EXOBIOLOGICAL EXPERIMENTS ON THE FIRST EURECA MISSION

G. Horneck[1], J. Barrett[2], A. Bieger[3], H. Bücker[1], K. Dose[3], J.M. Greenberg[4], J. Kiefer[5], H.D. Mennigmann[6], G. Reitz[1], P. Weber[7]
1) DFVLR, Inst. for Aerospace Medicine, 5000 Köln 90, FRG
2) Univ. of Wales, Dept. of Zoology, Aberystwyth, U.K.
3) Univ. of Mainz, Inst. for Biochemistry, 6500 Mainz, FRG
4) Univ. Leiden, Huygens Lab., Leiden, NL
5) Univ. Gießen, Radiation Center, 6300 Gießen, FRG
6) Univ. Frankfurt, Inst. Microbiology, 6000 Frankfurt, FRG
7) ESTEC, MP, Postbus 299, 2200 AG Noordwijk, NL

During the Spacelab 1 mission, two experiments (H. Bücker et al. 1984, G. Horneck et al. 1984) have provided data on the mechanisms of cosmic ray particle interaction with biological matter, on the synergism of space vacuum and solar UV radiation, and on the spectral effectiveness of solar UV radiation on spore viability. The first mission of the European Retrievable Carrier (EURECA) of the European Space Agency (ESA), scheduled for 1988, offers the opportunity to extend the exposure time to 6 months. The ESA core facility Exobiological Radiation Assembly ERA will accommodate 6 experiments to expose different biological or biochemical test systems to the complex interplay of the various environmental factors of space as well as to selected components of it.

The experiment ER 161 "Exobiological Unit" aims at a 6 months simulation of microbial systems travel through space either as isolated organisms or embedded in protective dust material. After retrieval, the following parameters will be investigated: (1) the action spectrum of solar UV radiation on survival and genetical changes of resistant invertebrates, microorganisms, viruses and transforming DNA as well as the stability of organic molecule complexes, (2) the role of chemical and physical protection mechanisms, and (3) the nature and reparability of damage produced by the components of space environment as well as by their combinations.

The experiment ER 162 "Free Flyer Biostack" is part of a radiobiological space research program to increase the knowledge on the importance of the structured components of cosmic radiation (HZE particles and nuclear disintegration stars) for biological specimens in space. Using the typical Biostack sandwich design, where layers of biological objects, such as spores, yeast cells, seeds, invertebrate

eggs are stacked between track detectors, special attention will be paid to the effects of rare components of cosmic radiation like iron nuclei or super heavy particles of high energy which are not yet available from ground-based facilities.

In the experiment ER 163 "Space Biochemistry" it is aimed to elucidate chemical reactions (e.g. dehydration, photochemistry) that occur in cellular (fungal conidia and bacterial spores), subcellular (purple membranes, chromatophores, proteoliposomes) and molecular systems (nucleic acids, proteins, amino acids, hexamethylentetramine) during long time exposure to free space, protected or unprotected from solar UV radiations. The significance of these processes with respect to survival, mutation induction and destruction of biosystems as well as to interplanetary life transfer and prebiotic and biotic evolution will be evaluated.

The experiment ER 164 "Dosimetric Mapping" will document the radiation environment throughout EURECA, to supply radiation baseline data required by several experiments of this mission.

The experiment ER 165 "Effects of Solar UV on Yeast" will study the action of solar UV radiation under space conditions on survival, mutagenesis and repair capacity in this unicellular eucaryotic system.

In the experiment ER 166 "Organic Chemistry in Interstellar Dust Grains" it is aimed to study UV induced changes in the structure of laboratory abiotically produced organic material in free space over long time intervals and subjected to the full spectrum of the solar UV flux, as well as the efficiency of this material in protecting bacterial spores against the influx of solar UV light.

For follow-on missions, an extension of research opportunities is being discussed, such as the availability of deep temperature environments in addition to space vacuum and solar UV radiation or a device to allow free floating of small particles, such as bacterial spores or simulated interstellar grains, in free space conditions.

Bücker, H. et al.: 1984, Science 225, 222
Horneck, G. et al.: 1984, Science 225, 226