CE5b

M111

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SKYLAB 2
M111 Experiment-Cytogenetics
Preliminary Report

Pre- and postflight leukocyte samples were obtained from the prime crew, the back-up crew and a control group beginning 4-2-73 (F-53) and ending 7-10-73 (R+18). Ninety cultures were processed by a modified method of Moorhead* requiring 16 to 18 hours to process each sample from blood to karyotype. The lymphocytes remain in culture for 72 hours, then are treated with Colcemid to stop mitosis, followed by treatment with hypotonic solution and numerous changes of fixative. The cells are flame fixed to slides and stained. Metaphase plates are examined for number and structure of chromosomes.

All of the ninety samples have been processed through staining requiring some 180 to 200 man hours. All specimens showed active mitosis except those cultured, by necessity, aboard ship on 6-22-73 (R+0) and 6-23-73 (R+1). They appeared to have been exposed to temperatures that did not allow for cell viability.

Ten individual studies have been completed requiring another 140 hours of time. In a blind study where each specimen is known to the examiners only by number, 100 cells are studied under the photomicroscope by each of two examiners for chromosome structure. The defects are noted and the cells photographed when it is not apparent which chromosome is involved. They are then individually cut out and paired to establish a karyotype.

Structural defects may be divided into two categories - those that are considered minor and include chromatid breaks, isochromatid breaks, and fragments. These are the result of a single break and occur in normal subjects in 2 to 3% of the cells analyzed. They are known to be increased following a viral illness, after ingestion of certain drugs, after exposure to radiation and after radioisotype injections. This increase is generally of a temporary nature.

The more major abnormalities involve multiple breaks and recombinations of chromosome material. These are known to occur in persons exposed to more significant ionizing radiation, to certain chemicals and drugs, and in persons with several disease states that have a high risk to develop malignancy. It is because of these associations that they are considered to be of more consequence.

It is extremely rare** to find such a major defect in a routine blood lymphocyte chromosome culture. In fact, we examine some 13,000 cells per year and do not see these defects.

Two observations were made in the SMEAT studies where controls were not available. First, there was a small and temporary increase in minor structural defects. Secondly, it was noted that each of the three SMEAT astronauts had at lease one or two major abnormalities, the cause of which was not apparent.

Since Skylab 2 specimens are being studied blindly, the subject and date studied are not known, but following are the results from the ten that are completely analyzed:

No. of Study	No. Cells Examined	% Minor Defects	Structural Rearrangements
10	257	5.0	1 - Translocation
25	244	7.4	1 - Exchange Figure
29	238	5.0	1 - Dicentric 1 - Exchange Figure
43	239	3.4	1 - Dicentric
46	244	2.5	
65	238	1.7	
77	231	5.0	
80	259	3.9	
84	223	0.5	

There is little that can be deduced from the date at this stage, except to say that it is already apparent that we will again see at least an occasional major exchange of chromatin. It will take another 1100 man hours to complete these studies.

In reference to Skylab 3, we would hope to be able to receive the samples R+0 and R+1 for culture in our own facilities, as the success of cell culture depends on very rigid treatment conditions.

I do not yet see the likelihood of defining the cause of these exchanges. There is no etiology apparent from reading the medical reports of Skylab 2. One problem with the cytogentic studies is that we have no base line data prior to entrance into the space program. I would like to strongly suggest that the chromosome patterns of the astronauts be determined at the time of their initial induction into the program and intermittantly thereafter. It is quite possible that the offending agent or activity occurs prior to their entrance into space. Information regarding the control group and the back-up crew might also be helpful.

* Moorhead, P.S., P. C. Nowell, W. J. Millman, D. M. Battips, and D. A. Hungerford: Chromosome preparations of leukocyte cultures from human peripheral blood. Exp. Cell. Res. 20: 613, 1960.

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