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

QUARTERLY PROGRESS REPORT #3
Period Covered: 1 July 1968 - 30 September 1968

Contract No. NASW-1714
SwRI Project No. 14-2329

Prepared for

Chief, Dissemination Branch, Code (UT)
Technology Utilization Division
Office of Technology Utilization
NASA
Washington, D. C. 20546

15 October 1968

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO HOUSTON

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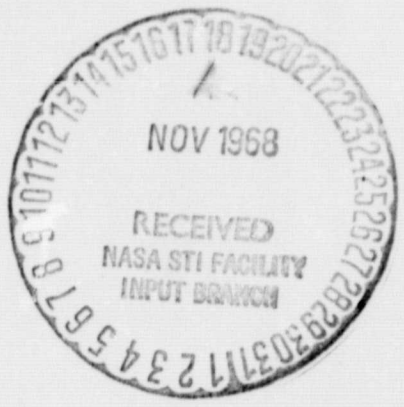

15 October 1968

Southwest Research Institute
8500 Culebra Road
San Antonio, Texas 78228

Prepared by: Ray W. Ware, M. D.
Louis S. Berger
Felix L. St.Claire, III

Approved:

William E. Cory, Director
Electronic Systems Research

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I. INTRODUCTION

I. INTRODUCTION

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 Application 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 (West Coast Institutions)
- Key Coordinators at User Institutions:
  - F. Hermann Rudenberg, Ph.D., Associate Professor, Department of Physiology, The University of Texas Medical Branch, Galveston, Texas
  - Jack B. Johnson, 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
W. R. Brian Caruth, Ph.D., Manager, Operations Research
J. Wray Fogwell, Manager, Electromechanical Research
Gerald Gardner, Ph.D., Senior Research Physicist
Stephen Juhasz, Ph.D., Editor, Applied Mechanics Review
Ulric S. Lindholm, Ph.D., Manager, Solid Mechanics
M. A. Schrader, Research Engineer
Richard T. Mannheimer, Senior Research Engineer
Paul D. May, Senior Research Chemist
Frank C. Milstead, Senior Research Engineer

II. NEW PROBLEMS

(1) PLR-3

Adaptive Prosthetic Physiological Control Systems

Source: Noel P. Thompson, M. D.
Chief, Bioengineering and Physiology Division
Palo Alto Medical Research Foundation

Date Submitted: 15 July 1968

The researcher seeks to devise a control system that will monitor the human body's physiological condition and maintain this condition at certain levels by an automated demand feedback system which administers drugs and other agents as needed. The character of human physiology immediately suggests a highly nonlinear system. It is hoped that NASA's work in nonlinear control system technology can offer some aid to this project which would benefit a large undetermined number of patients.

Initial Disposition:

A search statement of this problem was written and submitted to WESRAC.

Communications:

19 July 1968--Two references were forwarded to Problem Originator for evaluation: N68-12992, "Application of Modern Control and Nonlinear Estimation Techniques," California Institute of Technology; and N68-13580, "Conjugate Gradient Methods with an Application to V/STOL Flight Path Optimization," Interim Technical Report, Harvard University, Division of Engineering and Applied Physics.

5 August 1968--Search statement composed from inputs of Mr. Buck, Dr. San Martin, and Mr. R. J. Crosby was forwarded to WESRAC.

20 August 1968--Search results returned to Problem Originator from WESRAC.

24 August 1968--Search results were furnished to Problem Originator together with a cover letter by Mr. Buck reporting results of the WESRAC conference during which the search and screening of this problem was discussed.

13 September 1968--Dr. Thompson had partially finished his initial review of the Abstract Report. He stated that the WESRAC search was of considerable interest since it covered areas such as NASA and foreign (particularly Russian) publications not previously examined by him. He believed that the search would be of general value and was encouraged in that he is even more convinced of the necessity of his own research.

(2) NWR-4

Exercise Device for Handicapped or Confined Patients

Source: J. H. P. Hall
Executive Director
Northwest Institute for Rehabilitation and Research

Date Submitted: 23 September 1968

This problem involves finding utilization and/or improvement upon a static human exercise device that would be useable by confined persons. Such confinement would be in a bed, wheelchair, or would pertain to persons with limited muscular-skeletal range and locomotion.

Initial Disposition:

Problem submission is very recent. Strategy as yet undecided.

(3) NWR-5

Numerical Methods for Solutions to Wave Equations in Layered Media of Arbitrary Cross Section

Source: Dr. Arthur W. Guy
Assistant Professor
Northwest Institute for Rehabilitation and Research

Date Submitted: 23 September 1968

Numerical methods for the solution of differential and integral equations for electromagnetic waves, ultrasonic waves, and heat transfer problems in layered media of arbitrary cross section are sought.

Suitable mathematical techniques could provide a method of predicting heating in tissue due to the application of diathermy or ultrasound. The various layers encountered are fat, muscle, and bone, with cross sections that do not match the classical shapes, i.e., of cylinders, rectangles etc. Heat transfer and transfer in the various layers determine the temperature rise.

The setting up of the new research program to which this problem applies was stimulated by the following NASA publications: TN-D-3696, TN-D-3760, and TR-R-248.

Initial Disposition:

COSMIC was requested to prepare a list of applicable programs.

(4) SFM-3

Continuous Automated Monitoring of Isolated Heart Cell Contractions in Tissue Culture

Source: Mr. Harry Miller
Laboratory Coordinator
Cardiology Division
Stanford University School of Medicine

Date Submitted: 24 August 1968

The first phase of this problem requires an automated count and readout of the heart cell contraction rate (counts per minute) continuously repeated over at least a 7-hour period. It is desired to obtain a plotted curve of the heartbeat-per-minute versus time for this period. The second goal is to determine the dynamics of contraction of the cell groups: forces, velocities, acceleration, etc.

Initial Disposition:

This problem was taken directly to Dr. Seymour Stein of NASA Ames for consultation.

Communications:

29 August 1968--Mr. Felix St. Claire furnished to Problem Originator the results of his experience in the use of needle microelectrodes.

9 September 1968--Mr. Buck relayed to the Problem Originator the advice of Dr. Seymour Stein of NASA Ames. The problems of electrode poison were discussed, and the names of several researchers active in the problem area were also furnished to Mr. Miller.

16 September 1968--Mr. A. G. Buck visited Mr. Miller. The Problem Originator has decided to use photoelectric counting techniques rather than microelectrode cell potential methods. He will determine maximum harmless illumination intensity possible. Mr. Buck will search for suitable photodetectors and counting equipment.

(5) WSM-5

Techniques for Restricting Blood Flow in the Legs

Source: Loring B. Rowell, Ph.D
Research Associate Professor
University of Washington School of Medicine

Date Submitted: 21 August 1968

This problem is concerned with a method for the addition of cardiovascular constriction to those stimuli (heat and exercise so as to stress the cardiovascular system) which were investigated in WSM-4. The dependent variables were: stroke volume, central blood volume, visceral vascular resistance, etc.

The constricting device or material must leave the joints free for exercise and must be capable of a "stepwise" increase in vasoconstrictive pressure and area covered (percent of arms and legs).

Initial Disposition:

This problem was taken to the personnel of NASA Ames for consultation.

Communications:

14 August 1968--Mr. Buck demonstrated a standard inflatable splint and relayed to Problem Originator Dr. Stein's (NASA-Ames) suggestion of using a suitably modified unit to obtain the desired restriction on blood flow in the legs.

18 September 1968--Problem Originator was interviewed, and it was established that the pressure suit gear will have to be made to order and that this will take some months. Performance requirements were discussed with West Coast Consultant, and Application Team assistance will be coordinated with Problem Originator's equipment procurement.

(6) RNV-10

Measurement of Kinematic and Dynamic Parameters in the Handicapped Patient

Source: Jacquelyn Perry, M.D.
Orthopedic Surgeon
Chief of Kinesiology Research
Rancho Los Amigos Hospital

Date Submitted: 15 July 1968

This problem is concerned with the acquisition of more accurate and meaningful pressure and shear data from the foot of the paraplegic or hemiplegic patient during foot-floor impact and telemetering this information to some central terminal.

Objective assessment of a patient's state of ambulatory disablement by analysis of his gait can lead more readily and accurately to proper treatment of the many people with a walking handicap.

Initial Disposition:

The submitted problem statement and amplifying documents were given to Dr. Ulric S. Lindholm, manager, Solid Mechanics, Department of Mechanical Sciences, SwRI, for evaluation and recommendations.

Communications:

24 July 1968--Received a letter from Mr. A. G. Buck (concerning Mr. St. Claire's letter of 15 July) containing his (AGB's) recommendations for approach to this problem. They are as follows:

(1) Rapid survey of previous Biomedical Application Team problems; particularly Texas Institute of Rehabilitation and Research.

(2) Assuming parallel technology accomplished by NASA, direct contact either by search or problem abstract (particularly MSC).

(3) Recommendations by Biomedical Application Team to Problem Originator concerning system, number and positions of transducers, telemetry gear, etc., i.e., as advisors.

12 August 1968--Messrs. W. Fogwell, Manager, and R. Solberg, Research Engineer, Electromechanical Research Section, SwRI, were furnished a copy of the problem statement and supplementary descriptive material for their critical review.

11 September 1968--Mr. A. G. Buck visited with Mr. Daniel Antonelli, research associate of Dr. Perry, the Problem Originator. Mr. Antonelli approved highly of the miniature pressure transducer technology (TB 68-10246) received from NASA which he had previously reviewed. He stated that he could immediately use such units if commercial sources for manufacture could be located. North American Rockwell of Downey, California was contacted by Mr. Antonelli concerning the technology. North American Rockwell responded most cooperatively and actually loaned Mr. Antonelli one complete pressure cell for his inspection and evaluation. If actually used, this pressure cell will solve an important portion of the instrumentation problem.

(7) RNV-11

Acquisition and Telemetry of Whole Body Kinesiology in Handicapped Patients

Source: Jacquelyn Perry, M. D.
Orthopedic Surgeon
Chief of Kinesiology Research
Rancho Los Amigos Hospital

Date Submitted: 15 July 1968

This problem, which arose from RNV-10, deals with telemetering the pressure-shear data derived from human foot-floor impact and the whole body kinesiology of walking-handicapped patients.

A maximum of 30 channels of telemetered information is anticipated.

Initial Disposition:

Updating of search results from previously submitted relevant problems.

Communications:

15 July 1968--F. L. St. Claire wrote A. G. Buck inviting his input before deciding on the initial disposition.

24 July 1968--Received a letter from A. G. Buck (concerning Mr. St. Claire's letter of 15 July) containing his (AGB's) recommendations for an initial approach. They are as follows:

(1) Rapid survey of previous relevant Biomedical Application Team problems; particularly Texas Institute for Rehabilitation and Research.

(2) Assuming parallel technology accomplished by NASA, direct contact either by search or problem abstract (particularly MSC and Ames).

(3) Recommendations from prior experience by Biomedical Application Team to Problem Originator.

21 August 1968--Copy of search on biotelemetry furnished courtesy of Research Triangle Institute (Mr. E. Harrison, Jr.). This search was performed on Research Triangle Institute's problem (UNC-38).

23 August 1968--Conference was held with the Problem Originator wherein Mr. Buck demonstrated an ultraminiature FM transmitter from NASA-Ames.

29 August 1968--Commercial version (Whittaker Corporation) of NASA-Ames Telemetry Technology demonstrated to researchers.

11 September 1968--Results of previously performed searches on biotelemetry furnished by Mr. C. J. Laenger, Sr., to Problem Originator.

11 September 1968--Mr. A. G. Buck visited Mr. Daniel Antonelli, research associate of Dr. Perry. The commercialversion of the NASA-Ames developed miniature multichannel telemetry equipment, manufactured by Whittaker Corporation of Pasadena, had been demonstrated satisfactorily. Since Dr. Perry must demonstrate a system to her potential grantor, it is still necessary to obtain equipment with token funds for a 3-month period. Dr. Mooney, Mr. Antonelli, and Mr. Buck agreed that either a loan or a lease of Whittaker equipment would be attempted.

20 September 1968--Mr. C. J. Laenger, Sr., called Mr. Guy McGee at KASCenter to arrange for updating of biotelemetry search performed in the past on closely related problems (see 11 September entry).

(8) RNV-12

Temperature Regulation in Congenital Amputees

Source: Alice L. Garrett, M. D.
Chief, Cerebral Palsy
Rancho Los Amigos Hospital

Date Submitted: 29 July 1968

Human skin, especially that covering the extremities, serves one role by allowing excess body heat to dissipate into the atmosphere.

If the extremities are absent, the heat dissipating surface area of the body is substantially reduced. That fact plays heavily upon children who are born with limbs missing.

Ways are sought by which to keep these handicapped individuals cool in all atmospheric conditions (i.e., outside of air-conditioned enclosures) by assisting the existing skin surface in heat dissipation. The method must not be restricting and must allow freedom of movement.

Initial Disposition:

This problem, apparently solvable by existing hardware, was taken to NASA Manned Spacecraft Center personnel (Mr. Paul E. Purser, special assistant to the director) for loan of hardware.

Communications:

22 August 1968--The Problem Originator's request for loan of a liquid-cooled undergarment from NASA Manned Spacecraft Center was processed by Mr. Paul E. Purser, special assistant to the director. The requested loan was approved. Because her work is relevant to NASA research questions, the Problem Originator was requested to share her research results with NASA scientists.

11 September 1968--Mr. A. G. Buck visited Drs. Stiles and Mooney in Dr. Garrett's absence. The problem status was reviewed.

(9) RNV-13

Improved Laryngoscope for Patients with Rheumatoid Arthritis

Source: Alice L. Garrett, M.D.
Chief, Cerebral Palsy
Rancho Los Amigos Hospital

Date Submitted: 29 July 1968

Some patients who require insertion of tubes into their air passages (such as patients with certain joint diseases, especially children with their small tracheae) pose problems to the surgeon. A clear passage by way of a tube must be provided during corrective surgery. Insertion of the communicating tube between lungs and air supply becomes difficult when, due to diseased joints, the neck and jaw are stiff and immovable.

The laryngoscope, an optical instrument devised for visualizing insertion of communicating tubes into the airways, is nonflexible and useless in the pathologically rigid patient. It is suggested that a flexible fiber-optics instrument might substitute.

Initial Disposition:

Search request of NASA data bank is indicated.

Communications:

11 September 1968--Mr. A. G. Buck visited Dr. Claire Stiles, associate of Dr. Garrett. Dr. Stiles and Mr. Buck clarified two factors: (1) High resolution in the system is not required, and (2) The tube insertion process can be two-step; i.e., a guiding-locating laryngoscope can be inserted, followed by the breathing tube, and then the guiding device removed. It must be noted, on the other hand, that a simple flexible laryngoscope will not suffice. The tip end must be capable of multimotion control by the physician so that it can be properly guided through the air passage.

(10) RNV-14

Materials for Prevention of New Decubitus Ulcers

Source: E. S. Stauffer, M.D., Ph.D.
Chief, Spinal Cord Injury Service
Rancho Los Amigos Hospital

Date Submitted: 22 September 1968

Spinal cord injury patients with sensory loss develop pressure sores over the bony areas of the sitting surface while in a wheelchair. These sores take from 2 weeks to 4 months to heal, and some sores require surgical closure. The estimated average cost of a pressure sore is $15,000.

Many different types of cushions are manufactured today which are claimed to prevent pressure sores from developing. Yet, sores still do develop.

What is needed are materials which will perform satisfactorily as cushions. The materials should be elastic in a vertical direction yet relatively stable in a horizontal direction. The material should be able to "breathe," should be elastic, and should allow for even distribution of pressure over the seating area when the patient is in the sitting position. If the patient moves laterally, forces should redistribute appropriately.

Among the chief approaches used in the past, --

(1) Water cushions
(2) Molded foam
(3) Air cushions
(4) Silicon gel (Stryker Company).

To date, none of these approaches has yielded entirely satisfactory results.

No initial disposition has been made of this very recently acquired problem.

(11) RNV-15

Rapid Multiple Gas Measurement for Medicine

Source: Jack D. Hackney, M.D.
Physiologist
Rancho Los Amigos Hospital

Date Submitted: 22 September 1968

This problem is concerned with the analysis of multiple gases simultaneously in a medical setting. A rapid response time is required. Gases of interest are:

Group #1: O_2, CO_2, N_2, H_2O

Group #2: He (or Ne), C_2H_2 (or N_2O)

Group #3: Group #2 plus CO

The research goal is the simultaneous monitoring of alveolar gas, and arterial and mixed venous gas partial pressures, under a variety of conditions.

No initial disposition has been made of this very recently acquired problem.

III. BIOMEDICAL PROBLEMS

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; facility construction is now proceeding.
HUV-2	Advanced Computer Display and Interface Technology	Inactive
HUV-3	Computer Scheduling Techniques	Inactive
HUV-4	Heart Sounds, Interval Analysis	Inactive
HUV-5	End Tidal Air Sampler	Inactive
HUV-6	Ambulation Aid	Problem Abstract disseminated; inactive
HUV-7	Scheduling for Ward Patients	Inactive
HUV-8	Mechanisms of Onset of Orthostatic Hypotension	Transfer completed; inactive
HUV-9	Prosthetic Materials for Urinary Tract	Inactive
HUV-10	Instrumented Prosthetic Leg	Microsphere cushion prototype furnished for evaluation researchers.
HUV-11	Improved Gas Sample Flow Control and Measurement	Inactive
HUV-12	Special Automobile Modifications for Disabled Persons	Inactive

No.	Title	Status
Texas Institute for Rehabilitation and Research (Cont'd)		
HUV-13	Human Transfer Function Measurements	Inactive
HUV-14	Physical Space Utilization	Inactive
HUV-15	Advanced Computer Terminal and Display Technology	Inactive
HUV-16	Novel Joint Design Applied to Assistive Devices for Human Limbs	Inactive
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	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; actual transfer
SRS-7	Acoustic Pest Control Technology	Inactive
Baylor University Medical School		
BLM-1	Noiseless Gas Valves for "Artificial Heart" Use	Closed out

No.	Title	Status
Baylor University Medical School (Cont'd)		
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	Inactive
BLM-5	Transthoracic Energy Coupling Devices	Inactive
BLM-6	Biocompatible Spray-On Plastics, Impermeable to Bacteria	Inactive
BLM-7	Telemetry of Cardiovascular Data from Free-Ranging Animals	Inactive
BLM-8	Miniature Tape Recorder for Biological Data	Inactive
BLM-9	Cyclic Variation of Body Temperature in Mammals	Inactive
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 Extravascular Sensor Using Wireless Telemetry of Information	Inactive
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	Technology being evaluated by Problem Originator (No change).
GLM-5	Chronic Intracranial Pressure Measurement in Man	Technology being evaluated by Problem Originator (No change).

No.	Title	Status
The University of Texas Medical Branch, Galveston (Cont'd)		
GLM-6	A Model Vascular System	Reference documents are being evaluated (No change).
GLM-7	Viscosity Measurement of Minute Samples of Blood	Reference documents evaluated; possible Problem Abstract (No change).
GLM-8	Computer Program for Electroencephalograph: Period Analysis	Reference documents are being evaluated (No change).
GLM-9	Measurement of Local Tissue Oxygen Consumption, In Vivo	Actual transfer
GLM-10	Computer Program for Flame Spectrophotometry	Technology tentatively identified (No change).
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 (No change).
GLM-13	Multiple Cospectral Density Analysis of Time-Series Data	Problem Abstract disseminated; possible transfer being evaluated (No change).
GLM-14	Repetitive Measurement of Kidney Mass in Intact Animal	References being evaluated by Problem Originator (No change).
GLM-15	Respiration Volume and Rate Measurements in Unencumbered (Free) Child	Problem Originator evaluating reference material; NASA-ERC sensor prototype being furnished for evaluation.
GLM-16	In-Situ Tumor Mass Determination on Rat Leg	Search completed; results being screened at SwRI.
GLM-17	Respiratory Gases Measurement	References being evaluated by Problem Originator (No change).

No.	Title	Status
Wilford Hall USAF Hospital		
WLH-1	Blood Recirculation Technology	References being evaluated by Problem Originator (No change).
Palo Alto Medical Research Foundation		
PLR-1	Measurement of Outer and Inner Diameter of Blood Vessels	Problem under study; possible search request; no technical progress.
PLR-2	Measurement of Surface Kinematics of Canine Heart	Problem Originator has adopted his own satisfactory technique.
PLR-3	Automatic Control of Therapeutic Agents	References furnished, including WESRAC search yield; being evaluated by Problem Originator.
University of Washington Medical School		
WSM-1	Ultrasonic Coupling Techniques	Search results judged essentially inapplicable; direct contact with NASA researchers is sought.
WSM-2	Atherosclerotic Lesion Detection	Search referenced documents requested for study by Problem Originator.
WSM-3	Infrared Irradiation of Skin Surface	NASA-Ames suggestions being pursued.
WSM-4	Simultaneous Multistress Effects on the Cardiovascular System	Actual transfer; Research Phase II initiated.
WSM-5	Techniques for Restricting Blood Flow in the Legs	New problem
Stanford University Medical School		
SFM-1	Automatic EKG-Time Interval Measurement	References from related previous searches being evaluated by SwRI scientists.

No.	Title	Status
Stanford University Medical School (Cont'd)		
SFM-2	Automatic Techniques for Smoothing Blood Pressure Waveforms	References from related previous searches being evaluated by SwRI scientists.
SFM-3	Improved Monitoring of Heart Cell Contraction Parameters	New problem
Northwest Handicapped Center		
NWR-1	Motion Pattern Measurement of Patients	Search referenced documents requested for study by Problem Originator.
NWR-2	Pressure Measurement to Aid Prevention of New Decubitus Ulcers	Transfer in progress; suggested NASA-Ames technique being pursued.
NWR-3	Parameters for Telemetry Systems	Actual transfer; closed out.
NWR-4	Exercise Device for Handicapped or Confined Patients	New problem
NWR-5	Numerical Methods for Solutions to Wave Equations in Layered Media of Arbitrary Cross Section	New problem; inquiry sent to COSMIC.
Rancho Los Amigos Hospital		
RNV-1	Efficient Electromagnetic Power Transmission Through Living Tissue	Search results being evaluated by Problem Originator.
RNV-2	Design of Implanted Antennas	NASA-Ames telemetry transmitter being evaluated.
RNV-3	Electrode Wires for Implantation	Search results being evaluated by Problem Originator.
RNV-4	Optimum Neurologic Electrodes	Search results being evaluated by Problem Originator.
RNV-5	Pressure Measurement to Aid Prevention of New Decubitus Ulcers	Transfer in progress; suggested NASA-Ames technique being pursued.

No.	Title	Status
Rancho Los Amigos Hospital (Cont'd)		
RNV-6	Integral Impedance Matching, Impedance Transformation, and Signal Conditioning at the Transducer	Search results being evaluated by Problem Originator.
RNV-7	Shielded Rooms for Physiological Studies	Search results being evaluated by Problem Originator.
RNV-8	State-of-the-art Survey of Surface Biopotential Electrode Technology (EMG, EEG, ECG, . . .)	Search results being evaluated; transfer in progress; suggested NASA-Ames technique being pursued.
RNV-9	Shielding Techniques for Active Surface Biopotential Electrodes	Search results being evaluated by Problem Originator.
RNV-10	Sensors for Measuring Foot-Floor Impact Forces	Search request being prepared.
RNV-11	Measurement and Telemetry of Kinesiology of Handicapped Patients	Previous applicable searches being updated at KASCenter.
RNV-12	Body Temperature Regulation in Congenital Amputees	Transfer in progress (NASA-MSC technology).
RNV-13	Improved Laryngoscope for Use in Disabled Children	New problem
RNV-14	Materials for Prevention of New Decubitus Ulcers	New problem
RNV-15	Rapid Multiple Gas Measurement for Medicine	New problem
The University of Texas Medical School at San Antonio		
SNM-1	Enhancement of X-Ray Contrast Study Films	New films being sent to Jet Propulsion Lab for processing.

B. Problem Case Histories Status

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

Communications:

20 September 1968--Mr. C. J. Laenger, Sr., called Mr. Guy McGee to arrange for updating of biotelemetry search.

● GLM-2 Monitoring of Blood Pressure by Extravascular Sensor, Using Wireless Telemetry of Information

Communications:

20 September 1968--Mr. C. J. Laenger, Sr., called Mr. Guy McGee at KASCenter to arrange for updating of biotelemetry search.

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

Communications:

30 August 1968--Response received from Mr. Frederic A. Hills, Acting Chief, Technology Utilization Office, Electronics Research Center. A prototype of a respirometer developed at NASA-ERC is being made available for Dr. Wilson's evaluation. (NASA researchers connected with the development of this device are Mr. Lennart Long and Mr. Adelbert Lavery.)

● SNM-1 Enhancement of X-Ray Contrast Study Films

Communications:

5 September 1968--Dr. Ware sent Dr. Nathan (J. P. L.) another set of X-ray films together with a cover letter describing the film characteristics and requesting that enhancement procedures be applied.

● PLR-1 Measurement of Outer and Inner Diameter of Blood Vessels

Communications:

2 August 1968--Descriptive material on SwRI X-ray microfocus techniques and instrumentation was forwarded to consultant for possible application to this problem.

12 August 1968--Mr. Leonard Rastrelli, Assistant Director, Department of Structural Research, SwRI, was briefed on this problem. He will be in touch with the Problem Originator and Mr. Buck, to expand on the details of the SwRI developed microfocus X-ray equipment the week of 19 August 1968.

19 August 1968--Mr. Rastrelli was unable to reach the Problem Originator by telephone.

13 September 1968--Mr. A. G. Buck visited with Dr. Sacks for problem discussion. There was no really satisfactory solution produced at that meeting concerning a proper attack for this very difficult problem. Discussion was undertaken concerning the possibility of sequential dye X-ray techniques, but no firm conclusions were reached.

● PLR-2 Measurement of Surface Kinematics of Canine Heart

Communications:

13 September 1968--Mr. A. G. Buck visited with Dr. Neil Ingels for problem discussion and WESRAC report review. Dr. Ingels has achieved some success using the single-strand, micron-size fiber-optic approach for matrix spot instrumentation. Dr. Ingels was relatively pleased upon review of the WESRAC search. If not directly applicable, the abstracts reviewed served to encourage him in that he was not repeating another's work. Dr. Ingels expressed interest in the Biotronics Laboratory Inc. "Heart Motion Video Tracker" brochure furnished by Mr. St. Claire.

● WSM-1 Ultrasonic Coupling Techniques

Communications:

8 July 1968--Mr. Buck met with staff of WESRAC to discuss a rescreening of the search. This proceeded, and a new search yield was received 11 July 1968. It appears that, from the new search results, only very few citations are of potential benefit, and preparation of a Problem Abstract of this problem is being contemplated.

31 July 1968--Information on a delay line coupling unit was sent by Mr. D. Bendersky, Midwest Research Institute, to Dr. Ware. This material was forwarded to the consultant on the West Coast.

14 August 1968--Problem Originator stated during Mr. Buck's visit that, while no new directly relevant information was provided, some of the secondary search reports opened up new and different research fields.

● WSM-2 Atherosclerotic Lesion Detection

Communications:

29 July 1968--Received copy of search returns, "Rheology of Human Arteries."

14 August 1968--During visit with Problem Originator, Mr. Buck was given a favorable evaluation of the search results. Also the references may have suggested new directions of research.

18 September 1968--Problem Originator was interviewed and furnished positive preliminary evaluation of the search results. Further search evaluations will be made after reports of interest have been obtained and studied.

● WSM-3 Infrared Irradiation of Skin Surface

Communications:

19 July 1968--Search results returned to Problem Originator from WESRAC.

14 August 1968--Problem Originator stated during Mr. Buck's visit that, while the search appeared to have been well designed, no significant new information was discovered.

28 August 1968--NASA-Ames researchers (Messrs. Carl Neel, Ben Beam and John Dimeff) were consulted and suggested use of a 10.6 μ CO_2 laser. The Problem Originator was apprised of their advice and has been in touch with Sylvania Electronics Systems Electro-Optics Organization to investigate commercial laser sources.

18 September 1968--The Problem Originator stated in an interview that he felt that the NASA searches covered a segment of literature different from other searches previously performed and that they are highly effective.

● WSM-4 Simultaneous Multistress Effects on the Cardiovascular System

Communications:

Problem Originator is Loring P. Rowell, Ph.D., Department of Cardiology, Washington School of Medicine. This problem was unofficially submitted to Mr. A. G. Buck prior to formal initiation of Mr. Buck's activities as Project Consultant. As a result of Mr. Buck's effort, NASA Manned Spacecraft Center loaned two liquid-cooled garments to the Problem Originator in December 1967. In April, a letter of acknowledgement was sent to Mr. Paul Purser, special assistant to the director, at Manned Spacecraft Center, in which he expressed his appreciation for the loan and for furnishing a most positive evaluation of the usefulness of the furnished technology.

3 July 1968--A draft copy of the abstract of a paper to be considered for presentation at the Forty-First Scientific Session of the American Heart Association, 21-24 Nov. 1968, Bal Harbour, Florida, was received from the research physicians.

18 September 1968--The Rowell/Murray report has been accepted by the AHA for presentation at the national meeting in Miami in November. Preprints will be sent to Mr. Purser (NASA-MSC) and SwRI when available. The success of the WSM-4 program has encouraged Drs. Rowell and Murray to expand its scope.

20 September 1968--A new problem phase is being initiated by the researchers. They sent a letter to Mr. Paul E. Purser, NASA/Manned Spacecraft Center, summarizing the publications resulting from Phase I, outlining the problems to be investigated in Phase II, and requesting further loans of liquid-cooled garments.

● NWR-1 Motion Pattern Measurement of Patients

Communications:

13 August 1968--Problem Originator discussed search results with Mr. Buck; the initial evaluation was favorable, and selected documents have been ordered.

● NWR-2 Pressure Measurement to Aid Prevention of New Decubitus Ulcers

Communications:

1 July 1968--Mr. A. G. Buck wrote to Mr. J. C. Pemberton, President, Scanivalve Company, to acquaint him with Problem Originator's interest in the pressure measurement technique.

9 July 1968--Mr. A. G. Buck initiated investigation of commercial sources for plastic double-walled quilted pillows.

21 August 1968--Mr. Buck held conferences with various Ames researchers (Messrs. Dimeff, Kolbe, and Rathert) to review applicable NASA technology. Mr. Buck relayed to consultant the results of the Ames meeting.

30 August 1968--Mr. Buck is pursuing investigations into instrumentation developed at the hospital at the University of Pennsylvania. An initial response to his inquiry was received, and further information on the device developed at the University of Pennsylvania is being sought.

● SFM-1 Automatic EKG-Time Interval Measurement and
● SFM-2 Automatic Techniques for Smoothing Blood Pressure Waveforms

Communications:

19 July 1968--Request to Mr. J. Wheeler, NASA-MSC, for backup package on NASA Tech Brief 68-10060, "New Technique for Optimal Smoothing of Data."

19 July 1968--Mr. Jim Benson, Technology Utilization Office, Rocketdyne Corporation, was briefed on this problem and will consult with Mr. Buck and the Rocketdyne computer staff to see how their computer programs might be applied to this problem.

24 July 1968--Received response from request for Tech Brief 68-10060 from NASA-MSC, J. Wheeler. Backup package is being prepared.

25 July 1968--Dr. W. L. Anderson and Mr. L. Berger called Problem Originator and discussed his submitted problem at length. Dr. Anderson suggested an approach using matched filtering, and it was decided to begin re-examining two previously performed searches (GLM-3, -12; and HUV-4) to ascertain whether material was already at hand for performing the desired operations or whether some other disposition, such as a new search, was indicated.

12 August 1968--Received backup package from NASA TB 68-10060, "New Technique for Optimal Smoothing of Data" from Mr. John Wheeler, TUO, NASA-MSC, per Mr. St. Claire's letter 24 July 1968. This information was passed on to Dr. Wallace Anderson, SwRI, for evaluation and application.

17 September 1968--Results of two previously related searches were screened for related material. Problem Originator was advised of the actions of the Team. Requested documents are being evaluated by Team members.

● RNV-1 **Efficient Electromagnetic Power Transmission Through Living Tissue**

Communications:

11 July 1968--Search reports returned to Problem Originator. (Search covers both problems RNV-1 and RNV-2.)

29 July 1968--Received a Physio-Control Corporation bulletin entitled "Two Eleven Demand Pacer" which was sent to A. G. Buck for forwarding to Problem Originator for possible interest.

11 September 1968--During a visit by Mr. A. G. Buck with Dr. McNeal, it was established that WESRAC reports had been reviewed, and documents requested had been sent for. Dr. McNeal, using available 15-kHz equipment, is ready for performing implantation in a leg of a human afflicted from a cerebral hemorrhage. In pursuing his research, Dr. McNeal feels that the NASA documentary service is good, but he states that he thinks that the NASA personnel contribution is the best of all. As a result, Mr. A. G. Buck arranged for Dr. McNeal to visit Messrs. Edwards, Dimeff, and Fryer, of NASA-Ames Research Center, on 18 September. Subject of discussion to be optimum transmission factors as experienced by NASA-Ames. The planned visit is relevant to RNV-2, -3, and -4, as well.

● RNV-2 Design of Implanted Antennas

Communications:

10 July 1968--Search results returned to Problem Originator.

17 July 1968--Mr. C. J. Laenger, Sr. called Mr. A. G. Buck to initiate an inquiry about search results. It will be established why certain kinds of results (the effects of frequency, for example) and particular known applicable articles were not cited in the search yield.

22 July 1968--WESRAC was requested to review results of this search. Mr. C. J. Laenger, Sr. suggested that "frequency" be added as a search descriptor.

29 July 1968--Received a Physio-Control Corporation bulletin entitled "Two-Eleven Demand Pacer" which was sent to A. G. Buck for forwarding to the Problem Originator for possible interest.

7 August 1968--Mr. C. J. Laenger, Sr. sent two articles to Mr. A. G. Buck for relay to Problem Originator. These articles were entitled, "Low Frequency Piezoelectric Energy Conversion for an Intra-thoracic Artificial Heart" and "Apparatus for Efficient Power Transfer Through a Tissue Barrier."

23 August 1968--A conference was held with the Problem Originator wherein Mr. Buck demonstrated an ultraminiature FM transmitter from NASA-Ames.

● RNV-3 Electrode Wires for Implantation

Communications:

8 July 1968--Search results were furnished to Problem Originator who is setting up a laboratory for study of the submitted problem.

29 July 1968--Received a Physio-Control Corporation bulletin entitled "Two-Eleven Demand Pacer" which was sent to A. G. Buck for forwarding to the Problem Originator for possible interest.

● RNV-4 Optimum Neurologic Electrodes

Communications:

13 July 1968--WESRAC search report sent to Problem Originator.

● RNV-5 Pressure Measurement to Aid Prevention of New Decubitus Ulcers

Communications:

8 July 1968--Descriptive letter from Dr. Lombard on microsphere technology was furnished to Problem Originator during visit of Mr. Buck at the hospital.

9 July 1968--Mr. A. G. Buck initiated investigation of commercial sources for plastic double-walled quilted pillows.

30 August 1968--Mr. Buck is pursuing investigations into instrumentation developed at the hospital at the University of Pennsylvania. An initial response to his inquiry was received, and further information on the device developed at the University of Pennsylvania is being sought.

11 September 1968--Mr. A. G. Buck visited with Dr. Mooney, who is still searching for prosthetic pressure transducers. Mr. Antonelli (see RNV-10) was asked to demonstrate to Dr. Mooney the instrumentation equipment loaned by North American Rockwell in connection with RNV-10.

● RNV-5A

11 September 1968--Mr. A. G. Buck visited with Dr. Stauffer, Mr. Edberg, and Mr. Rogers. A manpower shortage has occurred at Rancho Los Amigos Hospital in connection with this problem. The current situation was sensed early this summer. As a result, the assistance from the Jobst Institute, The University of Pennsylvania, and Scanivalve has been greatly appreciated.

● RNV-6 **Integral Impedance Matching, Impedance Transformation, and Signal Conditioning at the Transducer**

Communications:

3 July 1968--A search statement draft was forwarded to the West Coast Consultant for review and submission to WESRAC.

(Since RNV-6 through -9 are derived from a common problem statement, some transactions relate to all four problems. Those common transactions will be reported singly under RNV-6).

8 July 1968--During a visit by Mr. Buck to Rancho Los Amigos Hospital, material from Mr. Jack B. Johnson (Team Consultant, Southern Res. Support Center, V. A.) was forwarded to Problem Originator.

15 July 1968--Many of the search returns from the RNV-4 search seem applicable to RNV-6 through -9. Mr. St. Claire requested that Mr. Buck intercede in transferring the documents to Dr. Waring.

17 July 1968--Search results from RNV-4 were forwarded to Problem Originator for review.

11 September 1968--Mr. A. G. Buck visited Problem Originator. All above abstract reports from WESRAC were reviewed by Dr. Waring, and document requests have been made accordingly.

● RNV-7 **Shielded Rooms for Physiological Studies**

Communications:

3 July 1968--Search statement draft forwarded to West Coast Consultant for review and submission to WESRAC.

24 July 1968--Search results returned to Problem Originator from WESRAC.

11 September 1968--Mr. A. G. Buck visited Problem Originator. All above abstract reports from WESRAC were reviewed by Dr. Waring, and document requests have been made accordingly.

● RNV-8 Surface Biopotential Electrodes (EMG, EEG, ECG, . . .)

Communications:

17 July 1968--Mr. C. J. Laenger, Sr. called Mr. A. G. Buck and informed him that if appropriate search results are obtained for RNV-4, questions posed on this problem should also be satisfactorily covered by that search. Pending the findings on the search procedure on RNV-4, action on searching RNV-8 has been tabled.

18 July 1968--Mr. C. J. Laenger, Sr. rewrote search and forwarded same to Mr. Buck for submission to WESRAC.

22 July 1968--Search request for WESRAC forwarded to Mr. A. G. Buck by Mr. C. J. Laenger.

23 July 1968--Revised search request submitted to WESRAC.

26 July 1968--Revised search request was reviewed at WESRAC and program was set up.

9 August 1968--Search returns forwarded to Problem Originator.

23 August 1968--Conference was held with the Problem Originator wherein Mr. Buck demonstrated an ultraminiature FM transmitter from NASA-Ames.

11 September 1968--Mr. A. G. Buck visited Problem Originator. All abstract reports from WESRAC were reviewed by Dr. Waring, and document requests have been made accordingly.

● RNV-9 Shielding Techniques for Active Surface Biopotential Electrodes

Communications:

3 July 1968--Search statement draft forwarded to West Coast Consultant for review and submission to WESRAC.

24 July 1968--Search results returned to Problem Originator from WESRAC.

11 September 1968--Mr. A. G. Buck visited with Problem Originator. All abstract reports from WESRAC have been reviewed by Dr. Waring, and document requests were made accordingly.

C. Transfer Status (30 September 1968)

Actual Transfer	Potential Transfer
HUV-1	GLM-2
SRS-6	GLM-4
BLM-3	GLM-5
BLM-6	GLM-7
GLM-1	GLM-10
GLM-3	GLM-15
GLM-9	BLM-8
GLM-11	NWR-1
SNM-1	NWR-2
WSM-4	
NWR-3	
RNV-5	

IV. SUMMARY OF PROJECT ACTIVITIES

The work performed during this period in connection with previously submitted problems and with the specification of newly submitted problems is documented in Sections II and III of this report. Meetings attended and site visits performed by members of the Biomedical Application Team were as follows (1968):

8-10 July	Dr. R. W. Ware and Mr. L. S. Berger, NASA/TUD, Washington, D. C.
15-19 July	Mr. C. J. Laenger, Sr., and Mr. R. J. Crosby, Texas Institute for Rehabilitation and Research, University of Texas, Medical Branch at Galveston.
15-18 July	Dr. R. W. Ware and Mr. L. S. Berger, Third Annual Meeting of the Association for the Advancement of Medical Instrumentation, Houston, Texas.
24 July	Mr. C. J. Laenger, Sr., Texas Institute for Rehabilitation and Research.
25 September	Mr. L. S. Berger and Mr. C. J. Laenger, Veterans Administration Psychiatric Hospital, University of Arkansas Medical School.

Mr. A. G. Buck, West Coast Consultant, made five nonlocal site visits, as well as numerous local site visits in the San Francisco area, as follows:

8 July, 23 August, 11 September:	Los Angeles area.
12 August, 17 September:	Seattle area.

V. INSIGHTS INTO THE TRANSFER PROCESS

Mr. Louis S. Berger has prepared a paper, "The Barriers - Communication Between Disciplines," which was presented to the Third Annual Meeting of the Association for the Advancement of Medical Instrumentation, July 15-18, 1968, Houston, Texas. A draft of this paper is included as Appendix A in this report.

VI. PROJECTIONS

Continuation of standard project activities is anticipated for the final quarter of 1968. We plan to continue meeting with problem originators, consultants, and selected NASA researchers; including travel to Manned Spacecraft Center, Houston, to investigate the possibility of using MSC computer facilities for implementing the studies of X-ray image enhancement with Dr. Nathan.

In addition, beginning in November, a series of site visits will be made to the problem originators at all participating institutions in order to collect, verify, and summarize all case history data on events which occurred during the program year. Particular attention will be paid to reporting and documenting the year's transfer activities.

REFERENCES FORWARDED

Ref. No.	Reference Title	Date

Texas Institute for Rehabilitation and Research

General

Scientific Data Systems: Brochure on "Biomedical Systems Capabilities" furnished to consultant for possible application to HUV-3 and HUV-7 — 24 July 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	The University of Texas Medical Branch	
	General	
	Chemistry by NMR, July issue of Science and Technology sent by R. J. Crosby to Dr. Rudenberg for Dr. Kischer	6 August 1968
	GLM-8, -12	
N66-23595	Techniques and Errors in Measuring Cross-Correlation and Cross-Spectral Density Functions	22 July 1968
	GLM-17	
N68-14167	Gas Volume Meter.	13 August 1968
N68-14505	General Description and Evaluation of an On-Line Oxygen Uptake Computer	10 July 1968
N67-19897	The Design, Fabrication, and Feasibility Testing of a Prototype Airborne Respiration Analyzer	10 July 1968
N66-23822	Development and Testing of a Prototype Respiration Analyzer, Phase II	10 July 1968
N66-31163	Development and Testing of a Prototype Respiration Analyzer	10 July 1968
N66-27237	A Feasibility Study of a Thin Film Oxygen Partial Pressure Sensor	10 July 1968
N66-35950	Two-Gas Atmosphere Sensor System Conceptual Design Study	10 July 1968
N66-35951	Development of a Two-Gas Atmosphere Sensor System (Mass Spectrometer)	13 August 1968
A67-0307	Breath-to-Breath Variations of Pulmonary Gas Exchange in Resting Man	26 August 1968
	Technology Inc. bulletin: "Oxygen Consumption Computer" furnished to Problem Originator	2 July 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	Palo Alto Medical Research Foundation	
PLR-2	"Heart Motion Video Tracker" from Biotronix Labs	3 September 1968
PLR-3	"SIM-1 The Model Patient," A. Paul Clark, et al., Datamation, p. 33, August 1968. Set to Mr. Buck for forwarding to Problem Originator.	14 August 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	Seattle Handicap Center	
NWR-1		
TB 65-10023	Miniature Stress Transducer Has Directional Capability	4 September 1968
TB 67-10020	Miniature Capacitor Functions as Pressure Sensor	4 September 1968
TB 68-10246	Miniature Pressure Transducer for Stressed Member Application	4 September 1968
	"Heart Motion Video Tracker" - Biotronix Labs	3 September 1968
	Requested from WESRAC	10 September 1968
N64-23428	Data from the Conference Dealing in Methods of Physiological Investigations of Human Beings	
N63-10944	Exploratory Investigation of the Man Amplifier Concept	
N64-31588	Feasibility Demonstration of Digital Displacement Sensing Techniques	
A63-20258	The Automatic Map Compilation System	

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	Stanford University School of Medicine	
	General	
TB 65-10365	Blood-Pressure Measuring System Gives Accurate Graphic Output	4 September 1968
TB 66-10314	Phonocardiograph Microphone Is Rugged and Moistureproof	4 September 1968
	SFM-1 and -2	
TB 68-10164	Digital Filter Synthesis Computer Program--forwarded to A. G. Buck for Robert E. Stenson, M.D.	11 July 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	University of Washington	
	General	
	"Problems of Diver Communication," E. Kent Hunter, 1967 Conference on Speech Communication and Processing, Office of Aerospace Research. Sent to Mr. Buck for Dr. Graham Duff	10 July 1968
TN D-4398	Review of NASA-MSC Electroencephalogram and Electrocardiogram Electrode Systems Including Application Techniques	10 July 1968
	WSM-2	
	"Compressibility of the Arterial Wall," Carew, et al., Circulation Research, Vol. XXIII, July 1968. Dr. San Martin suggested that this reference was relevant to the problem.	
	Requested from WESRAC	18 September 1968
N65-29149	Theoretical and Experimental Study of the Elastic Behavior of the Human Brachial and Other Human and Canine Arteries	
N68-16389	Biomechanics Within the Field of Cardiovascular Physiology	
A66-81278	Changes in the Elasticity of Arterial Walls During Muscle Exercise	
A64-18853	Interaction of Boundary Layer Flow with Arterial Walls	
N65-15353	The Effect of Gravitational Stress on the Arterial Wall	

REFERENCES FORWARDED

Ref. No.	Reference Title	Date

Rancho Los Amigos Hospital

General

TN D-4398	Review of NASA-MSC Electroencephalogram and Electrocardiogram Electrode Systems Including Application Techniques	10 July 1968
N67-10486	Ultrasonic Hand Tool Allows Convenient Diagnostic Scanning of Bone Integrity	2 August 1968
TB 67-10056	Adjustable Hinge Permits Movement of Knee in Plaster Cast	4 September 1968
TB 66-10626	Hydraulically Controlled Flexible Arm Can Bend in Any Direction	4 September 1968
TB 66-10484	Braking Mechanism Is Self-Actuating and Bidirectional	4 September 1968

RNV-1

TB 66-10486	Solid State Circuit Controls Direction, Speed, and Braking of DC Motor (also for 4, 7, 9)	4 September 1968
TB 68-10309	Feasibility Study of Wireless Power Transmission Systems	22 September 1968

RNV-2

	"Low-Frequency Piezoelectric Energy Conversion for an Intrathoracic Artificial Heart," Schuder, et al., IEEE Transactions on Biomedical Engineering, Vol. BME-15, No. 1, January 1968.	7 August 1968
	"Apparatus for Efficient Power Transfer Through a Tissue Barrier, Short Communications," IEEE Transactions on Biomedical Engineering, Vol. BME-15, No. 1, January 1968	7 August 1968

RNV-6

TB 68-10300	Conceptual Hermetically Sealed Elbow Actuator	22 September 1968
	"EEG Preamplifier," Martin Graham, IEEE Transactions on Biomedical Engineering, July/October. Sent by C. J. Laenger	13 June 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
	Rancho Los Amigos Hospital (Cont'd)	
RNV-10		
TB 67-10020	Miniature Capacitor Functions as Pressure Transducer	4 September 1968
TB 65-10023	Miniature Stress Transducer Has Direction Capability	4 September 1968
TB 68-10262	Silicon Strain Sensors Enable Pressure Measurement at Cryogenic Temperatures	4 September 1968
RNV-11		
TB 66-10624	Miniature Telemetry System Accurately Measures Pressure	4 September 1968
TB 68-10315	Gimbal Angle Sensor	22 September 1968

REFERENCES FORWARDED

Ref. No.	Reference Title	Date
MFS-14552	Sent to All West Coast Institutions for General Information (of particular interest to Dr. Perry at RNV): Descriptive brochure on Marshal Space Flight Center, "Automated Patient Monitoring System."	18 July 1968

APPENDIX A

THE BARRIERS - COMMUNICATION BETWEEN DISCIPLINES

THE BARRIERS - COMMUNICATION BETWEEN DISCIPLINES

Paper Presented at the Third Annual Meeting of The Association
for the Advancement of Medical Instrumentation
July 15-18, 1968

L. S. Berger

Until a few years ago, the transfer of aerospace technology to biomedicine proceeded at a relatively modest pace. Considering that a great body of potentially useful technology had been generated, why did not more intensive transfer activity develop? Certainly it was not lack of need. The need is indeed great in the biomedical areas, and there are many unresolved problems such as those vividly illustrated by Dr. Spencer, in his presentation this morning.

Since the need is great, why has not aerospace-derived technology been expeditiously transferred to the biomedical fields? While there are technical, economic, social, political, and even legal factors which may impede the desired transfer process, perhaps one of the most serious transfer impediments is the communication barrier which exists between biomedical researchers and the workers in physical sciences.

It seems that special problems can arise when communication is attempted across disciplines, because some important factors that make technical communication easy between engineer and engineer or among physicians are absent for the interdisciplinary case. When engineers communicate with one another or when physicians communicate with one another, they take advantage first of all of their common technical backgrounds, but, also and of equal importance, members of the same profession in their communications with one another more or less instinctively tend to take advantage of the common nontechnical bonds that exist within a discipline to achieve good communication. For example, their communications are very often informal and have continuity over relatively long periods of time. Communication between members of the same profession then have the features of communication between members of a closely knit, specialized, almost guild-like subculture.

By way of contrast, communication between members of different disciplines often takes on the character of communication between strangers. Specialists from diverse disciplines, therefore, not only have difficulty understanding each other technically, but their membership in dissimilar guilds or ingroups also importantly impedes the communication process by introducing nontechnical issues.

We consider that it is an important function of the Biomedical Application Teams to be aware of and help dissolve the technical as well as the nontechnical interdisciplinary communication barriers.

Technical problems of communication are, as a matter of course, looked for and expected at critical points in the transfer process, particularly during the initial formulation of a researcher's problem and during presentation of potential answers. To illustrate some of the technical barriers, let us look at the history of a computer problem example. We are requested to furnish a computer program for analyzing flame photometry data. Using a traditional and direct approach, a search of the literature in the context of chemical analysis methods turned up nothing useful. We therefore saw that, if a suitable computer program were to be located in the literature, it would have to be sought in a wider context. A theoretical physicist, who is a SwRI staff member, was brought in on an ad hoc basis to perform an in-depth mathematical analysis which revealed the structures of the underlying mathematical problem. The mathematical problem turned out to be relatively simple and straightforward, although requiring extensive matrix manipulation. A call to COSMIC, the NASA-sponsored Computer Software Management Information Center of the University of Georgia, mentioned earlier this morning by Mr. Day, established that appropriate computer programs were available. However, as is often the case, the interaction of the biomedical researcher with the Biomedical Application Team brought out some new aspects of the submitted problem, giving it additional definition and focus. In this case, the mathematical work demonstrated that an elaborate series of time-consuming, meticulous calibration runs would have to be performed by the biomedical researcher before the computer aid could be utilized. A detailed report was prepared for the biologist, and, at present, he is evaluating his resources, deciding on how the required background experimentation fits into his other commitments. As soon as he is ready to proceed, we will obtain the selected computer programs for him and thus complete the transfer process.

Turning now to the nontechnical interdisciplinary barriers, we find that these cover a rather wide spectrum. One type of nontechnical communication problem arises because good communication of complex information usually requires a connected, meaningful series of messages, amplifying the basic message content in diverse ways. This communication characteristic is likely to be absent in interdisciplinary communications. For example, in the past, when a physician would request information from a physical science information source, he most probably would receive a stack of tutorial literature in a single, one-shot response. The communication came to him as an isolated event, in contrast to the way the physician is used to receiving information in his own field from his peers. In his own work, the physician has information presented to him repeatedly and in context with other information which may have been received at some quite different time. In the interdisciplinary situation, communication is likely to be sporadic and disconnected.

One of the goals of the team effort is to furnish continuity of messages to the researchers. He is informed of the progress of his problem as it is processed, and he is frequently interviewed to obtain evaluations of what has been supplied to him. We use formal tools like follow-up questionnaires at various points in the transfer process and informal ways such as visits and telephone calls to encourage a continual dialogue.

We have said that specialists from different fields sometimes fail to communicate for nontechnical reasons and have cited the problem of message continuity. As a second example, another group of nontechnical problems arises because, on occasion, members of different professions, like other strangers, view each other with skepticism and even mistrust. For example, when specialists from widely differing areas attempt to communicate about technical matters, each may very well be taken aback by the other's lack of specialist training. Each person's opinion of the other may suffer, impeding good communication. Consider the position of the research physician working in an artificial heart program who requests engineering help with control systems. When he poses his questions in his terminology to a specialist in control systems, the physical scientist may be bothered by the biologist's lack of background experience in control theory. Most of us have had the experience of having someone outside our specialty ask us a question in our specialty and feeling as though there may not be much use in trying to answer it because of the questioner's inability to share our technical background and language and to fully understand and appreciate our answer. On the other hand, when the technologist does furnish the researcher some answers, the research physician may very well find that the physical scientist displays a great lack of appreciation for the complexity of the systems that the physician deals with, that he does not appreciate their nonlinearity, their variability from moment to moment, and the great number of only dimly understood parameters that might affect the function of a biologic system in important ways. We can begin to get a glimmer of how poor a history such an attempt at communication is liable to have. To bridge the communication gap between the strangers from different professional subcultures, we strive to serve as a sort of impedance match between the two mismatched groups. To the biologists, we offer communication with people familiar with his world, with whom he can share his common background. Similarly, to the technologist, we offer the possibility to communicate with a technical group that shares his general background. In the case previously alluded to, where a physician was seeking information regarding control systems technology applied in an artificial heart program, a document was prepared which describes the problem in engineering terms, after a suitable introduction which briefly presents the medical background of the problem. This document is called a Problem Abstract; its function will be discussed in more detail today by Dr. Jim Brown of Research Triangle Institute. A response to the Problem Abstract was received from a scientist at NASA's Lewis Research Center in Cleveland, and when the biological researcher was last interviewed, he stated that the references from Lewis appeared most valuable and were being

followed up by members of his research staff. Thus, each specialist communicates through a comfortable, familiar interface with specialists in other disciplines; we may mention that we are alert to the possibility of misunderstandings developing by this indirect communications structure, and that we safeguard against this hazard by continually checking and verifying the adequacy of the communications with each of the professional groups.

In this brief exposition we tried to show what some of the significant barriers are to communications between biologists, such as physicians and physical scientists. We have suggested that nontechnical as well as technical background differences are of great importance and illustrated a few of the ways in which both types of problems are approached by the Biomedical Application Teams. Throughout the day, additional ways in which we circumvent the communication barriers will be mentioned by other participants as they present various facets of the Biomedical Application Program. Thank you.