Breeder reactor: 'New sense of urgency'

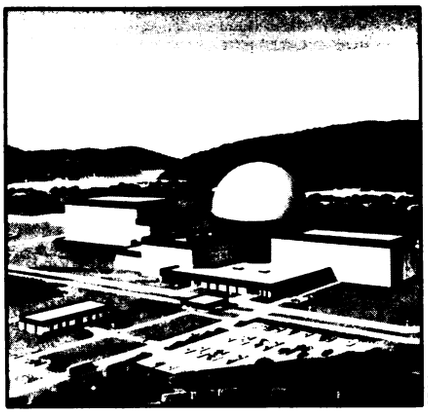
"A new sense of urgency" in the development of nuclear breeder reactors, with particular emphasis on the liquid metal fast breeder reactor, was called for this week in a report by a subcommittee of the congressional Joint Committee on Atomic Energy.

Speed is necessary, the report suggests, because the "assured" and "potential" low-cost uranium reserves of the United States, estimated at 3.6 million tons by the Energy Research and Development Administration, will otherwise be fully committed to conventional reactors by the mid-1990's, and "no additional reactors of this type could be built after this date" unless greater reserves are found. The breeder concept, according to the report, would give those 3.6 million tons an energy potential equivalent to 126 million tons of low-cost uranium, "an amount of nuclear fuel sufficient to supply nuclear powerplants for centuries."

"The time has come," the report says, "to end the discussion over whether or not this nation should have a breeder research and development program." The emphasis of future federal studies on the matter "should not be on the issue of 'should we do the job,' but on 'how best to get the job done.' "

The report takes an optimistic tone regarding the availability of solutions to safety concerns. In the case of reactor safety, "the subcommittee notes with satisfaction . . . that no credible situation or accident has been hypothesized to date for which adequate design and safety features are not under consideration." The panel recommended that ERDA pursue waste management studies "vigorously," although "the technology required . . . is largely in hand and . . . the critical delays being experienced today are primarily administrative and regulatory."

Established as the Ad Hoc Subcommittee to Review the Liquid Metal Fast Breeder Reactor Program, headed by Rep. Mike McCormack (D-Wash.), the group held several months of hearings leading up to the report, which also included testimony on the toxic effects of exposure to radioactive material. Although safe-handling standards must be maintained, the report notes, "there are no cases on record of human lung cancer attributed to exposure to plutonium. . . ." Furthermore, although about four tons of plutonium 239 have fallen on the earth from atmospheric weapons tests, "there is no indication that this plutonium deposition has caused any untoward health effects." The subcommittee thus endorsed "the high standards of plutonium protection that have been maintained in the past" but made no reference to tighter future standards beyond the continuation of biomedical research efforts.



ERDA

Clinch River Reactor: Congress pushes.

It was estimated by ERDA that research and development for the liquid metal fast breeder reactor will cost about $10.6 billion, and the panel reported a consensus from its study that this is a "reasonable estimate, although a few respondents voiced strong feelings that previous inabilities to meet cost estimates meant the figure would go much higher." The Clinch River Breeder Reactor, for example, a demonstration project to be built in Tennessee, was predicted by the Atomic Energy Commission in 1972 to cost $699 million. Last March, the report acknowledges, ERDA submitted "revisions to that arrangement" that included a new cost estimate of $1.736 billion, nearly 2.5 times the previous figure.

The subcommittee recommended that serious consideration be given to the possibility of establishing federally owned "energy centers" as locations for a variety of nuclear operations such as storage of fissionable materials, fuel processing and enrichment, temporary waste storage and research. Such centers might be able to reduce risks by offering decreased transportation distances, more effective physical security and better control of "routine releases" and waste materials. A survey by the Nuclear Regulatory Commission of possible sites for the centers was submitted to Congress on Jan. 19.

The subcommittee estimated that by the year 2000, the U.S. demand for energy will exceed the projected production of present sources by the equivalent of about 55 million barrels of oil per day, "about double what we are capable of producing in this country today." □

Preventing breast cancer relapses

The greatest progress in curing cancers in recent years has come in successfully combining different modes of therapy—surgery, drugs, X-rays, immunotherapy—so that together they are far more effective than if used alone (SN: 1/11/75, p. 26). A team of Italian scientists has now used a combination of three drugs to drastically reduce breast cancer recurrences in women who've had radical mastectomies. They report their findings in the Feb. 19 NEW ENGLAND JOURNAL OF MEDICINE. An editorial in the same journal hails the approach "as a work of monumental importance."

Gianni Bonadonna and his colleagues at the National Cancer Institutes in Milan gave 207 women who had had a radical mastectomy for breast cancer a combination of three drugs—cyclophosphamide, methotrexate and fluorouracil. One hundred-and-seventy-nine patients who had had a radical mastectomy for breast cancer did not receive the drug regimen, thereby serving as controls. After 27 months, 24 percent of the control subjects experienced breast cancer relapses; only 5.3 percent of women receiving the combination chemotherapy did. Long-term drug therapy was also minimally toxic to the patients so that they could receive the drugs in large dosages.

"Our results," the investigators conclude, "appear promising since they are translating into clinical evidence what has been strongly supported for years by animal model systems." They caution, however, that "not enough time has yet elapsed to indicate whether the difference in the rate of recurrence can also affect the rate of survival. . . ."

In the editorial, however, James F. Holland of the Mount Sinai School of Medicine in New York City is totally optimistic about the combination drug treatment. "The study from the NCI in Italy," he declares, "shows the value of both medicine and surgery in cancer therapy. How many hundreds of thousands of lives can be improved or indeed saved by application of the present information in the coming decade?" □

Immunizing against pregnancy

Investigators are taking a number of ingenuous approaches to designing new kinds of birth control. They are exploring, for instance, the possibility of giving specific hormones to turn off or impede conception; of interfering with specific enzymes that might be critical for conception; of turning off sperm production with heat, infrared rays and ultrasound (SN: 2/10/73, p. 93; 5/1/74, p. 309). Now a team of New Delhi investigators is looking into the possibility of immunizing women against a hormone that is essential for pregnancy.

Human chorionic gonadotropin (HCG) is a hormone that is synthesized early in pregnancy—six to eight days after fertilization of the egg. The hormone plays a

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

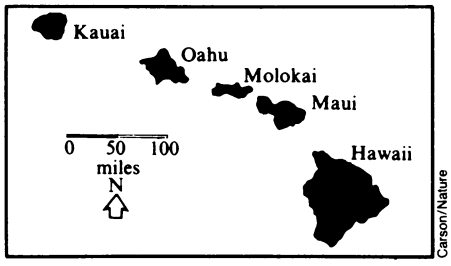
The evolution of the Hawaiian Islands and the evolution of fruit flies that followed have presented a unique opportunity to understand the mysterious evolutionary timing mechanism, the "protein clock." From a study of those islands and those flies, one researcher has now set the hands on that protein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



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)