crucial role in the establishment and maintenance of pregnancy. Specifically, it supports the corpus luteum, a yellow endocrine body formed in the ovary immediately after ovulation. In the hormone's absence, the corpus luteum sloughs off in menstruation. Thus the hormone's early appearance and obligatory role in pregnancy make it a suitable target for control of fertility. Because it has to travel through the bloodstream to reach the ovarian corpus luteum, it is susceptible to inactivation by circulating antibodies.

Active immunization against HCG poses two problems, however. One is the difficulty of raising antibodies against a hormone that a woman's body considers "self," not "foreign." The second is raising antibodies against the hormone without also raising them against chemically related hormones. To get around these problems, G.P. Talwar and his biochemistry and obstetrics team at the All India Institute of Medical Sciences purified and processed a chemical subunit of HCG so that it would have minimal cross-reactivity with other hormones. That way they hoped to avoid making antibodies against other hormones. Then they linked the HCG subunit to tetanus toxoid (toxin devoid of its toxicity, but retaining its ability to provoke antibodies). This way they hoped to provoke antibody formation against not only tetanus toxoid, but against HCG as well.

They were successful on both counts, they report in the January PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES, in both mice and human subjects. Antibodies reacted with the HCG subunit, but not with other hormones. The antibodies also neutralized the biological activity of HCG for up to a year. Immunization didn't disturb menstruation. □

# Hawaiian Flies: Setting the protein clock

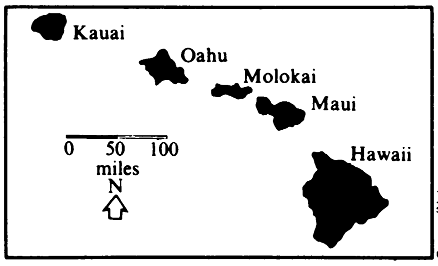
The evolution of the Hawaiian Islands and the evolution of fruit flies that followed have presented a unique opportunity to understand the mysterious evolutionary timing mechanism, the "protein clock." From a study of those islands and those flies, one researcher has now set the hands on that protein clock.

Geneticist Hampton L. Carson of the University of Hawaii at Honolulu combined data on the geologic evolution of the five islands and data on the biologic evolution of eight fly species on a graph explained in the Feb. 5 NATURE.

Geologists have reconstructed a detailed picture of the island evolution by dating the strata found on each of the twelve volcanoes that make up the five islands, Kauai, Oahu, Molokai, Maui and Hawaii. The islands are thought to have formed between about 560,000 and 100,000 years ago in a sequence from northwest to southeast, beginning with Kauai and ending with Hawaii. The eight fly species evolved on the islands, diverging genetically and migrating as the new islands formed. Their genetic differences, measured by "allozymic variation," make it possible, Carson says, to predict when each species evolved.

Allozymic variation is the difference in proteins from one species to another, determined by electrophoresis. Such measurement shows the eight flies to be quite similar genetically. As a group, they are large, conspicuous, long-lived fruit flies that inhabit wet rain forests. Each has a narrow geographical range and very likely evolved near their present locations after progenitor species migrated from older islands.

Carson chose *Drosophila heteroneura*, "probably the newest species in the series," as a standard for genetic comparisons with each of the other seven. Allozymic difference is derived from a complicated equation and is expressed as a percentage difference from *D. heteroneura*. "Before one species splits off into two," Carson explains, "the genetic similarity is, of course, 100 per cent. But after two species split, they start to accumulate protein differences in a regular fashion at a precise rate. This is what we call the protein clock."



Carson/Nature

*Island emergence linked to fly evolution.*

By plotting the genetic differences between the flies against time, measured by the known evolution of the islands, Carson was able to predict the points at which each species evolved and the speed of the protein clock. This speed, he suggests, is a rate of 1 percent genetic difference per 20,000 years. "This rate," Carson told SCIENCE NEWS, "is much more rapid than any suggested before. Evolution might take place more rapidly on islands—we just don't know that yet." But the fact that the geologic age of these islands is so precisely known, that the evolution of the insects was confined to the islands and that it took place on a much smaller scale than on a continent, he says, makes it possible to produce this precise number.

"I am sort of throwing out this 1 percent per 20,000 year figure to see how it might fit other data." He says he is hoping that others will reexamine theirs and see if perhaps their rates "could be reinterpreted" and if the figure could reflect the speed of the protein clock. □

# Electronic materials: A resources bonus

*In many ways the transistor did for man's brain what the earlier invention of the steam engine had done for man's brawn. It can be regarded as the instigator of the Second Industrial Revolution.*

—A.G. Chynoweth, Bell Laboratories

The sort of revolutionary substitution represented by transistors for vacuum tubes and of integrated circuits (which stemmed from transistors) for calculating machines is often called a functional substitution: A completely different approach to performing a needed function is found. Similar examples are the replacement of nuts and bolts by adhesives, of piston engines and propellers by jet engines, of fossil-fuel-fired boilers by nuclear reactors. A functional substitution can inspire the creation of entirely new industries. It can also alter energy consumption patterns.

One man who should know about such matters is A.G. Chynoweth, director of the Materials Research Laboratory for Bell Laboratories, where the transistor was invented. Chynoweth believes the potential contribution of electronics to the conservation of resources has not been fully appreciated or exploited. "In nearly every case, the substitution of solid state electronics for older techniques appears to have led to considerable savings in the amounts of material needed for manufacture and the energy required to operate the new equipment. To some extent the new development can be regarded as the substitution of light industry for heavy industry, of information technology for machinery."

Increasingly, electronic materials are considered alongside metals, ceramics and polymers as a major division in the field of materials technology. In the Feb. 20 SCIENCE, Chynoweth examines the outlook for electronic materials and comes to two "reassuring" conclusions: Electronic materials and solid state electronics may be more part of the solution to materials scarcity problems than a cause, and overall, the electronics industry is not very vulnerable to materials shortages. "No sudden, dramatic shortages are foreseen for any of the key elements."

Electronic materials include semiconductors, conductors, magnetic metals and crystals, dielectrics, piezoelectrics, ferroelectrics, lasers and electrooptical and magnetooptical substances.

Most of the elements in the periodic table are used in some kind of electronic equipment. In the telephone alone, 42 of the 92 natural elements are present, including such exotics as vanadium (in the receiver), palladium (in electrical contacts), krypton (in the ringer in a Touch-Tone set), beryllium (alloy in the dial mechanism), molybdenum (in the magnet)