

Amoebas, biology and the public

Claim of first artificial cell synthesis held to be door to a new research era

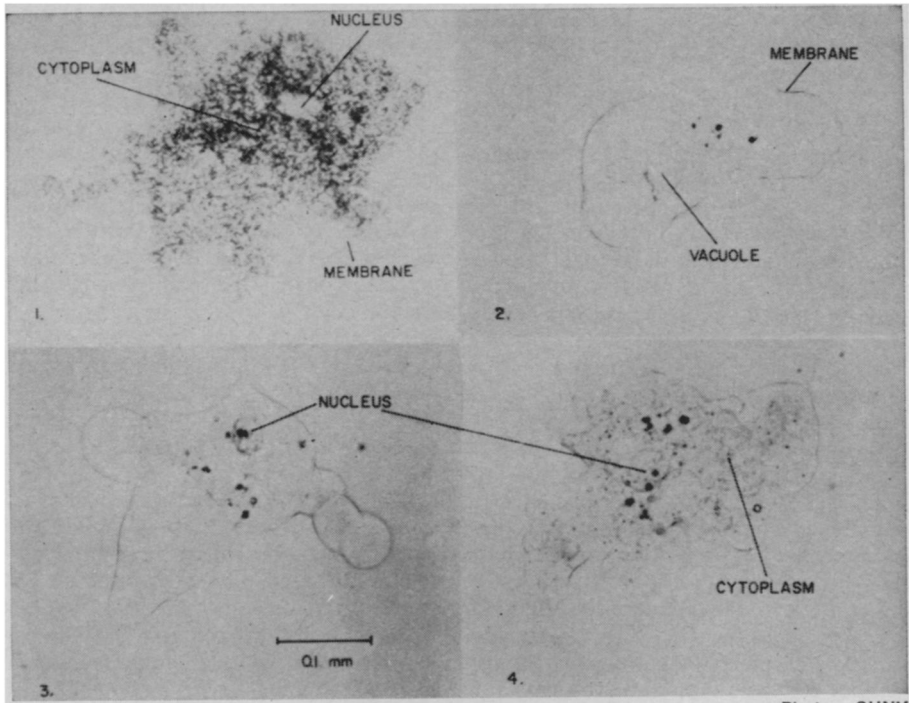
"A horse will build an airplane before man has created a living cell," L'Osservatore Romano, the official Vatican newspaper, declared in a recent issue.

The Vatican's observation was in response to widely circulated news accounts of work by a Buffalo, N.Y., scientist who claims the "first artificial synthesis of a living (and reproducing) cell." The scientist, Dr. James F. Danielli, feels the Vatican is overreacting, but quips, "I will be happy to discuss my work with them when I am in Rome a couple of months from now."

Interest in Dr. Danielli's experiments, which involve amoebas, was initiated by a letter he mailed Nov. 6 to a few journalists, inviting them to a dinner Dec. 7. At the dinner, he said, he would offer brief demonstrations and documentation of his studies, which he believes "open up a new era for artificial life synthesis, now being explored, e.g. for the synthesis of new microorganisms, new egg cells, and an organism capable of living on Mars." Dr. Danielli is director of the Center for Theoretical Biology at the State University of New York at Buffalo.

The main purpose of the dinner, according to Dr. Raymond Ewell, the University's vice president for research, was to inform officials of the National Aeronautics and Space Administration of the progress made by Dr. Danielli and his colleagues. "The press," he says, "was invited as an afterthought." The space agency has been funding the Buffalo work for the last few years at about \$150,000 a year. The grant will soon be up for renewal.

At a press conference preceding the



Photos: SUNY

An amoeba (1) is emptied (2) and reassembled with parts from other amoebas.

dinner, Dr. Danielli and his colleagues, Drs. Joan Lorch, Kwang W. Jeon and Charles Ault, described their amoeba experiments, which had been reported previously in the March 20 SCIENCE and again at an April meeting in Buffalo on artificial cell synthesis.

According to Dr. Lorch, who prefers to describe the achievement as the reassembly of a living cell rather than an artificial synthesis, the first step is to remove 75 percent of the cytoplasm or "flesh" and the nucleus from one amoeba, a single-celled organism. "It is essential that some cytoplasm remain in the denucleated amoeba," she explains, "to prevent physical collapse of its membrane, making microsurgery impossible." Subsequently, she reconstitutes or reassembles the amoeba by supplying it with the cytoplasm of a second amoeba and adding a nucleus from

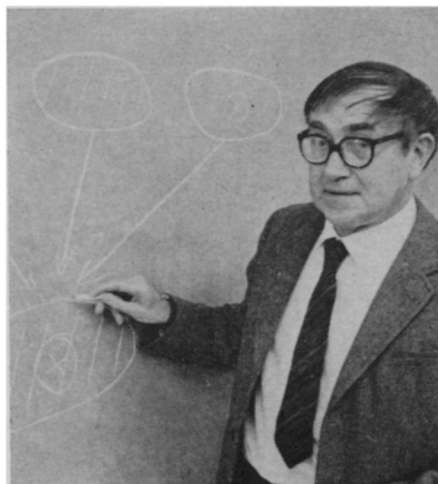
a third. When the reassembly involves amoebas of the same strain, 75 to 85 percent of the so-called newly synthesized creatures prosper, living and reproducing (by simple cell division) just like normal amoebas.

However, when the same experiment is attempted with amoebas of different strains, the success rate is only one or two percent. Says Dr. Jeon, now at the University of Tennessee, "This failure can be explained by the presence of what we have named lethal factor, a high-molecular-weight protein which appears to occur naturally in all amoebas we have studied."

Just what role the lethal factor, thought to be produced by the nucleus, plays in its native amoeba is unclear, but when introduced into the interior of a foreign amoeba, it kills the creature by inhibiting RNA synthesis. Although the reaction is analogous to immune rejection in higher organisms, Dr. Jeon maintains that lethal factor is not an antibody in the strict sense because it is continuously present in all amoebas and is not produced only in response to an antigen or foreign protein, as is the case in higher organisms.

The next stage in this research, Dr. Danielli observes, must be further exploration of the lethal factor so that it can be "outwitted," allowing a higher percentage of successful interstrain cell assemblies. Such an achievement, he declares, will be possible if research funds do not dry up.

Discussing the implications of his research, Dr. Danielli roamed through wide territories: "Within a century we shall probably be able to synthesize artificially any biological system or entity.



Dr. Danielli: "New era in synthesis."

By system or entity I refer to viruses, cells, animals and plants, ecologies and societies."

Specifically, he foresees the creation of higher plants with a capacity for fixing nitrogen and thereby eliminating the need for nitrogen fertilizers; tailormaking of organisms to treat sewage and desalinate water; production of human hormones or proteins that are in short supply, by the artificial manufacture of microorganisms able to make these products.

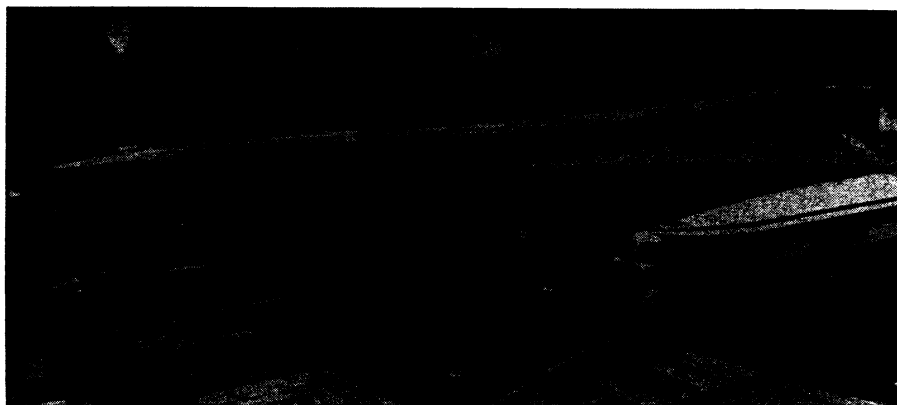
In addition, the Welsh-born scientist predicts the synthesis of human genes and the possibility of man "ending the genetic deterioration of the human race."

Because of the potential for misuse of such skills and because they may become available sooner than many scientists now think—"as soon as 10 or 20 years"—Dr. Danielli urges formation of a public body, possibly under the auspices of the National Science Foundation or the National Academy of Sciences, to oversee research in artificial life synthesis.

Most scientists agree that some type of genetic or cellular engineering of higher organisms, including man, is inevitable. Many, including Nobel laureates Marshall Nirenberg and Joshua Lederberg, have previously called for public consideration of its implications in advance of its reality. But whether Dr. Danielli's experiments themselves have actually hastened that day to the degree he claims is open to question.

ASSESSING PRIORITIES

The SST rejection



Boeing Co.

SST mockup at Boeing plant: Suddenly, new technology is no longer sacred.

Modern man almost always has given the go-ahead to new technology. One assumption has been that a technological advance is, per se, an improvement in the human condition. Another is that the national interest or national ego requires technological preeminence, either for defense, prestige or a favorable balance of trade. The actual decision makers, of course, have been gov-

Not all of his colleagues in the scientific community share his unbridled enthusiasm over the reassembly of amoebas of the same strain.

Dr. Danielli himself acknowledges other steps taken in this direction, including the recent synthesis of a gene by Nobelist Har Gobind Khorana (SN: 6/6, p. 547). Within the last decade, in fact, a series of advances have come about to move man closer to the age of cell synthesis and control. Dr. Nirenberg deciphered the code for DNA. In 1965, Dr. Sol Spiegelman synthesized bits of RNA (SN: 10/9/65, p. 227). In 1967, Dr. Arthur Kornberg accomplished the synthesis of a piece of viral DNA (SN: 12/30/67, p. 629). Dr. Robert Merrifield of Rockefeller University and Dr. Robert Denkwalter of the Merck Institute for Therapeutic Research independently synthesized an enzyme, ribonuclease, in 1969 (SN: 2/1/69, p. 112). Even on the clinical level, scientists moved in the direction of manipulating or changing human genes when a team of European investigators injected the Shope virus into two children in hopes of reversing an inborn metabolic error (SN: 9/5, p. 198).

Thus, a number of steps have already been recorded. Assessing the Danielli achievement, one scientist commented, "Dr. Danielli's success in reassembling amoebas is surely a neat and useful experiment, but it hardly opens a new era in artificial life synthesis. That has been done." □

corporations often remained as enamored as ever of new multimillion-dollar hardware, the people and their representatives, particularly in the Senate, were becoming disillusioned. Anti-pollution bills passed almost unanimously, projects such as the antiballistic missile system barely squeaked through and space budgets were cut.

Then last week came what may be one of the more significant decisions of all. The Senate voted 52 to 41 to accept an amendment introduced by Sen. William Proxmire (D-Wis.) to the transportation appropriations bill. The vote deleted the \$290 million asked by the Administration for this year's costs in developing a prototype supersonic transport. The 11-vote edge won by the SST opponents surprised everyone, both because it was such a complete departure from previous years when SST appropriations passed handily and because it gave such a wide margin to the opponents. There was jubilation in the offices of environmentalist groups such as the Sierra Club, which had led the efforts against the SST.

But the Senate vote does not assure the death of the SST. Backers—led in the Senate by Washington Sens. Henry M. Jackson and Warren G. Magnuson—promised all-out efforts to sway the Senate-House conference committee on transportation appropriations toward at least a subsistence appropriation for SST. But because the earlier House vote in favor of the SST appropriation had been narrow, SST opponents claimed any restoration of funds would have to be small; Sen. Jacob Javits (R-N.Y.), who voted against the \$290 million, indicated he might vote for a compromise \$100 million appropriation. An effort in the House this week to reverse its earlier pro-SST vote failed, 213 to 174.

The SST debate has from the beginning involved a variety of side issues. Backers pointed, for example, to severe unemployment in Seattle, the home of Boeing Aircraft Co., prime contractor for the SST. They also claimed that United States failure to develop an SST would give the Anglo-French Concorde, or even the Russian TU-144, an immense future world market for SST's and thus damage the United States' world trade posture. Opponents, on the other hand, suggested that public money for the SST could be better spent on social needs and that England and France might well follow the United States and halt development of the Concorde.

On the strictly environmental issues, both sides, when pinned to the wall, have to admit that the area is filled with unknowns. Precisely because so little is known of the SST's environmental effects, an edge was given to opponents, who were able to make a