

government's growing awareness of air pollution—especially from industrial factories. We were also told in several institutes of a growing governmental awareness of water pollution problems—specifically of heavy-metal effluents discharged into rivers, lakes, and marine waters. New programmes are being pursued to investigate heavy-metal concentrations in the human food-chain, but other than this very recent and newly financed work, we found almost no ongoing research on pollution problems *per se* in any of the institutions which we visited. The major emphasis in practically all botanical research was on crop-related problems.

Another area of conservation is that of energy-related conservation. There are some excellent uses of vegetative material for energy-related problems in China. For instance, we visited a marsh-gas electrical power station in Kwangchow, Canton, where we were told that 50 Kw of electricity was transmitted daily from methane gas production utilizing sewage with algal cultures. The remainder of the sewage is returned, after producing the 'biogas', to farmers as high-quality fertilizer. There were also large amounts of blue-green Algae and other plant fertilizers being used. The low-energy production of crops was also extremely impressive, as an indirect consequence of energy conservation.

In summary, the intensive goal of crop production to feed the Chinese people has conflicted with maintaining conservation areas. A great deal of energy in botanical science in the People's Republic has been focused on research surrounding crop plants, with far less investigative energy involving ecology and natural plant associations in the unique geographical region of the People's Republic of China. In terms of the cultivated eastern portion of China, few natural preserves exist, and little has been done to conserve the natural ecological habitats. However, vast

areas of natural vegetation are available for future study in the west and border regions—especially in the highlands, which are only partly explored botanically and are currently being described in the Chinese literature.

Intensive efforts are now being made to finish a work of major world importance, *The Flora of China*, planned in 80 volumes to be completed in 1985 (see above) and to comprise a systematic and taxonomic study of Chinese vegetation. Naturally this will include aquatic as well as terrestrial vegetation. The growing environmental awareness on the part of the Government of China, resulting in increased financing towards solving pollution problems (primarily of air pollution but also of water pollution by heavy-metals and other substances) has occurred only recently.

Although we were not given any lists of rare, endangered, or threatened, plant species, official requests to prepare such lists have recently gone out to Chinese botanists as indicated above. In general, a large infusion of money and energy had been occurring in the plant sciences in China in the last months before our visit, and this appeared to us to be a pattern which would intensify. One would hope that many new programmes to implement conservation of the precious naturally-occurring botanical resources of the People's Republic of China would stem from the recently announced 'Springtime of Science'.

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Defoliation Heterogeneity Over Costa Rican Highways

When the rainy season begins in the lowland deciduous forest of Guanacaste Province, northwestern Costa Rica, there is a flush of new foliage. At times (May–July), there is heavy defoliation of many species of forest trees. As this forest is cleared for cattle pasture and croplands,



FIG. 1. Large *Ceiba pentandra* (Silk-cotton) tree with crown defoliated by caterpillars except for that portion which is bathed in diesel-truck exhaust fumes from the road almost directly below. Photo: Professor Daniel H. Jansen, 15 July 1974, Pan-American highway north of Liberia, Guanacaste Province, Costa Rica.

occasional large trees are left standing whose crowns overhang highways. The Pan-American highway passes through the centre of Guanacaste Province and provides many examples of such trees. This paved highway sustains heavy traffic of large diesel trucks, whose exhaust then passes chronically through the crowns of the overgrowing trees. When these trees are attacked by defoliating caterpillars, it is common for the entire crown to be stripped of leaves except for that portion which lies more or less directly over the highway (e.g. Fig. 1).

In the 1978 rainy season, *Ceiba pentandra* (Bombacaceae) and *Enterolobium cyclocarpum* (Leguminosae) offered the best examples, but I have observed the phenomenon also with *Guazuma ulmifolia* (Sterculiaceae), *Sterculia apetala* (Sterculiaceae), and *Bombacopsis quinata* (Bombacaceae). I presume that this patchiness of damage is due to insecticidal action on the part of the diesel-truck exhaust fumes. I should add, however, that it could also possibly be due to changes in internal leaf-chemistry brought about through frequent bathing of the leaves in such fumes. Within-crown defoliation heterogeneity is also evident in forest trees in intact forest away from the highway, but this is obviously due to other causes.

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