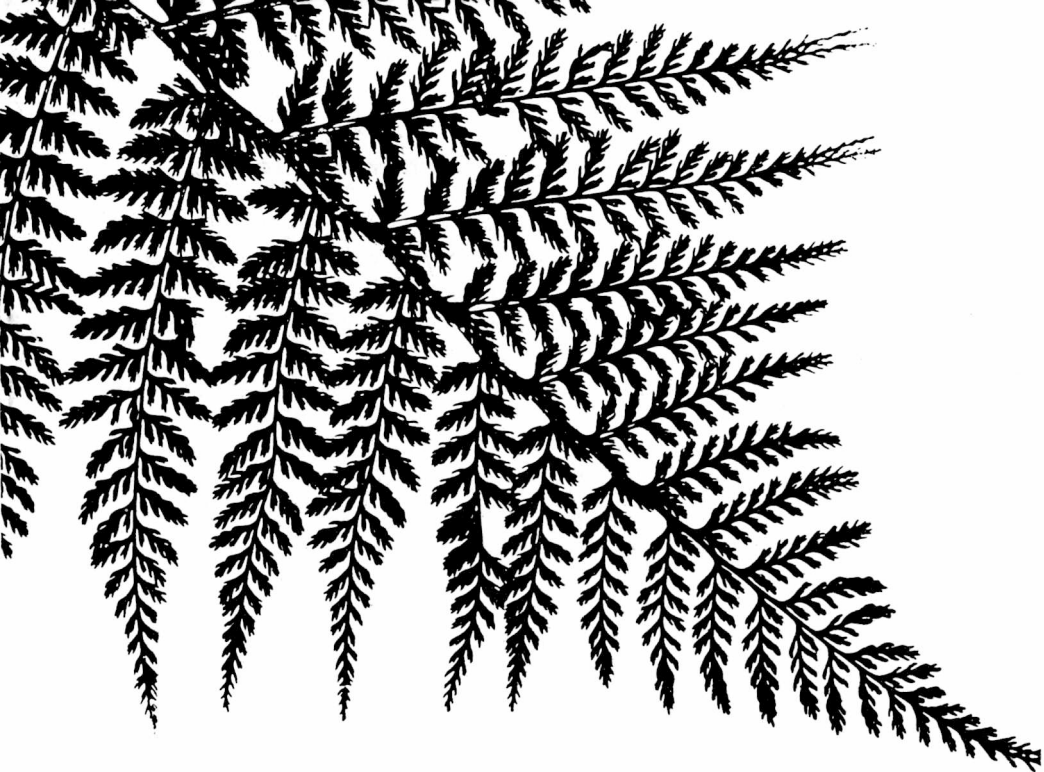




Kipuka Puau

SELF-GUIDING NATURE TRAIL



Hawaii Volcanoes National Park

January, 1965 •



Walking Time—approximately 1 hour

This pamphlet is a key to the numbered stakes which you will see along the one-mile trail. You may keep it if you wish, or return it to the holder at the end of the trail. The pamphlet is provided by the Hawaii Natural History Association so that you may have greater appreciation through better understanding.

In the maze of lava streams that pour out during Hawaiian eruptions, areas of older surface often escape cover by successive flows. Where an area is thus spared but nevertheless surrounded by a newer lava, a *kipuka* is formed. the word *kipuka* also means a loop or open space in a forest.

The soil in Kipuka Puauulu is composed of accumulated volcanic ash. Subsequent lava flows have covered most of these ash deposits but "islands" such as here and at Kipuka Ki were spared. If a large *kipuka* such as these is effectively isolated for a long period of time the plant inhabitants develop characteristics that reflect the nature of their history and environment, and a distinctive flora is evolved. This is true of Kipuka Puauulu which contains over 20 species of trees within its 100 acres. Botanists have long studied the treasures of Kipuka Puauulu; it is a significant place in the world of plants. Nowhere is there to be found a more dramatic example of the interplay of geological and biological forces, the intimate relationship between rock and plant.

The name *puauulu* has been variously interpreted. *Pua* means flower, but is also translated as a collection of things bound together. *Ulu* means to grow; it is also the name for breadfruit, a meaning which here seems inapplicable.

Kipuka Puauulu is a favorite bird haunt, hence the often applied nickname, Bird Park. Four common native birds, the *apapane*, *ūiwi*, *amakihi*, and the *elepaio* are illustrated in the exhibit at the trail's start. Other birds will be seen and heard along the trail. Since the birds forage in the lofty canopy of trees, and sing little during midday, patience and quiet are necessary for observing these interesting subjects.

Please help preserve this primitive scene by placing refuse in containers provided and by refraining from disturbing plants or natural specimens.



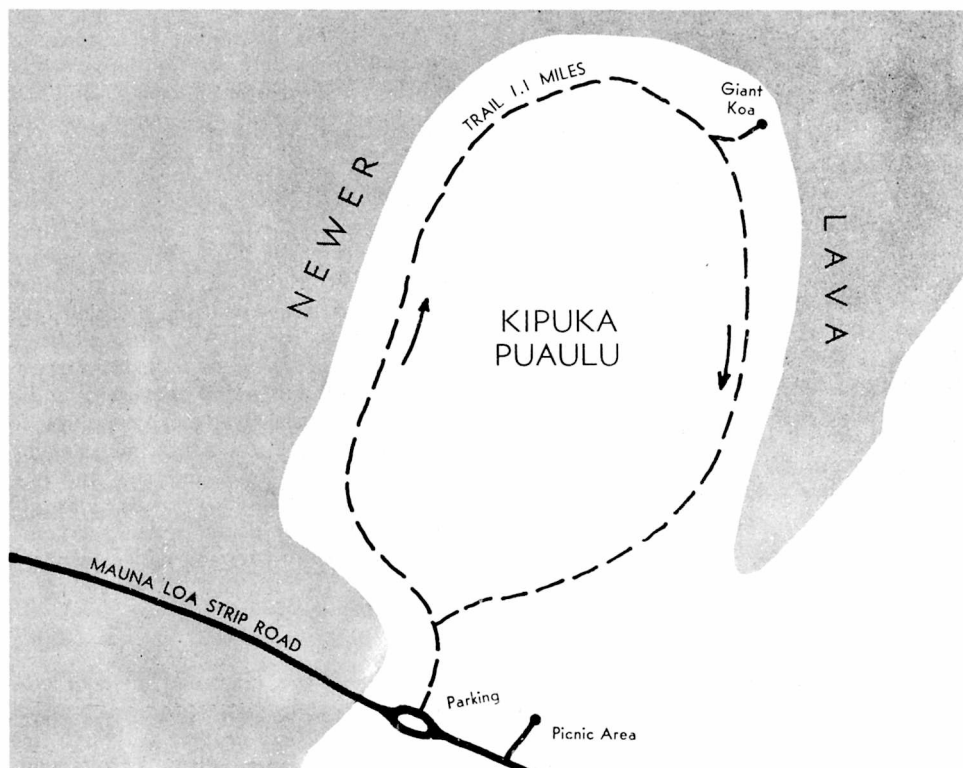
Aalii with capsules

1. You are now standing upon a recent lava flow a few hundred years old which surrounds Kipuka Puaulu. Hardy mosses and crusty lichens visible on the bare rock surface before you are often the first plants to occupy new lava. These tiny plants are

among the first agents to form soil—by secreting acids which attack the hard rock. Ferns and grasses are quick to grow in crevices and sheltered spots on the barren lava. In time they contribute their remains to a growing soil.

Aalii (*Dodonaea* sp.), the shrub before you, is one of the commonest roadside shrubs in the park. The seed capsules were used for leis and as a source of red dye by the Hawaiians. Spears were fashioned from the durable wood.

Look for bare outcroppings of smooth, ropy lava along the next 50 feet of trail. This lava, called *pahoehoe*, resulted from a cooling skin being dragged along by still molten, advancing lava beneath. Because of its relatively, smooth, unfractured surface, plants find it considerably more difficult to get a foothold on *pahoehoe* than on rough, blocky lavas.



2. The *ohia lehua* (*Metrosideros colina*) is one of the first trees to occupy new lava flows. Unable to send its roots very far down, the tree spreads its root system widely over the lava, thus obtaining support and water. These adaptable relatives of the eucalyptus are distributed throughout Polynesia and are the most conspicuous trees within the park. Ranging from sea level to 9,000 feet, they are found as forest trees on the slopes of Mauna Loa and as stunted forms on the Kau Desert. Showy pompoms of bright red stamens make them attractive while in flower, and provide sweet nectar for the native birds.

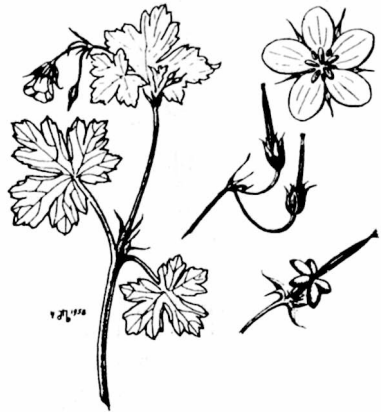
3. Standing on this rise, you are at the threshold of Kipuka Puaulu. Note the contrasting scenes before and behind you. Before you stands a climax forest, an association of trees and plants which has come to occupy this area over a long period of time and which, barring natural catastrophes, will not be replaced by another vegetation type. Behind you, the drier, scrub-bier-looking *ohia*-shrub complex represents a transitional stage.

(KEEP TO YOUR LEFT AT THE FORK IN THE TRAIL.)

4. The low, creeping plant with slender, spear-shaped leaves is called creeping dayflower or *honohono* (*Commelina diffusa*). Tolerant of shade, the creeping dayflower is important as a moisture-preserving ground cover. It is named for its habit of producing small, bright blue flowers which last but a day. It is related to the wandering-jew, a common cultivated plant on the mainland, and like its relative it roots readily at the joints.

The familiar looking fern is a species of swordfern (*Nephrolepis exaltata*). Swordferns are popular house plants, and are often used in rock gardens. They are pioneers on new lavas, and are frequently found growing in steam cracks. Like all ferns, they reproduce by releasing on the

wind great quantities of minute spores from rusty colored fruiting bodies on the undersides of the fronds.

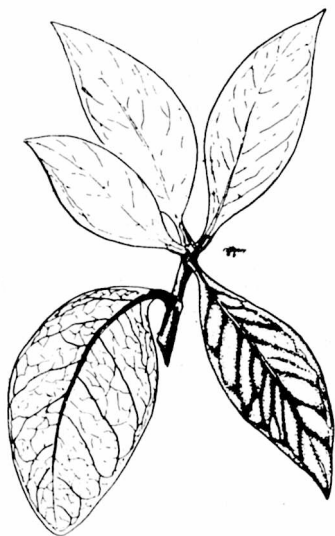


Geranium

5. Two of the commonest herbs forming a ground cover here are the native white strawberry (*Fragaria chiloensis*) and the introduced cranesbill (*Geranium carolinianum*). The strawberry is immediately recognized by its prostrate aspect and its serrated leaflets in groups of three. The strawberries are white even when ripe, and were eaten by the Hawaiians and by the *nene* or Hawaiian Goose, a native bird which is near extinction. Like all Hawaiian plants, the strawberry came from a far off land, the seeds probably carried by migrating birds and deposited undigested on the island in their droppings. Cranesbill was probably accidentally brought by man from Australia, and has long been a common weed in Hawaii. Like many other exotic species, it competes successfully with the native plants.

6. Overhead the Hawaiian olive or *olopua* (*Osmanthus sandwicensis*) spreads its glossy, leathery leaves. Although related to the cultivated olive, its fruits were

not suitable for food. The hard and strong wood was used for spears, adz handles and digging sticks.



Olopua

7. This large, handsome tree is a soapberry (*Sapindus saponaria*), named for a soaplike substance (saponin) contained within its fruits which lathers when wet. In some areas of Mexico it is still used in preference to manufactured soap, but there is no knowledge that Hawaiians ever used this readily available cleansing agent. Unlike the evergreen soapberries of tropical America, the Hawaiian forms shed their leaves in the winter. The plant may owe its wide distribution to the ability of its fruits and large seeds to float. Hawaiians gather the big, black seeds for seed leis.

As a result, relatively stable temperature and light conditions prevail. Growing within this small grove, are about ten species of smaller trees, tolerant of deep shade and well adapted to their dim environment.

9. The cosmopolitan bracken (*Pteridium aquilinum*) is probably the best known of ferns, and grows abundantly in open grassland. The native form, found from elevations of 500 to 9,500 feet, sends up its fronds from a creeping, under-ground stem. Varied use is made of the plant throughout the world as a medicine and basket material. Note how the young fronds or "fiddleheads" uncoil; this is typical of many ferns.



Mamane

10. The mamane (*Sophora chrysophylla*) is found from 2,000 to 10,000 feet on all islands except Molokai. Growing as a small tree or shrub, this member of the pea family has attractive yellow flowers and compound leaves. Livestock and wild goats eagerly eat it and have accounted for its eradication in many areas. Like other native plants the mamane receives protection in Hawaii Volcanoes National Park where stock grazing is not permitted and where wild goat populations are controlled. The hard and durable wood was used by the Hawaiians for agricultural implements and house posts, and by the kahunas, or priests, in religious rites as a symbol of authority.

8. Look straight up above you. Notice high overhead the canopy formed by the large trees. These largest trees form the upper story of the forest; their crowns, fully exposed to sunlight, coalesce to produce the deep shade of the inner forest.

11. The *kolea* (*Myrsine* sp.) was used by the Hawaiians as a source of red dye and charcoal, both of which were used to dye their *tapa* or fiber cloth. The wood was also used as timber for houses. Notice that the young leaves are reddish in color, the chemical anthocyanin imparts this color, and protects the young leaves from the strong rays of the sun.

See the familiar nasturtium growing in this area. Originally a native of Peru and more recently an escape from cultivated gardens, it now competes successfully with the native plants. Like most exotic species it is relatively free of natural enemies.

12. The *koa* (*Acacia koa*) is one of the largest trees in the Hawaiian Islands and is the dominant forest tree on the slopes of Mauna Loa. Like the *mamane*, these two widespreading trees before you are members of the pea family, and are native only to the Hawaiian Islands. The wood is hard, dark, and fine-grained. Carvings and bowls are made from it, and it is used locally in the manufacture of furniture.

13. This scarred soapberry looks as if it has endured the ravages of a fire. Actually, the tree was injured when a large branch ripped off the main trunk exposing the inner wood to the elements. A black mold growing on the trunk gives the appearance of charred wood. In spite of this deep gash in the tree, enough of the trunk's lifegiving cambium layer is intact to sustain it.

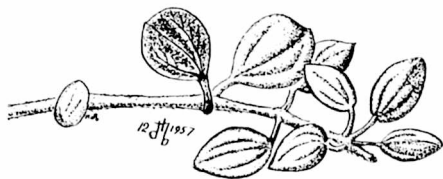
14. This ridge marks the edge of the lava flow from Mauna Loa that surrounded Kipuka Puauulu but failed to cover it. Note the difference between the forest growing on this relatively recent lava flow and that in the older *kipuka*.



Papala

15. The *papala* (*Charpentiera obovata*) is a rare, native tree in the park which is easily identified by the tiny, red flowers which hang loosely from the ends of the branches. The light, flammable wood was used by Hawaiians for fireworks. When the burning wood was heaved over cliffs, winds and rising air currents would buffet the glowing wood in brilliant display.

Notice the thick litter of leaves on the ground. These are broken down by bacteria and fungi in the process of decomposition, and are important in maintaining the rich soil of the *kipuka*.



Alaalawainui

16. The small herb with thick, succulent leaves forming the ground cover here is peperomia or *alaalawainui kane* (*Peperomia reflexa*), one of the many members of the pepper family which grow in Hawaii. See how the peperomia grows up the trunks of the trees about you. It is a successful epiphyte—a plant that grows upon another but which does not derive nourishment from it. Possessing a shallow root system, peperomia does well on the

rough-textured bark and crotches of these trees. Epiphytes are common in tropical areas of abundant moisture where competition for growing space is keen. Look for others along the trail.

17. *Mamaʻi* (*Pipturus* sp.) grows as a shrub or small tree throughout the islands especially in open woods below 4,000 feet. It was one of the most useful plants to the Hawaiians who used the inner bark for making *tapa* or fiber cloth. The small fruits were eaten as a laxative by adults and administered to children as a remedy for thrush (a mouth infection).

18. When the supply of true sandalwood (*Santalum* sp.) a chief item of early-day trade, began to run low, false sandalwood or *naio* (*Myoporum sanduicense*) was used as an inferior substitute. The true sandalwood was prized for the close-grained texture and fragrance of its heartwood, qualities which were lacking in the *naio*. Thus demand for the false sandalwood never became great, and they are still abundant. Unfortunately, the true sandalwood is now rare; some may be seen along the interesting Sandalwood Trail, not far from Park Headquarters.



Naio

19. This is a good spot to stop, look, and listen—for birds. Look up into the tops of the *ohia* trees overhead, and you may see the brightly colored *apapanes*

and *iiwis* feeding upon the nectar of the red *ohia* blossoms. These birds' protective coloration serves them well, as they are difficult to distinguish from the similarly colored *ohia* flowers. You may not always see these interesting birds, but you will probably hear them singing not far off.

By now you may have heard a peculiar sound, much like the steam whistle of a miniature kiddie train in an amusement park; if you haven't, you undoubtedly will before you finish your walk. It is the call of the pheasant, an exotic bird common in this area of the park.

20. In this open forest, the trees do not compete with each other in their efforts to obtain sunlight. Compare the wide-branching *ohia* in the distance with the narrow, crowded *koas* on the left skyline. Notice the row of slender, young *ohia* trees about 50 feet before you and slightly to your right. These "trees" are the up-turned branches of a downed *ohia* which, though fallen, still has its roots firmly in the soil. It has even sent down new roots from the trunk; each branch may thus develop its own root system and become an independent tree. In refusing to die this tree has given rise to a number of others. But even had it died, it would have indirectly nurtured new trees by contributing its body to the forest floor.

21. The pit below you is a collapsed lava tube. Lava tubes are formed when a river of molten lava crusts over through cooling, forming a shell out of which flows the still molten lava within. A tunnel or lava tube is left behind. Occasionally a portion of the tube collapses revealing what would otherwise remain undiscovered.

Here one can gauge the depth of the many layers of volcanic ash from eruptions of past centuries that have added to the soil of the *kipuka*.

22. Contrast the almost complete absence of grasses just ahead and the profusion of grasses in the clearing behind you. Only shade-tolerant trees and a few ground covering plants live in the deep forest. In these dark forests young trees are relatively free from the competition of weeds and grasses.

23. Look through the trees and see two treeferns (*Cibotium* sp.) The *kipuka* is not a particularly suitable environment for treeferns, but a few hardy individuals have managed to grow here. These moisture and shade-loving plants may reach a height of 40 feet in the fern jungle. The young uncoiled fronds were cooked and eaten as a starchy food by the Hawaiians.

24. The Hawaiian raspberry, or *akala*, (*Rubus hawaiiensis*) is a giant among raspberries, occasionally measuring two inches in length. The bearing season, like the taste and color of the fruit, varies with the location and with individual plants. Usually the berries are purplish, the blossoms and juice pink. The Hawaiians made an inferior *tapa* cloth from the bark of the *akala*, and they extracted dyes from the juice of the fruit

(TAKE THE SHORT TRAIL TO YOUR LEFT AHEAD TO SEE A GIANT KOA.)

25. This ancient *koa* is about 10 feet in diameter at its base, a giant among park trees. The ancient Hawaiians sought out large, tall, and straight-grown forest *koas* for their canoes. With great time and labor they hewed and burned out the hulls, using stone adzes and other crude implements.

Notice the epiphytes in the crotches and branches of the tree: white strawberry with leaflets in groups of three; Jerusalem cherry, an exotic plant with orange berrylike fruits; and the *ekaha* ferns. These

ferns, each consisting of a small, bladelike frond were called Maui's paddle. They are common epiphytes on forest trees.

(RETURN TO THE MAIN TRAIL.)

26. You are standing in a thicket of young *pilo* trees (*Coprosma rynchocarpa*), one of several species that occur as small trees or shrubs within the park. The *pilo* may be identified by the presence of small triangular sheaths at the bases of the leaf stems. Notice how thin and straight the trunks of these small trees grow. Deep forest trees typically grow in this manner in contrast to the wide-branching habit of open forest trees which obtain more sunlight by spreading out.

Pilo



27. Fifty feet beyond the sign is an *olapa* tree (*Cheirodendron guadichaudii*), one of the commonest forest trees. The name *olapa* was applied to those hula dancers who could best imitate the graceful motions of the *olapa* leaves in a breeze.

The lacy, attractive ferns are *palapalai* (*Microlepia setosa*) a commonly seen species in the park. The *palapalai* has a wide-spread range throughout the Pacific islands, and is easily recognized by fronds which taper in both directions—toward the tip and toward the base.



Olapa

28. This twining, native, vinelike plant is the laurel of old Hawaii. *Maile* (*Alyx olivaeformis*) was used by Hawaiians in making *leis*, and is still employed for that purpose. It was a symbol of esteem and peace, and two contending chiefs would sit together and weave a *lei* of *maile* to signify an armistice.



Maile

29. The large, shelflike growth on the trunk of the *ohia* tree is a bracket fungus, a primitive plant lacking chlorophyll and related to the molds and mushrooms. Unable to manufacture its own food as other plants do, it derives its nourishment from the tree on which it grows. Notice the thousands of tiny pores on the under surface of the fungus; tremendous quantities of microscopic spores are released from these pores and carried great distances by the wind.

If you look closely on the fungus and in the litter at the base of the tree, you will probably see some small snails and millipedes. These tiny animals feed upon plants and dead plant material, further breaking it down in the important process of decomposition.

30. This large patch of introduced mint (*Mentha spicata*) is the result of one plant that invaded this area. See how native plants are crowded out by hardy foreigners. When man introduces a new plant in an area, he must seriously consider the consequences to native vegetation.

31. The *opuhe* (*Urea sandwicensis*) is recognized by its large, oblong, dark green leaves with prominent veins; the stems exude a watery, milky fluid when broken. Like the *mamaki*, *opuhe* was used for making *tapa* cloth. Fibers from the bark are tough, and were used in making fish net cord.

32. Notice all the plants on this downed trunk. How many different kinds of plants do you suppose are living off this old tree? There are over a dozen species in this miniature community; how many can you identify? Present are: peperomia, *pilo*, white strawberry, cranesbill, blackberry, ferns, molds, lichens, and mosses. Note the slender stalks bearing tiny capsules growing up from certain mosses. When ripe, these capsules release tiny clouds of minute spores which reproduce new moss plants.

33. The *ti* plant (*Taetia fruticosa*) is one of the most conspicuous plants on the island. It is widely grown in gardens and otherwise used as a decorative plant. It may have been introduced by early Hawaiians who used the large leaves for thatch and skirt material. It was also used for wrapping food either for storage, handling, or cooking in earthen ovens. A crude musical instrument was made by blowing through a rolled leaf; and *oko-lehao*, a potent alcoholic beverage, was made from the roots of the plant.

34. You are again in a thicket of *pilo* trees. Do you find yourself being scolded by a number of small birds which inhabit this thicket? These vociferous residents,

the white-eyes and the red-billed leiothrixes may approach quite close to inspect you if you stand still for a moment.

The ground in this thicket and in other areas of the *kipuka* may give evidence of having been dug up by wild pigs grubbing for roots. These introduced pigs are quite destructive to native plants.

35. The small tree immediately behind the marker is a young *koa*. Juvenile *koas* possess a leaf structure totally unlike that of the adult. Growth begins with compound or fernlike leaves. Later the petioles (leaf stems) broaden markedly, replacing the young leaves with a sickle shaped organ termed a phyllode. Thus the adult "leaf" of the *koa* is not really a leaf, but a highly expanded leaf stem. This complete change in leaf structure undoubtedly reflects an important phase in the evolutionary development of the *koa*.

The light colored, mosslike plants growing upon the branches of the larger *koas* are lichens. Lichens are primitive plant forms which result from an alga and a fungus living in close association—two plants living as one.

36. Many grasses not native to the island grow in Kipuka Puau. Most of these were introduced with stock feed brought from the mainland. In some areas the grasses are so dense that it is impossible for native plants to become established. You may have seen planted trees along the trail which reflect an effort by the Park Service to restore certain native plants to the area.

37. Somebody thoughtlessly tossed aside an avocado seed; look at the avocado tree that grows here now. Well above optimum range for the plant, it has grown into a robust tree which cannot bear fruit.

38. In glades such as this, you may occasionally see the short-eared owl or *pueo* (*Asio flammeus*). Unlike other owls, this native predator hunts by day as well as by night, seeking out the small rodents that make up its fare. Like other predators it is of great importance in controlling the populations of its prey, thereby maintaining a biological balance.

You have now completed your 1-mile walk through Kipuka Puau. We sincerely hope that it has proved pleasant and informative and that your stay in Hawaii Volcanoes National Park has been enriched.

Your National Parks comprise the most superlatively scenic and scientific areas in the United States. Under the administration of the National Park Service, an agency of the Department of Interior, each of these primitive areas is being preserved in its natural state for our enjoyment and for the enjoyment of future generations.

(FOLLOW THE TRAIL BACK TO THE PARKING AREA.)

“NOTES”

THE PURPOSES OF THE
HAWAII NATURAL HISTORY
ASSOCIATION

Hawaii Volcanoes National Park

Haleakala National Park

City of Refuge National Historical Park

Formed for the purpose of cooperating with the National Park Service by assisting in the development of a better public understanding of the volcanology, geology, plant life, history, and related interests in the areas administered by the National Park Service in Hawaii. The Association aids in the development of the park museums and libraries, and offers publications, motion and still colored pictures of volcanoes and natural history of these areas for sale to park visitors.

Revenues derived from the activities of the Hawaii Natural History Association is devoted entirely to the purposes outlined above. Gifts and donations are accepted for museum or library development, or general use.