

SAMSPAC

Photosynthetic Exchange (Balancing) Systems
(For use in Sealed Cabins in Long Term Operations)

Director of Research
THRU: Chief, Dept. Space Medicine
THRU: Chief, Med. Sciences Divn.

Dept. Space Medicine

24 Jul 57
JGG/HS/mbn /2655

1. General Objectives:

- A. Gas exchange
 - 1) O₂ production
 - 2) CO₂ production
 - 3) Odor removal
- B. Re-utilization of waste, human and other
 - 1) Methods of preparation of waste as nutrients for algal growth
 - 2)
- C. Production of food supplement from excess algal growth
 - 1) Methods of processing of algae for use as animal and human food
- D. Design and construction of workable system utilizing data from A, B and C.

2. Overall Research Plan

The most efficient division of research efforts appears to be as follows:

All facets of the investigations concerning the basic physiology of various algae which might be suitable for this purpose should be done under contract by Dr. Myers at University of Texas. This should include for each alga investigated, the most suitable light spectrum, composition of culture media, light intensities and methods of application of light, and any other problems of basic physiology. A close liaison should be maintained by Dr. Myers with the Department of Space Medicine and Department of Microbiology.

The Department of Microbiology should utilize Dr. Myers results and continue with basic investigations, using modified techniques and materials where necessary. Studies with small animals in small closed ecological systems will be carried out in conjunction with these basic studies, recycling wastes and producing food substances from the algae.

The Department of Space Medicine, with the support of Department of Microbiology, will engage in design studies of a closed system capable of supporting larger animals (or a number of smaller animals) and/or human subjects. A preliminary study of the overall development of a working device to fulfill the basic objectives of these studies and to fit into the smallest volume of space with the least weight, will be the responsibility of the Department of Space Medicine.

Comment No. 1 continued on Sheet #2, attached.

JAMES G. GAUME, M.D.
Department of Space Medicine

SAMSPAC, DF, Subj: Photosynthetic Exchange (Balancing) Systems (For use in Sealed Cabins in Long Term Operations), 24 Jul 57

3. Attached is a protocol outlining tentative procedures designed to accomplish the in-house portions of these studies.

1 Attachment
Protocol

JAMES G. GAUME, M.D.
Department of Space Medicine

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TO: DIRECTOR OF RESEARCH FROM: Chief, Dept Space Med DATE 24 Jul 57 Comment No. 2
THRU: Chief, Med Sci Divn

The program set forth in Comment No. 1, approved.

1 Attachment n/c
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HUBERTUS STRUGHOLD, M.D., PH D.
Chief, Dept. Space Medicine

PHOTO SYNTHETIC EXCHANGE
BALANCING
R.D. 7758-651

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TO: Col Karstens
Director of Medical Research

FROM: Med Sci Div

DATE: 24 Jul 57 COMMENT # 3

1. Recommend approval of the approach outlined in the tentative protocols to meet the objectives presented in Comment # 1.
2. As you recall, these protocols are for work which was presented for cooperative effort between the Departments of Space Medicine and Microbiology approximately eighteen (18) months ago. At this time we decided that Dr. Gafford should place primary emphasis on the completion of his Ph.D. research and initiate, in pilot studies, as many facets as possible. This latter was accomplished in a very satisfactory manner between personnel of the two (2) departments.
3. You will recognize the attached protocol entitled "A Selection and Cultivation of Microorganisms Capable to Carrying Out Essential Functions in Closed Ecological Systems" as being for a study in which there has been a mutual support from the standpoint of funding and personnel support. A quick reading of the proposed studies can be obtained from the outline noted as PROTOCOL.
4. Your guidance for further action by these two (2) departments will be appreciated.

ROLAND B. MITCHELL
Acting Chief
Medical Sciences Division

PROTOCOL

The following studies will be undertaken:

1. Design of culture chambers -- various designs will be constructed and tested for their efficiency/power ratio.
2. Illumination -- types of light sources, intensities, spectra, and methods of application of irradiance will be investigated, including solar illumination.
3. Nutrients -- Basic data will be obtained using standard or modified media. Then animal and human excreta will be substituted or added to the culture to determine the suitability of these substances as algae nutrients alone or supplemented and what supplements are required. This will be done first with animals, then with human subjects.
4. Methods of preparation of wastes from animals and humans for maximum utilization by algae -- will include use of raw wastes, wastes treated by an activated sludge type process, by dessication with heat and/or vacuum, by incineration, and by any other process which may seem suitable during the course of these investigations.
5. Preparation of various algae used as food for animal and human subjects. This includes the biochemical analysis of each alga with regard to carbohydrates, fats, and proteins, amino acids, vitamins, minerals, and ash. Includes the preparation of dried algae as food tablets, wafers, or flour to be used alone or in combination with standard food materials in order to prepare acceptable meals using algae. Various cooking recipes will be studied.
6. Studies using animals in a closed system or in separate component parts of a closed system, using the information acquired in steps 1 through 5 above.
7. Design and construction of a workable closed system device capable of maintaining larger animals or human subjects.

JAMES G. GAUME, M.D.
Department of Space Medicine