SECTION 2

GENERAL DISCUSSION OF RESULTS AND CONCLUSIONS

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Aside from the inverse relationship between retinal blood vessel caliber and pO_2, there were no positive findings. In the case of the renal function and pulmonary function this is not surprising, as previous reports had led us to believe that none would occur as a result of our experimental design.

The wide variations noted in the creatinine levels must be ascribed to technical difficulties. Only one of the subjects showed any significant change in weight or surface area; subject 3 who deliberately although surreptitiously lost 15 pounds during the 34 days of confinement. However, the variations in creatinine excretion in this subject were no more marked than those observed in other subjects. The most probable source of error is the manner of urine collection.

Certain changes were anticipated but not observed in the case of the hematological and blood biochemistry sections. Helvey et al[1] reported changes in the blood picture of his subjects at all three pressures studied, i.e., 7.4, 5.0 and 3.8 psia. The alterations were much more apparent at 7.4 psia than at the two lower pressures of 5.0 and 3.8 psia.

Possibly the most striking change reported by Helvey et al[1] was the flattening of the peaks and shift to the left of the Price-Jones Curves. Our data indicates no such changes. In the absence of Price-Jones changes or any other alterations in blood morphology/biochemistry we can only suppose that some factor other than those anticipated was as least partially responsible for the changes noted in the Helvey study. This factor might have been mercury vapor as several mercury containing instruments were inadvertantly broken in the low pressure chamber during the course of the reported series of investigations.

The absence of significant alterations in the activities of the blood enzyme studies conducted by NMRI tend to substantiate our morphological findings. From our data, we can conclude that our experimental design produced no detectable alterations in the reduction-oxidation balance of the red blood cells. This appears to agree with A. A. Thomas[2] who has stated that a pO_2 of 300 mmHg appears to be the toxic threshold for oxygen.

The bacteriological studies indicate that although there was a general buildup of microorganisms on the bodies of the subjects and in their respective environments, this posed no special problem. However, a warning note was sounded. The isolation of Shigella Poly B, Bethesda Ballerup, and a coagulase-positive phage typeable staphlococcus, all potential pathogens, would seem to indicate a necessity for eliminating all potentially pathogenic organisms from each individual of a proposed space crew. Although there was only minimal intra-personal transfer between subjects, it must be emphasized that overt transfer can occur, and if a highly virulent strain of Shigella or Salmonella, for example, is introduced, the resulting affect could well be catastrophic in a manned spacecraft environment.

The nutritional aspect of this study is noteworthy only in that the diet was very well accepted and appeared to be adequate in all aspects.

There were no significant variations noted in the balance studies.

The psychological portion of this study, Sections 9, 9a, 10 and 11 reports changes which have significance only when related to confinement in the Bioastronautical Test Facility or control facility. No changes were noted which are considered relevent to the 100% oxygen or reduced pressure.

Some general comments arising from the debriefing session, which included both subjects and investigators, are in order. Probably the most common single source of annoyance to the subjects was the ratio of temperature/humidity. Although fairly precise control could be maintained by the automatic equipment it appears that no single set of conditions could satisfy all of the six experimental subjects for very long. There are a number of perfectly valid reasons for this.

1. The variety of suits used; i.e., USN Mark 4, USN Mark 5, NASA-MA-10 and NASA Apollo, was such that there were no common thermal characteristics. Each suit has quite different properties.

2. The suits were worn fully donned, except for the faceplate, for only about four hours a day. The remainder of the time the helmets and gloves were removed. In the case of the USN Mark 4 suits the rubber booties were cut off when moisture began to accumulate in them. All of these modifications to the various suits or the configuration in which they were worn produced a virtually insolvable problem when it came to providing not only a satisfactory temperature and humidity but in supplying vent gas flow at an optimum rate. This rate had been stipulated prior to the beginning of the run and was therefore maintained at 12 liters per minute. This was insufficient under the conditions mentioned above. Future studies of this type should provide individual control of vent gas.

Several other problems relating to the wearing of the full pressure suits arose. Sleeping presented a problem which was partially solved by "buttoning up" the suit. This not only insured optimum ventilation but, donning the helmet avoided pressure points on the neck which resulted from trying to sleep on the neck ring.

The flaking of skin and sloughing of hair has been mentioned previously but is raised again because of its pertinence in actual manned spaceflight. The flaking occurred in quantities sufficient to impair gas flow through the filters in the process of circulation and to litter the floor of the living compartment. Under weightless conditions this settling would not occur and the detritus would remain suspended in the environment.

Constant wearing of full pressure suits greatly impairs the effecting of adequate personal hygiene procedures. Although no build-up of pathogens occurred, all surfaces became markedly contaminated with coliform microorganisms. In this connection the use of the "O Gravity Sink" did nothing to improve personal hygiene, in fact quite the opposite. Microorganism levels reached staggering proportions and the use of the "Sink" was discontinued at the end of the first week. The washcloths remained a source of contamination throughout the entire period of the run. From a purely subjective point of view the subjects' attitudes with regard to his own state of personal hygiene at the end of the 34 days varied considerably. While no one considered himself to be "clean" not all of them felt "filthy" either.

REFERENCES

(1) Helvey, W. M., Albright, G. A., Benjamin, F. B., Gall, L. S., Peters, J. M. and Rind, H.: Effects of Prolonged Exposure to Pure Oxygen on Human Performance. Republic Aviation Corporation, RAC 393-1 (ARD 807-701), NASA (NASr-92), 1962.

(2) Thomas, A.A.: Personal Communication.