G.E. Super Bug Created to Clean Up Oil Spills

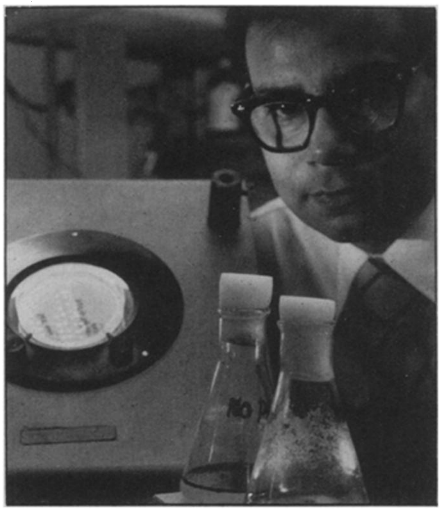
Modular designs are being used for buildings, furniture, equipment—and life forms. An industry scientist has now taken a modular approach to microbes—"add-a-characteristic"—and has created a super bacterial strain with a multiple appetite for petroleum. If all goes well, it will be munching on oil spills within a few years.

General Electric biologist Ananda M. Chakrabarty calls the new strain the "multiplasmid super bug." Using genetic engineering techniques, he has taken the oil digesting abilities from four separate strains of *Pseudomonas* bacteria and combined them in one recipient strain; hence, a modular microbe. The super bug, Chakrabarty says, can digest about two-thirds of the hydrocarbons in crude oil, and do it much faster and more efficiently than other biodegradation systems. What's more, when the bacteria are done polishing off the petroleum, they leave behind useful metabolic products; carbon dioxide (used by plants), water and protein (in the form of bacterial cells).

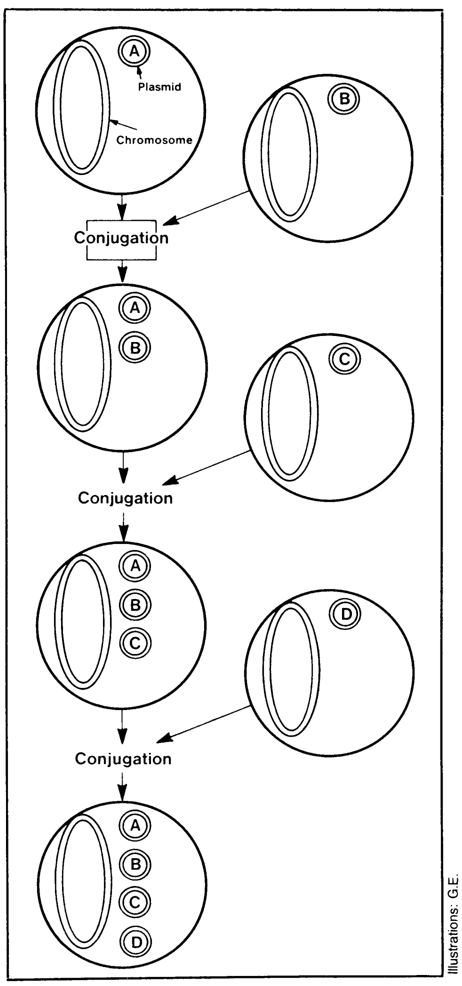
Chakrabarty and colleagues at the University of Illinois discovered about five years ago that a microbe's genetic ability to digest petroleum hydrocarbons is transmitted on "plasmids." These are tiny circular rings of DNA that exist in bacterial cells separate from the larger circular chromosomes and that often code for special advantageous characteristics (SN: 6/21/75, p. 404). Chakrabarty's particular achievement is to induce different strains of *Pseudomonas* to "conjugate" (exchange genetic information), in such a way that a recipient strain ends up with hydrocarbon-breakdown plasmids from three other strains. It then has the ability to digest many more types of petroleum hydrocarbons than any one strain can do by itself. The super strain works faster and more effectively than throwing the four strains into oil-polluted water separately, Chakrabarty says, because the strains compete with each other for available nutrients. The breakdown process then takes months or years instead of weeks.

Plasmids that code for separate characteristics, such as the enzyme mechanisms necessary to break down hydrocarbons, often are incompatible with each other and cannot exist in the same cell. Two of Chakrabarty's plasmids were incompatible, but he overcame this problem by fusing them into one larger one. He used ultraviolet radiation to "sew them together" in a permanent biochemical bond.

General Electric hails Chakrabarty's work as the "first successful application of advanced genetic engineering techniques" to create a microbe useful to man. Such techniques have come under some high-powered scrutiny, most notably by the leaders of the field who met at Asilomar, Calif., last February (SN: 3/8/75, p. 148). According to a classification system devised at the meeting, Chakrabarty's experiments would be considered among the least potentially hazardous. His system is safer, he says, because it involves only natural transfer in the living systems, instead of artificially induced recombination in test tubes. Besides this, he says, the super bug has been given positive characteristics. Conferring antibiotic resistance with genetic engineering is something to worry about, he says, but conferring competence for oil utilization isn't.



Chakrabarty and the multiplasmid bug.



Combining recipient and four plasmids.

General Electric sees a three- to five-year time scale for developing a practical product for fighting oil spills. The next steps will be laboratory and environmental testing. No one seems sure which government agency will regulate development of the new life form, but Chakrabarty presumes it will be the EPA. □

Bundle of charm: Two chi particles?

When experiments last fall first found new, extra heavy, unusually long-lived particles, many theoretical physicists speculated that these particles were manifestations of a newly proposed fundamental quality of elementary particles called charm. Charm had been introduced to theory to explain certain anomalies in the decays of particles possessing the quality called strangeness, and the new discovery would have been an independent confirmation of charm's existence.

If the new particles, generally called psi particles, are involved with charm, there should be a whole hierarchy of them, a succession of levels each somewhat heavier than the one before. There should be chains of radioactive decay running down the levels from highest to lowest. But for many months no such ladder of levels seemed to show, and the charm of the idea began to fade.

But now charm's back up there again. A few things that could be such levels have been found, first at Hamburg, most recently at the Stanford Linear Accelerator Center. They appear to be intermediate levels between the older heavy psi (3,684 million electron-volts) and the light one (3,095 MeV). Hamburg's is called P_c and has a mass either 3,520 or 3,260 MeV. SLAC has two, designated by the Greek letter chi, at 3,530 MeV and 3,410 MeV. Discussing the matter in the Sept. 11 NATURE, William Toner, a SLAC physicist, remarks that the P_c and the upper chi may be the same thing. Part of the time, it appears the psi(3,684) can decay into one of the intermediates by emission of a gamma ray. The intermediate can then decay into the psi(3,095) or some other particles. For the moment it's not a very numerous chain, but it's a beginning. □