THE MOST HOSPITABLE TREE

By ALEXANDER F. SKUTCH

When yet an undergraduate in college, I was familiar with that remarkable work "Botanische Mittheilungen aus den Tropen." In the nine slender volumes of this beautifully illustrated series of monographs, edited and in part written by the famous plant geographer A. F. W. Schimper, and published during the years 1886 to 1901, I became acquainted with some of the most fascinating phenomena of tropical botany: the adaptations of epiphytic plants, the strange modes of secondary thickening in the stems of woody vines, the complex relationships between ants and the plants that provide shelter for them, the famous gardens of the leaf-cutting ants. Perhaps no other single work so strongly influenced my determination to devote some years to the firsthand study of tropical Nature—years that have stretched on and on to nearly two decades.

To the young student of Nature in the first exhilaration of his studies, no Sir John Mandeville or Marco Polo had filled his pages with more wonder-stories than were to be found in these records of sober scientific investigation. And perhaps the most marvelous of all the volumes, both in the patent drama of the situation described and in the arduous series of delicate adjustments and readjustments between organisms implied in the relationship, was the monograph by Schimper himself, on the Cecropia tree and its carrion of ants. Widely traveled, enthusiastic, keen-sighted, endowed in no small degree with the capacity for "the scientific use of the imagination," the author pointed out the features that made the tree a most favorable abode for the ants, providing them not only with commodious lodgings but also with a special and delicate food. In return for food and housing, the herd of little biting ants defended the tree against its enemies. Such, in brief, was Schimper’s thesis, which, during many years’ residence and travel in widely separated portions of the range of the Cecropia tree, I have had constantly in the back of my mind, so that observations, made deliberately or by chance, were classified according to whether they confirmed or refuted it. Will this story, which stirred the imagination of the young student, stand the test of a far longer familiarity with the Cecropia tree than its author himself enjoyed?

When at length I reached the Tropics, I was not long in recognizing the tree whose remarkable history I knew so well. Indeed, the genus Cecropia, of the mulberry family, contains the most distinctive trees of the New World Tropics. It comprises thirty to forty species, distributed not only over the entire length and breadth of the intertropical areas of the American continents but in the Antilles and other outlying islands as well. Were a wizard to drop a naturalist at random, blindfolded, somewhere within the vast sweep of the earth’s central zone, no other single group of trees would so help him decide, by their presence or absence, whether he had been set down in the Western or the Eastern Hemisphere. For over its vast range, there is hardly a district with heavy or moderate rainfall where it is not abundant. It is absent only from desert and semidesert areas and from high mountains subject to morrual frosts. Yet in the equatorial Andes it grows abundantly up to an elevation of at least 8,500 feet, and in Central America to no less than 6,000 feet. Most common in the clearings and light second-
not ten men alive who could correctly name at sight half the species of trees in an acre of well-developed virgin forest anywhere in the tropical lowlands of the American continents. How refreshing, then, to find a tree so distinct from all its neighbors, in foliage, bark, form, and half a dozen other well-marked characters that there is scarcely any possibility of confusion! Any intelligent lad from some far northern land, sent with only a written description to a tropical forest and told to bring back a specimen of a Cecropia tree, should be able to pick it out unaided and at first sight. I know no other tree of the tropical American forests for which I would hazard the same statement.

The Cecropias are small, medium-sized, or rarely (for the Tropics) tall trees, never attaining the height of the giants of the forest, nor even remotely approaching them in the girth of their slender, graceful trunks. The bark is smooth, light-gray, whitish, or greenish in color and prominently ringed, at intervals of a few inches, with narrow ridges—wars left by the fallen bud-sheaths. This smooth, light-colored, strongly ringed trunk alone serves to distinguish the Cecropia from nearly all its neighbors. At its very base, where it bears the ground, the trunk becomes slenderer instead of thicker; and the deficiency in girth and strength is counterbalanced by the presence of numerous prop roots, sometimes springing from the base as high as 4 or 5 feet above the earth and descending obliquely until they enter the soil and ramify through it. Prop roots are not peculiar to the Cecropia—many other diorthoeholous trees, many palms, the pandanas, and even the maize plant have them—but they will distinguish it from the vast majority of the trees among which it grows. The boughs of the Cecropia are coarse, stiff, and few in number; the lowest branches usually springing from the base well above the ground. The branches are distributed in loose clusters, or false whorls, three to six together, with long stretch of branchless trunk between. Like the trunk, the obliquely ascending boughs diminish little in thickness from base to top, and they bear few branches of the second order.

If the leaves were small, such a branch system would produce a stiff and awkward tree; but on a well-developed Cecropia all suggestion of stiffness is prevented by the generous breadth and grace of carriage of the foliage. The ample leaves, sometimes a yard in diameter, are held in a more or less horizontal position at the end of yard-long, rounded stalks. They are plicate, rounded in outline, divided by deep and narrow indentations into long radiating lobes, and in some species alivyon on the lower sides, presenting a pleasing and characteristic aspect when tossed up by the wind. Rarely, as in Cecropia grandifolia of the eastern foothills of the Andes, the lobing has been developed to the point where the leaves are divided into distinct, stalked leaflets, all radiating from the end of the long common stalk, like those of the horse-chestnut tree.

The flowers, minute and individually inconspicuous, seem unworthy of a tree with such pronounced and individual characters. Yet in their arrangement they too are sufficiently distinctive. They are closely crowded in fingerlike aments, or catkins, in some species short and stubby, in others long and slender, sometimes twisted. These fingers are borne, in clusters of four or more, at the end of a common stalk, which may be short and stiff or long and pendulous. Male and female catkins are produced on separate trees, the former whitish and soon falling, the latter green and persistent, scarcely altering in appearance as their myriad florets swell into tiny one-seeded fruits. Each cluster of aments develops within a close-fitting sheath, which is white within and often has an attractive shade of pink or red on the exterior surface. This sheath splits along one side and drops when the flowers are ready to shed, or to receive, their pollen. It is the most colorful part of the tree.
A few words about the ecology of the Cecropia will help us to understand some of its peculiarity of form, especially its system of breeding. It is a tree seemingly adapted for the colonisation of denuded lands, whether these be a new clearing in the forest, an abandoned patch of cultivation, a flood plain along the shifting course of a great river, or the long, narrow band of bare earth streaked upon the mountain side by a landslide. On such areas, tropical vegetation wears its best hue, most riotous and undisciplined aspect. The competition among the colonizers is exceedingly keen; the slow-growing seedling, although of the noble lineage of the forest, has slight chance of success; victory—immediate victory, at least—favors the plant that can keep its "hand and shoulders" above its rivals and so enjoy full exposure to the strengthening, giving sunlight. A widespread, many-branching plant is likely to be overshadowed and crushed down by a tangled mat of vines and creepers. The successful tree must not only grow rapidly in height, but it also must be sparing in the matter of breadth, hugging itself together lest it waste much-needed energy in exuberant growth and give the eager, grasping vines a hold on itself. Such a tree is the Cecropia. Seemingly content only upon outgrowing its coarse pupa, in crowded tangles it may attain a height of 20 or 30 feet, or even more, before it ventures to extend a single branch. Its ample leaves, each of which seems capable of the photosynthetic work of a whole spray of the smaller leaves of a northern plant, fail when their activity is taken over by younger leaves above them, thereby giving the creepers no permanent grip upon the tree. So great is the heliotropism, or unwavering impulse, of the vigorous young Cecropia that its slender stem is commonly dilated upward and, like so many other tree, is thickest at the top, in the succulent green portion just below the apex. The invertebrate taster of the tree is a tree-crab, later when, when the tree has won the victory and spread its branches proudly above the rival vegetation, in part by sheer thickness, in part by the development of the stout prop roots at the base.

Such, then, are the appearance and mode of growth of the most highly individualistic tree of the American Tropics. We have already discovered, in its very liniments and most obvious outward vestiges, enough idiosyncrasies for any one tree. Yet we have scarcely begun to explore its peculiarities. Notice the branches of a Cecropia, and a host of small, brown or blackish, ants seen emerging out through narrow, symmetrically placed orifices. They run hastily over bark and leaves and on to any object touching them, each biting with all its small might: if it meets the body of an animal, cut through the young stem or a branch with a single sharp blow of the machete, and the severed end reveals a central hollow, left by the almost complete breakdown of the pith, wider than in any other young woody stem I know. Or stand quietly watching a stem of one of the ant-inhabited species. A keen eye will soon notice that each of the long, hollow leaf stalks is swollen at the base, where it touches the stem, on the lower side, into an angular, lance-like protrusion which is covered with brown hairs. After years devoted to the collection of tropical plants, handling thousands of species, I can recall no other tree with just such a leaf base. It would be remarkable by itself. The white, little white bodies, each about the size and shape of a small ant's pupa, that stud it over, like little white balls stuck up to the boil in a brown velvet pineapple. Watching patiently, one may be fortunate enough to see an ant in its hole, touching with its antennae one after another of the little white bealls, until it finds one that is ripe, plucks it off and, carrying it into the hollow center of the branch through one of the small apertures. These, constituting the special food of the ants, are the protein bodies, often called Müllerian corpuses in honor of their discoverer.

In harboring a colony of ants within its living tissues, the Cecropia is not unique in the vegetable kingdom. It belongs in a motley group known as the myrmecophiles, or ant-loving, plants. Like the other natural phenomena, the Cecropia can be most intelligently understood if we consider it in relation to the class of objects of which it forms a part.

The myrmecophiles plants have only a single feature in common: the habitual occurrence of colonies of ants in hollow living organs, which, in many instances, appear to have been specially developed for the accommodation of the insects. All or nearly all these plants are of tropical distribution. As a rule a particular species of ant is found in each true myrmecophiles plant—and sometimes the ant is restricted to this peculiar habitat—suggesting that the myrmecophilous habit was developed in relation to this particular kind of guest and that the plant has not merely chanced to produce a hollow organ open to tenancy by the first small insect that happens by. The myrmecophilous plants are scattered sparingly through a considerable number of unrelated families—Rubiacae, Piperaeae, Moraceae, Boraginoeae, Polygonumae, Melastomeae, Verbenaceae, Mimosaceae, etc.—indicating that they are not genetically related, but that the habit has developed independently in many distinct lines. The nature of the organs in which the insects are accommodated is as diverse as the families in which the myrmecophilous plants are classified. Perhaps the most common situation of the ant colony is in a stem left hollow by the breakdown of the central pith. Such ant-filled stems are found, in addition to the Cecropia, in the beautiful tree Averrhoa (Tripeparia) and in certain arborescent species of Piper. In Cordia alnoides the insects find shelter in gall-like hollow nodules, situated at the point where several branches depart together from the end of a thinker twig. In certain tropical melastomes (Fouquieria) they dwell in paired hollow lobes at the base of the leaf blade, each with a narrow orifice on the lower side of the leaf. In some Central American species of Piper they establish themselves in the long, narrow hollow formed by stipules that have conjoined with the petiole, thence making their way into the stem and emptying out into the empty central pith. In the bullhorn acacias the ant colonies are established in the great, hollow, horn-like hollow thorns, from which the curious little trees take their name. The hollows of the paired thorns communicate at their base, and one or more of each pair is provided by the ants with a small round aperture for going in and out. Perhaps the strangest of all the myrmecophilous plants are two epiphytic genera of the madagascan family, Hydnophytum and Myrmecodendron, natives of the Indo-Malayan area, whose curiously swollen stems are penetrated by a labyrinth of winding galleries in which the ants dwell. In eastern Costa Rica I found a species of polyopody form, not yet identified, whose slender stems, creeping over the mossy branches of trees, bear numerous brown gall-like bodies, about an inch in diameter, each with a doorway leading into a central hollow infected by tiny, stingless ants.

As a rule the host plant makes no special provision for the board of its lodgers. But in some instances the ants attend ophiads that suck the juices of the plant, which thus indirectly provides for the support of its guests. Perhaps the most hospitable of all these myrmecophiles are our Cecropia and the bullhorn acacias, which provide a special food for their guests in the form of small white, protein corpuses. In the Cecropia these tiny, many-celled corpuses are, as we have seen, liberally produced in meagre crops, on the composite base of each leaf stalk. In the acacia a single elongate, white food
particle terminates each of the myriad little leaves of the two-compound leaf, and once it has been pinched away by the ants that dwell in the hollow thorns at the base of the leaf it is not replaced. The food-bodies of the acacia are sometimes called hyphae, in honor of Thomas Dela, who first made them known to naturalists, just as Fritz Müller first described those of the Cecropia.

Of the ants regularly associated with these myrmecophilous plants, some are fierce and aggressive; but many are among the smallest, weakest, most docile and sluggish of their kind. They rarely if ever devour the foliage of their host plant or make indiscriminate attacks upon its living tissues. Some botanists believe that these ants benefit the plants in which they find shelter, by driving away feeding-insects, breathing mammals, and other enemies of vegetation. If this were correct, the association between ant and plant is one of mutual benefit; but the plant provides a lodging and sometimes also food for the ant, which in turn protects its host from attack. How true this is in the case of the Cecropia we shall now examine.

Of all ant-plants, except possibly the epiphytic myrmecophilous members of the malv family, which I have never seen in their native haunts in the Oriental Tropics, the Cecropia appears to be the most highly specialized. In other words, it seems to have made a greater effort to attract its ant guests than any of the ant-loving plants.

Three unique features make it especially favorable as an abode of ants:

1. A remarkably wide central hollow in the stem. Hollow stems are common in hackberries than in woody plants; but except the bamboo no woody plant I know possesses, in undecayed young shoots, a central cavity, so wide as this. Vigorous shoots often have a cavity fairly two inches in diameter—surrounded by walls only one-sixteenth of an inch thick—and this is to be found only a few inches below the growing tip of the shoot. When the tissues immediately surrounding the cavity become hard and resist-ant. When old fallen trunks decay away, this is the last part of them to disappear. The hollow internodes, with their enclosing walls and transverse partitions, remain lying on the ground like a chain of whitish, elongated, cylindrical boxes, or like the bleaching vertebrae of some huge ribless serpent.

2. The presence, in the wall surrounding the hollow that encloses the central cavity, of a pit, where the ants find it particularly easy to open a doorway. At the upper end of each of the short internodes, directly above the point of insertion of the leaf next below, is the small, somewhat elongate depression. The tissues separating the bottom of this pit from the central hollow are even thinner than the wall elsewhere; and they are composed of soft, thin-walled cells, vascular bundles being absent here. The ants find it easy to gnaw through the bottom of these pits; and in a tree inhabited by a Borassus colony, each one becomes the site of a doorway through which the insects pass in and out. Schliemper laid special stress upon these pits, pointing out that they were present in the species of Cecropia habitually infested by ants but absent from those that had not developed the myrmecophilous habit. Similar pits are said to occur in the walls of hollow-stemmed plants of other genera not inhabited by ants, but they are certainly very rare. I have never seen any plant other than Cecropia with such pits.

3. The protein grains at the bases of the leaf stalks. Although such corpuscles, which are of the nature of plants, occur on other plants, some not ant-plants, they are very rare. The only other plants upon which I have seen similar protein corpuscles are the bull-horn acacias, with their hollow thorns inhabited by fiercely stinging ants. In the Old World Tropics they are said to be found in the rubber tree, a species of cassia, where they are produced in tiny pitchers at the bases of the leaves; and on the long shoots of climbing species of Erythrina, which apparently do not attract ants.

Here, associated in the same tree, are three features—importantly wide central hollow, pits, and protein bodies—that although not unknown in plants not myrmecophilous are so rare that only one or two species are known. Not a few species of the Tropics for months or even years without finding—a part from Cecropia—any one of them alone, nor yet, are the chances for a random association of the three in the same species? About as good, I should say, as finding, while wandering through an uninhabited wilderness, an inn whose lower story has been opened at a tap, and led to a table excellently spread, and a bed prepared for the weary traveler. It is easier to believe that the Cecropia has developed these three rare features not by chance—in the sense that they are unrelated—but rather through natural selection, because they are useful in making it an attractive home for the ants that protect it from its enemies. Such was Schliemper's view. Let us see now how effective in guarding the tree the ants really are.

We may as well begin by considering the effectiveness of these Anteeas in guarding their home tree against those creatures most destructive to vegetation—with shame I write it—to themselves. As one of the abundant plants in the tall second-growth thickets, which in the Tropics are cut and burned to make fields for maize, rice, and other crops, the Cecropia is also subject to attack by the long machete of the agricultural laborer. The partition of ants serves not at all to protect the tree—and themselves—from destruction by his swinging blade; Cecropia trees are leveled indiscriminately with all the楼市 growth of giant herbs, bushes, vines, and other trees among which they form so conspicuous an element. The swaying laborer is indeed often bitten by the Anteeas, but it is only a few of them who bite; for they are among the less formidable of the hosts of ants of many kinds and habitats whose bites and stings—along with those of a variety of other insects—are an inseparable accompaniment of his toil. Pet the Anteeas can only bite with their mandibles. Their mode of attack is entirely mechanical; no venom is injected into the victim. Ants capable of inflicting really severe punishment sting, like bees or wasps, with the end of the abdomen, injecting a drop or so of formic acid. Neither biting ants nor biting bees—of which tropical America contains many kinds—command the same respect as their stinging relatives. I would rather endure the gnawings of a score of ants from the Cecropia's ants than one fierce sting of the long, slender ants that dwell in the bull-horn acacia, or, for that matter, of one of the tiny brown fire ants so annoyingly abundant about houses and lawns in tropical America. The Anteeas, weak and not particularly agile, are seriously inconvenienced by hair nozzle not that on the back of a man's wrist. A few of them biting away at the rough skin of a man's hand or arm causing him much discomfort.

Cecropia trees are as a rule left unmolested by man, except when he is clearing land for farming and other purposes, largely because they are of little use to him. Sometimes a segment is removed from a felled trunk, exposing the central hollow, which then serves as a gutter for conducing water—perhaps the only available substitute for a pipe in forest communities remote from both steel mills and native lumber. The tough fiber in the bark is sometimes twisted into rope or used for making hammocks; but where the bate (Heliconia) or the jute (Tanca), are available, the Cecropia is rarely disturbed for this purpose. The choice is determined by the superior fiber of the latter, not by the ants in the last. Yet the botanist will admit that Cecropia trees are unpleasant plants to collect; if the ants are individually...
not formidable, their very abundance is troublesome.

One has only to watch an Avecla ant weeder at his job among the hairs of his forswarm to suspect that on the body of a furry animal the insects would be as incapable of rapid and effective action as a man might be in the midst of the deers of a newly felled forest. Mammals of several kinds consume large quantities of the foliage of the Cecropia. The howling monkeys—these agile browseres of the tree-tops—are fond of its great leaves and the tender catkins, and in regions where they abound their vociferous bands are often seen among its branches. When first, in another banana, I studied Nature in the common range of the Cecropia and the howling monkey, I was reluctant to believe that the peculiar trees in which the monkeys foraged were indeed infested by ants. It seemed more likely—to one influenced by the writings of Schlimpery—that they had somehow escaped attention from the Aveclae. I recall vividly how, years ago, I cut into the trunk of a tall Cecropia, whose growth in

leaves of a certain tree (Brouallia cosusensis) too often for it to be considered a mere matter of chance. Of five three-toed sloths that I saw in one day, while paddling along a lagoon in western Panama, four were in Cecropia trees. One of these, a female carrying her baby upon her breast, was descending the trunk of a Cecropia that had been defoliated to the last leaf. In eating, as in other activities, the sloth is quite as slow and deliberate as its name implies; a single large Cecropia leaf will engage its attention for half an hour or more; and a denuded tree indicates long and persistent activity by the beast. One might suppose that the Cecropia would produce leaves faster than a sloth could consumme them. Like the monkeys, the sloth devotes a large share of its waking hours to scratching, with a steady, deliberat, mechanical action that scarcely reveals any trace of irritation or of feeling. In this instance, too, the source of irritation appears to be other than the Avecla ants, which can scarcely find their way through the beast’s coarse, dense pelage. When seated with its meal of foliage and finished with its scratching, the sluggish creature seeks the crotch of a stout limb, beaks its back forward until its short, dull face is hidden between its forearms, and remains quietly sitting and slumbering upright in the fork, a motionless mass of gray hair, all oblivious of the ants that crawl over the limbs all around it.

Birds of many kinds visit the Cecropia tree, either to rest among its branches—where the ants appear never to molest them—or for more special purposes. The thick green, fruiting catkins are a food attractive to fruit-eating birds as diverse as oropendolas, tanagers, barbets, orioles, and finches, which help scatter the tiny seeds far and wide and are responsible for the far-flung distribution of the tree. In the upper Trraba Valley of Costa Rica, these catkins are probably the most important food of frugivorous birds during the early months of the year, when fruits of other sorts are scarce. Other birds, from big squirrel monkeys to little wintering wood-warblers, seek the varied insects that thrive upon the succulent foliage. Although its coarse, open branch system makes the Cecropia a poor site for nests, yet a few kinds of feathered creatures build their homes upon it and raise their families without molestation by the ants; just as birds of more numerous kinds place their nests in the tall-horn acacias, evidently taking advantage of the protection afforded by the fiercely stinging ants that dwell in the thorns. The bulky, domed nests of the chipmunk flycatcher (Myiascheta simus) are not infrequently built in a crotch of a Cecropia tree.

Most of the feathered visitors to the Cecropia tree are beneficial, either in scattering its seeds or in removing insect pests. The theory that the Avecla ants are present as a standing guard of Carabaeus, and require that they keep their birds away. But one bird that habitually frequents the Cecropia, and certainly does it more harm than good, is attracted by the ants themselves. The big pilate woodpecker (Cedro belenana), a black bird with a flamboyant scarlet crest, fierce young trunks and the slender branches with its powerful chisel bill, to extract the ants and their pupa from the hollow center, now and again passing in its work of perforation and extraction to pluck off great numbers of the unfortunate Avecla that swarm over the bark. In widely scattered portions of its range, I have times without number watched these myrmecophagous woodpeckers at its feast. These ants are an important constituent of the bird’s diet. Like those other ant-eating members of the family, the flickers, the pilated woodpecker feeds its nestlings by regurgitation. This mode of bringing food to the nest is least prevalent among the New World woodpeckers than that of carrying it in the bill and has perhaps been developed in relation to the smallness of size of the individual particles that form the diet of those kinds abundant largely upon ants. The holes made in the branches and young trunks of the Cecropia are closed at length by wound tissues that eventually form great tumorous protuberances, but many young trees break across at the point where they have been pierced low in the stem. Trees that have received much attention from the woodpeckers are less flourishing than their undisturbed neighbors, while their ant colonies are greatly depopulated. In regions
AN OROPECTODICA

THE NO ONCE ON THE ORCEDES KAT'S FEETING CATER ON COROPEA. THE IS A YOUNG BIRD

where the woodpecker is abundant, it is in
crreditable that the ants can be of sufficient
service to the tree to compensate for the
tremendous injury that their presence brings
upon it.

To the piloted woodpecker the Corocista
is inuring in proportion to the number of its
ants it shelters; but to a number of small
birds of quite different tastes it is most at
tractive when the Ants are few or absent.
For only in the absence of the ants do the
little white protein corpuscles become abun-
dant and prominent on the furry cushions
at the bases of the petioles; and when this
occurs they offer a dainty food to a variety of
small birds. I have watched twelve species
take advantage of this food. The little, yel-
low-breasted Mexican honeyeater (Coroche
e maculina) is fond of these Säbä, which may
form a not unimportant article in its diet.
In parts of its vast range as distant as Costa
Rica and Ecuador I have repeatedly seen the
bird pluck off the minute white bodies with
the sharp tip of its strongly curved
black bill. The Páraiba warbler of the Tropi-
cal (Compacippithys poliocephalus) feeds upon
these dainties; while such wintering members
of the family as the Wilson warbler (Wi-
sonia parva), the Tennessee warbler (Ve-
mivora perligrina), and even the thicket-

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hunting mourning warbler (Opurovus phil-
delpheus) have also discovered their secret.
Among finches, the Mexican griseo (Tissrus
olivaceus) and the seedeaters (Sporophila
sp.), sometimes eat them; among tanagers,
the euphonias (Tasania spp.) and the blue-
rumped tanager (Celaopis gorgyroides); white
in the highlands of Costa Rica the green
little ovenbird known as Lawrence’s
spinetail (Acerocichla erythrospilus) consumes
them in numbers. In this same region dwells
the biggest bird that I have seen eat the
protein bodies, the yellow-thighed sparrow
(Paúlophorus tibialis), which is a flesh as
large as the toco. In the incessantly wet
mountains where the spinetail and this spar-
row dwell, the hollow stumps of the Corocista
are much of the time flooded with water,
with the result that they contain no ants to
share the protein bodies with the birds.

The ants of these small birds are of no
importance to the tree, nor do they help us
to decide whether the Ants ants form an
effective guard; yet their presence is fur-
ther evidence of the multiform bounty of the
Corocista.

But it is not in defending their home

tree against birds and four-footed animals,
so much as against the depredations of other
insects, that Schimper supposed the garrisons
of Ants ants to be of greatest service. Yet
frequently one sees a Corocista with its folli-
age more or less damaged by leaf-eating in-
sects. Sometimes the softer tissues of the
great leaves are all but consumed by a bud-
worm, even on trees with a thriving colony
of ants. My own observations, made largely
north of the Equator, are in full accord with
those of Karl Pickrig, who years ago, from
studies made in Paraguay near the southern
limit of the Corocista’s vast range, concluded
that the ants were destructive in protecting
the trees from a variety of insects and their
larvae.

But in the Tropics perhaps no insects as a
class are more injurious to vegetation than
ants themselves. Abundant as these crea-
tures are in the Temperate Zones, no one
who has not actually lived in the tropical
lowlands can form an adequate conception
of their numbers and variety in regions of
warmth. From evecies in the soil and the rocks to the topmost branches of the
great forest trees, they swarm everywhere in
unbelievable variety and abundance. At
times one’s dwelling will be invaded by a
host of leafcutter, or army ants, which flow
like a stream through every nook and cranny,
seeking out the small creatures of every kind
on which they prey. These carnivorous
legions perform their generally beneficial
work of clearing the house of vermin and
pass on; but smaller ants of various kinds
are always present; and no food escapes their
depredations unless stored in a sealed con-
tainer or in a cabinet with legs set in water.
The nests of these tropical ants are of the
most astounding variety. Some are placed
in the ground; some hang like great gray
stalactites from the lofty boughs of trees;
some occupy hollow dead branches; others
are wove of finest silk secreted by the lar-
val ants, among living foliage skillfully at-
tached to the walls. It is not surprising
that the growing organs of many spe-
cies of plants should have been discovered
and occupied by ants, which during the
course of ages became specially adapted to
life in these snug retreats, and in turn gradu-
ally produced changes in the structure of the
host; thereby developing the curious phe-
nomenon of myrmecophily.
The agriculturist in the Tropics wages a
never-ceasing war against the battalions of the
ants. They devour his seeds if germina-
tion is slow; they bite the young tender
tissues of plants, enlarge evecies in the back
of fruit trees for their nests, damage young
sprouts by covering them with earth, spread
mild mela phis over his sugarcane.

Since turning attention to practical agriculture in
the Tropics, I find it increasingly difficult to
hold faith in Schimper’s view that the extra-
fles of trees as common in the plants of the
warm regions are of service by attracting
beneficial species of ants. I have never
known a bigbunadb in tropical America
who had a good word for the ants. Yet in
the Orient the situation may be different.
In Japan and China certain districts collect,
in the forest and among the trees along
the seacoast, nests of a kind of large and fierce
red ant, which they hang in their mango
trees. Hence the ants protect the develop-
ing fruits by devouring the larvae of a beetle
(Cryptocephales monstrosa) capable of
causing great damage. The Javanese are
said to attend these red ants with care, pro-
viding flesh to suit their carnivorous tastes,
destroying other kinds of ants that are hos-
tile to them, and joining the mango trees
by bridges of bamboo to facilitate the
insects’ visits to all parts of the grove.
In ancient times the Chinese orchardists col-
lected and propagated ants, which they
placed in their oranges and tangerine trees
to keep them free of evecies. There was
actually a special class of laborers who col-
lected the ants.

But these husbandmen of the Far East
never had to contend with the leaf-cutting
Attas, which of all ants in tropical America
does most conspicuous injury to vegetation.
The nest of these brown spiney ants is made
underground, and with time it becomes a
far-flung labyrinth of chambers and inter-
communicating tunnels, beneath the wide
bare mound of earth thrown out during the
early course of its expansion. From the mound
as a center, narrow, well-defined pathways,
kept clean and bare of vegetation by the
ants, extend far and wide over the neighbor-
ing terrain. Along these myrmecina high-
ways a stream of ants is constantly flowing;
huge jow, deliberately stalkling soldiers,
slender workers of medium size hurrying to
their tasks, and tiny ants whose function is
not at once apparent. Those traveling out-
ward from the nest go unburdened; but in
the returning stream a large proportion of
the workers bear in their jaws pieces of
green leaf far larger than themselves, rising
above their backs like irregular standards or
subtackes. Hence comes the name, tigermu,
palms ants, sometimes applied to them.

Each bit of leaf is cut by the scissorlike
mandibles of a worker ant from the foliage
of a growing plant, whether tree, shrub, or
herb. As it is borne along by the worker
toward the nest, another smaller ant, or
sometimes two or three together, may be seen
clinging to the already huge burden and
being carried toward the mound. With less
these riders are attempting to bear the bur-
den themselves; but the strongest of those
attached to the bit of leaf is the guide, who
leads the workers into the air and marches off
with both cargo and assistants. Arrived at the
nest, the pieces of leaf are carried into the
subterranean chambers and out by the jaws of the ants into soil pits, which form a sort of compost heap, upon which a special kind of fungus is grown. The ants eat, not the leaf, but the fungus spawn, which produces a peculiar fusion of minute, knoblike bodies in white, fluorescent masses. It is supposed that the duty of the smallest class of workers is to weed the fungus gardens, removing all kinds of fungus growths except that upon which the population subsists. When they have served their purpose, the discarded bits of leaf, far from being eaten, are thrown out upon midden heaps near the entrance to the burrows.

Though these ants make use of the foliage of a great variety of plants native to tropical America—indeed, these were the only kinds available to them during the long centuries before Europeans, following Columbus, brought the products of the Old World to the New—some writers have thought they detected a special fondness for the leaves of cultivated species introduced from the Eastern Hemisphere. This seeming preference may be caused by the circumstance that in plantations, where little variety is within their reach, the Attas make severe attacks upon the dominant plant. A coconut plantation is a law may almost deluge the nearest ornamentals, whereas in the forest, with so many plants of so many kinds available, they show slight preference for particular species, and their injury to the vegetation is less evident. But it is certain that in many districts they cannot profitably grow crops, or enjoy beautiful shrubbery and flowers about their dwelling, without raising war-like sentiments against the leaf-cutting ants. Great care is taken to plantations employ squads of men for the sole purpose of destroying their nests, either by pumping poisonous gases into their leaf-cutting galleries, or by digging them out, leaving them in an enmity toward these fellow agriculturists even as he proceeds to destroy them; but he knows very well that he and they cannot both make a living from the same farm.

Are the Aztecs ants of the Ceropia tree an efficient means of destroying the destructive leaf-cutting Attas? Schleicher believed that they were. Examine a hundred Ceropias, in a district where leaf-cutting ants abound, and few if any will show severe injury by them. But the same would be true of any other kind of tree, native or introduced, except in plantations and doorways where the bare soil invades the establishment of Attas colonies, and they have little variety of vegetation to choose from. Rarely the Attas make great inroads upon the foliage of a Ceropia; cutting away the great leaves until only the principal veins remain, each margined by a narrow strip of tissue with circular indentations that reveal the ants’ mode of work. I have seen such depredations on Ceropias that supported a flourishing colony of Attas.

For several months I have been looking for a Ceropia that gave evidence of the work of the Attas but without success. This might be construed to favor the theory of mutual protection; but I have also failed to see the leaf-cutting ants at work upon a Boris (Heliconius), a soft-wooled, swift-growing tree of the same habitat as the Ceropia, and of as large that solid stem that provide no accommodation for ants. The Attas are happily not very abundant in this district, except in my experiments, a foreboding. Finally, in order to witness what would happen when Atta and Ceropia tree met and placed them upon the stem of a young Ceropia tree. The occupants were mostly in doors, and the unintentional trespassers wandered aimlessly about without meeting them; so I shook the sapling to bring the Ceropia outside. The little ants came pouring out their narrow doorways and raced about over stem and leaves, as if seeking the cause of the disturbances. Many of them passed close by the Attas; and often they ran beneath the long-legged brown ants, without paying any attention to them. This might happen a number of times, and the interlopers remain for several minutes unchallenged in the midst of the swarm of Attas. But sooner or later an Attas would seize an Attas by a leg, or more rarely by the body, and then one of several things might happen. Sometimes, in a manner difficult to understand, the tiny Attas would throw the big Atta from the tree, retaining its own hold. For other cases the Atta would continue until the unequal adversary fell, clutched together, to the ground. Or, if the struggle was long-drawn-out, other Attas, coming into the contestants would join the fray. They might make of the smaller ants against an undisturbed Atta and pass on, every one that came within touching distance of an ant already attacked would at once seize upon it. Soon the unfortunate leaf-cutter would be in the midst of half a dozen angry little Attas, pulling out its long legs this way and that, biting its hard brown body, until at length the whole writhing mass fell from the tree. Some of the Attas, especially the larger workers, easily repelled each attacking Atta with a single nip of their powerful mandibles and went wandering around until they reached the ground.

The same was true of some large black ants with golden abdomens that I found on the Ceropia trees—the Attas were helpless against their strong jaws. There is no doubt that the Ceropia tree’s garrison of ants attempts to repulse invading ants, in many instances with success. But if they are not stirred up, as in my experiments, a foreboding. The Attas placed one by one upon the Ceropia were lost, aimless, far outnumbered. From what I saw it was not difficult to picture a wide organized column of them marching the trunk of an otherwise undisturbed Ceropia and cutting the leaves, without meeting real resistance. The little ants came pouring out their narrow doorways and raced over stem and leaves, as if seeking the cause of the disturbances. Many of them passed close by the Attas; and often they ran beneath the long-legged brown ants, without paying any attention to them. This might happen a number of times, and the interlopers remain for several minutes unchallenged in the midst of the swarm of Attas. But sooner or later an Attas would seize an Attas by a leg, or more rarely by the body, and then one of several things might happen. Sometimes, in a manner difficult to understand, the tiny Attas would throw the big Atta from the tree, retaining its own hold. For other cases the Attas would continue until the unequal adversary fell, clutched together, to the ground. Or, if the struggle was long-drawn-out, other Attas, coming into the contestants would join the fray. They might make of the smaller ants against an undisturbed Atta and pass on, every one that came within touching distance of an ant already attacked would at once seize upon it. Soon the unfortunate leaf-cutter would be in the midst of half a dozen angry little Attas, pulling out its long legs this way and that, biting its hard brown body, until at length the whole writhing mass fell from the tree. Some of the Attas, especially the larger workers, easily repelled each attacking Atta with a single nip of their powerful mandibles and went wandering around until they reached the ground.