glion cells has shown that adrenergic cells do not have to be incubated with nonneuronal tissue in order to become cholinergic, provided the incubation medium has previously been in contact with the tissue. This result suggests that the tissue secretes a "factor" into the medium that induces the change. According to the Harvard group, the factor is a protein that they are now trying to isolate and characterize. They know, however, that it is not nerve growth factor (NGF), a protein that has long been known to be necessary for the normal development and maintenance of the peripheral sympathetic nervous system.

Moreover, there appears to be a need for some way to prevent adrenergic neurons from becoming cholinergic in the living animal. Most of the tissues that secrete the factor that elicits acetylcholine production in cultured nerve cells are innervated by cholinergic nerves. Thus, the factor might help the tissues to establish appropriate neural connections. Glial cells also produce it, however, and they are closely associated with many types of nerve cells, including adrenergic ones. If adrenergic neurons are exposed to cholinergic signals in vivo, then something must prevent them from converting to acetylcholine production.

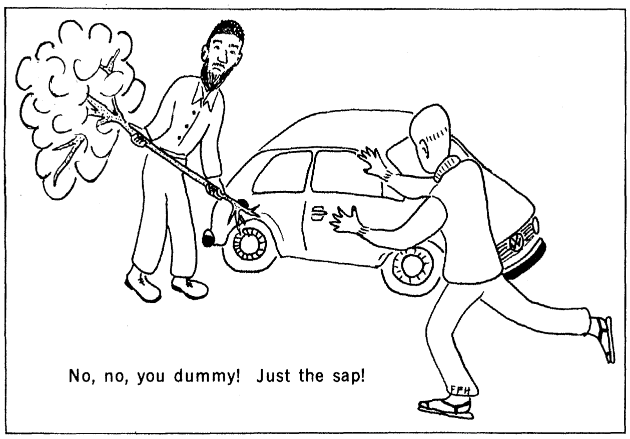
Cultured adrenergic nerve cells do not receive the normal innervation that they would have in the living animal. This lack of stimulation may underlie their ability to develop cholinergic characteristics. The Harvard workers have shown that stimulating cultured neurons electrically causes them to become resistant to the cholinergic signal and retain their initial adrenergic character.

In earlier work, Black and his colleagues demonstrated that stimulation by the first (cholinergic) nerves in a sympa-

Speaking of Science

Unlike Money, Diesel Fuel Grows on Trees

From the man and the country that brought us the petroleum plant comes now the diesel tree. Three years ago, Nobel laureate Melvin Calvin of the University of California at Berkeley returned from Brazil and reported that he had located several members of the genus *Euphorbia* which produce significant quantities of a milk-like emulsion of hydrocarbons in water (*Science*, 1 October 1976, p. 46). Calvin has been to Brazil again, and told the American Chemical Society last month that he observed a tree in the jungle that produces virtually pure diesel fuel.



No, no, you dummy! Just the sap!

Natives of the forest have known about the species, *Cobaifera langsdorfii*, for a long time, Calvin says. They drill a 5-centimeter hole into the 1-meter thick trunk and put a bung into it. Every 6 months or so, they remove the bung and collect 15 to 20 liters of the hydrocarbon. Since there are few Rabbit diesels in the jungle, the natives use the hydrocarbon as an emollient and for other nonenergy-related purposes. But tests have shown, he says, that the liquid can be placed directly in the fuel tank of a diesel-powered car.

A cross section of the trunk shows that the hydrocarbons collect in thin capillaries that may extend the full 30-meter height of the tree. A hole drilled into the tree probably collects hydrocarbons from capillaries ruptured by the drilling, Calvin speculates, so that it may be possible to increase the yield by drilling additional holes. An acre of 100 mature trees might thus be able to produce 25 barrels of fuel per year. Unfortunately, in the United States the tree would probably grow only in southern Florida, but the Brazilian government has already established experimental plantations.

Calvin concedes that *Cobaifera* will probably never represent a significant source of diesel fuel for the U.S. It is of interest chiefly as an example of the great diversity of materials produced by plants. Calvin's primary interest remains *Euphorbia*. On his northern California ranch he has a stand of *Euphorbia lathyrus* that is currently producing the equivalent of 10 barrels of petroleum per acre. He argues forcefully, however, that the yield could be improved dramatically by breeding and genetic selection and cites in support of this contention the tenfold increase in the yield of rubber plants achieved during the 1950's and 1960's. Already, he says, a Japanese group is obtaining 15 barrels per acre from a plantation on Okinawa.

Even at 10 barrels per acre, Calvin projects a price of about $40 per barrel for the finished product, roughly twice the cost of crude oil. But that comparison is misleading, he insists. The hydrocarbons from *Euphorbia* are primarily a blend of C_{15} compounds (terpene trimers) that, when subjected to catalytic cracking, yield various products virtually identical to those obtained by cracking naphtha, a high-quality petroleum fraction that is one of the principal raw materials of the chemical industry. Naphtha, he says, now costs $50 per barrel, a price that makes oil from *Euphorbia* competitive, even with the current yields.

The California chemist has spent 3 years promoting the potential of *Euphorbia*, and he thinks he has had some success. Several companies have approached him for advice and some, particularly mining companies, have begun conducting their own studies. *Euphorbia* requires relatively little water for cultivation and thus might prove a near-ideal species with which to reseed the surface after a strip mine has been closed down. What could be more appropriate, once the hydrocarbon resources have been removed from beneath the soil, than to begin growing new ones on the surface?—THOMAS H. MAUGH II

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