trumpets. Unfortunately, such an assemblage has been seen intact only in collections looted from El Cerro Encantado, but the excavated material, albeit fragmentary, indicates that the assemblage is indeed present there. To the southeast, El Cerro Encantado can, at least tentatively, be linked to Chupícuaro by the character of its subterranean stone features, certain resemblances in pottery form and decoration, and perhaps some of its burial practices (*5*). And Chupícuaro, in turn, has been fitted into the well-established chronological sequences for Central Mexico (*6*). Some resemblances in ceramics suggest the possibility that El Cerro Encantado may also be related to the early phases of the Suchil branch of the Chalchihuites culture of northwestern Zacatecas (*7*).

The date of 1800 ± 80 years ago is well within the range of carbon-14 dates for the shaft-tomb complex (*8*), which is known to have been in existence at least during the late pre-Classic, and it presents no anomaly in linking El Cerro Encantado and Chupícuaro. It is slightly early for proposing a relationship to the Chalchihuites culture, but the margin of error allows for a small overlap with the starting date of the phases in Zacatecas and may indicate that certain influences moved from south to north (*9*).

Although the chronological sequences linking West Mexico to other areas are steadily being expanded and strengthened, we need much more information about the nature and extent of cultural relationships. Furthermore, many of the early pre-Columbian cultures of West Mexico are still known almost exclusively in terms of their burial offerings. Numerous shell trumpets of Caribbean conch (*Turbinella angulatus* Solander, *Strombus gigas* Linné) have been found in the shaft tombs, and Caribbean shells occur in archeological sites throughout the region (*10*); hence, West Mexico was undoubtedly part of a widespread network of trade during the late pre-Classic. We need to know much more about the West Mexican cultures that were involved in that trade and also about the cultural influences that moved into and out of West Mexico. El Cerro Encantado itself may be lost to future work, but the surrounding area is thickly dotted with sites that might provide some of the answers.

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## Electrical Generation of Natural Aerosols from Vegetation

Abstract. *It is suggested that an alternative, or additional, source of the blue haze above heavily forested areas may be the generation of submicrometer-sized wax particles by the action of strong electrical fields at the tips of pine needles and other wax-covered plant surfaces. Exposure of pine needles to high potential gradients results in the production of airborne wax particles with diameters less than 0.6 micrometer.*

One of the striking features of heavily forested mountain areas is the persistent atmospheric haze that seems to trail from the trees and ridges. Often associated with the blue haze is such a pleasant odor of terpenes and other organic gases that one is reluctant to regard this combination as an example of air pollution. Yet there have been suggestions which imply just that. Rasmussen and Went (*1*) observed the widespread occurrence of terpenes in forests and considered the concurrent blue haze in a cause-effect relation. They correctly interpreted the bluish cast of the haze to indicate the presence of predominantly submicrometer-sized solid or liquid particles and speculated that the particles were the product of the photochemical effects of sunlight acting on terpenes and other airborne hydrocarbons. Went also suggested that the resulting aerosols might prove to be toxic (*2*), in analogy with the more notorious photochemical oxidants associated with motor vehicle exhaust.

The presence of a wax coating on the surface of leaves is an almost universal phenomenon throughout the plant kingdom. According to Eglinton *et al.* (*3*), the major constituents of the wax are alkanes, alcohols and acids (usually in the form of esters), polymerized aldehydes, and ketones, with the specific composition depending on the plant (*4*). In at least some cases, wax is extruded

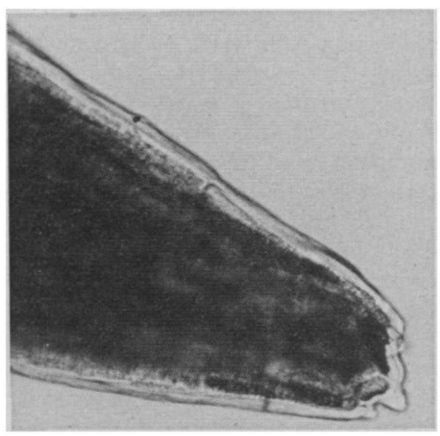

Fig. 1. View under a light microscope of wax fingers at the tip of a pine needle.

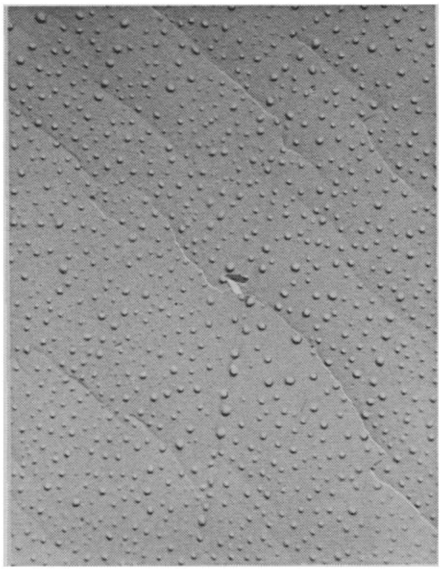

Fig. 2. Electron micrograph of wax particles generated from a pine needle at 20 kv (the torn area in the center is 0.7 $\mu$m long).

from the cuticle only while a leaf is growing (*5*), and, because of the lack of seasonal variation in wax composition (*6*), the wax coating apparently is not further affected by the plant metabolism (*7*). Although the wax layer on the tips of some pine needles is relatively smooth, other needles of comparable age from the same or from another pine tree may exhibit shapes similar to those shown in Fig. 1 (*Pinus echinata*). Wax fingers are also found on other species of trees. The tips exhibiting the elongated wax fingers tend to be in exposed areas such as on the tops of trees, on the outside of a lone tree, or on the margin of a stand. Melting of the wax cannot be invoked as an explanation for the observed configuration for several reasons, chief among which is that the tips point upward.

It is suggested that the wax fingers represent the preserved record of a conduction path which became molten during the atmospheric phenomenon usually referred to as brush discharge. To test that hypothesis, pine needle specimens were mounted on one of a pair of electrodes in a closed system and subjected to various electrical gradients in the laboratory. In each case carbon-coated disks were attached to the opposite electrodes, and the collected particulates were replicated and examined with an electron microscope. Particles collected when the pine needle was raised to a potential of 20 kv with respect to a flat plate 20 cm away are shown in the electron micrograph (Fig. 2). At lower potentials the particles were similar in size but less concentrated, whereas at 30 kv the wax fingers began to shatter and irregular strips and chunks were collected. The small wax particles released under low to moderately high potential gradients have diameters in the size range $< 0.6$ $\mu$m; particles in this size range may be a major factor in the production of blue haze.

Chalmers (*8*) has measured a significant conduction current passing through a small tree. The local, flat-field potential gradient easily can reach several thousand volts per meter as electrified clouds pass overhead; in an electrical storm gradients much higher than this may be recorded. These observations suggest that discrete wax particles in the appropriate size range to produce blue haze are generated by natural forces in the environment. Other types of vegetation, including grasses, could, in principle, emit wax particles under similar conditions. In the brush discharge phenomenon, high potential gradients occur at the sharp edges and tips of leaves, producing a blue glow at night. Undoubtedly, such factors as the dielectric strength of the wax, its melting point, the ambient temperature, the radius of curvature of the underlying conductive surface. and the exposure of the plant all have some bearing on the rate of production of wax aerosols. Other extrinsic factors, such as gaseous or particulate air pollutants, may affect the properties of the wax so as to reduce or enhance the rate of wax attrition, possibly leading to the denudation of the needle tip and the eventual loss of the needle because of excessive drying.

Went (*2*) has suggested that the blue haze aerosols, returned to the ground by various natural processes, may be a source of the petroleum formed in earlier geological periods. The presence of significant quantities of waxes in crude oil and the observation of a mechanism for the generation of wax aerosols in the environment suggest that the wax particles, which may serve as condensation nuclei for terpenes and other organic gases, may be a complementary factor in the phenomena described by Went. Another implication is that radioactive fallout collected on the sharp edges and tips of vegetation may be reemitted to the atmosphere during the next thunderstorm after its initial deposition. In this same connection, particulate silver iodide from cloud-seeding operations may be retained locally for a period of time and be reentrained into an unseeded cloud, producing the "memory effect" that has been observed by some atmospheric scientists (*9*).

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## Plastics on the Sargasso Sea Surface

Abstract. *Plastic particles, in concentrations averaging 3500 pieces and 290 grams per square kilometer, are widespread in the western Sargasso Sea. Pieces are brittle, apparently due to the weathering of the plasticizers, and many are in a pellet shape about 0.25 to 0.5 centimeters in diameter. The particles are surfaces for the attachment of diatoms and hydroids. Increasing production of plastics, combined with present waste-disposal practices, will undoubtedly lead to increases in the concentration of these particles. Plastics could be a source of some of the polychlorinated biphenyls recently observed in oceanic organisms.*

While sampling the pelagic *Sargassum* community in the western Sargasso Sea, we encountered plastic particles in our neuston (surface) nets. The occurrence of these particles on the sea surface has not yet been noted in the literature [we also collected petroleum lumps, which have received attention (*1, 2*)].