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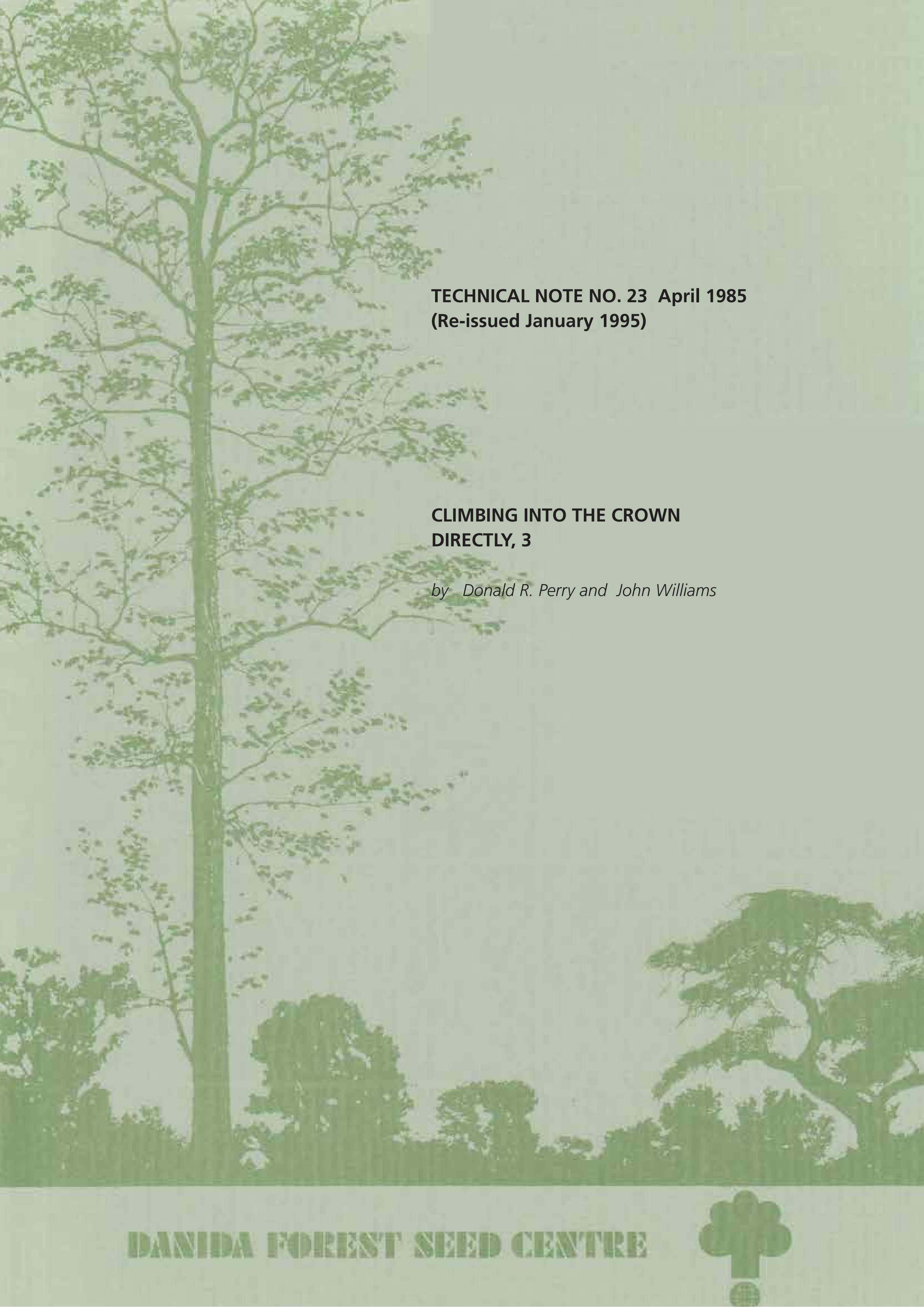

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CLIMBING INTO THE CROWN DIRECTLY, 3

by Donald R. Perry and John Williams

DANIDA FOREST SEED CENTRE

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by Donald R. Perry, Department of Biology, Un iversity of California, Los Angeles, California 90024, U.S.A.

ABSTRACT

A method of climbing into the canopy of tall trees is described, using equipment which does not damage the tree and which can be carried by a single person.

2. The Tropical Rain Forest Canopy: A Method Providing Total Access (page 7)

by Donald R. Perry, Department of Biology, Un iversity of California, Los Angeles, California 90024, U.S.A.

and

John Williams, Yeti Enterprises. Box 617, Topanga, California 90290, U.S.A.

ABSTRACT

An aerial rope network was constructed, using three emergent trees as supports, which provides access to a large volume of tropical rain foresst from ground level to above the canopy's upper surface. The virtually unexplored canopy community thus becomes accessible for a broad range of scientific research.

1. A METHOD OF ACCESS INTO THE CROWNS OF EMERGENT AND CANOPY TREES

Epiphytic plant distributions and densities within the upper canopy of tropical rainforests vary from tree to tree and with location (Went 1940, Richards 1964). Dominance by a given tree species in these forests tends to be lacking, and conspecifics are usually separated by long distances (Richards 1964). Spatial heterogeneity of plant species and of food resources such as flowers, fruits, and new leaves are primary factors in the movements and locations of numerous flying and arboreal animals (McClure 1966, Janzen 1971, Medway 1972, Frankie 1975).

Ground-level observations on these subjects are difficult, and quantitative studies are virtually impossible due to obstructing lower vegetation and the inaccessibility of the upper canopy, which ranges from 30 to more than 60 meters. Thus, the animal-plant interactions involving pollinators and foragers of canopy trees are largely unexplored. A knowledge of these interactions, however, is of major importance to an understanding of the structure and dynamics of tropical rainforest ecosystems (Regal 1977). Methods providing access and mobility in the canopy are essential for such studies, but most efforts have been put into constructing immobile structures such as towers, catwalks (Muul and Liat 1970), and platforms (Nicholson 1931, Hingston 1932, McClure 1966). Only one to a few trees can be closely studied from these structures, and the view of the canopy is often limited. A dozen towers, for instance would be needed to study adequately the pollination ecology of a single tree species, so the cost would be prohibitive.

Tree climbing methods should be non-injurious to trees and safe for the researcher. Pole-climbers have been extensively employed to climb tropical rainforest trees (Hingston 1932), but the climbing spikes punch holes in the trunks, promoting fungal infections and insect attack. Further, they are often dangerous and difficult to use since contact with the trunk, and with its assorted noxious animals, is necessary. Once the crown is attained, movement is limited to the region of the leader (main stem), and thus access to the peripheral branches is often impossible. Denison *et al.* (1972) pioneered a method for climbing large Douglas firs to conduct *in situ* quantitative studies on arboreal epiphytic community structure. Unfortunately, since long lag bolts are driven into the trunk every few feet to provide climbing support, the arguments against pole-climbers also apply to his procedures. He was the first, however, to apply rock climbing techniques, using rope ascendors (fig. 1-A), for scaling trees. The following method retains Denison's positive contributions while eliminating some of the problems.

I report here on a tree-climbing method which is mobile, non-injurious to trees, and inexpensive. It also provides access to the peripheral branches where flowers and fruits are often found. It was used extensively in the summers of 1974, 1975 and 1976 to study the pollination ecology of an emergent tree, *Dipteryx panamensis* (Perry and Starrett, 1983), factors influencing the micro-distributions of arboreal epiphytes (Perry 1978), and the vertical distributions of insect families in a lowland wet forest in Costa Rica.

Lowland tropical rainforest canopy and emergent trees are not readily climbed due to the general absence of limbs along the first 25 m of trunk. To avoid touching or injuring the trunk, a rope is climbed which is hung from a high point in the tree. The placing of the rope is achieved by using an 80-lb pull crossbow and weighted arrow to shoot a 30-lb test monofilament line over the tree's crown or high limb. The weighting of the arrow ensures its return to the ground. Tangling of the line is prevented by wrapping it on a spool. A stronger (120- to 240-lb test) braided nylon line is needed to lift the climbing rope into place. The braided line is too heavy to shoot directly into the canopy, so it must be pulled into the tree with the first line. A 240-lb test braided nylon line should be used when the rope touches several limbs, for abrasion becomes severe and a 120-lb test braided nylon line will break under these conditions.

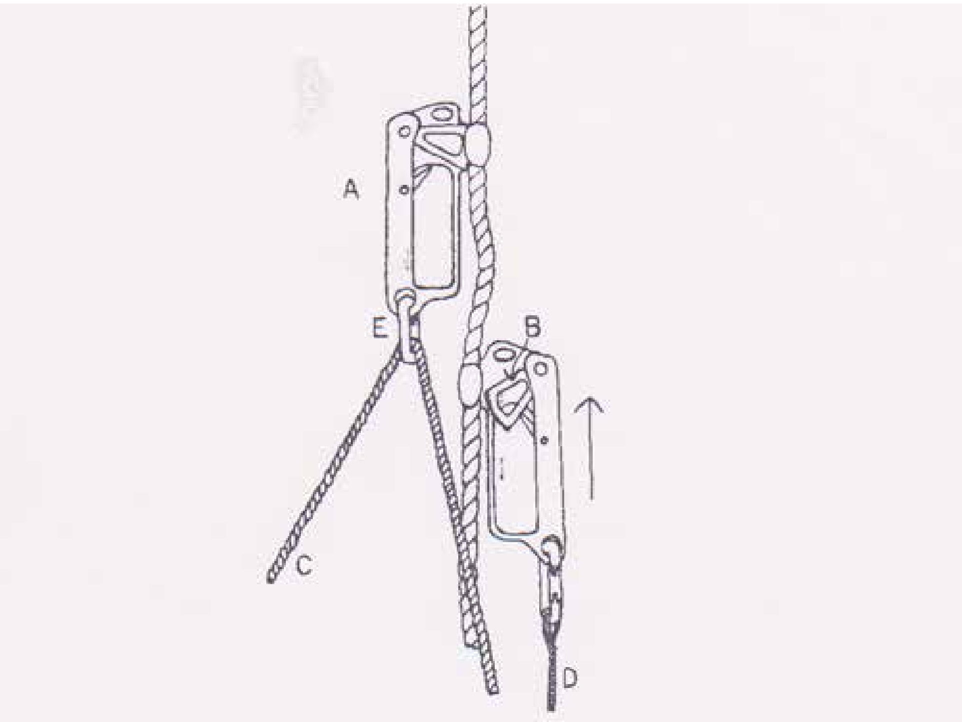

Figure 1. Upper rope ascendor (A) is connected by a carabiner (E) to rope loop (C) from harness. Footslings (D) are attached to lower ascendor. Toothed cam (B) is posiioned away from the rope, and this procedure allows for ascendor to be moved up or down.

Figure 2. Position of equipment during climbing procedure. The lower ascendor is being lifted to the upper ascendor. Note the strap-type harness which provides cool, comfortable support.

Once the climbing rope is in place, one end is secured near the ground. Rope ascendors are clamped to the free end of the rope as shown in figure 1. The ascendors operate by way of a spring-loaded eccentric cam (1-B) which lightly pinches the rope. They remain in place and when loaded with weight the cam pinches the rope tightly so that the ascendor will not slip down. A parachute harness (fig. 2 ; available at war surplus stores) is attached by a rope loop (fig. 1-C) and carabiner (fig. 1-E) to the upper ascendor. This provides comfortable support while climbing, resting and making extended observations. The lower ascendor similarly holds the foot slings (fig. 1-D). Now the rope can be easily climbed by following a simple procedure. The climber transfers all his weight to sit in the harness. He then lifts his legs and simultaneously slides the ascendor attached to the foot slings up the rope while the ascendor is unweighted. A full climbing cycle is completed when the climber transfers all his weight to the slings, and stands vertically, supporting himself by holding the taut rope above the upper ascendor with one hand while sliding this ascendor as high as it will go with the other.

At the top the rope can be rehung in a more advantageous location distally or proximally on a higher or lower limb to accommodate access to the area under investigation. An additional small piece of rope is used to tie oneself safely to the tree during this manoeuvre. Returning to the ground is accomplished by reversing the procedure and manually opening the cam so the unweighted ascender can be slipped down, or by rappelling (Blackshaw 1970).

Small platforms can be built using limbs for support. A small pulley aids in lifting equipment such as weather stations and insect nets up to the platform. A large number of these semi-permanent structures could be erected at little cost. Ropes may be placed in each tree or, to reduce costs further, small nylon lines may be left over the pulleys to lift a rope only when it is needed. A final advantage of this method is that the equipment needed for climbing can be carried by a single person.

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2. THE TROPICAL RAIN FOREST CANOPY: A METHOD PROVIDING TOTAL ACCESS

The canopy of the tropical forest possesses one of the most complex and diverse communities on the earth, yet there have been few effective methods for studying this aerial zone, and none of these provides comprehensive access to a large volume of forest. To observe the canopy, which varies in height from about 15 meters to above 60 meters, early investigators built towers and platforms in tall trees (Hingston 1932, Bates 1944, McClure 1966). Immobile structures such as these proved to be biased observation posts due to the high spatial heterogeneity in plant species and associated animal activities of tropical forests (Elton 1973). The usefulness of treetop platforms was expanded by Muul and Liat (1970), who built transects of catwalks extending hundreds of meters at various heights in the canopy. This method faciliated observations, but access to surrounding vegetation was severely limited. Further, catwalks were not ecologically benign since they offered new routes for canopy animals that in turn could influence colonization patterns on nearby limbs by epiphytes (Perry 1978b). Using advances made by Denison et al. (1972), Perry developed highly mobile tree-climbing methods that made the peripheral regions of every strong tree and the volume of forest under its crown accessible to investigation. Nevertheless, important regions of the forest remained inaccessible: i. e. the upper surface of the canopy with its high activity of insect and bird species, and a large fraction of the forest which is composed of weak trees unsafe for climbing, whose heights commonly reach 30 meters. To gain complete access to the latter regions for studies of pollination biology, we developed an aerial network of ropes, which provided access to above an acre of forest from ground level to above the historically inaccessible upper surface.

The study site was Finca La Selva, a field station owned by the Organization for Tropical Studies, located near Puerto Viejo, Heredia Province, Costa Rica. The work required only two people and was begun on 8 March, and ended on 1 April 1979. Following the lead of Muul and Liat (1970), who used trees as structural supports for their catwalks in a Malaysian forest, our minimum canopy research facility was constructed using three emergent trees in undisturbed lowland rain forest of the southeast corner of the University of Washington Research Plot I. The trees formed a triangle of approximately 100 meters on a side. Each was taller than the surrounding canopy by about 15 meters, a height that was essential to the function of the web.

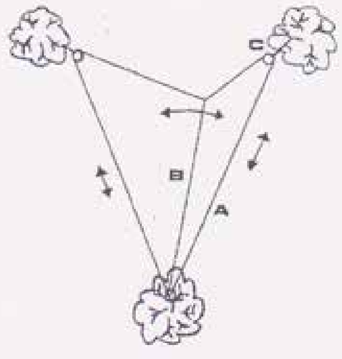

Figure 1. Diagram of rope network and its emergent tree supports. A canopy of various height (up to 30m) lies below the ropes. The perimeter rope (A) and internal rope (B) are adjustable owing to the presence of pulleys (C) in two of the trees. These ropes converge on the platform, where there is no pulley. After adjustment these ropes are tied directly to large limbs.

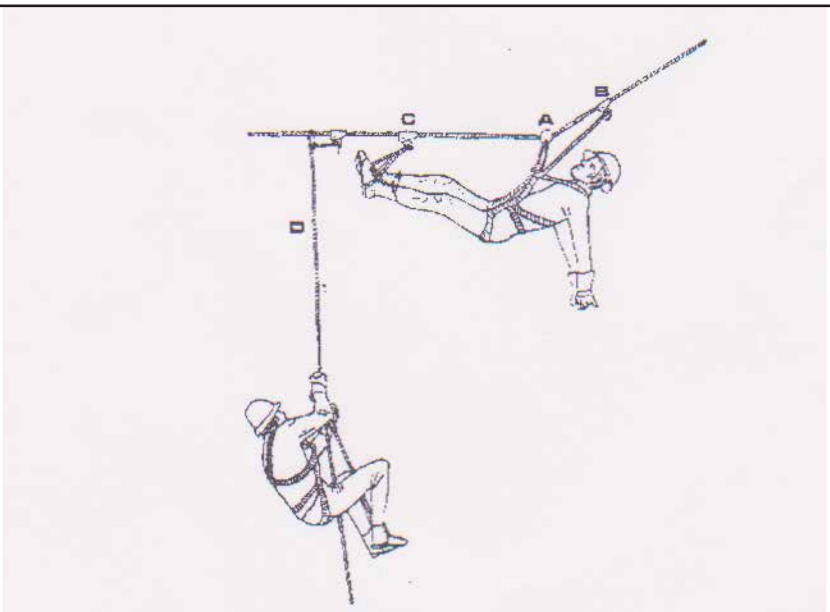

Figure 2. Movement along either the internal rope or perimeter rope is by means of a pulley (A) connected to a parachute harness. Coasting downhill can be stopped by an ascender (B) which also acts as a safety. Movement up the rope is by bringing C next to A and then extending the legs. Descent into the canopy is on a climbing rope (D) connected to the web by a carabiner and rope ascender. The ascender stops the rope from sliding downhill.

A small platform was constructed in one tree at a height of 32 meters which serves for sleeping, equipment storage, and access to the web. From the platform we shot 20 lb. test monofilament lines using a crossbow and arrows, to and between the two opposite trees, making a continuous loop (fig. 1). The position of these initial lines was adjusted to avoid abrasion against limbs, which would weaken the ropes when the web was in operation. The lines were replaced by 200 lb. test braided Nylon cords that were strong enough for use in pulling the 8600 lb. test, ½ inch in diameter, perimeter rope into place. The rope brand is Continental Dacron over Dacron, and is available through Continental Western Corporation, 2931 South Avil Avenue, Commerce, California 90040. Dacron was selected because it is nearly stretch-free and resistant to sunlight, though this rope does abrade easily. Because of this hazard, all ropes, especially where they extend into a tree crown, should be clearly visible so they can be inspected regularly. Rodents should not be overlooked as a source for abrasion since they may be attracted by salts left on the rope after handling.

Another support rope, the internal segment (fig.1B) was strung from the platform to the opposite segment of the perimeter rope. The perimeter rope is supported by pulleys (fig. 1C) at the trees opposite the platform allowing it to be rotated in a clockwise or counterclockwise direction. When this is done, the internal rope sweeps over most of the area within the rope triangle. These adjustments are made by removing or adding slack to the internal and perimeter ropes while on the platform.

Prior to use, extreme caution must be taken to ensure that the web is adjusted properly. In practice, if enough sag is not left in the support rope, then when a researcher climbs onto the web the tension in the rope can exceed its breaking strength. The amount of sag that is necessary for safe operation under a given load depends on the strength of the rope and connecting limbs. It is desirable to minimize resulting forces by selecting support trees which extend a considerable distance above the upper surface of the surrounding canopy. An in-depth consideration of the above problems is discussed by Macinnes (1972).

Since it is never possible to be certain of the strength of supporting limbs, it is always preferable that a web configuration be tested before it is put to use. This is done from the ground by hanging three people from a descent rope arched to the web's center. The people should be able to jump free of the rope in the event that a limb breaks.

Canopy access is primarily along the internal rope, but the perimeter ropes are also used, thereby increasing the total volume that can be reached. The researcher moves along the rope using a small pulley (fig. 2A). Downhill movement is achieved by coasting; stopping, by setting a rope ascender so that it grips the rope (fig. 2B); and uphill movement by using a rope ascender attached at the feet (fig. 2C) in a manner similar to that described by Perry (1978a).

The canopy's upper surface can be studied directly from the web. Access to any point below the treetops is by way of a descent rope (fig. 2D) using standard methods (Perry 1978a) The rope is connected to the web with a carabiner which takes the stress of climbing rather than the ascending device which only keeps the rope from sliding along the support rope. The descent rope can be left indefinitely in position and exited or entered at the ground. This procedure saves considerable time when extended observations are to be made. Several descent ropes can be left hanging to provide quick access to different points in the plot.

The most important considerations which limit the amount of area serviced by the web are 1) the height of the supporting trees above the forest's upper surface, 2) the distance between the support trees, 3) the strength of the web rope, and 4) the topographic relief. A web, which covers many acres of forest, could be constructed by using support trees at the tops of adjacent ridges.

The described method has broad application to studies in diverse fields of tropical biology. It is the first method to offer comprehensive access to a large upper volume of forest, including the hard-to-reach upper surface. The web has been used for studies on canopy community breeding systems, pollination biology, and phenology. It is reasonably simple to erect and so could be moved to new sites as may be demanded by the phenological patterns characteristic of tropical forests (Janzen 1967, Medway 1972). Since the total cost of the equipment for one web is not much more than one thousand dollars, it would be possible to erect many of them for simultaneous operation. Permanent automated facilities are possible at reasonable cost. These would offer effortless access to the canopy.

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