between 1600 and 1650 meters (5250 and 5400 feet). These slopes of the ridge, which is somewhat lower than the Twin Peaks, develop rich alder forests (type B) which intergrade into mixed jungles (type A) with numerous tree ferns on the steeper slopes. Elderberries and raspberries are conspicuous in disturbed places. The leaf humus is thin but very little rock is actually exposed.

Station 33. Twin Peak Valley. Steep valley down from saddle; altitudes between 1500 and 1675 meters (4925 and 5500 feet). This station includes a patch of moss-covered second-growth oaks and brush (type A, B, II) along limestone ledges at the lowest altitudes, and two rocky areas of natural mixed forest (type A) on the steep east-facing slope at higher levels. The small shells are mainly from the second growth, while the larger species occur in the natural forest.

Station 34. Valley East of Twin Peaks. Steep, east-facing slopes along valley about one kilometer east of Twin Peaks; altitudes around 1525 meters (5000 feet). This station includes a number of barren-looking ledges with scrubby second-growth brush (type B, II) along the trail which leads obliquely up and over the ridge, and also a patch of natural forest, which quite largely consists of alders (type B, I) but intergrades with mixed forest (type A) in very steep places. Small shells are remarkably abundant at the bases of the limestone ledges in the second growth.

Station 35. Old Canal. Along south slope of West Twin Peak, at an altitude of about 1500 meters (4925 feet). In the early development of the water power of the region, a canal about two meters wide by the same deep was constructed along the side of the Twin Peaks Range. In the region studied, a stretch about 1½ kilometers long, the inland wall of the ditch is usually natural rock, shales and dirty limestone, while the outer wall is built of limestone blocks and lined with cement. The steep adjacent slopes are largely covered by open pine forest mixed with patches of oaks (type C, I). The unused and partially ruined canal has become choked with brush and giant weeds, among them "mala mujer," which have deposited a thick carpet of humus (type C, II). A coarse, glaucous grass, which is very characteristic of the rocky slopes in the pine country, covers the inland wall of the canal. This station appears to present a concentration of the molluscan fauna which occurs much more sparsely in the clumps of oaks and even in the pine forest itself. Snails are quite abundant among the roots of the bunch-grass, in the debris of the ditch itself, on weeds, and on the cement outer wall.

Station 36. Limestone Talus. Easternmost hill of Twin Peaks range; altitudes around 1400 meters (4600 feet). About three kilometers northeast of Twin Peaks, the range terminates rather abruptly in a very steep-sided hill with escarpments along its east side. The south-facing slopes are covered with enormous blocks of dirty limestone and develop a sparse pine woods (type C, I). Between the pines are a few moss-covered oaks, while more extensive areas among the rocks mainly support mosses and liverworts, orchids and other aerophytes, the stout, glaucous bunch-grass mentioned above, and numerous rosettes of agave. The mollusks occur largely in the scanty leaf humus under the oaks, on and under the rocks, and around the bases of the agave plants.

Station 37. Oak Valley. Altitude around 1375 meters (4500 feet). This station includes a small patch of oak brush and vines at the base of shale cliffs in a small valley west of Twin Peaks. Most of the surrounding country is pine forest.

Station 38. Miguel Road. Altitude about 1350 meters (4430 feet). A well-trodden but very rocky road runs along the left side of the Vaso de Necaxa to the town of Miguel (plate I, B) near the head of the reservoir. Most of the uncleared slopes bear pine forests, but the valleys usually develop oak woods (type C, I). The places collected include a section of damp, shale cliffs, topped by an oak grove, along a brook near Miguel, and the similar escarpments nearer Necaxa, where the vegetation principally consists of the glaucous pine-grass and agave (type C, II). Collections were made in the latter region during rainstorms.

Station 41. Tenango Hills. Northern slopes of heavily wooded hills, three kilometers south of Necaxa and on opposite side of Vaso de Tenango (plate I, L); altitudes collected between 1400 and 1450 meters (4600 and 4750 feet). These steep-sided hills appear to be largely composed of dirty, metamorphosed limestone. The lower slopes are mainly covered by a forest that almost entirely consists of giant alders (type B), and appears to have been grazed recently, as the humus is usually bare and the sparse underbrush consists largely of plants which appear in disturbed situations, among them the notorious Urera. The steeper upper slopes expose numerous, precipitous ledges of rock and have developed a mixed forest with numerous vines and hanging roots of epiphytes (type A). At the strand lines between these two types of forest, a thin layer of decaying leaves covers the clayey soil, which is so highly impregnated with water that it makes a very precarious foothold. In places, considerable areas are covered with a low, succulent plant with leaves like a begonia. The mollusks are most abundant at this strand line, both under the dead leaves and on the trunks and leaves of trees. This station is one of the largest and richest patches of natural forest in the region studied.

Station 42. Tenango Spring. Near shore of Vaso de Tenango; altitude about 1350 meters (4430 feet). Near the lower limit of the forest in station 41, a natural spring has been enclosed by cement to form a watering trough. This artificial pool swarms with specimens of Physa, the only freshwater snail found near Necaxa. The main streams of the region are constantly in flood during the summer and the water of the reservoirs themselves is opaque from the quantities of sediment in suspension. However, the smaller streams are often clear, but I could find no trace of molluscan life although caddis-fly larvae were quite abundant. The erosion in most of these streams is very violent, and a single arroyo may build up an outwash fan of hundreds of tons of rock, including remarkably large boulders, during a few rainstorms. According to residents, freshwater shells are present in the Rio Necaxa at a rapids about two kilometers below Tepexic, but I was unable to visit this locality.

Station 51. Pine Slopes near Salto Grande. Right side of canyon of Rio Necaxa, just above intake gorge; altitudes between 900 and 1000 meters (2950 to 3300 feet). The west-facing slopes of the canyon below Salto Grande form series of steep, slaty-shale, talus fans, with a sparse growth of pines. A number of stream valleys develop a thick brush of broad-leaved shrubs and trees, while the crests of some of the fans have patches of oak woods, in which the sparse molluscan fauna was mainly found. All of these slopes easily develop land slides; one of these wiped out the oak woods in which I had collected about a week earlier, and temporarily dammed the Rio Necaxa itself with a mass of large boulders and clay, that formed a rampart about 12 feet high.

Station 52. Hidden Valley. Natural jungle on left side of same canyon; altitude around 950 meters (3120 feet). This station consists of a little patch of natural forest (type D, I) on steep, southeast-facing slopes in a little valley some distance back from the river. Numerous small streams cascade down over the limestone ledges, while the intermediate regions are covered with open forest that includes a few large, ceiba-like trees with extensive buttress systems. The shells mainly occur in the thin layer of decaying leaves and on the undersides of the large, subcircular leaves of a semiclimbing arum.

Station 53. Limestone Cliffs and Talus. Near the left side of Rio Necaxa above the intake gorge; altitude from 900 to 925 meters (around 3000 feet). This station includes a number of rich second-growth localities which are little above the level of the river itself. The one principally studied is on a steep talus-slope at the base of a cliff that attains a height of about 75 feet. At the east edge of this cliff, a swift brook, with numerous small falls, keeps the surrounding areas quite moist. The lower talus slopes are covered with thick, second-growth brush (D, II), which includes manioc, Cecropia and some "mala mujer." The upper slopes on the opposite side of the brook from the cliffs preserve more natural conditions (D, I). The large-leaved, semiclimbing arums are very numerous.

Station 54. Below Intake Gorge. Talus slopes and ledges on left side of Rio Necaxa; altitude about 800 meters (2625 feet). About a kilometer below Salto Grande (plate I, I), the Rio Necaxa passes through a very steep-sided and narrow gorge composed of slatelike shales and very hard, dirty limestone. Below this, the canyon widens out a little and the banks of the river are formed by old rock slides, which have developed a low forest with a few large trees. The immediate vicinity of the stream has a border of sycamores which appear to attain a height of almost 150 feet. The semiclimbing arum is also conspicuous in this place.

Station 55. Tepexic. Talus slopes and ledges on right side of Rio Necaxa below Tepexic Plant (plate I, U); altitude about 675 meters (2215 feet). This station is in the deep canyon of the Rio Necaxa below its junction with Rios Tenango and Nexapa, and is the most tropical of any of the habitats studied around Necaxa. The place collected consists of steep talus slopes with numerous ledges of calcareous shale, which higher up form bold cliffs. Both second growth (type D, II) and what appears to be natural jungle (type D, I) are present. Two brooks add to the humidity, especially since one of them has a fall about 100 feet high which spreads considerable mist over the adjacent vegetation.

PROGRESO, ESTADO YUCATAN

Station 61. San Ignacio. Semidesert about 10 kilometers south of Progreso (L 21° 17′, 89° 38′); altitude probably about three meters (10 feet). The town of Progreso is built on a long bar of coral sand, behind which lies a stretch of brackish swamps and lagoons, some deep, others very shallow and only filled during rains. Inside of this swamp area, the coral limestone plain rises almost imperceptibly; the sisal plantations begin near San Ignacio, the first stop on the railroad between Progreso and Merida. This plain is quite densely covered with a low thorn-forest, in which mimosae, sisal, arborescent and lower Opuntiae and various cacti with elongate, angular stems are quite noticeable. The region is remarkably like some of the coastal plains of the Dutch West Indies (H. B. B.; 1924, this series, no. 152, pl. vi, fig. 16), but the rock surface appears even drier, while the abundant vegetation shows the greater availability of ground water. Dead shells are very abundant under rocks, but living animals are remarkably difficult to find.

PART I. TERRESTRIAL OPERCULATES

HELICINIDAE

Although it has been recognized for some time that the shells in this family exhibit some degree of sexual dimorphism, very few accurate data have been published. For this reason, the following tables of dimensions mainly include only those specimens of which the sex could be determined, although the much larger remainder of each lot has assisted in the comparative remarks. The data show that the sexes of Helicinidae intergrade considerably in size and shape of shell, but that, as a rule, the whorls of the males increase more rapidly in diameter than do those of the females. Usually the male shells develop ¼ to ½ whorl less than do the females; when this is true, the former are smaller and more depressed than the latter (cf. *Helicina zephyrina*). However, in some species, the males and females have on the average an equal number of whorls, and in these cases the former are as large and high or larger and higher than the latter (cf. *Schasicheila misantlensis*).

Helicina (*Oligyra*) *delicatula* Shuttleworth

Type locality: Córdoba, V. C. AD, I, ad, 1, 3, 4, 5; Atoyac to Córdoba, 1300 to 3125 feet; mainly in habitats of type A, climbing up to about 10 feet in low brush during wet weather.

From the appearance of the shells, the males probably average smaller and more depressed than the females, but the male and female dissected are both near the means of their lots. Some of the shells are white with a greenish-yellow or reddish apex, but most of them have also a wide reddish band just above the periphery, which leaves a narrow, white

Dimensions[8]

	altitude	major diam.	minor diam.	whorls
H. delicatula Sh.	5 (?)	(7.5)	(6)	5
Station, 3 means:				
1 male	6.2	126 (7.8)	106 (6.6)	4 ¾
5 shells	6.3	127 (8.0)	113 (7.1)	4.6
Station 4, means:				
1 female	6.7	122 (8.2)	112 (7.5)	4 ¾
6 shells	6.6	125 (8.3)	110 (7.3)	4.7

one just below the suture. In a few, the lower limits of this band are much brighter, so as to form a narrow circlet of stronger color. The juvenile shells are angulate and in some of the adults even the last whorl is subangulate.

Animal: foot large; tenacles dark and long; eyes black. Lung: pebbled internally by venation, much as in typical species of Oligyra. Female genitalia (fig. ii-2): similar to those of *H. orbiculata* (1926, Proc. Acad. Nat. Sci. Philadelphia, 78, p. 39, figs. v, 1–3); ventral bursa with simple transverse branches; provaginal sac smaller; hypobranchial opening at about 1/3 length of uterus; terminal 1/7 of last brownish, remained with marked transverse constrictions. Male genitalia (fig. iii-12): also similar to those in type species of Oligyra (*l. c.*, fig. 4); first prostatic chamber about ½ length of secondary gonaduct; caecum short and basally swollen; tip of accessory prostate falls short of that of secondary gonaduct. Radula (table 1, fig. iv–25): similar to that of *H. orbiculata* (1922, P. A. N. S. Philadelphia, 74, pp. 42, 44, figs. iii–2, iv–11), but rhachidian central with markedly attenuate base, and comb-literal with blunter cusps.

The living animals of Helicina are almost as active as are the species of arboreal and semiarboreal pulmonates associated with them. The tentacles are conspicuous and almost constantly in motion. The large sole is functionally tripartite

[8] In the following statistical tables, the word dimensions will indicate that these same four measurements are given, and the subheadings will be omitted. For complete explanation of dimensions, see: 1924, this series no. 152, p. 34, footnote 33.

Table I. Radular Formulae in Helicinidae[9]

	Centrals			Lateral	Marginals				Rows
	A	B	C	D	2	3	4	Total	
H. delicatula	4–5	6–7	4	6		4	7	92	72
H. fragilis elata	2–3	6	4	8–9		8	6	91	74
H. succincta	4	6–7	4	8–9			5–6	60	83
S. minuscula	5	6–7	4	6			4	58	87
S. alata	3	4	4	6		6	4	68	87
S. fragilis	3–4	4	4	7		6	4	53	69
S. nicoleti	3	4	4	5–6	3	7	5	78	76
P. microdinus abditus	3	3	4	8	3	1	1	15	74

(cf. 1926, fig. viii–29); locomotion seems to be mainly accomplished by the broad and firm, central zone, which develops definite and numerous pedal waves, that move from the anterior towards the posterior end of the area, instead of forward (direct) as in most terrestrial pulmonates. The narrower and more flabby, lateral regions either slide over the substratum or exhibit uneven and coarse constrictions and expansions.

When, in a former paper (1922, p. 50), I regarded *H. notata* as a variety of *H. delicatula* and included both in the section Tenuis, I had only seen the specimens of the first species in the collections of the Academy of Natural Science of Philadelphia. *H. notata* is a distinct species and may belong in Tenuis, while *H. delicatula* appears to be a quite typical Oligyra.

Helicina (Succincta) fragilis elata Shuttleworth

H. elata Sh. (1852, Bern. Mit., 304), Córdoba, V. C. *H. mohriana* Pfr. (1861, Mal. Bl. 8, p. 172), Orizaba, V. C.

AD. III, bd, 1–6; Atoyac to Sumidero, 1300 to 3400 feet, all living specimens on rock ledges, weeds and lower brush, although they probably aestivate on the ground. Animal active, with remarkably long tentacles for its size.

[9] The first four columns give the number of cusps on the A, B, C and D plates; the next three, the number marginals on each side with 2, 3 and 4 cusps, respectively; the next to last column, the total number of marginals on each side; and the last, the number of transverse rows.

Dimensions

H. elata Sh.	5	90 (4.5)		5
H. mohriana Pfr.	4.5	111 (5)	104 (4.7)	5¼
Station 2:				
Means, 2 males	5.3	98 (5.2)	86 (4.6)	5¼
Station 4:				
One female	5.9	92 (5.4)	83 (4.9)	5¼
Station 5:				
Means, 2 females	5.4	100 (5.4)	93 (5.0)	5
Station 6:				
One female	5.1	102 (5.2)	94 (4.8)	4¾

Although the numbers are too small to be conclusive, the females are apparently larger than the males and increase in size and number of whorls at the lower altitudes. The name *elata* is here used for the smaller subspecies around Córdoba, while typical *fragilis,* from Guatemala, with the synonym *H. merdigera* Pfr., from Vera Cruz, appears to be the larger, lowland and southern form. All my specimens are unicolor, but include examples of both the yellowish and fulvous color-forms which appear in so many Helicinidae.

Animal: snout relatively large, expanded terminally into transversely oval disc; head and dorsum of foot grayish; remainder white. Intestine: as in Oligyra but midgut proper more slender towards constriction between it and hindgut. Lung: grayish in color; venation weak. Female genitalia (fig. ii–8): accessory sperm sac elongate; ventral bursa with prominent branches which radiate from its distal end; provaginal sac small, cream-colored, with long, gray stalk; reception chamber subspherical, quite large, grayish in color; uterus markedly constricted transversely and with an irregular, but prominent, longitudinal sulcus on ventral side, anterior 1/5 to ¼ brownish; hypobranchial orifice at about 1/3 length of uterus; cloaca spacious, with longitudinal, grayish lips. Radula (table I): similar to that in the group, but A-central with relatively inconspicuous cusps.

Helicina (Succincta) flavida strebeli Pfeiffer

Type locality: Mirador, V. C. (L 18° 59′, 96° 14′.) AD, 111, d, 54, 55; near Necaxa, 2215 to 2625 feet; similar in habits to *H. fragilis elata*.

Dimensions

H. strebeli Pfr.	4.5	111 (5)	104 (4.7)	5 ½
Station 54, means:				
3 males	4.7	108 (5.1)	95 (4.3)	4.6
3 females	5.4	105 (5.6)	92 (5.0)	5
Station 55, means:				
3 males	4.8	104 (5.0)	95 (4.6)	4.5
4 females	6.0	98 (5.9)	89 (5.3)	5
Extremes:				
6 males..........	4.4–5.2	104–111 (4.8–5.4)	92–98 (4.3–4.9)	4 ¼–4 ¾
7 females	5.2–6.1	95–110 (5.5–6.2)	84–94 (4.8–5.6)	4 ¾–5 ¼

The males are distinctly smaller and have a lesser number of whorls than the females. This small subspecies with less marked spiral striations intergrades slightly with typical *flavida*, but mainly occurs at lower levels around Necaxa, where it is quite common. It is a heavier and more solid shell than *H. fragilis*, which lacks the spiral striations and which, with a thinner peristome, shows more distinctly the columellar angulation of the group. My shells are almost all without bands, but the apex is commonly rufous and both yellowish and brownish color-forms are represented.

Helicina (*Succincta*) *flavida flavida* Menke

Type locality: Jamaica (*sic*); my station 36, near Necaxa, Puebla, now chosen (Menke actually had other species from the vicinity of the nearby Papantla). ABCD, III, abd, 33, 35–38, 52, 53; near Necaxa, 3000 to 5500 feet; living individuals infrequent in the pine country, aestivating at the bases of the glaucous bunch-grasses (see introduction) and agave along cliffs and ledges, but climbing up on both of these and on the lower vegetation during wet weather; approaching *strebeli* in habits and frequence, as well as form, at stations 52 and 53.

As will be noted from the dimensions given, almost all of the specimens of this subspecies are readily separable from those of the smaller *strebeli*, if one compares males with males and females with females. In addition, practically all the shells from the pine country and the higher altitudes have a narrow,

Dimensions

H. flavida Mke.	6.7	100 (6.7)		
Stations 35, 37:				
Means, 3 males	5.4	107 (5.8)	95 (5.2)	4.8
Station 36:				
Mean, 2 males	6.3	104 (6.5)	91 (5.7)	5.1
One female....	7.2	100 (7.2)	93 (6.7)	5.5
Station 52:				
Means, 2 females	6.1	107 (6.5)	97 (5.9)	4.9
Station 53:				
One male	5.4	104 (5.6)	94 (5.1)	4.8
Means, 3 females	6.3	99 (6.3)	90 (5.7)	5.1
Extremes:				
6 males	5.4–6.7	101–111 (5.6–6.8)	88–96 (5.1–5.9)	4 ¾–5 ¼
6 females	6.0–7.2	98–111 (5.9–7.2)	87–98 (5.3–6.7)	4 ¾–5 ½

or rarely wide, reddish, spiral band just above the periphery, and the ground color as well may be distinctly tinged with rufous. However, a few of those from station 36 and more from stations 52 and 53 are unicolor like my specimens of *strebeli.* The largest females approach in size the smallest shells of *H. succincta,* but that species is readily distinguished wherever it occurs with *H. flavida.*

Female genitalia (fig. ii–7): similar to those of *H. succincta* (fig. ii–4), but all connective tissue very dark; ventral bursa somewhat more elaborately lobed and black in color, as are also reception chamber and provaginal sac; V-organ dark gray with lighter pedicel; accessory sperm sac ellipsoid, with small but prominent lobules; uterus mainly cream-colored, with simple transverse wrinkles; cloaca spacious.

Helicina (Succincta) succincta Martens

Type locality: Córdoba, V. C., probably at higher altitudes than those collected by me. ABCD, III, bde, 24, 33–35, 37, 38, 41, 52, 53; around Necaxa, 3000 to 5500 feet; usually solitary, climbing up on brush to about 10 feet above ground.

Dimensions

H. succincta Mart.	8.5	106 (9)	88 (7.5)	5
	10	100 (10)	90 (9)	5
Necaxa:				
St. 34, 1 female	9.2	98 (9.0)	91 (8.4)	5 ½
St. 35, 1 female	9.9	100 (9.9)	92 (9.1)	5 ½
St. 37, 1 female	8.8	106 (9.3)	93 (8.2)	5 ¼
St. 41, 1 female	8.4	105 (8.3)	93 (7.8)	5
St. 24, 1 female	7.8	106 (8.9)	95 (7.4)	5 ¼
St. 52, 1 male	7.8	109 (8.5)	97 (7.6)	5
St. 53, 1 male	8.9	100 (8.9)	88 (7.8)	5 ¼
Means:				
5 females	8.8	103 (9.0)	93 (8.0)	5.3
2 males	8.3	104 (8.7)	92 (7.7)	5.1

Animal: with less black pigment than in *H. flavida.* Female genitalia (fig. ii–3, 4): accessory sperm sac especially large, with three coarse lobes; ventral bursa relatively simple, bifurcate distally; provaginal sac small, flattened lanceolate; uterus simply constricted transversely, anterior 1/5 to ¼ brownish; hypobranchial orifice at 1/3 length of uterus. Male genitalia (fig. iii–13): first prostatic chamber about 2/5 length of secondary gonaduct, with apex beyond that of accessory prostate; caecum short and quite stout. Radula (table I, fig. iv–26): as in group.

In both Oligyra and Succincta, the base of the comb-lateral (fig. iv–26) has an oblique lamella which extends up over the back of the D-plate in the next transverse row. The D and E laterals appear to be cemented together by a deposit between this lamella, the body of the corresponding E plate and the backs of those in the next transverse row. This gives the appearance of the "wing" which I originally (1922) described as characteristic of these groups. As I have already indicated (1926, p. 41), the lamella in Oligyra is more obsolete than that in Succincta. Those of my previous figures (1922, figs. iv–10, 11, v–23, 24, 25) which show the D and E plates evenly separated are of course artificial and partially incorrect conceptions; actually the D and E plates break on separation in Oligyra and Succincta, although they often pull apart easily enough in some species of Helicina.

Helicina (*Oxyrhombus*) *cinctella* Shuttleworth

Type locality: Córdoba, V. C. AD, I, abcde, 6; Sumidero, around 3400 feet; frequent, similar in habits to *H. zephyrina*.

Dimensions

H. cinctella							
Sh.	8	137	(11)	119	(9.5)	5 ½
St. 6, 5 females:						
Means	9.2	131	(12.0)	114	10.4)	5 3/20
Extremes.	8.7–9.6	119–139	(11.1–12.7)	105–121	(9.8–10.7)	5–5 ¼

The single male dissected is not quite so small as the smallest female. Some of the shells are uniformly white, while the base and a narrow band above the carina is always light in color; the ground color varies from white to bright yellowish. Above the periphery, most specimens develop a band of chestnut or darker color; this may be sharply or vaguely limited apically and in one shell extends to the suture.

Animal: foot large as in *H. zephyrina*; tentacles long and grayish in color; dorsum of foot and top of head behind tentacles grayish. Female genitalia (fig. ii–5): V-organ as in *H. concentrica* (1926, p. 42, vi–10, 11); ventral bursa similar to that in Oligyra but transverse branches more complexly lobate; provaginal sac flattened lanceolate, weakly lobed; uterus long, mainly cream-colored, simply constricted transversely, anteriorly 1/6 brownish; hypobranchial orifice at 1/3 length of uterus; cloaca as in *H. concentrica*. [These genitalia are evidently intermediate between those of Oligyra and those of *H. concentrica* although the complexity of the ventral bursa distinctly approaches that in Tristramia as well.] Male genitalia (fig. iii–14): first prostatic chamber a little less than half length of secondary gonaduct, the tip of which extends slightly beyond that of accessory prostate; caecum short; male orifice continued by a groove between two folds on mantle wall.

Helicina (*Tristramia*) *zephyrina zephyrina* Duclos

Type locality: Vera Cruz (Sallé). AD, III, abcde, 1–5; Atoyac to Córdoba, 1300 to 3125 feet; the most abundant and active Helicinid around Córdoba; climbs high into the trees although, on account of its operculum, it appears unable to attach itself there during dry periods, as do the arboreal pulmonates.

Dimensions

Station 2:							
7 males.	11.7	116	(13.6)	98	(11.5)	5.4
8 females	13.1	108	(14.0)	93	(12.3)	5.8
Station 4:						
7 males.	11.5	117	(13.5)	100	(11.4)	5.3
11 females	12.8	109	(14.0)	95	(12.1)	5.7
Extremes:						
14 males.	11.3–12.0	112–121	(12.8–13.9)	94–105	(10.7–11.9)	5–5 ½
18 females.	12.4–14.4	99–117	(12.3–15.0)	87–99	(11.2–12.7)	5 ½–6

The males with a lesser number of whorls average smaller, more depressed and more nearly subangulate than do the females. Both sexes show a slight decrease in size at the higher altitude, and the species appears to be replaced by *H. cinctella* at Sumidero. A number of the females from Potrero (station 2) represent the form *elatior*; in the above statistics, it will be noted that the range of variation in major diameter index is 9 per cent for the males and 19 for the females. The color variation is much as in the larger series from southern Vera Cruz (1922, this series, no. 106, p. 34).

Foot: very large when fully extended, acuminate posteriad as in most species of Helicina. Female genitalia (fig. ii–6): much as in *H. funcki* (1926, p. 42, fig. v–8); accessory sperm sac larger, with a dorsal lobe; ventral bursa with complex branches radiating from its very base; provaginal sac relatively smaller and simpler; uterus appearing longer as specimen is more extended.

Lucidella (*Poenia*) *lirata* (Pfeiffer)

Type locality: Yucatan. D, I, a, 1; Atoyac, 1300–1475 feet; infrequent, on ground under dead leaves. The single female dissected was larger than either of the males examined.

	Shell altitude	Shell major diam.	Aperture altitude	Aperture diam.	Whorls
Male shell	2.90	139 (4.02)	56 (1.61)	116 (1.87)	4 ¾

Animal: snout small but long, oral disc transversely oval, deeply bifid; sides of foot grayish; tentacles medium in length, almost black in color. Lung: scarcely pigmented; venation weak. Female genitalia (figs. ii, 9–11): V-organ whitish, with prominent, ovoid protuberance to left of its apex (cf. *Lucidella aureola;* 1926, p 47, fig. vii–19); accessory sperm sac not certainly recognized, as it was broken away on removal of provaginal sac, but believed to be a small, bilobed sac imbedded in latter, with a short, stout stalk as in *L. aureola;* reception chamber short, lobate, with a 4-lobed protuberance at position of provaginal chamber; ventral bursa flattened ellipsoid with a few weak lobes; provaginal sac flattened, deeply lobed on left side (as in *L. aureola*), with a stout stalk of medium length; uterus coarsely lobed, anterior 2/5 brownish, remainder light cream-colored; hypobranchial orifice very near apex of uterus; cloaca very large with relatively small opening.

Schasicheila (*Necaxa*) *minuscula* (Pfeiffer)

Helicina minuscula Pfr. (1859, P. Z. S., 29), *Schasichila minima* "Pfr." S. & P. (1880, IV, p. 98, fig. iii–6), Misantla, V. C. (L 19° 56′, 97° 44′; 410 meters). *S. minuscula* F. & C. (1893, II, p. 452, fig. liv–7).

Type locality (now chosen): Misantla, V. C. ABCD, III, a, 24, 35, 37, 41, 51, 54; around Necaxa, 2625 to 4925 feet; quite rare, under dead leaves, usually near bases of rock ledges. Material in Academy of Natural Sciences of Philadelphia (A. N. S. P. no. 45639), from Chamá, Guatemala (Hinkley).

	Shell		Aperture		Whorls
S. minuscula (Pfr.)......	3 (?)	(4.5)			4
S. minima (S & P), fig.	5.5	115 (6.3)	58 (3.2)	100 (3.2)	
Necaxa shells:					
St. 37, male	4.56	129 (5.87)	65 (2.95)	104 (3.06)	3 ¾
St. 51, male	4.76	119 (5.66)	61 (2.90)	101 (2.93)	3 ¾
St. 41, female (?)........	5.59	121 (6.74)	61 (3.42)	103 (3.52)	4

The original description of *S. minuscula* is rather vague, but Strebel and Pfeffer had access to much of Pfeiffer's material and their *S. minima* is very probably a misspelling of *minuscula* as they refer to Pfeiffer as the authority. When, in 1922, I stated that *S. minima* was unidentifiable, I had not seen fresh material of this species; Strebel and Pfeffer's figures show quite clearly the knobby appearance which is a characteristic of unworn examples of the present species (see below).

The males are smaller than the single female dissected. The superior process of the operculum (S. & P. give an inner view) is narrower and more pointed but about equal in length to the broad, rounded, inferior process, which is hollowed out on the inside. The horny operculum projects even more beyond the columellar edge of the calcareous plate than in *S. fragilis* (figs. v–30, 31). The parietal angle of the peristome is much more shallowly and broadly emarginate than in any other species of the genus. Fresh shells are bright rufous in color but fade to a light brown.

All of the species of Schasicheila are characterized by the marked development of cuticular structures, which give fresh, and especially young shells a very peculiar appearance. Unfortunately, these epidermal outgrowths are largely worn away from even the older living specimens, so that their analysis has usually been omitted from the description of the various species. The underlying growth wrinkles, which are evident even in bleached shells, are quite regular and appear to be almost uniform throughout the genus; they are prominently developed on the amber-colored, embryonic shell itself.

Fundamentally, the cuticular ornamenation consists of numerous, spiral ridgelets or rows of hair-like projections. Most of these are low and minute, but five principal series may be much more pronounced. The most prominent of these circles the periphery of the shell and consists either of one to a few rows of very high, fluted flanges, which become broken into fringes in dried shells (cf. S. & P.; 1880, IV, fig. ii–10), or of series of long, hair-like processes (my fig. v–32). Even in worn specimens, this peripheral series is often preserved on the penultimate whorl, over the suture between it and the last whorl. In addition, four other similar but usually lower circlets may be developed: one almost halfway between the periphery and the upper suture, the other three on the basal side (cf. Strebel; 1873, I, fig. iv–7).

The following key to all of the known species of Schasicheila is mainly based on the development of these cuticular structures, although I am somewhat uncertain about the exact ornamentation of the forms which could not be studied from living or alcoholic material.

Key to Species of Schasicheila

1. Inner marginals of radula 4-cusped; notch in peristome shallow; cuticular growth riblets and spiral ridgelets stronger in broad zones, which are parallel to the growth lines and give the appearance of rows of very heavy bosses (Subgenus **Necaxa**, new); alt. 5.5, maj. diam. 115 (6.3), 4 whorls; type locality, Misantla, V. C. *S. minuscula* (Pfr.) (+*minima* S. & P.)

   Inner marginals less than 4-cusped; notch in peristome prominent; cuticular outgrowths not accentuated in definite zones................(2)

2. Principal spirals developed as rows of long, cuticular, hair-like processes; inner marginals tricuspid....Subgenus **Atoyac**, new..........(3)

   Principal spirals developed as cuticular ridges, which are more or less continuous, although fluted; inner marginals bicuspid. Subgenus *Schasicheila* s. s.....(5)

3. Epidermis light-colored to brownish; hairs heavy, long and dark in color; lesser cuticular spirals prominent, broken into high triangular processes like short hairs..(4)

   Epidermis bright yellow; hairs widely-spaced, fragile and transparent; lesser spirals subobsolete; 4.9, 100 (4.9), 4½; Los Canoas, San Luis Potosí ....*S. xanthia* Pilsbry

4. Larger species; hairs of principal spirals often with lateral branches; 8.2, 113 (9.3), 4½; Córdoba, V. C. *S. alata* (''Menke'' Pfr.)

   Smaller species; hairs of principal spirals simple or forked; 4.5, 133 (6) 4; Diente, near Monterey, Nuevo Leon....*S. fragilis* Pilsbry

5. Growth riblets accentuated so as to obscure relatively weak lesser spirals ....(6)

   Growth riblets not stronger than lesser spirals...............................(7)

6. Shell with a peripheral carina; 5.5, 124 (6.8), 4; Diente near Monterey, Nuevo León....................................*S. vanattai vanattai* Pilsbry

Shell with three rounded carinae; 3.7, 122 (4.5), 3½; near Victoria, Tamaulipas ....*S. vanattai tricostata* Pilsbry

7. Largest species; lesser spirals of entire surface developed as rows of coarse hairs, which may be forked at tip but are rarely confluent; 11, 148 (16.3) 4½; Córdoba, V. C. ....*S. nicoleti* Shuttleworth

Smaller species; at least apical surface with confluent spiral ridges, and apparently without distinct hairs..(8)

8. Usually larger; apical surface with heavy cuticular spirals; umbilical surface with lower spirals, which are produced along growth lines into quite regular, triangular processes.
S. misantlensis F. & C.................................(9)

Usually smaller; spiral ridges of both surfaces lower and thinner, sometimes frayed but apparently not as in preceding (may be in fresh specimens?)............*S. pannucea* (Morelet)........................(10)

9. Last whorl weakly subangulate even after removal of epidermal structures; 9.5, 126 (12), 4½; Misantla, V. C.
S. misantlensis (+ *S. hidalgoana* Dall)

Last whorl more evenly rounded, at least in bleached shells; 10, 125 (12.5), 5; Alvarez Mts., San Luis Potosí..................*S. palmeri* Dall

10. Superior process of operculum obsolete, inferior process short; 9, 122 (11), 4 to 5; San Luis, Peten, Guatemala.
S. pannucea F. & C. (+ *S. pilsbryi* Wagner)

Superior process of operculum distinct, inferior process long; 8.5, 129 (11), 3 2/3; Chamá, Guatemala.
S. hinkleyi Pils. (+ *S. pannucea* Wagner)

In *S. minuscula,* the cuticular spirals are rather widely-spaced (11 counted between periphery and suture of last whorl), and are unevenly developed, so as to be prominent in zones (16 counted around periphery of last whorl), which are about as broad as their interspaces, and quite closely, although somewhat irregularly, parallel the growth lines. The principal spirals are accentuated, although rather less so than is usual in the genus. In the regions where the spiral ridges are prominent, the growth riblets develop cuticular outgrowths which buttress the spirals and produce with them fine grids. This edipermal sculpture catches the dirt, so that the vicinity of the prominent spirals in each zone appears to the unaided eye as a small transverse boss, which gives living shells the knobby appearance of Strebel and Pfeffer's figures, mentioned above.

The living animals of all of the species of Schasicheila examined are relatively slow-moving and inactive. The sole of the foot is elliptical and comparatively short; in preserved specimens, it appears to be divided into two halves by a longitudinal groove, but this bifid condition is not so evident in life. Locomotion is accomplished by coarse and irregular waves (only one or two on the pedal disc at the same time), which move from the posterior end anteriad. Usually, the two sides of the foot move in unison with each other, but they can act separately to a slight extent.

Animal (in *S. minuscula*): sides of foot very coarsely and prominently grained; bright buff to dull yellowish brown, clouded with large, irregular blotches of black; tentacles dark, quite short and blunt. Mantle: jet black with white border in female; with large blotches of black in male. Lung: venation consisting of coarse, transverse branches with radiating smaller vessels from both sides; network inconspicuous. Female genitalia (figs. iv–17, 18): V-organ long and wormlike, looped dorsad at apex, pedicel elongate and relatively simple; accessory sperm sac inconspicuous, as in *S. misantlensis* (1926, p. 49, figs. viii–24, 25); ventral bursa very large, twisted so as to lie across dorsal side of pedicel, expanded and coarsely lobed distally; reception chamber short but broad, deeply folded transversely; provaginal sac lanceolate, short but stout; provaginal stalk stout, with a subspherical protuberance at ventral side of its base; hypobranchial duct very short; uterus stout, longitudinally sulcate along its left side so as to demarcate a finely lobed region above hindgut, anterior 1/3 brownish; cloaca and cloacal orifice very large. Male genitalia (fig. iii–15): first prostatic chamber stout, less than 1/3 length of secondary gonaduct; accessory prostate simple and relatively broad, recurved around apex of secondary gonaduct; caecum stout, curved around to right side under accessory prostate, apex beyond base of first prostate. Radula (table I, fig. v–28): rhachidian central broad; comb-lateral with sharper cusps and narrower base than in *S. misantlensis* (1922 fig. v–20); inner eight marginals four-cusped.

Schasicheila (*Atoyac*) *alata* ("Menke" Pfeiffer)

Type locality: Mexico; Córdoba, V. C. now chosen. AD, I, abcd, 1–6; Atoyac to Sumidero, 1300 to 3400 feet; quite common aestivating in rock crevices, but climbing up on rock faces, tree trunks, and even a few feet into the lower vegetation during wet weather.

Dimensions

S. alata (Pfr.)				
Station 1, means:				
Dwarf shell..	6.3	111 (7.0)	98 (6.2)	3¾
4 males..........	7.7	115 (8.9)	94 (7.3)	4.3
3 females......	8.2	113 (9.3)	94 (7.7)	4.5
Station 4, means:				
8 males	7.4	112 (8.1)	92 (6.7)	4.3
12 females ..	7.6	112 (8.5)	93 (7.1)	4.5
Station 6, means:				
2 males	8.5	111 (9.5)	90 (7.7)	4.5
1 females	9.0	112 (10.1)	91 (8.2)	4.5
Extremes:				
14 males	6.9–8.6	104–119 (7.5– 9.6)	87–97 (6.3–7.8)	4¼–4½
16 females ..	7.1–9.0	109–117 (8.0–10.1)	88–99 (6.9–8.2)	4¼

The females average slightly larger with a greater number of whorls than do the males. Apparently, both sexes increase in size on the steepest slopes, that is, in the rainy zones, especially at Sumidero, but decrease in the flatter country around Córdoba. The cuticular ornamentation is very similar to that in *S. fragilis* (fig. v.–32). *S. alata* is the genotype of the new subgenus, Atoyac (see key).

Animal: sides of foot with dark blotches; mantle without much pigment. Female genitalia (figs. iv–19, 20) : similar to those of *S. minuscula,* but V-organ even more elongate; ventral bursa relatively larger and recurved more noticeably; provaginal sac lobate along its left side. Male genitalia (fig. iii–16) : as in the genus; caecum long, folded on itself near base of accessory prostate. Radula (table I, fig. v–27) ; similar to that of *S. misantlensis,* but inner marginals tricuspid.

Schasicheila (*Atoyac*) *fragilis* Pilsbry

Type locality: Diente, near Monterey, Nuevo León. AD, I, a, 1; Atoyac, 1300 to 1450 feet; infrequent, in leaf humus and talus.

	Shell			Aperture				Whorls
S. fragilis Pils.	4.5	133	(6)					4
Atoyac, st. 1:								
male shell.................	3.71	140	(5.19)	66	(2.45)	100	(2.46)	3½
male shell.................	4.02	134	(5.40)	68	(2.75)	94	(2.70)	3¾
largest (female?)....	4.04	143	(5.76)	68	(2.75)	97	(2.68)	3¾

The single female dissected is larger than any of the males. The sculpture has already been described in the key; in my specimens (fig. v–32), the minor spirals are more conspicuous and numerous than in the cotypes, but otherwise the structure and form are very similar in both lots of shells. The calcareous plate of the operculum is almost smooth externally, but scattered granules, which form a denser zone near the outer margin, can be detected under a lens. Both superior and inferior processes are present on well-developed opercula; in the specimen figured (figs. v–30, 31), the inferior process is much longer than usual and appears to have received a narrower addition after attaining the adult condition. (Cf. difference between *S. pannucea* and *S. hinkleyi.*) The horny plate is very thin; its palatal margin coincides with that of the calcareous plate, but it lacks the processes and its columellar margin is convex, so as to extend considerably beyond that of the outer plate. The female genitalia are very similar to those of *S. alata*, but the provaginal stalk is relatively longer, the provaginal sac itself is simple, and the uterus is less lobate above the hindgut. The radula (table I) differs from that of *S. alata* in minor particulars only.

Schasicheila nicoleti Shuttleworth

Type locality: Córdoba, V. C. D, I, a, 4; Las Tortolas, about 2650 feet; a single slightly immature female, from deep layers of rotting leaves, in one of the richer depressions of the limestone hills.

Animal: foot dark in color; tentacles almost black; mantle jet black. Radula (table I): similar to that of *S. misantlensis*, but bicuspid marginals less strikingly developed and fewer in number.

Schasicheila misantlensis Fischer et Crosse

Schasicheila panucea ''Morelet (?) oder neu'' S. & P. (1880, IV, p. 98, figs. ii–10, a–c). *S. pannucea misantlensis* F. & C. (1893, II, p. 449, fig. liv.–5b), Misantla, V. C. *Schasicheila hidalgoana* Dall (1897, Naut. II, p. 62), Encarnación, Hidalgo (L 20° 51′, 99° 5′; alt. 2280 meters); Pils. (1903, P. A. N. S. Philadelphia, 55, p. 783, figs. li–8, 8a); H. B. B. (1922, pp. 53, 57, figs. v–18, 20), radula; H. B. B. (1926, p. 49, figs. viii–24, 25, 26), anatomy. *?S. palmeri* Dall (1905, Smith. Misc. Coll. 48, p. 191, figs. xliv–3, 5), 7200 feet, Alvarez Mts., and San Dieguito, between Tamasopo (L 21° 57′, 99° 22′; alt. 400 meters) and Valles, San Luis Potosí.

ABCD, III, abc, 32–38, 41, 52–55; around Necaxa, 2215 to 5500 feet; frequent, mainly in rock crevices or talus, but climbing up on rock surfaces and trunks of trees to at least 10 feet above ground.

Most American conchologists, including myself, have missed the fact that Fischer and Crosse, contrary to their usual habit, used the name *misantlensis* in both their Latin and French descriptions and evidently meant to propose it as a subspecies. As the original description of *S. hidalgoana*, without figure, was apparently founded on dead, bleached shells, its identification would be rather difficult, but Pilsbry's figure, and the specimens on which it is based, are plainly the same species as the Necaxa and Misantla shells.

The specific separation of any of the six names, listed in the table of dimensions, is very dubious. Certainly, as regards size, the Necaxa series contains individuals which might be placed in any one of them, although none is as high as the typical measurements of either *S. pannucea* or *S. pilsbryi*. No fresh specimens of *S. pannucea* are before me, but partially worn shells of *S. hinkleyi* show the ornamentation given for *S. pannucea* in the key; until more accurate data are obtained, it seems best to consider *S. misantlensis* and *S. pan-*

		Dimensions		
S. pannucea F. & C.......	9	122 (11)	100 (9)	4 to 5
S. pilsbryi A. J. W.....	10	120 (12)	100 (10)	4–4½
S. hinkleyi Pils.	8.5	129 (11)		3 2/3
S. p. misantlensis F. & C.	9.5	126 (12)	105 (10)	4½
S. hidalgoana Dall.	8.5	141 (12)	112 (9.5)	near 5
S. palmeri Dall.	10	125 (12.5)	95 (9.5)	5
	8.5	129 (11.0)	94 (8.0)	5
Station 34, means:				
2 males....	10.0	134 (13.4)	111 (11.2)	4¼
3 females.	9.0	135 (12.1	113 (10.1)	4¼
Station 35, means:				
2 males....	9.4	128 (12.0)	108 (10.1)	4¼
2 females.	8.9	136 (12.1)	114 (10.2)	4¼
Station 38:				
1 male......	9.2	128 (11.8)	108 (9.9)	4¼
Station 41, means:				
1 male......	9.7	130 (12.6)	109 (10.6)	4¼
2 females.	9.5	135 (12.8)	116 (11.0)	4¼
Station 53, means:				
4 males....	8.6	130 (11.1)	111 (9.5)	4¼
1 female..	8.8	130 (11.4)	111 (9.8)	4¼
Station 55:				
1 shell......	7.7	131 (10.1)	109 (8.4)	4
Extremes:				
10 males....	8.1–10.1	124–135 (10.5–13.5)	104–114 (9.0–11.3)	4¼
8 females.	8.5– 9.7	127–141 (11.4–13.2)	111–119 (9.8–11.5)	4¼

nucea as separate species. In some of the specimens of *S. misantlensis* the superior process of the operculum is barely noticeable, in others, well developed. Although I have seen no other specimen of either *S. misantlensis* or *S. pannucea* with as elongate an inferior process as that on the typical operculum of *S. hinkleyi*, the development of the last is very similar to that in one of the opercula of *S. fragilis* (figs. v–30, 31) and I am very doubtful of its validity as a specific character. All the Necaxa shells retain some degree of angulation on the last whorl, even after the cuticular flange is lost, but none of them is as badly worn as are the cotypes of *S. palmeri* in the Academy of Natural Sciences of Philadelphia.

As will be seen from the table of dimensions, the males of *S. misantlensis* average somewhat higher and are usually slightly larger than the females, while both sexes develop the same number of whorls. Apparently, the shells decrease in size at the lower altitudes, which agrees with the smaller dimensions of *S. pannucea,* the more southern form.

Supplementary dissections from the Necaxa material (station 34) lead me to believe that the peculiar caecum (X, figures cited) of the female genitalia is actually the ventral bursa; in *S. minuscula, S. alata* and *S. fragilis,* it is only separated from the reception chamber by a narrow fold, but, in *S. misantlensis,* it has been carried higher so that it appears to rise from the pedicel. The other small protuberance which I took for a vestigial ventral bursa is probably a lobe of the provaginal chamber. Also, in more completely adult animals, the left side of the uterus is coarsely lobed, the long-ellipsoid provaginal sac is much larger, so that it extends to near the apex of the V-organ, and the accessory sperm sac is slightly better differentiated. The distal end of the caecum on the male genitalia is similar to that in *S. alata.*

Pyrgodomus microdinus abditus, new subspecies

Type locality: Las Tortolas, Córdoba, V. C. (station 4). A, I, b, 1, 4, 6; Atoyac Gorge to Sumidero, 1300 to 3400 feet; firmly glued into the cracks of vertical faces of limestone ledges or moving around the edges of seepage films and attached bryophytes; shells of living animals thickly encrusted with soft, calcareous deposits.

Shell (fig. v–34): imperforate; turbinate conical, quite thin and fragile. Color: yellowish green, sometimes with earlier whorls tinged with rufous (type), rarely entire shell dull brick-red. Whorls: 4.5 in adult males, 4.8 in females; markedly convex, almost angulate above suture, which is distinctly impressed. Embryonic shell: distinctly demarcated; ¾ whorl; yellowish green or dull chestnut in color; growth wrinkles quite distinct. Later whorls: growth wrinkles weak; spiral ridges low and becoming indistinct on last whorl, where 7 are developed above and 14 below periphery. Aperture: inclined at angle of about 50° to long axis of shell, so that it appears transverse; actually broadly ovate, almost as wide as long. Peristome: thickened internally and very slightly flaring in adults; white columellar callus broadly reflected but terminated abruptly at its distal end so as to form a distinct angle where it passes into the obliquely truncate basal angle of the peristome.

Operculum (fig. v–33): about 1 1/3 times as long as broad; horny plate flat and very thin, but larger than calcareous one, so that it extends beyond latter except along its concave columellar margin; outer surface of calcareous plate very slightly concave, with minute, inconspicuous granules; growth lines almost concentric; subspiral nucleus relatively large, nearly central in position.

	Shell			Aperture				Whorls
P. m. microdinus:								
Morelet	4	100	(4)					6
ANSP (ex. auct.), juv.	3.01	104	(3.12)	42	(1.25)	135	(1.69)	5¼
P. m. chryseis:								
Tristram	4	75	(3)					6
ANSP (Chamá, Guat.)	3.93	90	(3.52)	40	(1.56)	118	(1.84)	6
P. simpsoni:								
ANSP (paratype)	2.12	108	(2.29)	43	(.91)	141	(1.28)	4¾
P. m. abditus, station 1:								
one male	2.63	100	(2.63)	40	(1.06)	126	(1.34)	4¾
one female	3.12	100	(3.13)	39	(1.23)	135	(1.62)	5¼
P. m. abditus, station 4:								
type male	2.00	111	(2.22)	41	(.83)	135	(1.13)	4½
means, 6 males............	1.97	109	(2.14)	43	(.86)	131	(1.11)	4.5
means, 5 females........	2.26	109	(2.47)	42	(.96)	133	(1.28)	4.8
P. m. abditus, station 4:								
minima, 6 males..........	1.84	102	(2.08)	38	(.77)	123	(1.06)	4½
maxima, ditto..............	2.04	115	(2.26)	48	(.97)	138	(1.19)	4¾
minima, 5 females......	2.15	105	(2.40)	39	(.88)	124	(1.19)	4¾
maxima, ditto..............	2.35	112	(2.54)	46	(1.07)	145	(1.39)	5

As shown by the table of dimensions (the specimens of *P. microdinus abditus* measured are only a few taken at random from each lot), this subspecies is much smaller and more depressed and the adults have a lesser number of whorls than typical *microdinus*. Also, the color of the light form of *abditus* is decidedly more greenish than the corresponding one in *microdinus* (or *chryseis*). The males are smaller than the females and develop a lesser number of whorls. At Atoyac (lower altitude), the subspecies increases notably in size, height and number of whorls, and thus approaches the typical Guatemalan shells.

The three specimens of *P. microdinus microdinus* from Morelet in the A. N. S. P. (no. 14634) are all immature and have faded to a straw color. Specimens of *P. microdinus chryseis* from Chamá, Guatemala (Hinkley, A. N. S. P. no. 45668), look to me like the fresh adults of the same thing, but it will require larger series to disprove the subspecific status (cf. Pilsbry; 1920, P. A. N. S. P., p. 197). An adult of *P. simpsoni* (Ancey), from Utila Island, Honduras (A. N. S. P. 58068; cf. Pilsbry: 1903, P. A. N. S. P., fig. xlix–4), shows about the size and proportions of *abditus*, but is distinctly more angulate, has a subacuminate spire, and develops much stronger spiral ridges. The angle at the base of the columellar callus in Pyrgodomus is somewhat reminiscent of the emarginate condition in Stoastomops.

Animal: similar in appearance to that of *Stoastomops walkeri* (H. B. Baker; 1926, p. 50, fig. viii–29), but lateral zones of markedly tripartite foot somewhat wider; mantle little pigmented. Female genitalia (figs. iv, 21–23): V-organ with elongate apical swelling somewhat as in Viana (1926, figs. viii–32, 33); accessory sperm sac small, spherical, situated near middle of dorsal side of pedicel; ventral bursa relatively larger than in Viana, long ellipsoid in shape; provaginal sac rounded triangular, coarsely lobed; uterus with longitudinal division near left and caecum-like lobe near right side; hypobranchial orifice at 1/5 to 1/6 length of uterus. Male genitalia (fig. iv–24): first prostatic chamber only about 1/3 length of secondary gonaduct; accessory prostate short (apex near base of sperm duct) but very broad (enveloping right side of gonaduct both ventrally and dorsally), rather vaguely constricted into a few segments; caecum quite long; terminal sac exceptionally long. Radula (table I, fig. v–29) : all paired centrals with cusps; D-plate developed as a cuspid T-lateral; marginals few in number, inner ones bicuspid.

Although Pyrgodomus evidently belongs in the Vianinae, the absence of unicuspid marginals from the radula necessitates a change in the original definition of the subfamily (H. B. Baker; 1922, p. 38). The female genitalia are rather similar to those in Viana, but the short accessory prostate of the male system is more like that of Stoastomops. Thus, Pyrgodomus appears to be a distinct genus at the very base of the Vianinae; it apparently includes only the mainland form. As already indicated (1922, p. 61), the small Cuban species, which resemble it in shell characters, belong in the genus Eutrochatella; for them, the new subgenus **Microviana,** type *Helicina rupestris* Pfr. (1839, Arch. Naturg. I, p. 355) from near Matanzas, Cuba, is now proposed.

The absence of unicuspid marginals in a group with a true T-lateral, and the resemblance in the male genitalia and columellar callus of Pyrgodomus and Stoastomops, suggests that the peculiar D-laterals of the latter group and Stoastoma may be simplified T-plates rather than modified comb-laterals. In any case, Stoastoma and Stoastomops are sufficiently distinct from the remainder of the Helicinidae to constitute a separate subfamily, the Stoastominae (Stoastomidae C. B. Adams).

POMATIASIDAE

Licina (*Choanopomops*) *largillierti* (Pfeiffer)

Type locality: Yucatan. E, I, ad, 61; near Progreso, Yucatan; frequent, aestivating under slabs of rock, but rapidly climbing up on the brush under the impetus of even a short shower.

All the adult shells are decollate. The females average larger than do the males as appears usual in the family.

Dimensions

L. largillierti				
(Pfr.)	12.5	48 (6)		4
Station 61, means:				
5 males	9.7	63 (6.1)	51 (4.9)	3.3
3 females	11.3	59 (6.6)	49 (5.5)	3.5
Ditto extremes:				
5 males	9.3–10.7	57–60 (5.9–6.4)	47–48 (4.7–5.1)	3¼–3½
3 females..........	9.9–11.8	61–67 (6.5–6.8)	50–53 (5.3–5.8)	3½

Radula (table II, fig. vi–35): 116 transverse rows; central not much smaller than first lateral, cusp long, acuminate; first lateral with markedly acuminate cusp of medium length; second lateral heavy, with strong reflection which usually develops 5, large, well-formed cusps; marginal high and relatively narrow, with an oblique row of 47 (mine) to 63 (A. N. S. P. no. 61468, Tekanto, Yucatan) cusps. Radula of *Choanopoma lincina* (A. N. S. P. no. 13605, Jamaica; table II, fig. vi–37); central smaller in proportion to first lateral, cusp more elongate but not acuminate; first lateral with very long, triangular cusp; second lateral with extensive but thin reflection which develops about 10 weak serrations; marginal relatively broad, with a nearly transverse row of about 107 cusps.

Table II. Radular Formulae of Pomatiasidae

	Central	First Lateral	Second Lateral	Marginal
L. largillierti	1	1	4–6	47–63
L. grateloupi	1	1	4–5	56
L. inculta	1	1	5–6	42
L. puertoplatensis	1	1	5	55–57
L. decussata	1	1	5–6	64–65
L. antiguensis	1	1	5–6	57
L. aripensis	1	1	6–7	80–84
L. williamsoni	1	1	5–6	70–71

Although the radulae of the Chondropominae are remarkably uniform, certain minor differences do appear when one studies examples from various groups. While these cannot always be used for generic separation, they do seem to indicate the natural relationships in the subfamily. The type of radula found in *L. largillierti* and *L. grateloupi* is practically the same (see table II) as those of *Cyclostoma incultum* Poey from Trinidad, Cuba (A. N. S. P. 48577), *C. perplicatum* Gundlach from Cuba (A. N. S. P. 13701), *Choanopoma puertoplatense* Pfr. from Puerto Plata, Santo Domingo (A. N. S. P. 14169), *Cyclostoma decussata* Lam. from Porto Rico (A. N. S. P. 13582), *Adamsiella antiguensis* Pfr. from Wetherill Bay, Antigua (A. N. S. P. 109158), *Adamsiella aripensis* Guppy from Trinidad (A. N. S. P. 13757), and *Tudora williamsoni* H. B. Baker from Venezuela. Radulae similar to that of *Choanopoma lincina* occur in Henderson and Bartsch's (1920, Proc. U. S. Nat. Mus., 58, p. 49) first two groups of Annularia s. s. (pp. 72, 73), in their Colobostylus (p. 76), in their typical groups of Tudorisca (p. 76) and Tudorops (p. 77), and in their group of *Diplopoma retrorsum* (p. 79); this series is practically limited to Jamaica and Central America.

The generic name that I am tentatively using for this group, Licina Gray (November, 1847), is unfortunately founded on one of those semimythological species (*Nerita labeo* Müller), which appears to have escaped all modern collectors. If the Hispanolan group, to which the type is supposed to belong, be found to have the Choanopoma type of radula, Annularita H. & B., now considered as a subgenus of Licina, can probably be used.

The new subgenus **Choanopomops**, type *Cyclostoma largillierti* Pfr., contains three quite distinct groups: 1) the typical group, which practically coincides with Henderson and Bartsch's group of *Annularia illustris* (p. 73), after the exclusion of the Troschelvindex on which it is founded; 2) a lesser Antillean group, their group of *Adamsiella antiguensis* (p. 71); and 3) the mainland group of *L. williamsoni*, which may tentatively be considered to include *Tudora williamsoni* and subsp. *secana* H. B. B. from Venezuela, *Adamsiella aripensis* Guppy from Trinidad, *Cyclostoma aspratile* Morelet from Ecuador, *C. thoreyanum* Philippi from Bolivia, *Adamsiella osberti* Tristram and *Cyclostoma rigidulum* Morelet from Guatemala, and *Choanopoma chiapasense* C. & F. and *C. sumichrasti* C. & F. from Mexico.

In the typical group of Choanopomops (cf. Strebel; 1873, I, fig. 1–4), the calcareous plate of the operculum is parallel to the horny one as in Tudora; this is quite different from the condition in Choanopoma s. s., where the outer plate is tilted obliquely with respect to the inner one. However, in Choanopomops, the calcareous portion is incomplete and so does not completely cover the horny base of each whorl; this is in contrast to the condition in Tudora s. s. and Licina s. s. In the group of *L. williamsoni,* so far as known, the operculum is fundamentally similar to that in *L. largillierti,* but is more nearly circular, like the aperture, and more closely coiled (H. B. Baker; 1923, this series, no. 137, fig. ii–8). Both Choanopomops and Licina s. s. differ from Tudora in the development of a duplex or multiplex, instead of simplex, reflection of the peristome.

Licina (*Choanopomops*) *grateloupi* (Pfeiffer)

Type locality: Yucatan. E, I, ad, 61; common, living with *L. largillierti,* but about twice as abundant.

Dimensions

L. grateloupi				
(Pfr.)	16	44 (7)		5
Station 61, means:				
8 males........	12.1	57 (6.9)	47 (5.7)	3.4
12 females.....	13.1	56 (7.4)	47 (6.2)	3.3
Ditto extremes:				
8 males........	11.1–13.0	55–61 (6.4–7.6)	45–52 (5.4–6.2)	3¼–3¾
12 females.....	12.2–14.1	53–59 (6.7–8.1)	45–51 (5.7–7.0)	3¼–3½

All the shells are decollate. Although the sexes intergrade extensively in size, the females average larger than the males. This and the preceding species could almost be separated on size alone; they do not appear to intergrade in sculpture.

Radula (table II, fig. vi–36): quite similar to that of *L. largillierti.*

Chondropoma (*Chondropomium*) *cordovanum* (Pfeiffer)

Type locality: Córdoba, V. C. AD, III, ad, 1–6; Atoyac to Sumidero, 1300 to 3400 feet; frequent to common, almost entirely on and at the base of limestone ledges.

Dimensions

C. cordovanum				
(Pfr.)	13 –15.5	46–47 (6 –7.3)		7– 7½
Station 1, means:				
13 males........	10.0	65 (6.5)	52 (5.2)	6.1
8 females......	12.2	60 (7.4)	50 (6.1)	6.5
Station 4, means:				
19 males........	10.2	62 (6.3)	49 (5.0)	6.1
10 females....	12.5	57 (7.2)	48 (5.9)	6.5
Extremes, sts. 1, 4:				
32 males........	9.1–10.8	58–68 (5.8–7.0)	46–57 (4.5–5.9)	5¾–6½
18 females....	11.1–13.9	53–62 (6.5–8.0)	42–57 (5.2–7.5)	6¼–7
Station 6:				
1 female........	10.3	59 (6.1)	50 (5.1)	6

All the shells are entire, but the apical 1½ to 2 whorls are empty and very brittle. Pfeiffer's largest specimen must have been an extremely elongate female; even his smallest shell is towards the upper limit of variation in my material. The color pattern is very variable in intensity. The ground color ranges from very light to dull brown; when the latter, the second whorl (empty) is bluish as in *C. rubicundum*. The apex may be either light or dark in color.

CYCLOPHORIDAE

Poteria (*Neocyclotus*) *dysoni berendti* (Pfeiffer)

Type locality: Campeche, Campeche (cf. Strebel; 1873, I, p. 10). E, II, a, 61; three dead, bleached shells from near San Ignacio Station.

Dimensions

P. berendti (Pfr.)....................	13	(22.5)	(17.5)	5
Station 61:				
3 shells..................................	14.2	135 (19.1)	109 (15.5)	4¼
	14.3	136 (19.4)	113 (16.1)	4¼
	15.6	137 (21.4)	114 (17.7)	4½

In all these shells, the aperture is briefly solute and distinctly angulate above. I suspect the first two are those of males.

Aperostoma mexicanum salleanum (Martens)

Type locality: Córdoba, V. C. D, III, a, 1–6; Atoyac to Sumidero, 1300 to 3400 feet; frequent, especially in disturbed situations such as the edge of coffee plantations, usually burrowing into the leaf mould, but rarely on the surface during wet weather.

Dimensions

A. mexicanum (Mke.)	9	(20.3)		
A. salleanum (Mart.)	12	(27.5)	(21.5)	5½
Station 2, means:				
1 male	15.4	157 (24.1)	122 (18.8)	5¾
3 females	17.7	147 (26.0)	122 (21.7)	6
Station 3, means:				
3 males	15.5	154 (23.8)	122 (19.0)	5½
Station 4, means:				
2 females	17.3	164 (28.4)	128 (22.1)	6

A number of the specimens show a marked tendency to carry the last whorl up on the spire (cf. Strebel; 1873, I, fig. I–1); this produces a much more depressed shell than usual. Both the "*mexicanum*" and "*salleanum*" types of aperture and all intergradations between them are present in the material; on this basis, the species can hardly be divided into even two ecological forms (cf. H. B. Baker; 1922, this series no. 106, p. 42). However, the Córdoba shells certainly average considerably larger than do the lots from the lowlands of Vera Cruz; *A. mexicanum mexicanum* may be considered as a smaller, lowland subspecies, of which the type locality is near Papantla, V. C. (L 20° 25′, 97° 15′).

Aperostoma walkeri, new species

Type locality: forest on south side of Vaso de Tenango, near Necaxa (station 41). AB, I, a, 32, 41; Necaxa, 4600–5400 feet; infrequent and sporadic, found only in the two localities, under dead leaves along strand lines between alder and mixed forest on steep slopes.

Shell (figs. vi–38, 40): broadly umbilicate (umbilicus a little more than 1/5 to ¼ of greatest diameter), depressed; quite heavy and almost opaque. Color: apex dull chestnut; young shells greenish white; last whorls dull golden, usually with an indefinite lighter band around periphery. Whorls: 4¼ (type) to 4½ in adult males; 4¾ in adult females; rapidly increasing in diameter; rounded at periphery but slightly flattened above; suture distinctly impressed. Embryonic shell: ¾ whorl; epidermis eroded even in young specimens; forming a papilliform apex. Later whorls: growth wrinkles closely spaced and rounded, but considerably more prominent and regular than in *A. mexicanum.* Aperture: slightly oblique (inclined about 20° to long axis of shell) and very large (almost ½ greatest diameter of shell); almost circular in outline. Peristome: white, slightly thickened but barely reflected at periphery of palatal margin, distinctly reflected along columellar and upper palatal borders; continued across parietal wall by a thick callus, much as in non-solute specimens of *A. mexicanum.*

Operculum (fig. vi–39): slightly smaller than aperture so that it may be drawn in about 1/8 of a whorl; thin and horny; circular except for the obliquely truncate end of last whorl which fits into parietal angle of shell; with 6 narrow whorls; suture externally overlapped by free outer edges of each whorl; outer surface dull, with indistinct growth lines; inner surface also dull except on polished area for muscle attachment. Muscle scar: markedly eccentric so that its center is displaced by about ¼ of its diameter towards parietal wall of shell (when animal is retracted) from that of entire operculum; roughly circular in outline but with margin beyond center of operculum deeply indented so as to leave the last uncovered.

This species looks very much as if young shells of *A. mexicanum* had assumed the adult characters before attaining the

Dimensions

A. lutescens						
(Pfr.) 13			(21)		(15.5)	4½
A. cooperi						
(Tryon) 12		133	(16)	117	(14)	4½–5
Station 32, means:						
6 males ..	8.5	147	(12.5)	117	(9.9)	4.4
2 females.	9.4	158	(14.8)	124	(11.7)	4¾
Station 41, means:						
type male	7.3	141	(10.3)	111	(8.1)	4¼
3 males ..	7.2	152	(11.0)	118	(8.5)	4¼
4 females	9.5	154	(14.6)	121	(11.5)	4¾
Extremes:						
9 males ..	6.6–9.0	137–156	(10.1–13.2)	109–125	(8.1–10.3)	4¼–4½
6 females.	9.2–9.8	137–163	(13.4–15.6)	114–129	(11.0–12.4)	4¾

full number of whorls. As indicated in the description, the adult peristome of *A. walkeri* is much less expanded than in *A. mexicanum*. The specimens of *A. walkeri* from higher altitudes are larger than those from lower, and the females are distinctly bigger than the males.

Amphicyclotus and Hadropoma (= Aperostoma) have been separated as genera by Fischer and Crosse on the basis of the expanded peristoma in the latter group, so that finally they placed *A. lutescens* in the former, although they recognized its close resemblance to that latter assemblage. *A. walkeri* is practically intermediate in expansion of the peristome between *A. mexicanum* and *A. lutescens*. For this reason, the generic distinction can no longer be maintained, and Amphicyclotus must give way to the older generic name. However, two subdivisions are clearly recognizable in the Mexican species with a horny operculum: Aperostoma s. s., with its peculiar papilliform apex, quite uniform coloration and strong and regular growth riblets; and the subgenus Amphicyclotus (type *Cyclostoma boucardi* Pfr.) with more rounded apex, dark or banded coloration, and more irregular growth riblets, which are disturbed by oblique or subspiral wrinkles. *A. mexicanum* (Menke), *A. walkeri, A. lutescens* and *A. cooperi* (Tryon) appear to be the four species of Aperostoma s. s., although *Cyclostoma moricandi* Pfr., from Brazil, certainly has many of the characters of this group.

Addendum

As will be obvious from the text of this paper the symbols for the mahoganizing factors M, M, M and Q, Q, Q have been only provisionally separated. They should be identified as soon as S′, S′, S′ has been experimentally divorced from Q, Q, Q which is not yet materialized.—Exactly the same applies to the corresponding whitening factors, the identity of which is equally probable.

Description of Plates

All figures are made with aid of camera lucida. Scales for drawings of shells and genitalia represent one millimeter; those for radular figures indicate 50 microns (.05 mm.).

PLATE I. VICINITY OF NECAXA

Map adapted by permission of Mexican Light and Power Company from blueprint given me by Mr. Dokuschevsky. Vertical (north to south) and horizontal (east to west) lines, drawn across areas not included in survey, are one kilometer apart. Contour interval 50 meters.

Nos. 7–16. Altitudes in hundreds of meters.

Nos. 23, 24, 31–38, 51–55. Stations (see introduction).

A—Presa de Acatlán.
B—Miguel.
C—Vaso de Necaxa.
D—Canadita.
E—Twin Peaks.
F—Necaxa dam.
G—Mesa de Necaxa.
H—Salto Chico.
I—Salto Grande
K—Planta de Necaxa.
L—Vaso de Tenango.
M—Tenango dam.
N—Tenango.
O—Rio Tenango.
P—Tlalchichila.
R—Rio Necaxa.
S—Rio Nexapa.
T—Rio Xaltepuxtla.
U—Planta de Tepexic.

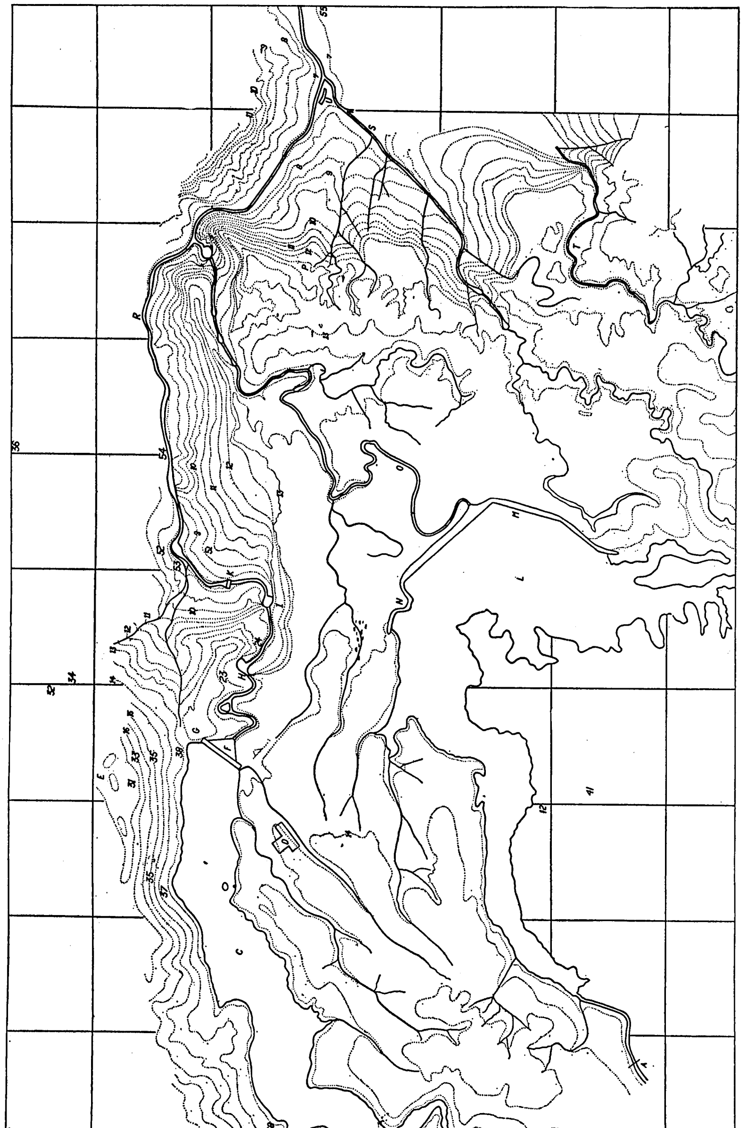


PLATE II

Uppermost scale in lower right hand corner of plate is for figs. 5 and 6; middle one for figs. 2, 3 and 4, lowest for figs. 7, 8, 9 and 10. Ovaries and most of slender oviduct are omitted.

FIG. 2. *Helicina delicatula* (station 4). Ventral view of apical organs of genitalia, dissected apart; provaginal sac twisted so dorsal side is uppermost.

FIG. 3. *H. succincta* (station 34). Ventral view of apical organs as in fig. 2.

FIG. 4. *H. succincta.* Dorsal view of V-organ, pedicel and accessory sperm sac from same individual as fig. 3.

FIG. 5. *H. cinctella* (station 6). Ventral view of apical organs as in fig. 2.

FIG. 6. *H. zephyrina* (station 4). Ventral bursa.

FIG. 7. *H. flavida flavida* (station 36). Ventral view of apical organs as in fig. 2.

FIG. 8. *H. fragilis elata* (station 4). Ventral view of female genitalia, as in fig. 2.

FIG. 9. *Lucidella lirata* (station 1). Dorsal view of female genitalia; V-organ slightly separated; other organs in normal positions.

FIG. 10. *L. lirata.* Ventral view of same genitalia as in fig. 9.

FIG. 11. *L. lirata.* Ventral view of apical organs of same individual; magnification 2.6 times that of fig. 10.

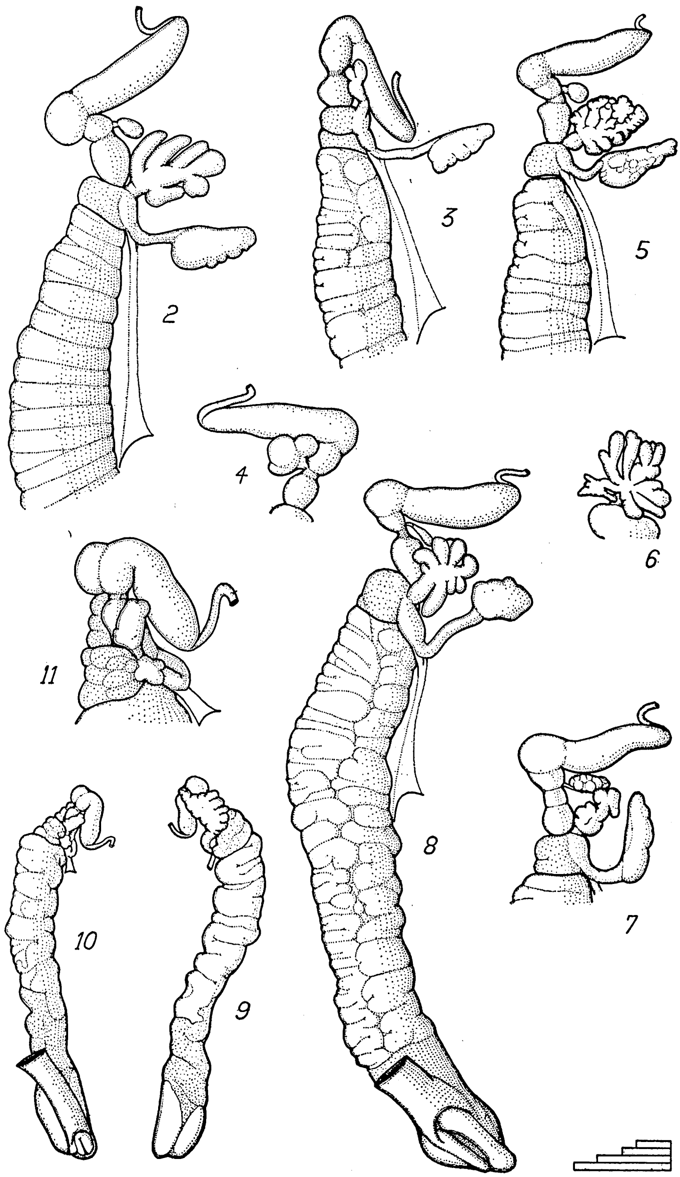

2
3
5
4
6
11
8
7
10
9

PLATE III

Uppermost scale at lower edge of plate is for fig. 14; next for figs. 12 and 13; third for fig. 16; and lowest for fig. 15. Testes and most of primary sperm duct are omitted.

FIG. 12. *Helicina delicatula* (station 4). Ventral view of male genitalia with organs in normal positions.

FIG. 13. *H. succincta* (station 34). Ventral view of male genitalia as in fig. 12.

FIG. 14. *H. cinctella* (station 6). Ventral view of male genitalia as in fig. 12.

FIG. 15. *Schasicheila minuscula* (station 37). Ventral view of male genitalia as in fig. 12.

FIG. 16. *S. alata* (station 1). Ventral view of male genitalia, with accessory prostate dissected loose and turned back.

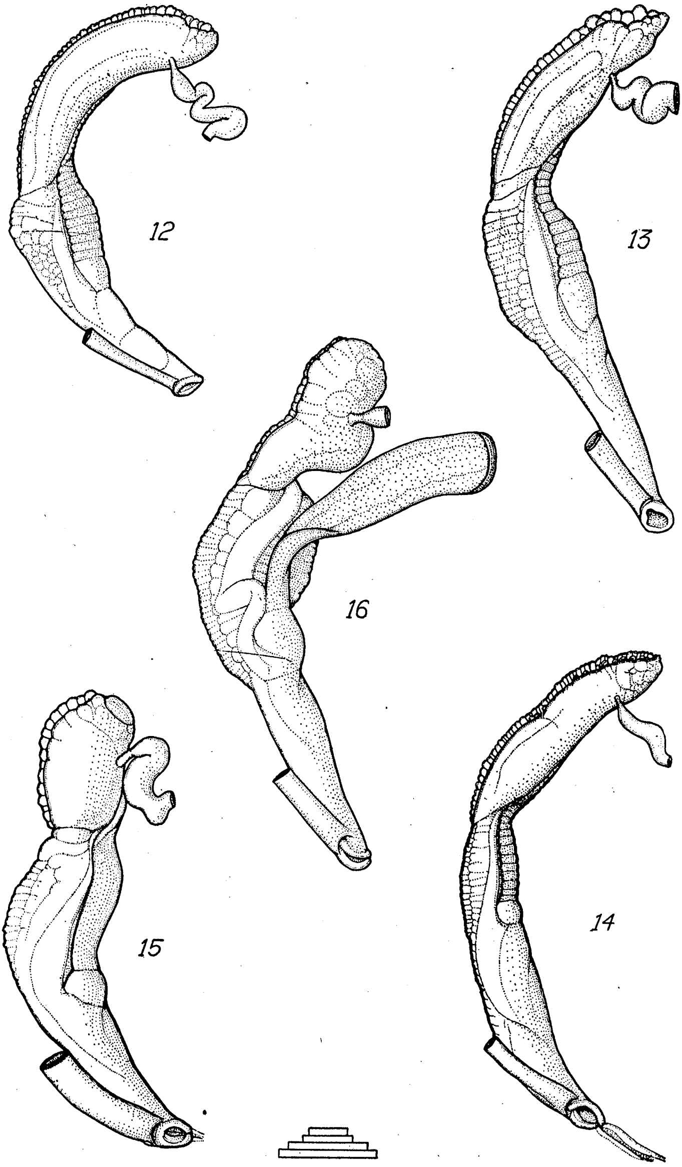

12
13
16
15
14

PLATE IV

Uppermost scale in lower right hand corner for radular diagrams in figs. 25 and 26; next for figs. 19 and 20; third for figs. 17, 18, 21, 22, 23 and 24; fourth for fig. 26; and lowest for fig. 25. Arrangement of dissections as in plates II and III.

FIG. 17. *Schasicheila minuscula* (station 35). Ventral view of female genitalia with V-organ partially straightened.

FIG. 18. *S. minuscula.* Dorsal view of apical organs of same individual; provaginal sac with ventral side uppermost.

FIG. 19. *S. alata* (station 4). Dorsal view of apical organs as in fig. 18.

FIG. 20. *S. alata.* Ventral view of female genitalia of same individual; arrangement as in fig. 17.

FIG. 21. *Pyrgodomus microdinus abditus* (station 1). Ventral view of female genitalia with organs in place.

FIG. 22. *P. microdinus abditus.* Dorsal view of apical organs of same animal with V-organs slightly separated.

FIG. 23. *P. microdinus abditus.* Ventral view of V-organ and pedicel from same individual.

FIG. 24. *P. microdinus abditus.* (station 1). Ventral view of male genitalia with organs in place.

FIG. 25. *Helicina delicatula.* Central teeth of radula in normal relations, and diagram to show position of tips of teeth in right half of a transverse row, with each 7th marginal indicated by a cross-line.

FIG. 26. *H. succincta.* Lateral complex of radula, and diagrams of transverse row as in fig. 25.

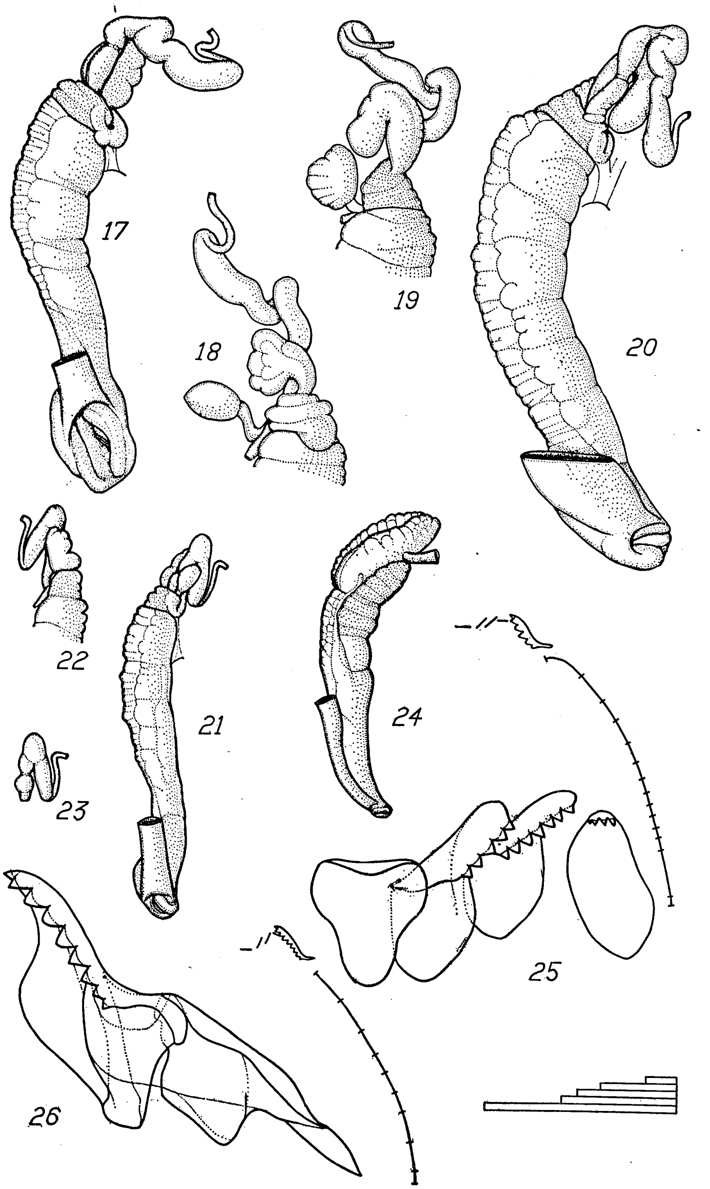

17
18
19
20
22
21
24
23
25
26

PLATE V

Upper scales under figs. 27, 28 and 29 is for diagram of transverse row, lower ones for teeth shown in detail. Uppermost scale at bottom of plate is for figs. 30 and 31; second for fig. 32; lowest for figs. 33 and 34.

FIG. 27. *Schasicheila alata* (station 1). Centrals, lateral complex and tip of first marginal; centrals in normal relations, but interval between them and lateral complex greatly exaggerated. Diagram of right half of transverse row as in fig. 25.

FIG. 28. *S. minuscula* (station 51). Centrals of radula in normal relations, and tip of first marginal. Diagram of transverse row as in preceding.

FIG. 29. *Pyrgodomus microdinus abditus* (station 6). Centrals, lateral complex and first marginal. Relations and transverse row as in fig. 27.

FIG. 30. *Schasicheila fragilis* (station 1). Outer view of an operculum with especially long inferior process.

FIG. 31. *S. fragilis.* Inner view of same operculum.

FIG. 32. *S. fragilis.* Profile of last whorl with lesser spiral ridgelets and hairs of prominent spirals shown in outlines.

FIG. 33. *Pyrgodomus microdinus abditus* (station 4). Outer view of operculum.

FIG. 34. *P. microdinus abditus.* Outline of type shell.

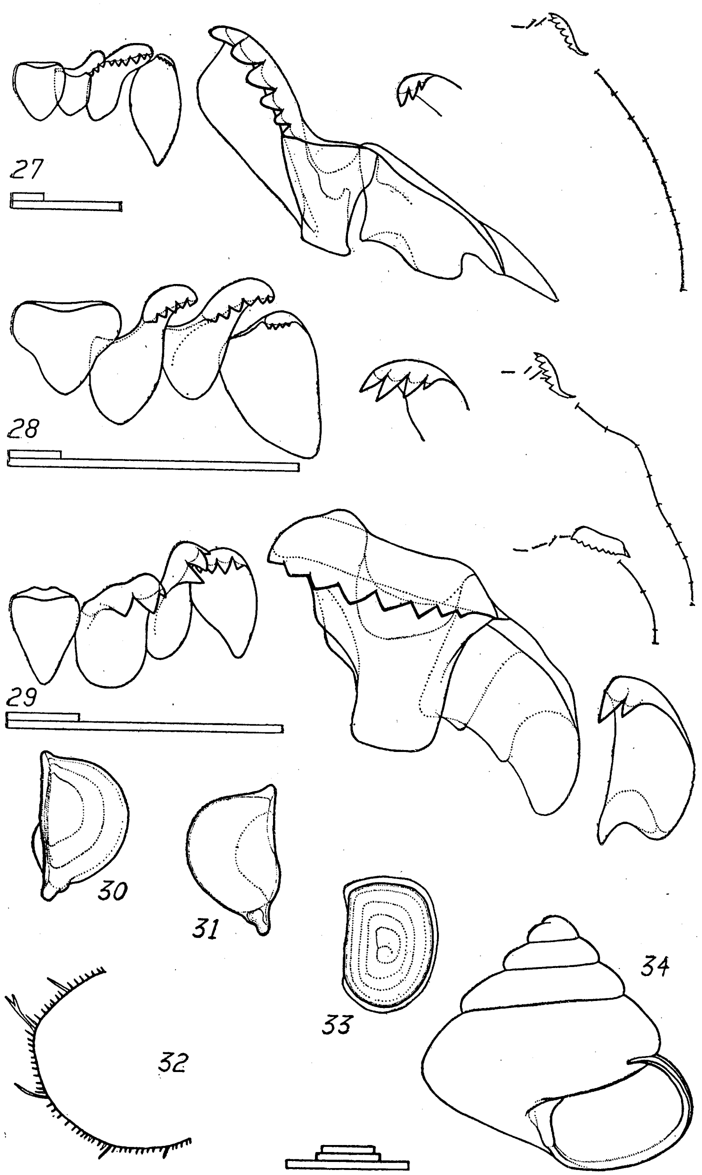

27
28
29
30
31
32
33
34

PLATE VI

Uppermost scale at bottom of plate is for figs. 38 to 40; next for fig. 37; third for fig. 36; and lowest for fig. 35.

FIG. 35. *Licina largillierti* (station 61). Central, right laterals and right marginal in usual relations. Also, from another radula (A. N. S. P. no. 61468, Tekanto, Yucatan), lateral view of central (A) and inner views of left first (B) and second (C) laterals.

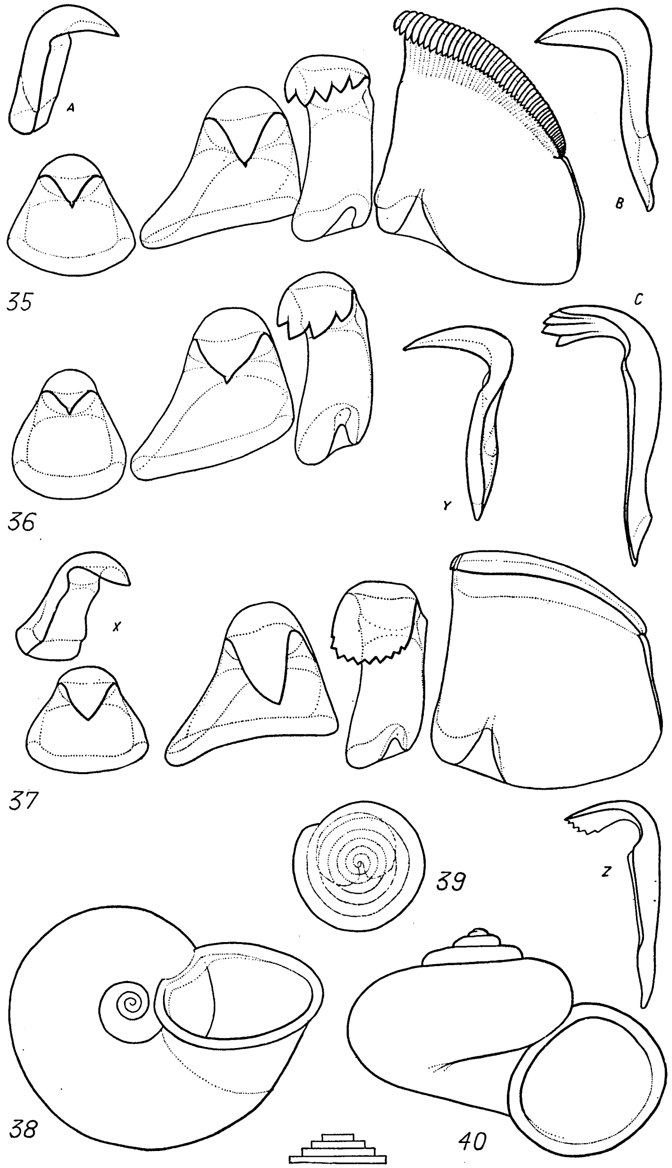
FIG. 36. *Licina grateloupi* (station 61). Central and right laterals in usual relations.

FIG. 37. *Choanopoma lincina* (A. N. S. P. 13605, Jamaica). Central, right laterals and right marginal with intervals slightly exaggerated; cusps not differentiated in figure of marginal. Also, from same radula, lateral view central (X), and inner views of left first (Y) and second (Z) laterals.

FIG. 38. *Aperostoma walkeri* (station 41). Umbilical outline of type shell.

FIG. 39. *A. walkeri.* Inner view of operculum of type shell, with outline of muscle scar indicated.

FIG. 40. *A. walkeri.* Lateral outline of type shell.


A
B
35
C
36
Y
X
37
39
Z
38
40