Medical Research System

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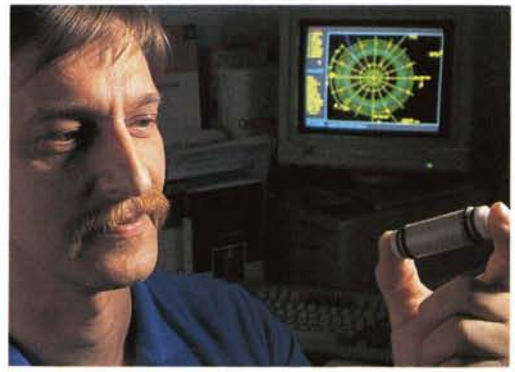
NASA MICROGRAVITY CELL TISSUE STUDIES LEAD TO DEVELOPMENT OF AN IMPORTANT MEDICAL RESEARCH SYSTEM

In 1992, three Johnson Space Center (JSC) researchers were named co-recipients of the 1991 NASA Inventor of the Year Award for development of a rotating bioreactor cell culture apparatus that promises extraordinary benefit to medical research. The awardees were Ray P. Schwarz, Dr. David A. Wolf, and Tinh T. Trinh. Dr. Wolf is an astronaut and space physician. Schwarz and Trinh were engineers employed by a JSC contractor at the time of the invention.

The work of the JSC trio began as a hardware development for study of the effects of microgravity on mammalian (including human) cell tissue cultures, along with a parallel investigation of a means to protect easily-damaged cell cultures during launchings and landings of the Space Shuttle. In the process of simulating zero gravity biosynthesis, the group serendipitously developed the bioreactor that makes it possible to produce many types of cell cultures that will otherwise not grow outside the human body. The invention is widely regarded as a significant advance that opens new avenues in cancer research, tissue regeneration research, and general research into the functions of cells and tissues.

To commercialize the technology, Ray P. Schwarz and his project manager, C. D. Anderson, formed Synthecon, Inc., Friendswood, Texas to manufacture and market the Rotary Cell Culture System (RCCS), a refined version of the JSC technology. NASA granted exclusive licenses to the patents and the company introduced the RCCS late in 1992. Schwarz, now chief engineer of Synthecon, is shown ***at right*** examining a component of the bioreactor. C.D. Anderson, Synthecon president, is pictured ***below right*** consulting with company chief biologist Dr. Marlene Warner.



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Standard laboratory techniques for growing mammalian cells limit the size and quality of the tissues and generally produce only flat two-dimensional tissue. Tissues grown in the bioreactor are larger, three-dimensional, and they exhibit many of the structural and chemical characteristics of normal tissue. NASA scientists have seeded cultures with the same mixture of cells that normally occurs in the human body and observe their growth and development into tissue material very similar to the parent tissue.

The RCCS enables growth of human tissue, cancer tumors and virus cultures outside the human body, which may allow study of the transformation and growth of cancers continuously as they advance from single cells to tumors; ***at right*** is a magnified view of a mass of colon cancer cells grown in the RCCS. Cancer treatment clinics may also be able to use the technology to perform multiple tests of chemotherapeutic agents on a patient's own cancer *outside* of the patient's body. For AIDS research, the RCCS can produce human HIV host cells that can be infected and studied in the effort to develop an AIDS vaccine.

The components of the RCCS are shown ***at upper far right***. The system includes a tubular cylinder that is enclosed by the end caps shown in the foreground to form the cell culture chamber. The chamber is filled with a liquid medium (***bottom right***) to which tiny micron size beads have been added (mammalian cells must attach themselves to an object in order to grow and the beads provide the requisite attaching surface). The culture chamber is then rotated around a horizontal axis and the cells establish an orbit that approximates free fall through the liquid medium.

The cells are fed oxygen necessary for growth by diffusion into the chamber through a porous wall. As the cells or cell clusters grow, the speed of rotation is adjusted to compensate for the increased sedimentation rate of the denser cell masses. The RCCS has no internal moving parts, therefore minimal turbulence and "shear" forces that might damage the delicate cells. The results of several years testing, says a NASA report, show that the rotating bioreactor has proved to be "a significant tool for use on Earth in the culturing of mammalian cells" and has demonstrated that it is "at least an order of magnitude superior to the prior known technology for mammalian cell culturing."

The Mid-Continent Technology Transfer Center's Houston (Texas) Office played a supporting role in the commercialization of the RCCS. The center's primary work involved assistance to Synthecon in preparation of a strategic plan enabling the company to map out its capital needs based on growth prospects. Mid-Continent also helped Synthecon by arranging contacts with JSC, NASA Headquarters and commercial service providers, such as accounting firms and management consultants. The Mid-Continent Technology Transfer Center is one of six NASA Regional Technology Transfer Centers established in 1991 to facilitate transfer of technology from NASA and other government agencies to the private and academic sectors (see page 134). •

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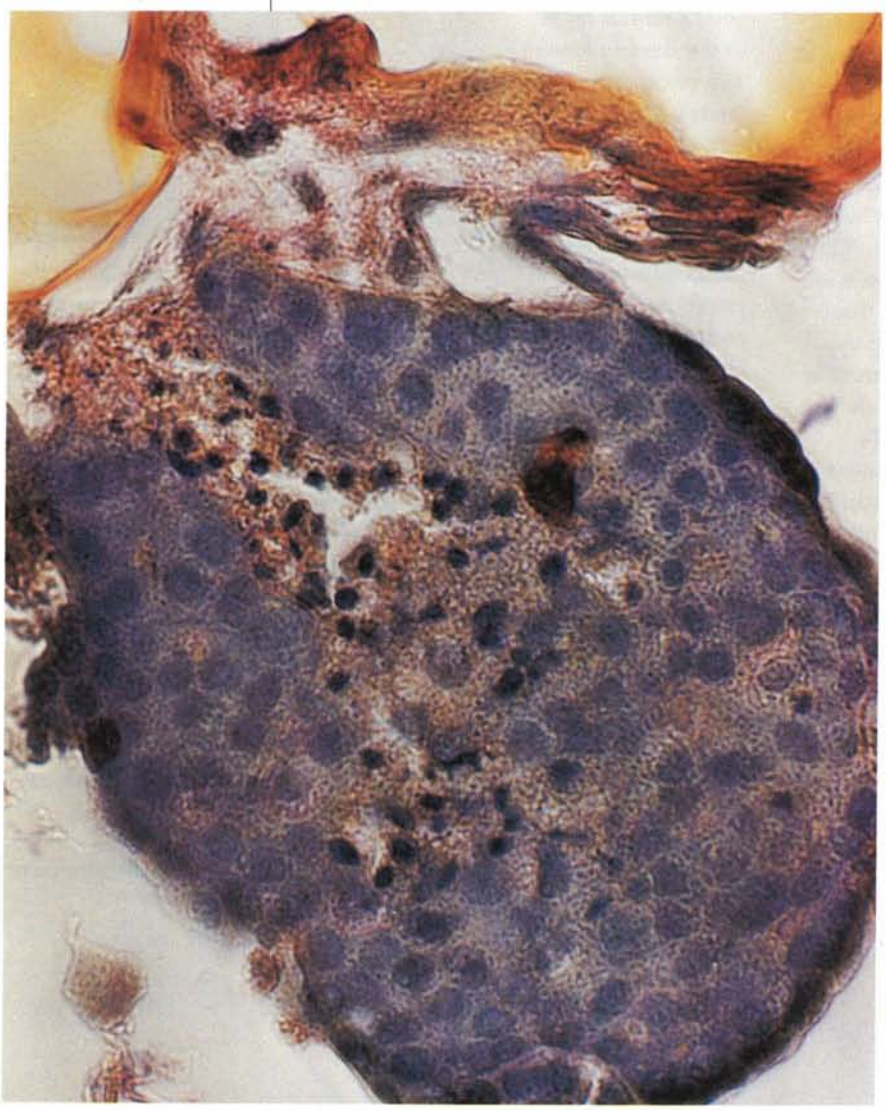

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