The Medilab Mir Module

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The Mir Russian/Soviet space station was operational from 1986 to 2001. During that period, the Mir Core Module (1986) was supplemented with several modules boosted into orbit and docked to the central docking apparatus: Kvant-1 (1987), Kvant-2 (airlock, 1989), Kristall (semiconductor research, 1990), Spektr (power and Earth remote sensing, 1993), and Piroda (Earth resources research, 1996). The early Soviet plans for Mir were quite expansive and involved servicing by the Buran Soviet space shuttle.[9] The development of the Buran disappeared with the collapse of the Soviet Union. U.S. involvement in the Shuttle-Mir Program was agreed to in 1992 and included long-duration visits by seven U.S. astronauts beginning in 1995, a "near-Mir" Shuttle rendezvous flight in 1995, and nine Shuttle dockings from 1995–1998. There were initially plans by the Soviets to install a dedicated biomedical module between 1990 and 1994 that was described as the "Medilab Module," which was defunded after the fall of the Soviet Union and the resulting financial crisis. There were also initial plans for the U.S. Mir astronauts to be heavily involved in the biomedical research onboard the Medilab Module.[10]

The Medilab module was proposed in 1987 by the Institute of Biomedical Problems (IBMP) and was to be dedicated to in-flight medical care and biomedical research. It was designed to be 4.1 m in diameter and 11 m long in size with a pressurized volume of 100 m^3 (3500 ft^3). It was to have integrated computer support, an animal holding facility, and a man-rated centrifuge. It was planned that it would be used continuously by one clinical physician and one physiologist. There were plans to perform survivable animal surgery and to develop anesthetic techniques onboard Medilab.[1] One of the goals was to identify the optimal duration of human exposure to spaceflight and it was considered a critical step in enabling future long-duration space missions such as a Mars expedition.[2,3,5] More advanced plans were to add a re-entry vehicle dedicated to emergency medical evacuation.[1] In 1989 it was reported that 12 new specialist cosmonauts were in training for the Medilab program, including physicians, biochemists, veterinarians, and biologists.[8] Certainly it appears that the Medilab design and concept was a reaction to several U.S. Space Station Freedom design components that were well publicized in 1986, such as the Health Maintenance Facility (HMF) and the Crew Health Care System (CHeCS), which included exercise countermeasures, environmental monitoring, and health care.[6] Space Station Freedom and the HMF were defunded in 1993 and replaced with the International Space Station.

The specific objectives[3,4] of the Medilab Module were:

- Medical monitoring
- In-flight medical care
- Psychological support[7]
- Countermeasures for deconditioning
- Environmental monitoring and control
- Human physiological research
- Animal/cellular/plant research in adaptation to microgravity

Dr. Grigoriev (director of the IBMP) stated, "In order to solve these problems effectively, it was considered essential to develop a dedicated biomedical laboratory for incorporation into the Mir Space Station. This laboratory would be equipped with state of the art scientific research equipment and computer support, and would be maintained by specialists highly proficient in the areas of space biology and medicine."[3]

The designed module had several sections[3] (see **Fig. 1**):

- Transfer compartment—docking port to Mir and storage
- Human-rated short arm centrifuge
- Scientific research compartment—medical investigation equipment (Cardiovascular, respiratory, neurovestibular), countermeasures (ergometer, treadmill), workstation with medical computer for data collection and analysis
- Therapeutic and prophylactic compartment
- Medical care area—included operating table, ventilator, monitor, defibrillator, diagnostic equipment, medical treatment kits, task lighting, X-ray machine
- Biochemical analysis
- Psychological support workstation
- Biological research compartment (this would be separated from the rest of the Medilab module by a hatch and with decreased cabin pressure to isolate any atmospheric contamination)
- Animal holding facility for 50 rats
- Workstation (glove box?) for animal procedures and surgery
- Biochemical analysis for animals
- Animal centrifuge
- Biological rack for animal cells and plant experiments

The Medilab Module was an ambitious concept that unfortunately was never realized due to the collapse of the Soviet Union. As such, it was another example of political situations impacting ambitious plans for space exploration. The Vietnam

From Paris, TX.

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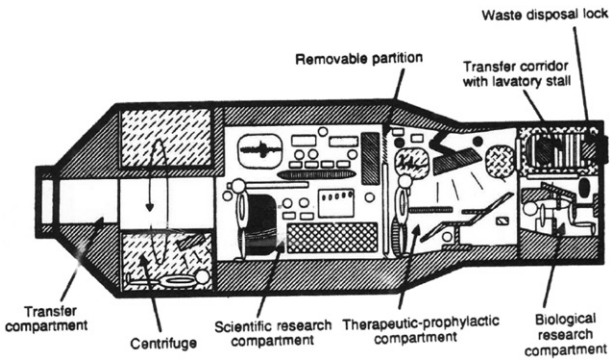

Fig. 1. Schematic of the designed Medilab Mir module[3] showing the different sections as described in the text.

War effectively curtailed the Apollo Lunar Program and the Apollo Applications Project. All of the Apollo-Saturn hardware was then relegated to museums. The 9/11 disaster had much to do with the eventual termination of the Shuttle and Constellation programs. The possibility of achieving biomedical research goals that have still not been realized such as human-rated centrifuge research and the extensive development of techniques in animal surgery/anesthesia is especially disheartening. The only survival animal surgery performed in space to date were the limited rat dissections performed on the Neurolab Shuttle mission (STS-90) in 1998. Even more disappointing in the cancellation of Medilab was that there was a great opportunity for U.S. researchers to be heavily involved through the Shuttle-Mir Program. It is noted that of the seven U.S. Mir astronauts, three were physicians (Thagard, Linenger, Wolf) and one was a biochemist (Lucid).

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