SOUTHWEST RESEARCH INSTITUTE ASSISTANCE TO NASA IN BIOMEDICAL AREAS OF THE TECHNOLOGY UTILIZATION PROGRAM

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I. INTRODUCTION

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A. General

The aeronautical and space activities conducted by the National Aeronautics and Space Administration (NASA) are creating an impressive body of knowledge of great potential scientific and technological usefulness. In carrying out its congressional mandate to disseminate this information for ultimate benefit of the general public, NASA has engaged in an extensive publications program; in particular, publications under the auspices of NASA's Technology Utilization Division (TUD) are specifically aimed at expeditiously transferring NASA developments to the scientific and industrial community.

Special difficulties are encountered when it is attempted to transfer NASA-derived technology, by means of TUD publications alone, to scientists in the biomedical fields. These scientists are particularly overburdened by the copious amounts of published biomedical material; additionally, they are by and large unfamiliar with the language and symbology of the physical and engineering sciences. As a result, technology in physical science and engineering has often not been as effectively transferred to biomedical applications as it deserves to be.

The TUD's investigations of the chain of events leading to the introduction of new products, technological inventions, and methods into medical practice have suggested that the biomedical research teams at medical schools and similar biomedical research institutions play a key role in this process. New discoveries, introduced by these groups, tend to proceed naturally through stages of professional approval, manufacturing interest and participation, on to the level of the practicing physicians, bringing direct health benefits to the public. It would seem an attractive goal to introduce NASA-derived advances at the level of the biomedical research team, and thus to utilize the existing channels to the medical practitioner and his patients for effective technological transfer.

As a result of these investigations, NASA's TUD has developed a general methodology for the solution of this important and special technological transfer problem. Prominently included in this methodology was the establishment of several strategically placed Biomedical Application Teams consisting of appropriately cross-trained and broadly experienced physical and biological scientists. It is the task of the Biomedical Application Team to facilitate and improve the productive interaction between NASA centers and biomedical research teams. Emphasis is on interpersonal contact, in which the cross-trained members of the Biomedical Applications Team form an active link between these two groups of scientists. A flexible system is

maturing in which both principal groups, NASA personnel and biomedical researchers, freely and effectively participate in mutually beneficial exchange of skills and knowledge.

B. Participating Personnel

The following scientists are participating in the program:

- Southwest Research Institute Biomedical Application Team, Southwest Research Institute Personnel:
  - Ray W. Ware, M.D., Director
  - Louis S. Berger, Assistant Director
  - Raul San Martin, M.D.
  - Charles J. Laenger, Sr.
  - Robert J. Crosby
  - Chester A. Heath
  - Felix St. Claire
- Special Consultant: Andre G. Buck
- Key Coordinators at User Institutions:
  - C. W. Hall, M.D., Asst. Professor, Department of Experimental Surgery, Baylor University School of Medicine, Houston, Texas
  - F. Hermann Rudenberg, Ph.D., Associate Professor, Department of Physiology, The University of Texas Medical Branch, Galveston, Texas
  - Jack B. Johnson, Asst. Chief, Biomedical Instrumentation Section, Southern Research Support Center, Veterans Administration, Little Rock, Arkansas
  - Mr. John Hall, Seattle Handicapped Center, Seattle, Washington
  - Mr. Don Baker, University of Washington, Department of Bioengineering, Seattle, Washington
  - Mr. H. A. Miller, Stanford University School of Medicine
  - N. P. Thompson, M.D., Palo Alto Medical Research Foundation
  - Joseph Canzoneri, III, (SRS), Director, Biomedical Engineering, Texas Institute for Rehabilitation and Research, Houston, Texas
  - V. Mooney, M.D., (SRS), Rancho Los Amigos Hospital, Downey, California

Other Southwest Research Institute Staff consulted:

- Leon M. Adams, Ph. D., Manager, Organic and Polymer Chemistry
- Wallace L. Anderson, Ph. D., Senior Research Engineer
- Robert Bond, Ph. D., Senior Research Physicist
- J. Wray Fogwell, Manager, Electromechanical Research
- Gerald Gardner, Ph. D., Senior Research Physicist
- Stephen Juhasz, Ph. D., Editor, Applied Mechanics Review
- Richard T. Mannheimer, Senior Research Engineer
- Paul D. May, Senior Research Chemist
- Frank C. Milstead, Senior Research Engineer

II. NEW PROBLEMS

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HUV-16

TITLE: Novel Joint Design Applied to Assistive Devices for Human Limbs

SOURCE: Mr. Thorkild Engen, Department of Orthotics
Texas Institute for Rehabilitation and Research

This problem developed out of the "Reverse Problem Case History," described on pages 106 and 107 of SwRI Final Report, NASr Contract No. 94(09), 1 July 1966 through 31 October 1967. Mr. Engen, in his visit of 20 September 1967 to Ames Research Center, was introduced to the new joint design concepts developed in current hard spacesuit technology. He requested that information be made available to him, so that he could assemble joints of this type for his clinical evaluation.

COMMUNICATIONS WITH NASA CENTERS:

February 28, 1968--Mr. George G. Edwards, TU Officer, Ames Research Center, furnished Mr. Engen a copy of a new technical paper by Mr. H. C. Vykukal entitled, "Advanced Developments in Hard Spacesuit Technology," which is to be presented at the ASME (Aviation and Space National Conference), Beverly Hills, California, June 16 through 18, 1968.

The bearings used by Mr. Vykukal are manufactured commercially by the Kaydon Engineering Corporation, McCracken St., Muskegon, Michigan, 49443. Typical item numbers are KA70X5 and KA55X5.

SRS-7

TITLE: Acoustic Pest Control Technology

DATE SUBMITTED: 8 March 1968

SOURCE: James O. Wear, Ph.D., Acting Chief
Southern Research Support Center
Veterans Hospital
Little Rock, Arkansas

INITIAL DISPOSITION:

Because of previous activity in this problem area, several members of the Biomedical Application Team were aware of existing commercial technology. The commercial company (Bio-Sonic, Inc.) was contacted, and it was learned that both Texas A&M and a government agency at Denver are evaluating their method and equipment, which is protected by patents.

COMMUNICATIONS:

March 13, 1968--Mr. C. J. Laenger, Sr. of the Biomedical Application Team wrote a letter to the problem originator explaining the existing commercial development programs.

March 19, 1968--Problem originator called to say that he was following up Mr. Laenger's information.

April 1, 1968--Consultant called Mr. Laenger to inform him that the problem originator had followed up the furnished information, that further work was being considered in this problem area, but that for the time being, no further Application Team activity was indicated. It was requested that this problem be put on inactive status.

III. BIOMEDICAL PROBLEMS

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A. Problem List and Status Summary

No.	Title	Status
	Texas Institute for Rehabilitation and Research	
HUV-1	Reduced Workload Environment for Physically Handicapped Patients	Phase 1 and Phase 2, actual transfer
HUV-2	Advanced Computer Display and Interface Technology	Inactive
HUV-3	Computer Scheduling Techniques	Solution to staffing problem is being sought
HUV-4	Heart Sounds, Interval Analysis	Second search results are being evaluated
HUV-5	End Tidal Air Sampler	Inactive
HUV-6	Ambulation Aid	Problem Abstract disseminated
HUV-7	Scheduling for Ward Patients	Solution to staffing problem is being sought
HUV-8	Mechanisms of Onset of Orthostatic Hypotension	Completed
HUV-9	Prosthetic Materials for Urinary Tract	Staff consultation planned with Biomedical Application Team specialist
HUV-10	Instrumented Prosthetic Leg	The original, very broad problem, has been placed on the inactive list; the project has been funded and will be used to generate new problem statements

No.	Title	Status
HUV-11	Improved Gas Sample Flow Control and Measurement	Inactive
HUV-12	Special Automobile Modifications for Disabled Persons	Inactive
HUV-13	Human Transfer Function Measurements	Solution to staffing problem is being sought.
HUV-14	Physical Space Utilization	Transfer in progress
HUV-15	Advanced Computer Terminal and Display Technology	Closed Out
HUV-16	Novel Joint Design Applied to Assistive Devices for Human Limbs	Transfer in progress
	Rice University	
RCU-1	"Artificial Heart" Control System Technology	This problem has been combined with BLM-4
	Veterans Administration Southern Research Support Center	
SRS-1	Indirect Measurement of Blood Pressure During Rest and Exercise on Arms and Legs	Periodic literature review is requested
SRS-2	Catheter Tip Transducer for Blood Pressure and Flow Measurement	Periodic literature review is requested
SRS-3	Locating Tip of Stomach Tube	Status inactive
SRS-4	Materials Suitable for Dry Electrode Fabrication	Periodic literature review is requested
SRS-5	Temperature Regulatory Mechanisms of the Body	Periodic literature review is requested
SRS-6	Investigations of Cutaneous Stimuli	Closed out
SRS-7	Acoustic Pest Control Technology	New problem

No.	Title	Status
	Baylor University Medical School	
BLM-1	Noiseless Gas Valves for "Artificial Heart" Use	Closed out
BLM-2	Support Slings for Postoperative Care of Large Animals	Closed out
BLM-3	Triggering on R Wave of ECG	Actual transfer
BLM-4	Valve for Proportional Gas Flow Control	Technology tentatively identified
BLM-5	Transthoracic Energy Coupling Devices	No new information
BLM-6	Biocompatible Spray-On Plastics, Impermeable to Bacteria	Technology is being evaluated by problem originator
BLM-7	Telemetry of Cardiovascular Data from Free-Ranging Animals	Contractor has been informed of search results
BLM-8	Miniature Tape Recorder for Biological Data	Technology tentatively identified - unable to obtain prototype for evaluation
BLM-9	Cyclic Variation of Body Temperature in Mammals	Information has been furnished to problem originator. Application of this information is as yet unspecified.
	The University of Texas Medical Branch, Galveston	
GLM-1	Analysis of Transitional Flow-Convection/Diffusion	Transfer accomplished; problem closed out
GLM-2	Monitoring of Blood Pressure by Extra-Vascular Sensor, Using Wireless Telemetry of Information	Inactive

No.	Title	Status
GLM-3	Determination of Local Blood Flow, Blood Gas Concentration, and Blood pH in Small Portion of an Organ	Actual transfer
GLM-4	Implanted Blood Pressure Transducer	Unchanged
GLM-5	Chronic Intracranial Pressure Measurement in Man	Unchanged
GLM-6	A Model Vascular System	Reference documents are being evaluated
GLM-7	Viscosity Measurement of Minute Samples of Blood	Reference documents are being evaluated
GLM-8	Computer Program for Electroencephalograph: Period Analysis	Reference documents are being evaluated
GLM-9	Measurement of Local Tissue Oxygen Consumption In Vivo	Actual transfer
GLM-10	Computer Program for Flame Spectrophotometry	Technology tentatively identified
GLM-11	Elimination of Electrostatic Charge in Experimental Animals	Closed out; actual transfer
GLM-12	Computer Selection and Elimination of Artifacts	Reference documents are being evaluated
GLM-13	Multiple Co-Spectral Density Analysis of Time-Series Data	Problem Abstract disseminated
GLM-14	Repetitive Measurement of Kidney Mass in Intact Animal	References being evaluated by problem originator
GLM-15	Respiration Volume and Rate Measurements in Unencumbered (Free) Child	Problem originator evaluating reference material
GLM-16	In-Situ Tumor Mass Determination on Rat Leg	Meeting is planned for researcher and Biomedical Application Team members for 1968

No.	Title	Status
	The University of Texas Medical School at San Antonio	
SNM-1	Enhancement of X-Ray Contrast Study Films	Enhancement procedure has not yet been successful. New X-rays are being sent to the Jet Propulsion Laboratory.

B. Problem Case Histories Status

HUV-1--The grant application was approved, and a research project initiated March 1968: Reduced Workload Environment for Physically Handicapped Patients.

COMMUNICATIONS WITH NASA CENTERS

February 15, 1968--Louis Berger called Mr. John Samos, Technology Utilization Officer, Langley Research Center, and requested assistance with technical drawings and possibly surplus hardware for the user institution. Mr. Samos is going to be in touch with Mr. Canzoneri and work out arrangements for furnishing the requested aid.

February 23, 1968--Mr. Samos and Mr. Canzoneri discussed Texas Institute for Rehabilitation and Research needs for material and engineering information. Mr. Samos is gathering appropriate materials and will be in touch with Mr. Canzoneri.

February 28, 1968--Mr. John Samos called Mr. Joe Canzoneri. He said that no further written information on the rehabilitation system sketch is available, but Mr. Canzoneri should feel free to call Mr. Don Hewes, who drew the sketch of application of the reduced gravity simulator (r.g.s.) to biomedicine. Mr. Spady is looking into the question of obtaining surplus equipment. It has been established that a J-bar is available, and probably slings are available also. Mr. Samos is getting a reference for a possible source of the helmet (possibly at Manned Spacecraft Center) and will get that information to Mr. Canzoneri.

OTHER COMMUNICATIONS

March 12, 1968--Literature search on medical data derived under conditions of weightlessness was submitted to KASCenter following telephone discussion with problem originator by preparers of search statement.

March 13, 1968--Mr. R. J. Crosby began review of NASA TTF-368, translation of Russian, "Problems of Space Biology," for articles relevant to Dr. Vallbona's interests in physiological parameters measured in reduced gravity or simulated reduced gravity environments.

March 22, 1968--Mr. R. J. Crosby verified by telephone call the proposed search strategy developed by the search specialist at KASCenter.

April 4, 1968--In response to an inquiry by Texas Institute for Rehabilitation and Research researchers, Mr. Dave Bendersky, Midwest Research Institute, was telephoned to obtain information on helmet respiratory gases collecting scheme and triaxial accelerometer availability. The information obtained was forwarded to the requesting researchers.

HUV-2 Advanced Computer Display and Interface Technology

February 28, 1968--Problem originator stated in interview that he requests this problem to be put on inactive status. He has made his purchasing decisions on the basis of information submitted by search and feels that he is up-to-date on available information.

HUV-3 Computer Scheduling Techniques

COMMUNICATIONS

February 28, 1968--Problem originator stated in interview that much helpful information had been furnished by the Biomedical Application Program on this problem. His main problem now is to find a staff member who would be able to utilize this information and apply it to Texas Institute for Rehabilitation and Research scheduling problems. He inquired about the possibility of using a NASA programmer or one of NASA's subcontractor's programmers at Texas Institute for Rehabilitation and Research's expense for an extended period of approximately 6 months be investigated.

February 28, 1968--Problem originator stated in interview that Tech. Brief 67-10510, "Probabilistic Approach to Long Range Planning of Manpower" is of interest to him and will request backup package from Manned Spacecraft Center.

March 19, 1968--Inquiries were initiated as to potential programming staff help by means of telephone call by Louis Berger to Mr. Paul Woytovich of the NASA Office of Tracking and Data Acquisition. Mr. Woytovich advised consultation with computer scientists at Ames, Jet Propulsion Laboratory, and Manned Spacecraft Center to get their suggestions and recommendations as to which contracting organizations might be consulted to furnish staffing help as per problem originator's request.

HUV-4 Heart Sounds, Interval Analysis

Consultant is evaluating new search results and is also evaluating Tech. Brief 67-10598, for which he intends to obtain a backup package.

HUV-5 End Tidal Air Sampler

COMMUNICATIONS

December 8, 1967--Problem originator stated in interview that he desired to drop this problem for the time being. It is placed on an inactive list. No help was furnished on this problem by the program, except to confirm the problem originator's impression that no applicable new technology was readily available.

HUV-6 Ambulation Aid

No responses obtained from Problem Abstract dissemination to date.

HUV-7 Scheduling for Ward Patients

COMMUNICATIONS

March 19, 1968--Inquiries were initiated as to potential programming staff help by means of telephone call by Louis Berger to Mr. Paul Woytovich of the NASA Office of Tracking and Data Acquisition. Mr. Woytovich advised consultation with computer scientists at Ames, Jet Propulsion Laboratory and Manned Spacecraft Center to get their suggestions and recommendations as to which contracting organizations might be consulted to furnish staffing help as per problem originator's request.

HUV-8 Mechanisms of Onset of Orthostatic Hypotension

COMMUNICATIONS

December 8, 1967--Problem originator stated that no new use had been made of furnished information. It appears as a result of interviewing the problem originator that no additional service can be provided by the Team on this problem. The problem was therefore put on the "completed" list.

HUV-9 Prosthetic Materials for Urinary Tract

COMMUNICATIONS

November 8, 1967--Negative search appraisal returned from problem originator. It is planned to have problem originator meet with a Team specialist

in synthetic materials to specify the problem in suitable physical science terms. Subsequently, a second literature search may be performed and/or a Problem Abstract prepared.

HUV-10 Instrumented Prosthetic Leg

COMMUNICATIONS

November 6, 1967--Dr. Ware called Dr. Sid P. Leverett, Biodynamics Branch, USAF SAM, regarding availability of microspheres for conforming interface. Dr. Leverett will try to obtain a sample for Texas Institute for Rehabilitation and Research to evaluate.

December 8, 1967--Dr. Peterson interviewed. He has sent for follow-ups on Science Information Exchange and has not received material from applicable project.

February 15, 1968--Gave to consultant two references for artificial leg instrumentation: (1) Source for Microballoon Spheres, and (2) A Reference for Direct Casting of a Human in Rigid Polyurethane Foam.

February 28, 1968--Consultant stated in interview that a grant application has been submitted. Four areas are likely to be in need of help: transducers, telemetry, pattern recognition, and casting problems. This problem will be placed on an inactive list and will be used as a source to generate focused problem statements in the four problem areas.

March 14, 1968--Dr. Spencer (Director, Texas Institute for Rehabilitation and Research) was interviewed concerning the grant application which had been approved. He furnished the Biomedical Application Team with copies of the grant application as a start toward specifying suitable problems for problem statement submission.

March 18, 1968--Descriptive material and cover letter was received from Michael McCally, M.D., Chief, Environmental Medicine Division, Biomedical Laboratory, Wright-Patterson AFB. This material described microballoon support restraint technology. Contract work performed by Northrop Space Laboratory for Holloman AFB. This material was forwarded to principal investigators of the newly funded grant on March 23, 1968.

March 28, 1968--Dr. Peterson acknowledged receipt of microballoon technology description and requested information about availability of microballoons for clinical trial.

HUV-11 Improved Gas Sample Flow Control and Measurement

December 8, 1967--After consultation with Texas Institute for Rehabilitation and Research staff, this problem was put on inactive list.

HUV-12 Special Automobile Modifications for Disabled Persons

COMMUNICATIONS

November 29, 1967--Dr. Spencer informed Dr. Ware by telephone that automobile assimulation hardware had recently been obtained. Dr. Spencer was requested to ask Mr. Canzoneri to furnish a description of the recent acquisition, as well as the problem status in general.

December 8, 1967--AETNA simulator has been installed at facility; meetings scheduled to specify problem areas.

February 14, 1968--Louis Berger met with Mr. Canzoneri and Mr. William Reese to discuss the status of the research and demonstration grant application. It was agreed that this problem will be put on the inactive list until the researchers decide what problem areas would specifically be appropriate for generation of well-specified problems.

HUV-13 Human Transfer Function Measurements

COMMUNICATIONS

February 28, 1968--Problem originator stated in interview that since no personnel were available for implementing the system suggested by the Langley development, this problem should be placed on the inactive list.

March 19, 1968--Inquiries were initiated as to potential programming staff help by means of telephone call by L. Berger to Mr. Paul Woytovich of the NASA Office of Tracking and Data Acquisition. Mr. Woytovich advised consultation with computer scientists at Ames, Jet Propulsion Laboratory and Manned Spacecraft Center to get their suggestions and recommendations as to which contracting organizations might be consulted to furnish staffing help as per problem originator's request.

HUV-14 Physical Space Utilization

COMMUNICATIONS

February 28, 1968--Problem originator was interviewed and stated that a grant application has been submitted which will concern itself with live simulation studies in the subject area. Should the grant be approved, there would be a possibility of hiring a staff member to do parallel computer simulation work, in which case the problem would be reactivated. For the time being, this problem is being placed on the inactive list.

March 19, 1968--Inquiries were initiated as to potential programming staff help by means of telephone call by L. Berger to Mr. Paul Woytovich

of the NASA Office of Tracking and Data Acquisition. Mr. Woytovich advised consultation with computer scientists at Ames, Jet Propulsion Laboratory and Manned Spacecraft Center to get their suggestions and recommendations as to which contracting organizations might be consulted to furnish staffing help as per problem originator's request.

HUV-15 Advanced Computer Terminal and Display Technology

This problem has been combined with HUV-2.

SRS-1 Indirect Measurement of Blood Pressure During Rest and Exercise on Arms and Legs

COMMUNICATIONS

December 12, 1967--Problem originator stated in interview that the problem should be put on the status of periodic literature review. A 6-month cycle was requested.

SRS-2 Catheter Tip Transducer for Blood Pressure and Flow Measurement

COMMUNICATIONS

December 12, 1967--Problem originator stated in interview that the problem should be put on the status of periodic literature review. A 6-month cycle was requested.

SRS-3 Locating Tip of Stomach Tube

COMMUNICATIONS

December 8, 1967--Problem originator stated in postsearch status form that no further action on this problem is required.

SRS-4 Materials Suitable for Dry Electrode Fabrication

COMMUNICATIONS

December 12, 1967--Problem originator stated in interview that the problem should be put on the status of periodic literature review. A 6-month cycle was requested.

SRS-5 Temperature Regulatory Mechanisms of the Body

COMMUNICATIONS

December 12, 1967--Consultant stated that the problem originator has distributed the furnished information among his coworkers. He requested

that the problem be put on a 6-month cycle of periodic literature review status.

SRS-6 Investigations of Cutaneous Stimuli

COMMUNICATIONS

March 1, 1968--Problem originator has left the staff of the participating institution and the problem is accordingly closed out. A follow-up of use of references will be made.

BLM-1 Noiseless Gas Valves for "Artificial Heart" Use

COMMUNICATIONS

December 8, 1967--Status report furnished. Problem originator stated in interview that this problem is being solved by a contractor who is reengineering a commercially available solenoid valve. This problem is accordingly considered withdrawn.

BLM-2 Support Slings for Postoperative Care of Large Animals

COMMUNICATIONS

December 8, 1967--Problem originator stated that this problem has been solved independently by the investigator and that no further information is required. Accordingly, this problem is being withdrawn.

BLM-3 Triggering on R Wave of ECG

COMMUNICATIONS

April 5, 1968--Dr. C. W. Hall stated in telephone conversation with Dr. Ware that the R wave triggering device had been completed, used on several experimental animals, and, finally, on 20 March 1968, used on a human patient. The device worked very satisfactorily during the entire time that the patient was on the artificial ventricular assist device, and will be made a permanent addition to the De Bakey clinical artificial heart system.

BLM-4 Valve for Proportional Gas Flow Control

The most up-to-date technical fabrication information available on a NASA developed control system is being sought from Lewis Research Center.

BLM-5 Transthoracic Energy Coupling Devices

COMMUNICATIONS

December 8, 1967--Problem originator stated in interview that information obtained through the program was interesting, but no specific information was submitted on coupling through the chest wall. No investigation has been undertaken concerning the energy transfer methods that were brought to the problem originator's attention through this program.

BLM-6 Biocompatible Spray-On Plastics, Impermeable to Bacteria

COMMUNICATIONS

Dr. Hall stated in telephone conversation with Dr. Ware that the polyamino acid film treated nylon velour material, prepared by Southwest Research Institute's Department of Chemistry and Chemical Engineering, was used on a pig experimentally to cover an area of third degree burn as a skin substitute. Results were stated to be excellent.

With regard to a second film (irradiated polyethylene), Dr. Hall stated that the testing machine under construction was leaking and that, pending receipt of O-ring seals to correct this condition, continuation of test trials would not be possible.

BLM-7 Telemetry of Cardiovascular Data from Free-Ranging Animals

December 8, 1967--Problem originator stated that this problem was turned over to a commercial instrument company in Houston. They have been working on the system for about 3 months and are testing prototypes. Information collected by the Application Team will be made available to the commercial contractor.

January 9, 1968--Computer search results forwarded to H. D. Millar, who is subcontracting telemetry work for problem originator.

February 5, 1968--L. Berger called Mr. H. Millar for follow-up of use made of search results. Mr. Millar stated that the references so far appeared to be extremely useful for general background information. They have been given to a new project engineer, with instructions that the engineer should select references of particular interest and request full documents as indicated.

BLM-8 Miniature Tape Recorder for Biological Data

COMMUNICATIONS

No change.

BLM-9 Cyclic Variation of Body Temperature in Mammals

COMMUNICATIONS

March 21, 1968--Descriptive material on NASA project 15G-B2299 (A System of Monitoring of Deep Brain Temperatures) was received from the Technology Utilization Officer, NASA headquarters. This material was forwarded to problem originator with cover letter.

March 26, 1968--Problem originator returned a positive evaluation of information sent on the NASA Franklin Institute Research Project.

GLM-1 Analysis of Transitional Flow-Convection/Diffusion

Transfer accomplished.

GLM-2 Monitoring of Blood Pressure by Extra-Vascular Sensor, Using Wireless Telemetry of Information

COMMUNICATIONS

February 16, 1968--Consultant has notified Application Team that problem originator is too involved with other matters to continue work on this problem at the present. The problem is therefore being placed on the inactive list.

GLM-3 Determination of Local Blood Flow, Blood Gas Concentration, and Blood pH in Small Portion of an Organ

Unchanged.

GLM-4 Implanted Blood Pressure Transducer

COMMUNICATIONS WITH NASA CENTERS

January 11, 1968--Mr. C. J. Laenger called Mr. E. Edwards, Technology Utilization Officer, Ames Research Center, and was advised that the status of availability of capacitance transducers (Mr. Coon's devices) is unchanged. Requested references are being furnished to problem originator.

GLM-5 Chronic Intracranial Pressure Measurement in Man

COMMUNICATIONS WITH NASA CENTERS

January 11, 1968--Mr. C. J. Laenger called Mr. G. Edwards, Technology Utilization Officer, Ames Research Center, and was advised that the status of availability of capacitance transducers (Mr. Coon's devices) is unchanged. Requested references are being furnished to problem originator.

GLM-6 A Model Vascular System

Requested references have been furnished to problem originator, and are being evaluated by him.

GLM-7 Viscosity Measurement of Minute Samples of Blood

Requested references have been furnished to problem originator, and are being evaluated by him.

GLM-8 Computer Program for Electroencephalograph

Requested references have been furnished to problem originator, and are being evaluated by him.

GLM-9 Measurement of Local Tissue Oxygen Consumption In Vivo

No new information has been furnished on this problem.

GLM-10 Computer Program for Flame Spectrophotometry

COMMUNICATIONS

February 29, 1968--Problem originator was interviewed and furnished detailed and specific descriptions of the procedures that had been used to date in the flame spectrophotometry analysis. It was decided that since a ready-made computer program seems to be unavailable, further analysis of the mathematics of the problem needs to be undertaken. Preparation of a problem abstract draft is in progress.

March 21, 1968--Problem Abstract draft was prepared by Dr. C. G. Gardner, submitted to NASA March 21, 1968.

GLM-11 Elimination of Electrostatic Charge in Experimental Animals

Closed out; actual transfer.

GLM-12 Computer Selection and Elimination of Artifacts

Requested references have been furnished to problem originator, and are being evaluated by him.

GLM-13 Multiple Co-Spectral Density Analysis of Times-Series Data

COMMUNICATIONS

December 7, 1967--Problem originator was interviewed. He is still evaluating reference articles furnished to him, and he also stated that he was

familiar with the approach suggested by Mr. Peter Mengert, Electronics Research Center, in Mr. Mengert's response to the disseminated Problem Abstract.

GLM-14 Repetitive Measurement of Kidney Mass in Intact Animal

COMMUNICATIONS

Problem originator is evaluating computer search results.

GLM-15 Respiration Volume and Rate Measurements in Unencumbered (Free) Child.

COMMUNICATIONS

February 15, 1968--Louis Berger spoke with Dr. Rudenberg who informed him that problem originator valued the package concerning research on remote sensors which was furnished by Electronics Research Center on November 20, 1967.

February 29, 1968--Problem originator indicated in interview that he will furnish his evaluation of documents and other search results with recommendation for priorities for the order in which applicable research program should be investigated.

GLM-16 In-Situ Tumor Mass Determination on Rat Leg

COMMUNICATIONS

Problem originator is planning a trip to Southwest Research Institute to evaluate potentially identified aerospace technology.

RCU-1 "Artificial Heart" Control System Technology

COMMUNICATIONS

February 15, 1968--Problem originator was forwarded five references furnished by Mr. Harrison Allen of Lewis Research Center in response to Problem Abstract RCU-1 which overlaps BLM-4.

SNM-1 Enhancement of X-Ray Contrast Study Films

COMMUNICATIONS WITH NASA CENTERS

March 27, 1968--Mr. Berger contact Dr. R. Nathan by telephone to to verify the status of processing of X-ray films previously submitted. Dr. Nathan stated that the films had been scanned and digitized and attempts had been made to obtain enhanced visualization of gall stones. The results of these attempts were considered by JPL personnel to be poor; nevertheless, these results will be provided for Dr. Zanca's evaluation. Dr. Nathan stated that he hopes to obtain funding with which to continue the biomedical applications of JPL enhancement techniques in June 1968, and that he would, at that time, welcome submission of additional films.

C. Transfer Summaries

Actual Transfer	Transfers in Progress	Technology Tentatively Identified
HUV-1	HUV-14	HUV-3
GLM-1 (completed)	HUV-16	HUV-7
GLM-3		HUV-13
GLM-9		BLM-8
SNM-1		GLM-2
SRS-6		GLM-4
BLM-3		GLM-5
BLM-6		
GLM-11 (completed)		GLM-10

IV. SUMMARY OF PROJECT ACTIVITIES

IV. SUMMARY OF PROJECT ACTIVITIES

The work performed during this period in connection with previously submitted problems and the specification of two newly submitted problems is reported in Section III of this report. Site visits by members of the Application Team, performed in connection with submitted problems, were as follows:

- 1 November 1967: Mr. R. J. Crosby, and Mr. F. St. Claire--Texas Institute for Rehabilitation and Research;
- 7, 8 December 1967: L. Berger--Texas Institute for Rehabilitation and Research and the University of Texas Medical Branch at Galveston;
- 15, 16 December 1967: Dr. Quentin Hartwig, Dr. Ray W. Ware, and Louis Berger--Texas Institute for Rehabilitation and Research (meeting with Dr. W. Spencer, Director) and Baylor University College of Medicine (Michael DeBakey, M. D.);
- 15 February 1968: Dr. Ray W. Ware, Mr. A. G. Buck, and L. S. Berger--Texas Institute for Rehabilitation and Research;
- 28 February 1968: L. S. Berger--Texas Institute for Rehabilitation and Research;
- 29 February 1968: L. S. Berger--The University of Texas Medical Branch at Galveston; and
- 14 March 1968: L. S. Berger--Texas Institute for Rehabilitation and Research.

In addition to conducting business directly related to submitted problems, the above trips routinely included discussion about improved procedures, new approaches, and the generation of new problem statement submission, as well as in most instances including briefings of staff members at the participating institutions who had not yet been made thoroughly familiar with the program.

Trips were also taken in connection with briefing of key researchers and administrators at institutions which are being added to the program. Upon the acquisition of the services of our special consultant for the West Coast region, Mr. A. G. Buck, the following trips were taken:

- 1-4 March 1968: Dr. Ray W. Ware and Mr. A. G. Buck visited the Palo Alto Medical Research Foundation, the Rancho Los Amigos Hospital, and Ames Research Center;

- 27-29 March 1968: Mr. L. S. Berger and Mr. A. G. Buck visited the following institutions--Rancho Los Amigos Hospital, University of Washington, Seattle (Biomedical Engineering Department), and the Seattle Handicapped Center.

Miscellaneous conferences attended were:

- 31 October-1 November 1967: Dr. Ware and Mr. Berger attended a joint Application Team meeting hosted by the Research Triangle Institute;

- 12, 13 February 1968: Dr. Ware and Mr. Berger attended a conference on the utilization of space technology in mental retardation research, sponsored by NASA and The National Institute of Child Health and Human Development. On this occasion, the Southwest Research Institute Team presented a paper titled "Search Strategy in Communication Networks in the Biomedical Application Program."

(Work concerning new problem solicitation was minimal during this reporting period, since the program operated at a reduced level, pending completion of contract negotiations.)

V. INSIGHTS INTO THE TRANSFER PROCESS

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The conclusions that were expressed in the last Final Report regarding thoughtful consideration of potential new problems were applied in communications with the new as well as the older participating research institutions. In order to improve the program efficiency, a number of problem areas of interest to newly participating researchers at the University of Texas Medical Branch were prescreened, and resulting information was furnished to these researchers, together with suggestions about potentially fruitful problem areas, as a guide to planning problem statement submission.

Preliminary discussions were initiated at the Texas Institute for Rehabilitation and Research for the purpose of developing new problem statements. It was agreed that particularly favorable conditions for problem statement submission existed in the case of two newly funded research projects which had available funds, personnel, and which involved specific and pressing problem areas. These funded projects will be important sources of new problem statements. Team members will work closely with the research program investigators in developing problem statements from these projects.

The need for careful approach to problem statement acceptance was discussed also at some length during briefing sessions with key administrative and research personnel at three of the new member institutions: Rancho Los Amigos Hospital, University of Washington, Department of Biomedical Engineering, and Seattle Handicapped Center.

During the first year of program performance, we frequently found that researchers and administrators at participating institutions had stereotyped misconceptions about the aims and mechanisms of the NASA program. Frequently, staff members believe the program to be essentially a literature search and information retrieval program; perhaps this misconception was engendered by some of the terminology which frequently crops up in the program execution, such as information transfer, technology transfer, technology utilization. The assumption also was sometimes made that the program would routinely furnish hardware on request, and that its function was similar to that of a hardware surplus disbursing agency. It seemed indicated, in the light of these misconceptions, to emphasize in initial briefing interviews the things that the program was not primarily concerned with, as well as describing the program function in positive terms. It remains to be seen whether this approach will significantly reduce the researchers' misconceptions about the ongoing program.

VI. PROJECTIONS FOR THE NEXT QUARTER

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The next quarter's effort will be concentrated in two major areas: (1) Implementing the program at the institutions on the West Coast which have recently been added to the program; this will include continued briefings of the special consultant who will primarily be responsible for communications with these institutions, to make him thoroughly familiar with the procedures and practices which have been developed in conjunction with this program over the past year and a half. In addition, as this consultant has extensive administrative experience within NASA, and, since he is looking at the program with a fresh and unbiased viewpoint, his suggestions and recommendations for improving program efficiency will be solicited. (2) The institutions who have participated since the program inception will continue to be serviced.

In connection with the new participating member institutions, interest profile development will continue, and problem submission will be simulated, subject to the considerations discussed in Section V. Essentially, these institutions are at the stage that our old member institutions were in the beginning of the program, and the work to be performed in this phase of institutional development will parallel the work performed at the old institutions a year and a half ago, with the benefit of application of the skills and insights gained in institutional development during the first 18 months of project performance.

Regarding the older institutions, most of the previously submitted problems have either become inactive or have resulted in actual or potential transfers; in the latter case, Team activity will center about aiding completion of transfer activity as required, including complete documentation. The approaches to new problem submissions from the Texas Institute for Rehabilitation and Research, Baylor University School of Medicine, and The University of Texas Medical Branch, which have been discussed in Section V, will be followed during the next quarter.

Some changes in staff utilization of institutions in the Houston/Galveston area have been planned: Mrs. Sarah Garrison, Information Specialist at Texas Institute for Rehabilitation and Research, will take over much of the document dispersal and records keeping function previously executed by Mr. Joe Canzoneri. It is planned to spend sufficient time with Mrs. Garrison to work out efficient procedural details. It is also planned to have two members of the Biomedical Application Team take on increasingly more of the Team contacts at Texas Institute for Rehabilitation and Research and The University of Texas Medical Branch at Galveston, in order to utilize the Team's capabilities more efficiently. Mr. C. J. Laenger, Sr.,

and Mr. Robert J. Crosby have technological backgrounds and interests which will be especially useful in the problem areas of intense activity in the two last mentioned member institutions.

Besides frequent site visits to the participating member institutions, a program review meeting is planned at Southwest Research Institute for late May, and a Technology Utilization Division staff meeting will be attended at Langley Research Center in early June.

VII. DOCUMENTS FURNISHED TO PROGRAM PARTICIPANTS

Ref. No.:	Problem No.: HUV-3 Reference Title	Chronology Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher

Two NASA Computer programs, and general instructions on dealing with the COSMIC Center at the University of Georgia:

MFS-1135	Computer Code for Determining the Transient Behavior of Optimum Inventories (North American Aviation-Rocketdyne) 13 September 1967.
GSFC-493	SIFT: Semi-conductor Information Filing Technique (Booz-Allen). 13 September 1967.
PB 67-10240	Vis-a-plan Management Technique Provides Performance - Time Scale (also refers to HUV-7). 5 January 1968
TB 67-10348	Computerized Parts Lists System Coordinates Engineering Releases, Parts Control, and Manufacturing Planning. (Applies to HUV-7). 5 January 1968

Problem No.: HUV-14

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
NPO-10326	"Jet Propulsion Laboratory Facilities Utilization and Occupancy Survey. 6 December 1967.				

Problem No.: GLM-2

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A64-10413	A Simple FM Subcarrier Oscillator Suitable for Physiological Telemetry	Oct. 30, 67	Nov. 2, 67	Dec. 12, 67	Dec. 14, 67
A65-10740	A Miniature Self-Pulsing Oscillator for Biomedical Telemetry	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	
A65-25369	A High-Performance Miniature Biopotential Telemetry System	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A66-22298	Microcircuit-Microwatt Design Techniques for New Internal Medical Sensors	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
N63-10152	Techniques of Physiological Monitoring Volume 1. Fundamentals	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N63-15903	A Digital Readout Technic Applicable to Laboratory and Aerospace Medical Monitoring of Physiologic Data	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N63-21498	Biological Telemetering and Space Flight	Oct. 30, 67	Nov. 2, 67	Dec. 27, 67	Jan. 19, 68
N63-21536	The Possibilities of Experimental Evaluation of the Cerebral Blood Supply Under Conditions of an Altered Gravitational Field	Oct. 30, 67	Nov. 2, 67		
N64-13722	Internal Four-Channel Physiological Telemetry System Prototype Development	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68
N64-13872	Techniques of Physiological Monitoring. Volume II: Components	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	
N64-27314	Biological Passive Telemetry	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68

Problem No.: GLM-2

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N65-16620	A Miniature Self-Pulsing Oscillator for Biomedical Telemetry	Oct. 30, 67	Nov. 2, 67		
N65-14491	Techniques of Physiological Monitoring Volume III: Systems	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 4, 68
N65-17230	Validation of the Aerospace Medical Research Laboratories 3-Channel Personal Telemetry System	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 7, 68
N65-25270	Bibliography on Biosensors. A Sampling of the World Literature 1960-1964. Volume III	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N66-19635	External Bioelectrodes: A Battery Substitute for Biological Telemetry Systems	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 7, 68
N66-24548	State-Of-The-Art Biological Data Handbook	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N66-35021	Neurophysiological and Behavioral Studies of Chimpanzees	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N66-36280	Pacific Northwest Laboratory Annual Report for 1965 in the Physical Sciences. Volume 4: Instrumentation	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N67-19417	Research on Microminiature Passive Telemetry for Biological Measurements	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N64-24231	Transducers for Measurement, Part 1. Introduction and Theory of Pressure Measurement	Jan. 22, 68	Jan. 24, 68	Mar. 18, 68	Mar. 19, 68

Problem No.: GLM-2

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A64-25773	Trans. for Measurement, Part II. Devices for Measuring Pressure	Jan. 22, 68	Jan. 24, 68	Mar. 18, 68	Mar. 19, 68
A63-10606	Automatic Blood Pressure Indicator	Jan. 22, 68	Jan. 24, 68	Mar. 18, 68	Mar. 19, 68
A66-38797	A Miniature Pressure Transducer	Jan. 22, 68	Jan. 24, 68	Mar. 1, 68	
A67-11102	A Precision Capacitive Pressure Transducer Suitable for Airborne Applications	Jan. 22, 68	Jan. 24, 68	Mar. 12, 68	Mar. 14, 68
N65-16623		Jan. 22, 68	Jan. 24, 68	Mar. 1, 68	

Problem No.: GLM-2

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
These references were obtained by the problem originator:					
A65-81057	A Progress Report on Radio Telemetry From Inside the Body				
A66-81864	Telemetry of Blood Pressure in Free-Ranging Animals via an Intravascular Gauge				
A65-33281	Biomedical Instrumentation in Space Medicine				
A66-39797	In Vivo Experiments with the Bioelectric Potentials				
A67-26171	Implant Biotelemetry and Microelectronics				
N63-22980	Development of Telemetry Devices for Dental Research				
A64-80537	Utilization of Bioelectricity as Power Supply for Implanted Electronic Devices				
A65-81054	The Artifact Problem in Telemetry of Physiological Variables				

Problem No.: GLM-3

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
	A reference cited in Midwest Research Institute's current quarterly report in connection with their problem KU-3 seems applicable to GLM-3, and accordingly was forwarded to problem originator: "Blood Gases: Continuous in Vivo Recording of Partial Pressure by Mass Spectrograph", S. Woldring, G. Owens and D. C. Woolford, Science, August, 1967, pp. 885-887.				5 September 1967
TTF-492	Problems in Space Biology on cerebral blood volume; Vol 5 requested from SwRI 18 March 1968 - (also applies to GLM-5).				3 April 1968

Problem No.: GLM-5

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
	A Miniature Pressure Transducer, Massey, B. S., and Kavrak, I., J. Scie. Instrum, 1966, Vol. 43, p 569 ff. This paper was cited as a reference for problem KU-26, "Chronic Intracranial Pressure Measurement," in Midwest Research Institute's Quarterly Rept. No. 2, 1 August - 30 October 1967, p. 4 (Ref. 11).				27 November 1967
TTF-492	Problems in Space Biology - on cerebral blood volume; Vol. 5 requested from SwRI 18 March 1968 (also applies to GLM-3).				3 April 1968

Problem No.: GLM-6

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N66-35027	Velocity and Pressure Measurements of Pulsating Flow in a Flexible Tube	Oct., 67	Mar. 19, 68		
N67-14572	(NASA-CR-80888) Proceedings of the Fourth International Congress on Rheology Part 4. Symposium on Biorheology	Oct., 67	Mar. 19, 68	Nov. 30, 67	Mar. 19, 68
PB 175 719	Final Report on the Mock Circulatory System Life Sciences Division, Hydrospace Research Corporation, April 1967. Sent at Dr. Ware's suggestion.				Feb. 20, 68

Problem No.: GLM-7

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A64-11980	Viscosity of Liquid He II	Oct. 30, 67	Nov. 2, 67	Dec. 13, 67	Jan. 19, 68
A66-12519	The Vibration Method of Measuring The Viscosity of Liquids	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A66-21885	Cone-and-Plate Viscometry-Explicit Formulae for Shear Stress and Shear Rate and The Determination of Inelastic Thixotropic Properties	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 20, 68
N63-20408	NBS Viscometer Calibrating Liquids and Capillary Tube Viscometers	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	
N64-19041	Microdetermination of The Viscosity of Polyphenyls	Oct. 30, 67	Nov. 2, 67	Feb. 2, 68	Feb. 2, 68
N66-11514	Method of Measuring the Viscosity of Fluids	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 1, 68
N66-11860	A Detailed Procedure for Determining Intrinsic Viscosities of Polymer Solutions	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 1, 68
N67-14465	Some Flow Properties of Blood	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68
N67-14493	A Shear Creep Viscometer for Rheological Studies of Polymers	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
27 July	Problem originator was given Tech Brief 66-10539, "Computer Programs Perform Spectral Analysis of up to Seven Time Series." Additional backup information requested from Marshall Space Flight Center.				20 June 1967
MFS-0723	RAVAN: Random Vibrations Analysis Program, Marshall Space Flight Center - Computation Laboratory.				13 September 1967.
MFS-12870	VITRAN: Vibration Transient Analysis Program (Lockheed); descriptions of the computer center facility for these programs (COSMIC) and instructions for obtaining the tapes.				13 September 1967
Provided with 3 October returns from KAS Center:					
TND-4161	Method of Analyzing Dynamic Data Characterized by a Time-Varying Frequency Spectrum.				
CR-846	Launch Vehicle Wind and Turbulence Response by Nonstationary Statiscal Methods.				
A67-29104	Analysis of Brain Wave Records from Gemini Flight GT-7 by Computations to be used in a Thirty Day Primate Flight	Oct. 8, 67	Oct. 15, 67	Dec. 11, 67	
A66-37604	Comprehensive Spectral Analysis of Human EEG Generators in Posterior Cerebral Regions	Oct. 8, 67	Oct. 15, 67	Dec. 11, 67	
A67-21715	Electrocardiogram Preprocessing Unit	Oct. 8, 67	Oct. 15, 67	Dec. 11, 67	Dec. 14, 67
A67-25989	Stochastic Approximation-A Recursive Method for Solving Regression Problems	Oct. 8, 67	Oct. 15, 67	Nov. 24, 67	Nov. 27, 67

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N66-15117	Autocorrelation Techniques Applied to the Fetal Heart Signal	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 6, 68
N66-19335	Automatic Analysis of Diurnal Periodic Changes in Human Electroencephalogram	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 6, 68
A66-24231	A Hybrid Computer System for the Measurement and Interpretation of Electrocardiograms	Oct. 8, 67	Oct. 15, 67	Nov. 20, 67	Nov. 20, 67
N66-24193	Correlation Analysis of the EEG of a Man Both in the Normal Condition and with Cerebral Centers of Damage	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 19, 68
N66-24991	Analysis of Baseline and Gemini Flight GT-7 EEG Data with Specification of On-Line Computing Requirements	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	
N66-27539	Analysis of Brain Wave Records from Gemini Flight GT-7 by Computations to be Used in a Thirty Day Primate Flight	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	
N67-10886	Spectral Analysis Techniques and Pattern Recognition Methods for Electroencephalographic Data	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 7, 68
N66-33387	Spectral Analysis Techniques and Pattern Recognition Methods for Electroencephalographic Data	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 7, 68

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N66-12444	Combination of Wavemeter and Integrator for Simultaneous Evaluation of Quantitative Wave Patterns and Mean Amplitude of Brain Potentials	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 7, 68
N66-15009	Theory and Practice of Measurements of the Electroencephalographic Sign Correlation Coefficient	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 7, 68
N66-11873	Monitoring Psychomotor Response to Stress by Evoked Auditory Response	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	
N67-19682	New Methods of Analysis of Electro-physiological Responses	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 6, 68
N67-25591	Signal Variance and Its Application to Continuous Measurements of EEG Activity	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	Jan. 19, 68
N67-18723	Computer Analysis of EEG Data for Normative Library	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 6, 68
N67-19092	Electroencephalographic Baselines in Astronaut Candidates Estimated by Computation and Pattern Recognition Techniques	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	Feb. 16, 68
N67-11917	Analogic Device for Statiscal Measure-ments of Correlation in Time	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	March 6, 68
N67-12028	Analog Computer for Analyzing Electro-encephalograms	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	Feb. 16, 68

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N66-10190	Health Physics and Medical Division Progress Report, January - December, 1964	Oct. 8, 67	Oct. 15, 67	Nov. 14, 67	
A65-13378	Spectral, Cross-Spectral, and Bispectral Analysis of Low Frequency Electro-magnetic Data	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A65-19896	Epoch Detection-A Method for Resolving Overlapping Signals	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A65-21484	Analysis of Brain-Wave Generators as Multiple Statiscal Time Series	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A65-23393	Spectrum Analysis for Telemetry and Data Acquisition	Oct. 30, 67	Nov. 2, 67	Mar. 1, 68	Mar. 4, 68
A65-24193	Compression of Bioastronautical Data	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A65-34695	Digital Spectral Analysis	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A65-34784	Preliminary Results of a Micropulsation Experiment at Conjugate Points	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 6, 68
A65-34815	A New Correlator Applying Hybrid Analog Digital Technique	Oct, 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 16, 68
A65-36166	Application of Certain Statiscal Methods to the Treatment of Information in the Space Domain	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A66-10480	Analog Versus Digital Data Analysis- an Introduction	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A66-13608	Transfer Function Determination as a Means of On-Line Checkout	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A66-15500	Spectral Density Analysis Used for Random Vibration Testing Programs	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A66-15508	Some Analog Methods for Power Spectral Density Analysis	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A66-19099	An Electronic Correlator for Separation of Signals According to Their Shape	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 20, 68
A66-21694	A Theory and Method for Correlation Analysis of Nonstationary Signals	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A66-21731	A Method of Determining Cross-Correlation Coefficients of Time-Varying Signals	Oct. 30, 67	Nov. 2, 67		Feb. 20, 68
A66-24722	A Look at Vibration Analysis	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A66-36657	Frequency Measurements with Short Measurement Times Using an Autocorrelator	Oct. 30, 67	Nov. 2, 67	Nov. 24, 67	Nov. 27, 67
A66-36888	A Computational Compensation for Measuring System Dynamics	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 16, 68
A67-10604	A User's Evaluation of Power Spectral Analysis Procedures	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14. 67

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A67-11090	Analog Device for Statiscal Measurements of Correlation in Time	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 7, 68
A67-10249	Optical Spectrum Analysis of Large Space Bandwidth Signals	Oct. 30, 67	Nov. 2, 67	Dec. 11, 67	Dec. 14, 67
A67-25732	Consideration in the Analysis of Arbitrary Waveforms	Oct. 30, 67	Nov. 2, 67	Dec. 27, 67	Jan. 19, 68
A67-26561	Automatic Multichannel System for Recording and Processing Experimental Information on a Digital Computer for the Study of the Inhomogeneous Structure of the Ionosphere	Oct. 30, 67	Nov. 2, 67		
N63-14241	Magnetic Tape Copies of MIT Geophysics Program Set I	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68
N65-10036	Statistical Electroencephalograph Model	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68
N65-11516	Studies in Electroencephalography	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68
N65-19365	Comparison of Power Spectral Density Techniques as Applied to Digitalized Data Records of Nonstationary Processes Part I	Oct. 30, 67	Nov. 2, 67		
N65-27204	The Analysis and Display of the Information Contained in Time-Varying Signals	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 6, 68
N65-27954	Hybrid Analog-Digital Techniques and Random Process Studies	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 19, 68

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N65-28757	Collection of Neurophysiological and Cardiovascular Data with Data Reduction Pattern and Correlation Analysis	Oct. 30, 67	Nov. 2, 67		
N65-28764	Statiscal Limits on Computer Defined EEG Patterns Related to Behavior	Oct. 30, 67	Nov. 2, 67		
N65-32027	Neurophysiological Correlates of Information Transaction and Storage in Brain Tissue	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N65-35076	The Spectral Characterization and Comparison of Nonstationary Processes	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 4, 68
N65-35667	Spectra of Nonstationary Random Processes	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 4, 68
N66-11989	Fourier Analysis Computer Program	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 7, 68
N66-12548	Representation and Analysis of Signals. Part XIX: Digital and Computer Programs for Signal Analysis	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 6, 68
N66-20598	An Analysis of Dynamic Power Spectra	Oct. 30, 67	Nov. 2, 67	Mar. 1, 68	Mar. 1, 68
N66-28476	Comparison of Analog and Digital Methods for Vibration Analysis	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 20, 68
N66-28847	New Methods in Functional Analysis of Biomedical Data	Oct. 30, 67	Nov. 2, 67	Dec. 19, 67	Mar. 7, 68
N66-36053	Study of Random Process Theory	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68

Problem No.: GLM-8, -12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N67-12809	Power and Cross-Power Spectrum Analysis By Hybrid Computers	Oct. 30, 67	Nov. 2, 67		
N67-16992	Bioastronautics Laboratory Research Tool	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Feb. 20, 68
N67-17076	Dual One Dimensional Analysis and Display Program	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 14, 68
N67-19908	User's Guide for the Digital Time Series Analysis Program. Phase I and II			Jan. 2, 68	Jan. 19, 68
A64-81314	Autocorrelation and Crosscorrelation Analysis of "Labeled Work Rhythms" in the Human Egg During Muscle Work	Oct. 30, 67	Nov. 2, 67		
A65-82206	Correlation Analysis of Changes in the Human Electroencephalogram During Elaboration of a Rhythmic Motor Stereotype				
TB 67-10602	New Technique for Determination of Cross-Power Spectral Density with Damped Oscillators				Mar. 22, 68

Problem No.: GLM-10

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
N66-10768	Computer Program for the Analysis of Visible Spectrmetric Data: Chromaticity	Oct. 30, 67	Nov. 2, 67	Nov. 30, 67	Mar. 1, 68
N67-19098	Notes on Digital Spectral Analysis	Oct. 30, 67	Nov. 2, 67	Jan. 3, 68	Jan. 19, 68
N67-26633	Principles of Optical Data Processing for Engineers	Oct. 30, 67	Nov. 2, 67	Jan. 3, 68	Jan. 19, 68
N67-10658	Processing of Data Issued from a Spectrometer	Oct. 30, 67	Nov. 2, 68	Nov. 30, 67	
N66-22735	An Improved Flame Spectrometer for Biologic Calcium Analysis had already been obtained, and was found to be of no value.				
	Information sent on the IL Flame Photometer-143, manufactured by Instrumentation Laboratory, Inc.				Jan. 3, 68

Problem No.: GLM-12

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
TB-63-10003	"New Low-Level AC Amplifier Provides Adjustable Noise Cancellation and Automatic Temperature Compensation" was given to problem originator 27 July 1967. A backup package was requested from Ames Research Center. This supplementary information was forwarded to researcher 23 August.				
TB-67-10262	"Solid State Circuit Averages Multiple Signals and Rejects those Varying Significantly from the Average" was sent to problem originator on 6 September 1967.				
MFS-0723	RAVAN: Random Vibrations Analysis Program, Marshall Space Flight Center - Computation Laboratory, sent 13 September 1967.				
MFS-12870	VITRAN: Vibration Transient Analysis Program (Lockheed); descriptions of the computer center facility for these programs (COSMIC) and instructions for obtaining tapes, sent 13 September 1967.				
TND-4161	Method of Analyzing Dynamic Data Characterized by a Time - Varying Frequency Spectrum. Provided by KASC with search returns.				
CR-846	Launch Vehicle Wind and Turbulence Response by Nonstationary Statiscal Methods. Sent to researcher 3 October 1967.				

Problem No.: GLM-14

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A66-32171	(For Dr. Rodin, GLM-16, also) Mass Measurement of Man in a Zero Gravity Environment	Jan. 22, 68	Jan. 24, 68	Mar. 1, 68	
N66-38922	(For Dr. Rodin, GLM-16, also) Development of Prototype Mass Measurement System for Spaceflight	Jan. 22, 68	Jan. 24, 68	Mar. 1, 68	

Problem No.: GLM-15

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
	The following reports, furnished courtesy of Mr. J. T. Dennison, TUO, Electronics Research Center, were sent to problem originator December 6, 1967:				
	Honeywell, Inc., Monthly Progress Report, March 1967, Contract NAS 12-531, Oculometer Development				
	North American Aviation, Inc., Space and Information Systems Div., Final Report, NAS 12-1, Feasibility of Techniques for monitoring physiological variables without attached sensors.				
	Philco-Ford Corp., WDL Division, Progress Report 3325, 30 May 1967, Contract NAS 12-121, Progress Report on Physiological Monitoring Technique using unattached sensors.				
	Tech. Report 3107 - Remote Measurement of Blood Flow Velocity in Space Flight.				

N66-37217	Preliminary Analysis of the Metabolic Rate Monitor System	Jan. 22, 68	Jan. 24, 68	Mar. 1, 68	Apr. 3, 68

Problem No.: RCU-1

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
References furnished by Mr. H. Allen of Lewis Research Center: sent to Dr. C. W. Hall (overlaps BLM-4)					Feb. 15, 68
	Mechanical Assistance to the Circulation: The Principle and the Evaluation or Results				
	Controller for Heart Assist Units				
	Cardiac R-Wave Detector (E-4020)				
	A Physiological Approach to Assist the Circulation				
	Respect the Integrity of the Large Veins and Starling's Law				

Problem No.: WLH-1

Ref. No.:	Reference Title	Chronology: Requested by Originator	Request processed at SwRI	SwRI Obtained Reference	Forwarded to Researcher
A67-11945	Distortion of a Free Surface During Tank Discharge	Requested by Dr. Ware	Nov. 29, 67	Jan. 24, 68	Jan. 24, 68
A67-14604	Handling Liquid Propellents (sent Dr. Breslau)	Requested by Dr. Ware	Nov. 29, 67	Dec. 13, 67	Jan. 19, 68 Mar. 1, 68
N67-14605	Fat Embolism - A Hemorheologic Disturbance	Jan. 12, 68	Jan. 12, 68		
N65-25876	The Possibility of Inhibiting and Stopping Blood Flow by a Magnetic Field	Jan. 12, 68	Jan. 12, 68		

GENERAL REFERENCES FORWARDED

Ref. No.	Reference Title	Date Sent
Sent to University of Texas Medical Branch:		
Langley package on microwave spectroscopy furnished to consultant:		15 February 1968
1.	The Application of Microwave Spectroscopy to Contaminant Analysis, Chemical Engineering Progress Symposium Series, Vol. 62, No. 63, 1966, W. F. White	
2.	Improvement and Optimization of a Mass Spectrometer Employing a Photoionization Source, Poschenrieder and Warneck, Final Report, Contract No. NASI-6335	
3.	Development of a Mass Spectrometer Employing a Photoionization Source, Poschenreider and Barrington, Final Report, Contract NASI-4927	
4.	Microwave Spectroscopic Identification of Atmospheric Contaminants, Mississippi State University Department of Physics, Status Report on NASA Grant NGR 25-001-008	
5.	Microwave Spectroscopy of Molecules Bibliography 1964-1966, NASA Grant NGR 25-001-008, Mississippi State University Department of Physics	

GENERAL REFERENCES FORWARDED

Ref No.	Reference Title	Date Sent
Sent to University of Texas Medical Branch:		
NASA TT F-492	Problems of Space Biology, Vol. 5 Dynamics of the Cerebral Blood Volume Under Normal Conditions and Gravitational Stresses - general reference, per request March 18, 1968.	3 April 1968
SP-5046	Selected Electronic Circuitry	16 August 1967
SP-5031	Microelectronics in Space Research	21 September 1967
Sent to TIRR:		
Selected Listings of TU Publications (Tech. Briefs through December 1965)		30 November 1967
SP-5023	Medical and Biological Applications of Space Telemetry	30 November 1967
SP-5010	Selected Shop Techniques	30 November 1967
SP-5024	Bibliography on Welding Methods	30 November 1967
SP-5034	The Electromagnetic Hammer	30 November 1967
SP-5025	Plating Cu on Al	30 November 1967
SP-5017	Metal-forming Techniques	30 November 1967
SP-5009	Selected Welding Techniques, Part II	30 November 1967
SP-5002	Reliable Electrical Connections	30 November 1967

GENERAL REFERENCES FORWARDED

Ref. No.	Reference Title	Date Sent
Minutes--Aluminum Welding Symposium (Marshall Space Flight Center) October 13, 1964		30 November 1967
Information on Ordering of Tech. Briefs		30 December 1967
Sent to Mr. J. T. Hall, Jr., Superintendent of Construction, two GATE computer program descriptions		6 March 1968
TB 66-10534	Search results for problem GLM-8, -12 sent to Dr. Peterson; "Miniature Piezoelectric Triaxial Accelerometer Measures Cranial Accelerations," and Appendix V, Muscle Accelerometer from Midwest Research Institute's August 5, 1966, report sent to Dr. Spencer	12 December 1967 20 February 1968
TB 67-10598	"Cardiotachometer with Linear Beat-to-Beat Frequency Response" Copy of TB 66-10534, "Miniature Piezoelectric Triaxial Accelerometer Measures Cranial Accelerations," and Appendix V, Muscle Accelerometer from Midwest Research Institute's August 5, 1966 report	20 February 1968 20 February 1968
TB 67-10302	"Improved Compression Molding Process," sent for possible interest on HUV-10 and general reference	19 March 1968
TB 67-10602	"New Technique for Determination of Cross-Power Spectral Density with Damped Oscillators"	21 March 1968

GENERAL REFERENCES FORWARDED

Ref. No.	Reference Title	Date Sent
Sent to TIRR:		
SP-72	Symposium on the Analysis of Central Nervous System and Cardiovascular Data Using Computer Methods (also sent to UTMB)	25 August 1967
SP-5067	Assessing Technology Transfer	25 August 1967
SP-5041	NASA Contributions to Cardiovascular Data Using Computer Methods	25 August 1967
SP-5038	Magnetic Tape Recording Technology	25 August 1967
SP-5031	Microelectronics in Space Research	25 August 1967
SP-5044	Selected Casting Techniques	3 August 1967
SP-5021(02)	Cumulative Index to NASA Tech Brief 1963-1965	3 August 1967
SP-5036	Bibliography on Electromechanical Transducers	3 August 1967
SP-5022	Micropower Logic Circuits (also sent to UTMB)	3 August 1967
SP-5019	Advanced Valve Technology	3 August 1967
SP-5006	The Measurement of Blood Pressure in the Human Body	3 August 1967
SP-7010	Clarity in Technical Reporting	3 August 1967
SP-7012	The International System of Units - Physical Constants and Conversion Factors	3 August 1967

GENERAL REFERENCES FORWARDED

Ref. No.	Reference Title	Date Sent
Sent to TIRR:		
General reference on information theory: IEEE Spectrum, January 1965, R. T. James, Data Transmission--The Art of Moving Information		3 March 1967
Backup packages on Ames accelerometer		18 April 1967
Backup packages on the Ames pressure transducer (Mr. Coon)		18 April 1967
JPL report on Enhancement Techniques for X-rays (Tech. Report No. 32-1028)		18 April 1967
TB 67-10348	Computerized Parts List System Coordinates Engineering Releases, Parts Control, and Manufacturing Planning	11 December 1967
TB 67-10510	Probabilistic Approach to Long Range Planning of Manpower" (should be entered on HUV-3	31 January 1968
	Meddars Library Search No. 3-67, "Computers in Design of Hospital or Medical Facilities" (should be entered on HUV-3)	31 January 1968