NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

RESEARCH GRANT NSG 237-62

FINAL REPORT

THE UNIVERSITY OF CALIFORNIA, LOS ANGELES

INSTITUTE OF GEOPHYSICS AND PLANETARY PHYSICS

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Submitted by

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Institute of Geophysics and Planetary Physics

University of California, Los Angeles

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In 1961, the first proposal to the National Aeronautics and Space Administration was submitted for support of the interdisciplinary program in education and research in the areas of Space Science, Space Biology and Space Engineering. In the fourteen years since that original proposal, some 178 grants have been given to members of the UCLA faculty to begin research programs. There is no question in our minds that the sustaining grant program provided a unique opportunity for the University of California at Los Angeles to begin research projects in a multitude of areas.

The philosophy as stated in our original proposal that, " the investigation of space is not neatly fenced into specific areas. Engineering must mix with science and the sciences must mix with each other. The space age presents an enormous responsibility for scientists to describe not only physical conditions in space but the influences which these conditions will have on life exiled from its natural realm. To do this job it will be necessary to train not only large numbers of students in Engineering and in the physical and Biological Sciences but also to equip them with broadly interdisciplinary knowledge, specifically designed to implement careers in this new field."

"The Space Center will integrate the various research activities on space, will stimulate new research in space oriented areas and will provide a framework in which students will undertake interdisciplinary work."

I think that this philosophy and the objectives set out originally have been met to the highest degree possible.

The National Aeronautics and Space Administration provided three grants to UCLA; the General Sustaining Grant, the NASA Fellowship Grant, and the Space Science Building Grant. The Building Grant provided a 35,000 square foot building dedicated to space science research. Slichter Hall is an excellent research facility and UCLA is indebted to NASA. The NASA Fellowship Grant was also a great benefit to the University. It not only provided fellowships for a great number of graduate students, but also funds to bring outstanding scientists to the campus for brief visits.

The NASA General grant has been administered since its inception by a committee of UCLA faculty appointed by the Chancellor. The members of this committee are as follows:

Dr. Willard F. Libby, Chairman
Director of the Institute of Geophysics and Planetary Physics

Dr. William Ross Adey, M.D.
Associate Director of the Brain Research Institute

Dr. Lawrence Aller, Professor and Chairman
Department of Astronomy

Dr. John French, M.D., Director
Brain Research Institute

Werner Hirsch, Professor of Economics and Director of the Institute of Government and Public Affairs

Dean Chauncey Starr, Dean of the School of Engineering and Applied Sciences

This committee met on a regular basis during the lifetime of this grant for the purpose of evaluating proposals from the members of the UCLA faculty; for setting the goals and priorities for the sustaining grant; and for making awards to the faculty for research programs that would best utilize the funds they had at their disposal.

When the space program began in the early sixties it was clear that no university was capable of generating and sustaining the necessary programs in space education and research without the support of outside funding. Fortunately, NASA recognized this too and during the last fourteen years it has encouraged space related research and education in those universities whose activities contribute most to the NASA mission. The Sustaining Grant program as we have mentioned, was unique at least to the University, and in many ways, allowed the space science committee the flexibility of directing research programs which would otherwise not have been possible. The most important aspect of this grant is the support of lunar research which was also appropriate to graduate student training. As a result, the Department of Planetary and Space Science, devoted entirely to graduate instruction in these disciplines, came into existence largely through the help of the NASA Grant.

Semiannually, since this program began we have reported on the various subgrants which were given by the committee so there is no need to go into detail on these research programs. I think that it is important to note that many of

the projects which began with seed money from the sustaining grant program have matured and indeed, have received substantial support from not only NASA but from other governmental agencies to continue on these areas of research. Illustrative of this is the work originally begun under the sustaining grant program, by Dr. Lawrence Aller, from the Deparmtent of Astronomy. In 1964 a 24" telescope was installed near Ojai, California under the NASA program. Since that time it has been largely supported by the National Science Foundation. Professor Paul Coleman received funding in the early years for the development of magnetometer experiments as well as developing methods for the analysis of the data provided by various space flights. Since that time Dr. Coleman and his associates have been involved on many NASA funded programs and are responsible for the development of the subsatellite used on Apollo 15. This Space Physics group is still the largest NASA supported program at UCLA and are active in the Mother/Daughter program as well as many of the Mariner flights.

In 1968, Professor J. W. Schopf was given a sub-grant from the sustaining program to equip a new laboratory for organic geochemical and micropaleological investigations of precambrian sediments. This new facility was of great importance to Dr. Schopf as he was a Principal Investigator on the first lunar contracts after the Apollo 11 mission. Dr. Schopf was a member of the original lunar scientific committee and his laboratory is certainly one of the finest of its kind.

Experimental plasma physics programs were begun in 1963, under the direction of Dr. Ken MacKenzie of the Physics Department. These programs have grown not only in their magnitude but in their importance in today's energy starved society. The original programs funded from the sustaining grant program are now being carried on at a much higher level of support by the Atomic Energy Commission.

One of the subgrants in this program was for the Analysis of Carbon Compounds in Carbonaceous Chondrites. Over the years nearly 50 researchers have been supported throughout this country for the studies of Carbonaceous Chondrites. In 1967 NASA made a specific grant to continue on the work on Carbonaceous Chondrites and many people supported under this program were later to become Principal Investigators under the lunar science programs. Drs. Cyril Ponnumperuma, formerly of Ames Research Center and now the University of Maryland, deserves a great deal of credit for the coordination of the Carbonaceous Chondrite Program.

The Crystal Growing Laboratory, under the direction of Dr. Hans Bommell has been supported almost since the inception by the sustaining grant program. At the present time, a group of faculty from the departments of Physics and Chemistry are making a proposal to the National Science Foundation for the establishment of a Materials Research Laboratory and early indications are that this program will be funded. This is an exciting outgrowth of the original Crystal Growing

Laboratory. In addition, the School of Engineering has a Department of Materials which has had a close association with the Crystal Growing Laboratory and receives a great deal of its funding from the National Science Foundation and the Department of Transportation.

In 1971, Dr. Libby and Dean Starr set out to develop an interdisciplinary program in Environmental Science and Engineering. At the present time, this doctoral program, now in its fifth year, has graduated 4 students and has an enrollment of nearly 50. A large part of the success of this new doctoral program can be attributed to the sustaining grant program which over the years, has facilitated the inner action of faculty from many disciplines and the beginning of joint research programs which have enabled us to look at several sides of a particular research program. Indeed, when we look at our Environment, we realize that no single discipline is represented and therefore, we must understand the inneractions of these disciplines upon each other if we are going to solve some of our environmental ills.

The NASA sustaining program has benefited many universities, not only in assisting the development of many new research programs, but also in the development of interaction between faculty and students.

There is no question in our minds that the sustaining grant program was of great assistance to the universities in

the development of research programs but also to NASA. It is important that the Congress understands that if we are to set goals, such as th_ space program, that this kind of support and this kind of program is essential to seeing that those goals are attained. Certainly, over the next several decades, energy and our environment are going to be two of our most pressing needs for research, and that, perhaps the solution to these programs we face might well be found if a similar program such as the NASA sustaining grant program were developed.

STATISTICAL INFORMATION REGARDING NASA GENERAL

		Approximate Number
A.	Number of Faculty Supported Under NASA General	127
B.	Number of Students Who Received Support	175
C.	Number of Disciplines and/or Departments Involved	15
D.	Number of Students Receiving Doctoral Degrees	25
E.	Number of Students Receiving Master's Degrees	37
F.	Number of Papers Resulting From NASA Support	312

RESEARCH PROGRAMS SUPPORTED UNDER NASA GENERAL

Aller, L., Fundamental Problems in Astronomy

Aller, L., 24 Inch Telescope for Planetary and Stellar Observations

Aller, L., Site Survey for a Large Telescope for Planetary and Stellar Studies

Aller, L. and Whitford, A., State-Wide Committee on Telescope for the Southern Hemisphere

Aller, L., Southern Hemisphere Site Survey

Aller, L., and Epps, H.W., Image Tube Project

Aller, L. and Riegel, K., Radio Astronomy

Aoki, M., Control of Systems Whose Characteristics Change Randomly at Random House

Balakrishnan, A.V., and Weber, C.O., Signal Design for Space Communication Channels

Barry, J.D., Coleman, P.J., Libby, W.F. and Marshall, L., Reflection by Free Radicals in the Earth's Ionosphere

Barry, J.D., Coleman, P.J., Libby, W.F. and Libby, L.M., Radio Frequency Reflection by Free Radicals in the Earth's Ionosphere

Bennion, D.N., High Energy Electrodes in Non-Aqueous Electrolytic Solutions

Bernhardt, A.F., and Libby, W.F., Intense Short Wavelength Light Sources

Berger, R., Organic Geochemistry

Berger, R., Isotopic Organic Chemistry

Bommel, H.E., Crystal Growing Laboratory

Bommel, H.E., Solid State Physics

Bommel, H.E. and W.F. Libby, Crystal Growing Laboratory

Bommel, H.E., Kennedy, G.C., Haygarth, J., and Libby, W.F., Crystal Growing Laboratory

Boolootian, R.A. and Caplan, R.I., The Effect of Rocket Exhausts Containing Certain Elements on Rocky Intertidal Marine Communities on San Nicholas Island

Bullock, T.H., Pattern Recognition of Sensory Signals in Animals

Bunshah, R.F., Physical Vapor Depositions of Alloys

Caputo, M., Investigations of Earth's Gravity Field and Hydrostatic Flattening

Carterrette, E.C., and Friedman, M.P., Quantitative Analysis of Judgement

Charwat, A.F., Surface Temperature Measurement on Sublimating Surfaces

Charwat, A.F., and Redekopp, L., Sublimation of Bodies with Finite Conductivity and Nonuniform Heat Input

Charwat, A., and Gazley, C., Fluid Mechanics and Diffusional Processes in Thin Liquis Films on Rotating Discs

Chu, C., Combustion of a Moving Liquid Droplet

Chu, C., Opposed-Jet Diffusion Flame as a Tool for Chemical Kinetics Studies

Cole, R.R., Material Shaping by Electrolysis at High Current Densities

Coleman, P.J., and Snare, R.C., Geomagnetic Observatory, Tungsten, Northwest Territories, Canada

Coleman, P.J., Jr., Fehr, R., and Ben-Ary, B., Rocket Project

Coleman, P.J., Jr., and Barry, J., Magnetically Shielded Test Facility

Coleman, P.J., Jr., Magnetohydrodynamics Project

Coleman, P.J., Jr., Magnetic Fields Laboratory

Coleman, P.J., Jr., and Simmons, L., Magnetically Shielded Test Facility

Coleman, P.J., Jr., Mariner Project

Coleman, P.J., and Fehr, U., Magnetohydrodynamics Project

Coleman, P.J., Gillespie, E.S., and Benjamin, C.R., Antenna Project

Collins, R., Diffraction of a Shock Wave at a Plane Interface in a Stratified Gas

Davis, R.C., Jensen, C.A., Wood, L., and W.F. Libby, Laser Studies

Denny, V.E., and Kastenberg, W.E., Transient Thermal Response in Chemically Radioactive Porous Media

Dong, S.B., Selna, L.G., Konishi, D., Tso, F., and Pokras, J., Dynamics of Laminated Anistropic Plate and Shell Structural Systems

El-Sayed, M., Chemistry and Spectroscopy Under High Field of the Giant Laser Beam

English, J., and Asimow, M., Feasibility Study of a Large Scale Educational System

Flamm, E.J., and Lingenfelter, R.E., The Effect of Radiation on Mutation Rates

Flamm, E.J., and R.E. Lingenfelter, Lunar Luminescence

Flamm, E.J., and Lingenfelter, R.E., Atmospheric Tritium

Flamm, E.J., and Lingenfelter, Solar Neutrons and the Earth's Radiation Belts

Flamm, E.J., and Lingenfelter, R., Neutron Production in Solar Flares

Flamm, E.J., and Lingenfelter, R., Production of Carbon 14 by Solar Protons

Flamm, E.J., and Lingenfelter, R.E., Neutron Leakage Flux from Solar Proton Interactions in the Atmosphere

Flamm, E.J., and Lingenfelter, R., Neutron and Proton Radiation Doses from Solar Flares

Flanigan, A., Two Aspects of the Influence of Dissolved Hydrogen on the Behavior of Iron and Steel

Forster, K., Linearization of the Three-Body Problem

Frankel, J.P., and Appel, M., Effects of Proton Bombardment on Materials for Shielding Against Solar Flares

Gazley, C., Transient Fluid Mechanics

Hawthorne, M.F., Electrochemical Studies Related to Synthetic Nitrogen Fixation

Haygarth, J.C., and Katzman, H., Diamond-Cementing

Hazi, A.U., and M.F. Fels, Disocciation of H_2 bu Electron Impact: Production of H^- and Metastable H Atoms

Helbing, R.K.B., Superthermal Beam Studies

Herrick, S., Methods of Orbit Determination and Integration: Current Work on Icarus and Jupiter's Satellites

Hershberger, W.D., Plasma Resonance in Solids and Microwave Studies of Semiconductors

Hurty, W.C. and Habib, J.N., General Instability of Structures

Hyder, C.L., Prominence Emission Line Polarization and Other Research in Astronomy

Jensen, C.A., Wood, L., and Libby, W.F., Superconductivity and Intense EUV Sources

Jensen, C., and Libby, W.F., Ultraviolet Investigation

Jensen, C., and Libby, W.F., Laser

Jensen, C.A., Wood, L.L., and Libby, W.F., High Power Plasma Generator

Kane, J., Motion of Mass Particles in the Solar System

Kaplan, I., and Brooks, R., Atomic Absorption Spectrometer I

Kaplan, I., Cycling of Elements in the Biosphere, Hydrosphere and Atmosphere and the Chemical Evolution of Life Evolution

Karplus, W.J., Digital Processing of Video Information from Satellite and Space Probes

Karplus, W.J., and Vidal, J., Quantization Errors in Hybrid Computation

Karplus, W., High Speed Transfluxor Analog Memory for Telemetry

Kasper, J.V., Chemical Laser Studies in Explosion Systems

Kaula, W.M., Dissipation of Tidal Energy

Kaula, W.M., Analysis of Earth Satellite Orbits

Klement, W., Jr., Metastable Structures in Miscellaneous Materials Rapidly Quenched from the Melt

Knapp, W.J., Development of Refractory Materials for Structural Applications

Knuth, E., Molecular Beam Laboratory

Knuth, E.L., Research in Molecular Relaxation Process at Low Temperature

Kopa, R., Air Pollution Research

Kopp, E.H., Coupled Waveguide Antennas

Krishnamurti, T., Tropical Meteorology

Lal, D., Isotopic Studies of Solar Wind Material

Lal, D., Libby, W.F., and Sethi, D.S., Chemical Analysis of the Solar Wind (Laundry Bag)

Leondes, C., Stear, E., Stubberud, A., and Wiberg, D., Guidance and Control Technique

Libby, W.F., L.L. Wood and J. Leventhal, Tritium Studies

Libby, W.F., and R.H. Ide, Radiochemical Studies

Libby, W.F. and L.L. Wood, Solar Radioactivity

Libby, W.F., Rare Gas Chemistry

Libby, W.F., Libby, L. Marshall and Wilson, R.G., Stimulation of Jupiter's Radio Emission of Io

Libby, W.F., Solar Wind Analysis

Libby, W.F., Wood, L.L. and Jensen, C.A., Solar Radioactivity

Libby, W.F., Wood, L.L. and Jensen, Stellar Radioactivity

Libby, W.F., Wood, L.L. and Jensen, C.A., High Power Plasma Generator

Libby, W.F., Environmental Science and Engineering

Libby, W.F., Analyses of Carbon Compounds in Carbonaceous Chondrites

Libby, W.F. and Sheridan, M., Space Fluids

Libby, W.F. and Aegerter, S., D-Electron Chemistry

Libby, W.F., Stratospheric Residence Time from Radioactive Fallout

Libby, W.F., Barry, J.D., Coleman, P.J., Libby, L.M., Radio Reflection by Free Radicals in the Earth's Ionosphere

Libby, W.F. and Seckback, J., Growth of Organisms Under High Concentration of CO_2

Libby, W.F., Appleman, D., and Aegerter, I., Growth of Organisms Under High Concentrations of CO_2 (Project Greenhouse)

Libby, W.F. and Corneil, P., Venus Project

Libby, W.F., Lal, D., and Aegerter, S., Studies of the Composition of the Solar Wind

Libby, W.F., Payton, P., Verba, J., and Arnold, J., Analysis of the Solar Wind Using Washing of the Lunar Fines

Lin, T.H., and Taylor, J.E., Ultimate Strength and Stress Field of Plates and Shells Under Lateral Pressure and Edge Compression

Liu, C., Low Density Gasdynamics and Moment Method in Rarefied Gasdynamics

Liu, C., Low Density Gasdynamics

MacKenzie, K.R., Experimental Plasma Physics Program

Mackey, R., Low Light Level Imaging Instrumentation

Mills, A., Heat Transfer During the Condensation of Liquid Metal Vapors

More, V., Special Reference to the Adverse Effects of Meteorological Manipulation: Devising Legal and Political Controls

Nath, A., Post-Auger Ionization Relaxation

Nath, A., Mossbauer Studies on Auger-Exchange in Cobalt Chelates

Neumann, J.P., Determination of the Knoop-Hardness of Refractory Metal Single Crystals

Nicol, F., Raman Spectroscopy of Calcium Carbonate at Very High Pressures

Nielson, R.G., Warwick, J.W. and Libby, W.F., A Fifth Source of Jupiter Decametric Radiation

Nobe, K., Fuel Cell and Corrosion Research

O'Brien, P.O., Shadow Factors of Large Sources and Shadow Casters in Space Environment

Ono, K., Irradiation Strengthening of Titanium and its Alloys

Ono, K., and Neumann, J., Effect of Point Defects and Ordering on the Mechanical Properties of Intermetallic Compounds

Orbach, R., Report on the Neutron Defraction Reactor

Prowse, D.J., Nuclear Emulsion Experiment Utilizing Flights of the X-15

Rao, C., and Z. Sekera, Measurements of Sky Brightness and Polarization During the Solar Eclipse of November 12, 1966

Reiss, H., Use of Statistical Thermodynamic Methodology in the Solution of Information Problems

Reiter, G.S., and Thomson, W.T., Stability of Multi-Bodied Satellites

Riegel, K.W., Hydrogen Line Observations of Galactic Radio Sources

Roberson, R.E., Technical Proposal, Study A.

Roberson, R.E. and Wittenburg, J., Studies in Spacecraft Dynamics - Satellite Stability Studies

Roberson, R.E., Studies on the Rotational Dynamics of Spacecraft

Roberson, R.E., Studies of the Dynamics of Non-Rigid Satellites

Roberts, S., Analytic and Experimental Study of Inelastic Axisymmetric Deformation and Stability of Spherical Shells

Robinson, L.B., Effects of Pressure on Magnetic Interaction

Robinson, L.B., Study of Methods for Calculating Frequency Between Electrons and Atoms

Rosenthal, D., Influence of Texture on Fatigue of Titanium and Titanium Alloys

Rott, N., and Liu, C.N., Fluid Mechanical Problems of Low Density Gas Flows

Rott, N., and Liu, C.N., Fluid Mechanical Properties of Low Density Flows

Rubenstein, M.F. and McKee, R., Filament-Matrix Structure

Schopf, J.W., Precambrian Paleobiology

Shafrir, U., Studies on the Motions of Qarticles

Shafrir, U., Hydrodynamics and Cosmic Dust Research

Stampfl, R.A., Communications Research Laboratory

Stear, E., Vidal, J., Moore, G., DiStefano, J., and Segundo, J., Biocybernetics:

Stern, R., An Investigation of Ultrasonic Propagation in Ferromagnetic Materials

Tao, T.F., Developments of Far Infrared Technology

Tao, T., Surface Wave Propagation Along a Bounded Quiescent Cesium Plasma Column

Tao, T., Surface Wave Propagation Along an Anistropic Column

Taylor, J., Analytical Methods for the Optimum Design of Structures

Thomson, W.T., Technical Proposal, Study B

Thomson, W.T., Study in Spacecraft Dynamics

Van Vorst, W.D., Capillary-Pressure as Function of Liquid Saturation in Porous Media

Van Vorst, W., Capillary Pressure on Magnetic Interactions in Metals

Venkateswaran, S., Synoptic Study of the Ionosphere During the Quie Sun Period

Viswanathan, C.R., Spin-Lattice Relation Time Measurement in Laser and Maser Materials

Viswanathan, C., Spin-Lattice Relaxation Time Measurement in Laser-Master Materials

Viterbi, A., and Carlyle, J., Research in Coding and Detection Theory with Application to Space Communication

Wasson, J.T., Neutron-Activation Studies of Meteorites and of Natural Gamma-or-Positron-Emitting Nuclides

Wasson, J.T., Atomic Absorption Spectrometer II

Wasson, J., Enhancement of the Computer Facility

Wazzan, A., The Pressure Dependence of the Magnetic Transition Temperature in Terbium

Wazzan, A.R., Heat Transfer of Gas-Particle Flow in a Supersonic Convergent-Divergent Nozzle

Wazzan, A.R., Single Crystal Elastic Constants of Gadolinium

Wazzan, A.R., Effect of Pressure Upon the Magnet Interactions of Metals

Wazzan, A.R., Mass Transfer Coefficient

Westmann, R., Constitutive Laws for Soil Mechanics

Wilson, R.G., Warwick, J.W., Dulk, G.A. and Libby, W.F., Europa and the Decametric Radiation from Jupiter

Wolf, J.A., Jr., Solid Structure Dynamics Interaction for Space Flight Support Structures

Wood, L., Aldridge, F., Davis, R.C., Jensen, C., and Libby, W.F., Plasma Studies

Wood, L., Davis, R., Jensen, C., Potter, F., and Libby, W.F., Intense Short Wavelength Light Sources

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