Meeting -- Thursday, May 8, 1969

Richard Gifford,
General Manager
General Electric Company
Communication Products Department

BIOGRAPHICAL SKETCH OF RICHARD P. GIFFORD

Richard P. Gifford has served as General Manager of General Electric's Communication Products Department at Lynchburg, Virginia since February 1963. He is responsible for all phases of development, manufacture and marketing of a variety of communication products, including mobile and personal radio, microwave relay and multiplex equipment. He was born in New York City in 1922. He joined General Electric in 1946 after graduation as a mathematics major at Harvard University in 1943 and three years Naval experience.

At General Electric, he assisted in the establishment of the first television relay from New York City to Schenectady; he was later involved in development and design work for two-way mobile radio equipment at Electronics Park, Syracuse. He then served in a succession of managerial assignments in product design engineering before appointment to his present position.

He is a Fellow of the Institute of Electrical and Electronics Engineers; in the IEEE Group for Vehicular Communication he served nine years on the Administrative Committee and was chairman 1960-62. In the Electronic Industries Association, he is a member and past chairman of the Industrial Electronics Panel.

Mr. Gifford is   Chairman of the Joint Technical Advisory sponsored by IEEE and EIA, and has been a member since 1962. He is Chairman of the JTAC Subcommittee on Electromagnetic Compatibility, and has served on the subcommittee for Space Communications. In June 1965, he was appointed to the Frequency Management Advisory

Council of the Office of the Director of Telecommunications Management. In 1966, he served as a member of the Telecommunications Science Panel called by the U. S. Department of Commerce.

Among Mr. Gifford's published articles are "Knee of the Nose", IEEE G-VC Transactions, June 1954; "Spectrum Pollution", IRE International Convention Record, Part 5, Vol. 10, 1962; "Radio Spectrum Management", Associated Public Safety Communication Officers Bulletin, October 1962; and recently he served as a member of the three-man JTAC Editorial Executive Committee which prepared and published the book, "Radio Spectrum Utilization", 1964.

5/23/66

✓ Fellow of the Institute of Electrical & Electronics Engin

✓ 22 years experience in Radio & Telecom

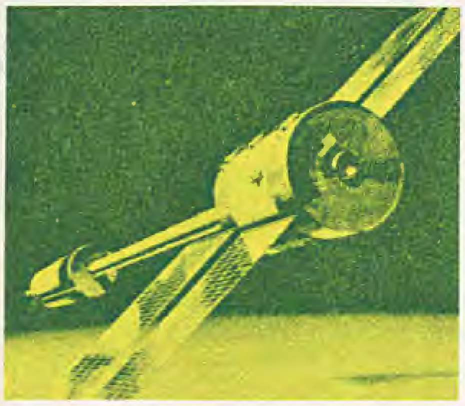
Member of ~~the~~ Joint Tech Adv Committee IEEE & EIA and of its Committee on Space Communication

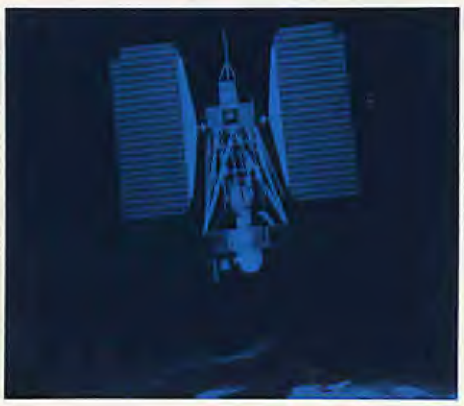
~~Chosen~~

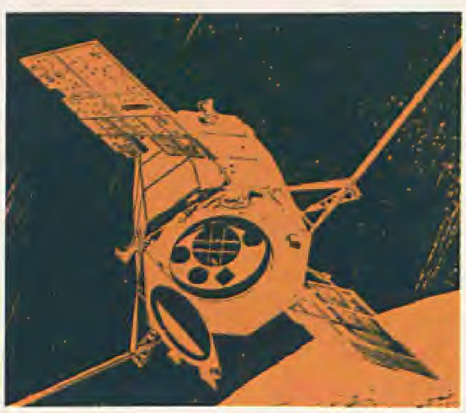
Now Chairman of JTAC

also chairman of the JTAC committee on Electromagnetic Compatability whose report he will now summarize.






Space Division

GENERAL ELECTRIC

"1960s Achievements prologue to the thrust of 1970s"

"The achievements of the first decade in space are prologue to the new thrust and direction of America's space program in the years ahead. The science, technology and proven hardware of the '60s will play an important role in the development of highly useful, earth-orbiting satellites for communications, meteorology, navigation, and earth-resources applications, all designed to fully utilize the unique qualities of space to help solve some of the earth's problems. Much greater and significant international cooperation and participation will help make these efforts a success world-wide. In addition, major emphasis will be placed in the 1970s on continuing significant levels of scientific and technological endeavors in space.

"Large manned space bases, involving space shuttles and space stations, may also become realities. Beyond the exploration of the Moon lie the challenges of the planets and deep space, where missions will be measured in terms of months and years. Unmanned interplanetary probes, ranging far into our solar system, will continue to pave the way for manned explorations. Some will be powered and propelled by nuclear energy, to make each voyage more efficient and effective.

"These are the technological challenges we face. Of equal, if not overriding importance, are the management challenges of the '70s: to convert from the explosive technological phase of the '60s into the more value-measured environment of the future, and begin the integration of space into the total economic fabric of the country. As true maturation is accomplished, space will take its competitive place in the world of commerce, and in the equation of supply and demand.

"GE's Space Division, one of the largest and most diversified space firms in industry today, is tackling these twin challenges of the '70s, technology and management.

"With its unmatched breadth of participation in America's space program since 1958, GE has developed new technologies and contributed to more than 50% of all satellites launched by the United States. The management of the GE Space Division has been active in the space program since its inception and is applying its program-proven experience to the new challenges of the 1970s."

"This report is designed to present a summary of GE contributions and experience in each of these mission areas. It establishes that GE is proficient over the full spectrum of space mission and systems: manned systems, science, lunar and applications programs, planetary systems, aerospace ground systems, technologies and management programs, here in the United States and overseas."

Mr. Fink was named to his current position June 1, 1969, after serving as General Manager-GE Space Systems Organization at Valley Forge for almost two years. In his previous position, he was responsible for a 6,000-man space research and development activity located at the GE Valley Forge Space Center.

Mr. Fink joined General Electric in 1967 after four years of distinguished service in the Department of Defense as Deputy Director of Defense Research and Engineering for Strategic and Space Systems, and earlier as Assistant Director for Defensive Systems.

He received DOD's highest award for civilians, the Distinguished Public Service Medal, from Robert S. McNamara for his contributions to the nation in strategic offensive and defensive weapon systems, the military space programs and major missile and space ranges.

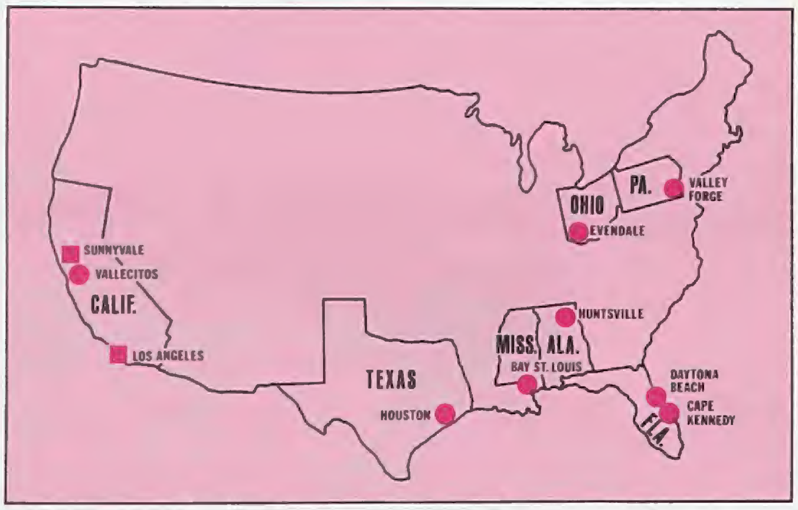
Mr. Fink has been an active participant in the aerospace industry for over 20 years in a wide variety of aircraft, missile, and space programs. He received both a Bachelor of Science Degree and a Master of Science Degree in Aeronautical Engineering from the Massachusetts Institute of Technology in 1948.

Daniel J. Fink
Vice President and
General Manager
Space Division

Contents

10,000 Employees at Ten Locations

General Electric's Space Division employs approximately 10,000 persons at ten locations throughout the United States. Of these, approximately 2900 are scientists and engineers representing a broad range of disciplines. Total floor space at these locations is over 3,000,000 square feet.



● R&D Centers
■ Field Installations

In operation since 1960, GE's Valley Forge Space Center, one of the largest and most complete space research, development, and test facilities in the world, serves as the headquarters of the Space Division.

Manned Programs

General Electric is a pioneer in the manned space programs of this country, beginning as one of the original contractors on the first Space Cabin study in 1958. An array of engineering studies over the next five years, dealing with the role of man in space, both military and scientific, coupled with two- and four-man orbital mission simulations, laid the foundation for OSS (Orbiting Space Station) studies. Neutral buoyancy experiments, which confirmed man's ability to perform complex tasks in a zero g environment, were also conducted prior to the award of a contract on the Air Force's Manned Orbiting Laboratory for experiment integration.

In the area of aerospace medicine, three phases of the IMBLMS Program (Integrated Medical and Behavioral Laboratory Measurement System) have been completed. The objective of this program is to provide a system for conducting experiments to determine and measure the effects of extended space missions on man. It is expected that this system will be flown on the first prolonged orbital space station missions.

GE also participated in manned programs as one of three Apollo Study contractors, and was later selected to provide reliability and quality assurance assessment and systems engineering support to NASA for all Apollo missions. Additional Apollo activities include spacecraft and launch vehicle checkout facilities systems developed in conjunction with NASA and built by GE, and captive firing and test of Saturn V boosters at NASA's Mississippi Test Facility performed with the direct support of GE personnel. In all, more than 6,000 GE employees have contributed to the success of the Apollo program.

This spectrum of contribution to manned programs, ranging from design studies to hardware and support activities, is unmatched in the industry. Under contract GE capabilities are now being applied to lunar exploration, the new generation of manned space stations that will serve as multi-purpose laboratories for physiological and biological measurements, and for science and applications missions.

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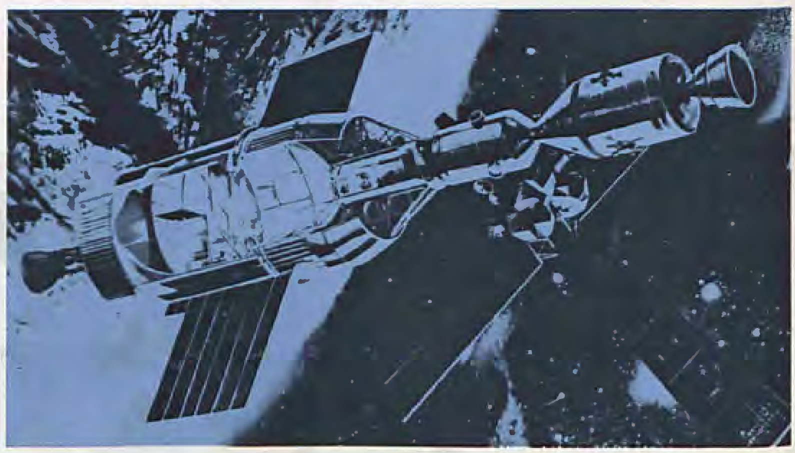

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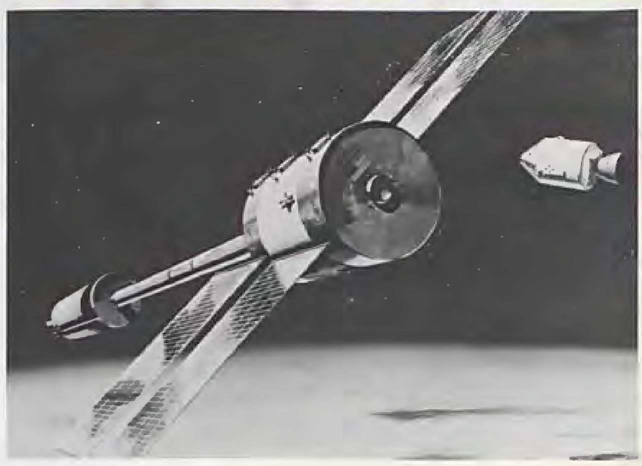

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A. As a major contributor to the success of the historic Apollo program, GE has been involved with this program since its inception.

B. Technologies developed on the Manned Orbiting Laboratory will be utilized for the Space Stations of the 1970s.

C. GE will supply electrical equipment for the telescope mount, as well as checkout equipment, for Saturn Workshop, to be launched in 1972 to study medical and scientific phenomena.

D. GE, teamed with North American Rockwell, is one of two teams conducting studies for a Space Station to serve as a laboratory in preparation for future manned exploration of planets.

E. IMBLMS will be used primarily to assess mission effects on the crew's physiological and behavioral status.

F. Reusable Space Shuttles of the future will lower cost of space travel and land on conventional jet runways.

G. Acceptence Checkout Equipment (ACE) is typical of the GE equipment furnished to check out Apollo launch vehicles.

H. Special two-man space cabin experiments were utilized to simulate and assess man's performance on space missions as early as 1963.

Applications Programs

GE has been a participant in a broad range of NASA applications programs since the late 1950s, including meteorological, communications, navigation, and earth resources. As the requirements for applications satellite missions developed, so did spacecraft hardware technology such as stabilization and control to meet the practical, long-life, earth-pointing needs of the new missions. This work resulted in space-qualified components for stabilization and control of Nimbus, and for current and future programs such as Earth Resources Technology Satellites, Broadcast Satellites, and Applications Technology Satellites.

Nimbus III, currently in active-life orbit, is achieving both qualitative and quantitative advances in weather data acquisition on a global scale. The first Nimbus satellite was launched in the Summer of 1964 and operated successfully for about one month. Nimbus II, during its 32 months of active life, established a world's long-life-in-space record for complex, earth-orbiting satellites.

Current utilization of GE applications satellite technology is focused on NASA's Earth Resources Technology Satellites and Applications Technology Satellites F&G.

The mission of Earth Resources Technology Satellites is to determine those data which can be best acquired from space and to develop the technological capabilities for acquiring and using such data in the fields of agriculture, forestry, geography, cartography, geology, hydrology and oceanography. GE is emphasizing sensor development and data management as the keys to success for operational earth resources missions.

The Applications Technology Satellite (ATS) Program is intended to advance the state of the art in long-life NASA applications-type satellites. For example, ATS F&G will include experiments for evaluation of space broadcasting in both Brazil and India as educational media. GE has a broad spectrum of contracts ranging from key components to user studies for specific broadcast services.

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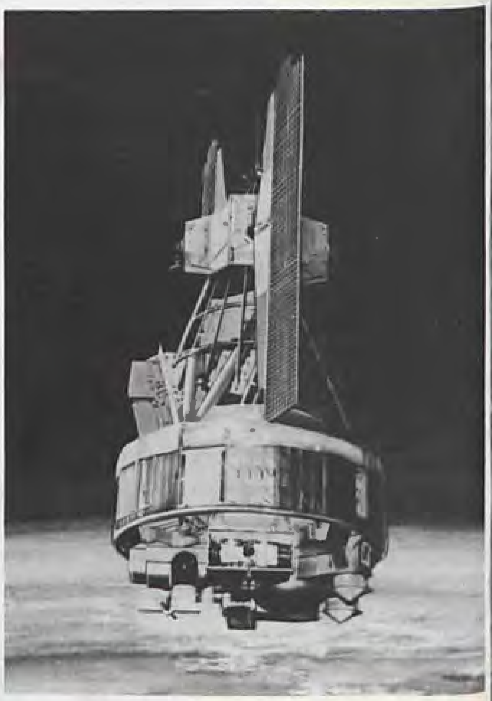

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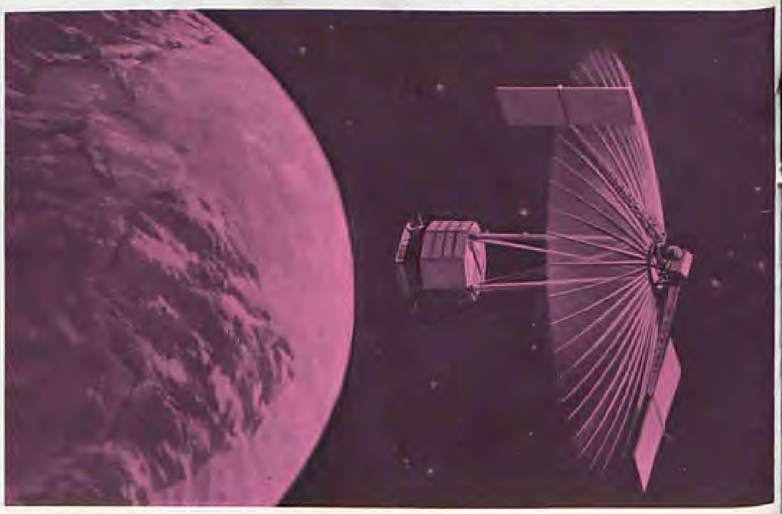

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A. NIMBUS III passed its mission requirements milestone on October 14, 1969, and is continuing to provide meteorological data on the world's weather and atmospheric conditions.

B. Hurricane Camille was identified early through photographs such as this, supplied by NIMBUS III in 1969.

C. ATS F&G will advance spacecraft technology through experiments in space communications, navigation, air traffic control, and meteorology.

D. GE is working with India and Brazil to bring the benefits of space via TV broadcast satellites to their populace.

E. ATS A, D, E carried a GE passive stabilization system using the earth's gravitational field as a restoring force.

F. GE is a phase B study contractor for Earth Resources Technology Satellites (ERTS) which are scheduled for launch in the early 1970s.

Science and Lunar Programs

Some of the more complex challenges of science and lunar programs are being met through the application of such diverse technologies as space power, stabilization and control, and new, precise electro-optical systems at GE.

SNAP-27 is a 63.5 watt, plutonium-fueled thermoelectric power generator developed for the AEC. It provides power for the Apollo Lunar Surface Experiment Package (ALSEP), which was left on the Moon by Apollo 12 astronauts. It is now operating continuously in temperature extremes ranging from — 280 degrees F to + 170 degrees F, and is designed to supply electrical power to the lunar experiments for over a year.

The stabilization and control system of the NASA Orbiting Astronomical Observatory (OAO) is an extremely accurate celestially-oriented attitude control system having the capability of pointing astronomical telescopes at any position in space. Accuracies of one-tenth of one second of an arc, can be achieved with this system. OAO II, which completed one year in space on December 7, 1969, is proving a bonanza to the scientific community by providing a volume of astronomical data several times that originally envisioned for the mission.

A lightweight optical system, called Sisyphus, is under development and will be used to determine location and velocity of meteoroids and asteroids for the planning of future interplanetary missions. The Sisyphus detection system uses three independent, identical optical subsystems with overlapping fields of view to sense the reflected or scattered solar radiation from an interplanetary particle. It is being developed for the Pioneer F&G mission through the asteroid belt to Jupiter.

Other present research, supported by many advanced facilities, embraces a broad spectrum of scientific and engineering disciplines: environmental phenomena and interactions; plasma physics; atmospheric chemistry, which is being applied in the monitoring of the atmosphere for carbon monoxide by satellite; meteor and planetary physics; materials and structures; and space processing programs in which biologicals, e.g., vaccines could be produced in bacteria-free, zero-g environment of space.

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A. GE's Orbiting Astronomical Observatory (OAO) stabilization and control system accuracy is equivalent to zeroing in on a person's eye at 500 feet and holding for one hour.

B. OAO photographs such as this one are taken under ideal conditions above the earth's atmosphere, without distortion.

C. GE's SNAP-27, left on the moon by Apollo 12 astronauts, is supplying day and night nuclear power for lunar experiments.

D. This lunar-based Sisyphus, a lightweight optical system, will be used to determine size and velocity of impacting material, and enable better hazard evaluation for long-term lunar activity.

Planetary Programs

Studies and hardware dealing with unmanned exploration of the solar system play an important part in GE's space activities. A new generation of larger, more complex spacecraft, technically more sophisticated than any previously flown, will be required to fulfill the missions of the '70s. GE experience in reliability planning is being brought to bear on the development of such long-life spacecraft that must operate completely unattended without maintenance and repair.

Extensive technical and managerial experience has resulted in optimization of mission and spacecraft configuration redundancy, quarantine technology, spacecraft nuclear systems integration, data management systems and spacecraft design flexibility. During the '60s, GE applied more than one and a half million engineering man-hours to studies which have focused primarily on Mars, Venus and Jupiter.

GE is now providing attitude and scan control systems for Mariner '71, the first Mars orbiter, whose mission will be to measure and observe atmosphere and environment over a several month period. Significant support is expected to continue into the Viking program, which will consist of a Mars orbiter and lander, whose mission will involve measurement of environmental conditions of both the Martian atmosphere and surface. The lander will also probe for evidences of life. Additional potential applications include the Venus/Mercury flyby.

Other planetary work includes the TOPS Power Conditioner for providing 90% efficient, power conditioning electronics for the 12-year grand tour of the outer planets. General requirements are being reduced to specifications, with breadboard circuits and performance demonstration to follow.

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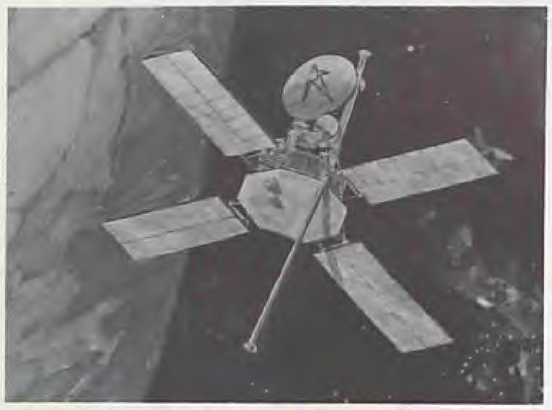

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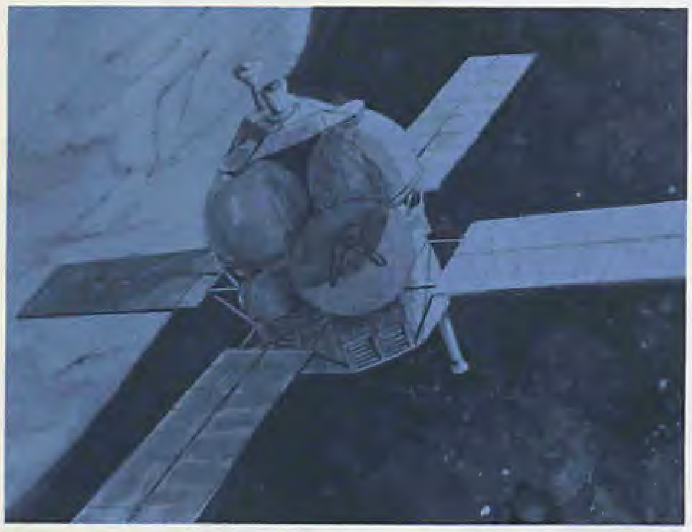

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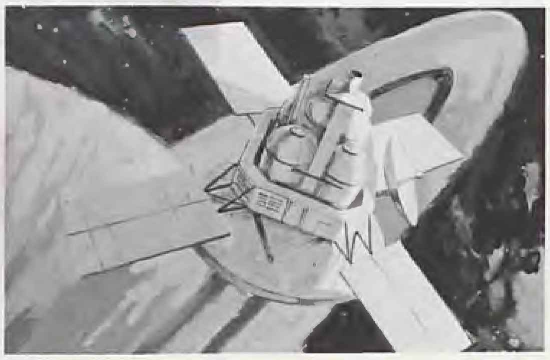

E. In 1973, a Mariner spacecraft may set out for Mercury using the gravity of Venus to help speed it on its way.

F. Mariner '71 will present the first opportunity to closely examine Mars over a period of several months. GE is contracted to develop the spacecraft's attitude control system.

G. GE is studying both the nuclear capability and power subsystem for a Thermoelectric Outer Planet Spacecraft (TOPS).

H. Viking missions will increase our knowledge of Mars in several scientific areas, particular emphasis is on learning about the life that may be there.

Ground Programs

Drawing on its experience in designing electronic equipment, GE has developed and produced a variety of space ground systems, including large-scale, real-time, computer-controlled, information-processsing systems for automatic or semiautomatic checkout of manned spacecraft. For example, equipment was designed and built to monitor and checkout the two million different parts and systems of the Saturn-Apollo space vehicle. Other ground systems include automated propellant loading control systems for the Saturn launch vehicles.

Television coverage of Apollo spacecraft splashdown was also supplied by the Transportable Satellite Telecommunications terminal (TRANSATEL), which made it possible for millions of people throughout the world to see the recovery of U.S. astronauts from Apollo missions, live and in color.

Data systems and software products are provided by GE's Command and Information Systems team as a capability that covers the total space mission, from manufacturing and training, to launch site and in orbit.

GE has also designed and built a Nuclear Power Plant Simulator, which is used to train operators for boiling-water reactor plants. This system duplicates in function and appearance a typical nuclear power plant control room and utilizes digital computer techniques and math modeling to simulate all systems external to the control room.

The newest development, designated as Computer Integrated Test Equipment (CITE), is a computer-operated system for automatic checkout of large space or electronic systems. Building on the technology developed for the pre-launch checkout of Apollo spacecraft, CITE represents the next generation of sophisticated ground systems.

GE-developed ground systems are providing a continuity of leadership from Apollo to the Safeguard Program.

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A. Building on the GE Apollo pre-launch checkout equipment, CITE will perform more tasks with fewer people in a shorter time.

B. Transatel's portability makes it possible to transmit color TV, via satellite, from almost anywhere in the world.

C. Static firing of the Apollo boosters is conducted at NASA's Mississippi Test Facility, with GE support, prior to their arrival at Cape Kennedy.

D. Launch operations at Cape Kennedy are the culmination of intense monitoring and checkout programs with GE equipment to insure flight readiness on all Apollo missions.

E. Aerospace technologies are being applied by GE to this nation's defense programs in areas such as Safeguard.

F. Simulator for training operators of nuclear electric power generator plants was designed utilizing Apollo checkout technologies.

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G. GE is currently managing the renovation of this large Air Force compressor facility at Wright-Patterson.

H. Typical of the application of GE's space management expertise to socio-economic programs is its VISTA activity, where it has operated a VISTA training program in Texas.

I. GE management teams are under contract to help solve the problems of the damage-ridden cities and towns humbled by Hurricane Camille.

J. The operation and maintenance of NASA's sprawling 25-square mile Mississippi Test Facility requires a wide variety of GE's management services from engineering to property control.

K. The Iowa Power and Light Company's automation equipment capabilities program is another example of how GE management applies its specialized capabilities outside the space industry.

Management Programs

Management and technical services for government and business are an integral part of GE space activities. Current work at NASA's Mississippi Test Facility at Bay St. Louis, has evolved from successful performance at similar government facilities, such as the Hanford Atomic Power Operation in Hanford, Washington; the Idaho Test Station at Idaho Falls; and the Malta Test Station, Malta, New York.

Typical services include program management, technical facilities development and operation, control and measurement functions; associated contract and subcontract administration, document management, program visibility and reporting, data management, and other related services. These capabilities are being applied to aerospace, oceanography, socio-economic programs, institutional projects, municipal systems, transportation, utilities, and business and industrial management.

GE has been awarded five contracts by Mississippi Gulf Coast municipalities, to provide coordinating, planning, and technical services on proposed improvements, including public facilities, which suffered major damage during Hurricane Camille in 1969.

As an example of a technical facility challenge, GE is under contract to the Air Force for the development, design, installation, and checkout of state-of-the-art equipment to modernize a major research facility at Wright-Patterson Air Force Base near Dayton, Ohio.

It is also under contract to operate the antenna range at Pasadena, California for the Jet Propulsion Laboratory.

GE has also designed and developed special electronic data acquisition equipment, and provided data reduction services for the Barbados Oceanographic and Meteorological Experiment (BOMEX).

Aerospace management techniques are being applied in the non-space field for the Iowa Power and Light Company of Des Moines, Iowa, which GE is assisting in the development of a work management system required to maintain control and provide status of the field force activities.

Technology Programs

The major goal in helping assure the success of future missions is the early determination of enabling technologies, i.e., those that are the most essential or constraining in the accomplishment of tomorrow's missions.

Against the backdrop of reliability and long life in space, GE has been emphasizing the technologies of electric power, attitude control, advanced sensors, life support and data management. Data management at GE is now also emerging as perhaps the key technology, as work goes forward from ground-based orbital software programs toward the massive, operational data requirements of Earth Resources Technology Satellites.

A development demonstration model of a 30-watt per pound roll-up solar array has been built and tested. In the field of electro-optics an infrared vidicon camera is under development for thermal imaging with high resolution and rapid recovery from high-intensity radiation.

The GE-designed-and-built stabilization and control system for Nimbus satellites has performed flawlessly in keeping these satellites stable and pointing directly to the Earth to within plus or minus one degree.

Major contributions to the utilization of man in space are being made in four key areas of Life Systems: Biosciences, life support engineering, aerospace medicine, and human engineering.

For repairs in space GE is developing ARMS (Application of Remote Manipulators in Space) a system which consists of a master station with a human operator, either on Earth or in an orbiting space station; a slave which is in orbit, and a tender which is also in orbit.

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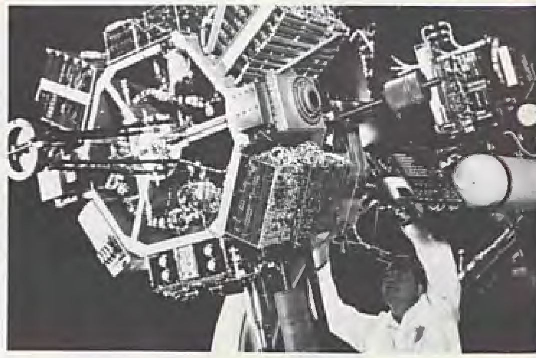

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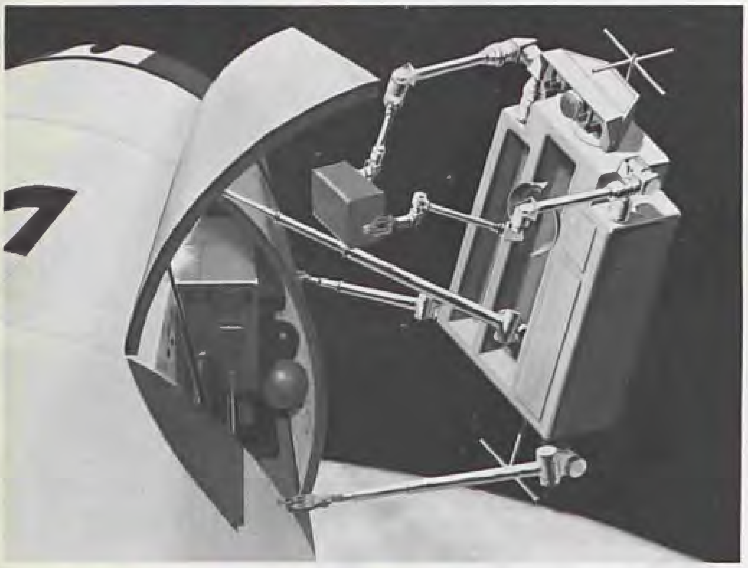

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A. Very accurate stabilization and control systems developed by GE have performed successfully on Nimbus and OAO.

B. Advanced solar array is being developed by GE for NASA with a 30 watt/pound design goal.

C. This unique, low level, optical pulse receiver optimized for the 1.065 micron neodymium laser wave length represents two orders of magnitude improvement over nongain silicon photodiodes.

D. Life Systems experimentation is being conducted through controlled buoyancy to learn more about man's capabilities in space.

E. A new technique for predicting performance of low-speed ball bearings for use in space is typical of the bearing technology activity at GE. This program helps produce smoother running, low-noise bearings with high reliability.

F. ARMS, a space manipulator, is under development by GE to perform remotely controlled repair functions in space.

G. GE is developing an infrared vidicon camera for thermal imaging with a high resolution and rapid recovery from high intensity radiation.

H. This mobile laser radar air pollution probe was developed by GE to remotely detect the accumulation and motion of air pollutants.

Specialized Facilities

Some of the most advanced space-environment simulation and test facilities in the world are to be found in the GE Space Division. The goal of these unique facilities is to assure long-life reliability of space vehicles and mission success. Testing starts at the component level with a dime-sized chip, works up to sub-systems, and culminates in the totality of the space vehicle.

At the Valley Forge Space Center a variety of equipment, ranging from 2-foot bell jars to massive 39-foot diameter and 54-foot high vacuum chambers, is used for terrestrial testing of spacecraft parts and systems before exposure to the hostile environment of outer space. Complex, long-life vehicles face conditions in duplicated space environments ranging from booster vibration to the cold, black vacuum of space they will later encounter.

The Space Sciences Laboratory's laser radar facility near Valley Forge will enable tracking and ranging on satellites for precision geodetic measurement.

One of the simulation systems in Apollo System's Simulation Laboratory is Computed Perspective Image Generation. This is a technique employing computer-generated color TV-like pictures to simulate operations ranging from space applications such as spacecraft docking and landings, to driver training for students on the highway and skippers of supertankers on the high seas.

Looking forward to the inevitable nuclear powered space systems of the future, GE maintains significant nuclear research and development facilities. The Vallecitos Nuclear Center, the country's largest, privately-owned nuclear research laboratory, includes four reactor facilities, four megacurie hot cells, an extensive radio chemistry laboratory, a 25,000 curie Cobalt-60 source, reactor-spent fuel storage pools, and earth-covered storage bunkers. Additional items include non-destructive testing capabilities, microsphere production capabilities, and a complete radioactive materials laboratory. At Evendale, Ohio, the nuclear facility accommodates high-temperature alkali-metal Rankine cycle space power development, processing and fabrication of nuclear fuel elements, and high temperature materials technology activities. Conventional as well as toxic, radioactive and pyrophoric materials can be processed and worked.

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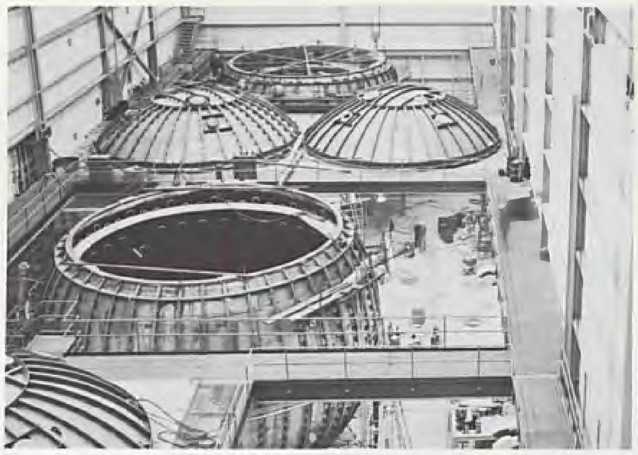

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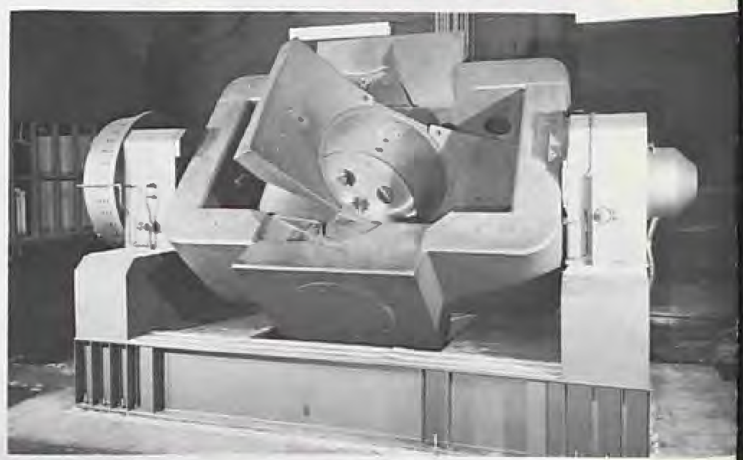

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A. Testing for long-life of a spacecraft in cold, black space begins in the 39-foot vacuum chambers at the GE Space Center.

B. The 54-foot by 32-foot solar chamber simulates "sun" in a thermal vacuum chamber. Intensity ranges from 120-140 watts per square foot of solar radiation.

C. A three-axis simulator at the GE Space Center, capable of supporting loads up to 2000 pounds, helps ensure spacecraft control systems' satisfactory performance in outer space.

D. Controlled buoyancy facility provides gravitational conditions similar to those of space missions, to enhance man's ability to work in this unique environment.

E. The 14 x 14 x 17 foot anechoic enclosure provides the simulated RF space environment for the conduct of spacecraft system RF compatibility test.

F. Nuclear powered systems under development at GE may hold the key to the future of deep space exploration.

G. Simulation laboratories make it possible to isolate and correct potential problems, before they occur, in critical areas like spacecraft dockings.

H. GE's completely integrated engineering, manufacturing, quality control and test service is capable of producing hybrid film circuits and assemblies and combining these assemblies into functional black-box components.

I. The football-field size highbay area located at the GE Space Center is one of the largest "class 100,000" clean rooms in the world today.

J. Basic space research and development programs at the GE Space Sciences Laboratory have been conducted since 1956.

International Operations

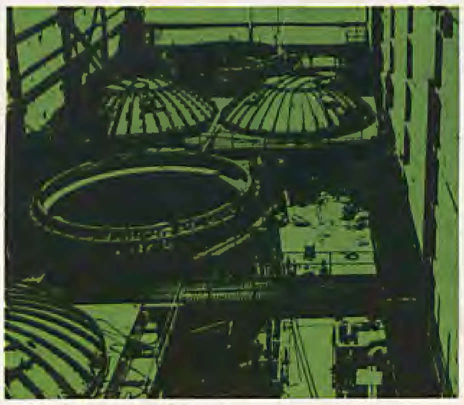
Space Division, involved in virtually every space mission in the U.S. space program, is also an active participant in international space programs. This worldwide space involvement includes Brazil, France, Germany, India, Japan, the Netherlands, and the United Kingdom.

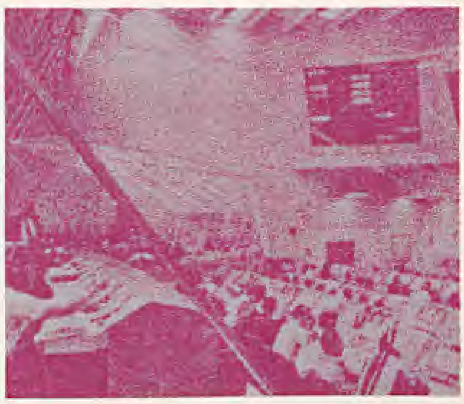
The role of the Space Division overseas is very broad since it has active programs with governments as well as industrial firms and supranational space organizations. Thus, GE not only has arrangements for the reciprocal exchange of space technology in developed countries, but it is in a strong position to assist developing countries in the application of space technology to their national requirement, e. g., direct broadcast systems for educational purposes.

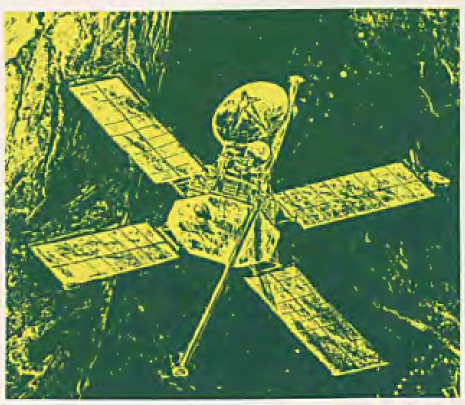
In addition to its active participation overseas, GE is a leader in fostering international understanding of the utilization of space through such organizations as EUROSPACE and the International Astronautical Federation.

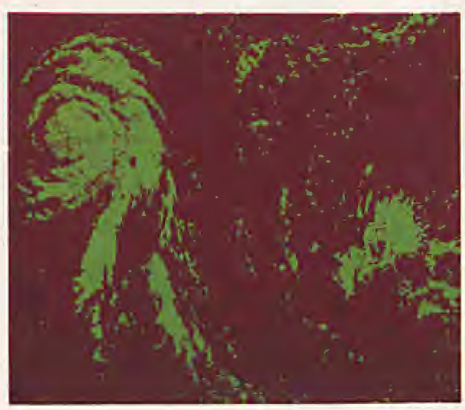
International cooperation in space will grow very rapidly in the next decade. As a leading contributor to the U.S. space program, GE supports the concept, consistent with U.S. policy, that technological developments of domestic space efforts are fully utilized throughout the world for the common good of all mankind.

Space Division









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GENERAL ELECTRIC

PIB-A-52

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* "WHAT WE HAVE HERE IS A FAILURE TO *
* C O M M U N I C A T E" *
* BY: R.P. Gifford *
* * * * * * * * * * * * * * * * * * * *

The title of this paper has been borrowed from the key line in a recent allegorical movie called "Cool Hand Luke". The problem in communications being referred to at the time was the failure of Luke to conform to a plethora of rules and regulations at a prison farm. In Luke's case the problem in communications was rectified - they thought - by simply adding more of the same - more rules, more confinement, more chains.

But this is not going to be a paper on prison farms, our penal system or the conflict of the individual with an organized establishment - popular as those subjects seem to be today.

The problem that I am referring to has somewhat broader horizons - the total breadth, depth and development of human society.

"WHAT WE HAVE HERE IS A FAILURE TO COMMUNICATE"

And now - in some 4,000 words - let me explain.

First of all, let me establish a better image of what I mean by the breadth, depth and development of human society - or just you and I will have a "failure to communicate".

I choose to look upon man as a biological entity - an animal - fitting into the order of nature yet endowed by God with unique talents that in some mysterious way are to serve His ultimate and infinite purpose.

Like most other animals, man is instinctively motivated to survive. He is a social animal in that he seeks and finds security in group or family relationships.

But unlike other animals, man is uniquely endowed

- with a talent to create tools that amplify his physical and mental energies,

- and with a soul that can be motivated beyond the limits of natural biological instinct.

It is the impact of these two special attributes that give us upward development - the history of man. That history is a step by step narrative of the consequences of the interplay of man's inventiveness and man's complex motivations - ranging from serving God to serving self.

Our modern era is the product and consequence of all the tools that have been invented plus the motivations that led to the inventions - all followed by new motivations in turn created by the tools invented. Tools and motivation, in mixture are the fuel for the history of man.

When studying the history of man in these terms, it is helpful and particularly germane to this paper, to consider some basic divisions within the category of tools. The most basic division would be:

- tools of production - tools that increase man's capacity to feed, clothe and shelter the community of man,

- tools of transportation - tools that increase man's capacity to bind together the community of man through physical exchange,

- tools of communication - tools that increase man's capacity to bind together the community of man through mental exchange.

Now, just for a moment, reflect with me - close your eyes and consider the impact on history as man developed tools of production, transportation or communications. Consider first, tools of production such as:

fire
stone shaping
pottery
weaving
metal forming

the lever
the wheel
alchemy - leading to explosives

conversion of stored energy such as that in:

wood
oil
gas
flowing water or
the atom itself,

into almost any form of motion or light.

Consider the impact on history as man developed tools of transportation such as:

rafts
oar-propelled ships
horses, camels, elephants
carts, carriages
balloons
trains
automobiles
air planes
rockets

and finally consider the impact on history as man developed tools of communication such as:

oral language
written language
mathematical language
painting, art, architecture
signal fires
the printing press
semaphore
telegraph
telephone
radio
television

Each of these - and many, many, more have progressively expanded the capability of man to build things, move things and exchange information and ideas. In the last two hundred years, the rate of expansion of that capability has been explosive.

But the most interesting facet of that explosion - starting perhaps with the printing press - is the intricate interrelationship of the advances in all three categories of tooling.

- consider how the printing press played its role in enabling educators, government officials, churches, merchants and financial institutions to reach people never reached before.

- consider the impact of such readily available, visable publicity in creating new markets for goods and services.

- consider then the role of broader market opportunities on the development of new forms for transportation and more efficient modes of fabrication, to respond to increased demand.

- and then, to close the loop, consider how those new means of transportation and production brought new requirements for better communications - for education, for dissemination of up-to-date information, for safety in travel.

Just these brief examples are sufficient, I believe, to make the point that history of man is in fact the record of the consequential impact and the complex interrelationships of the products of man's inventiveness in the hands of individuals motivated by metaphysical forces that go beyond mere instinct for self or familial survival, love and protection.

Man literally has now at his command "tools" and energy that can propel him into still greater horizons or that can rub out all of the consequence or history of his being. I am reminded here of the closing scene of "On the Beach" - it was a view of a city in Australia - a modern city that at the end of the era of Man becomes nothing, because there is no living soul to enjoy, accept or reject, love or despise that mass of steel, concrete, glass and blowing rubbish. We then can see the city for what it always has been - just a tool of man for his glorification and satisfaction, ~~and~~ Without man, it is nothing.

Frankly, gentlemen at this point, I seem to find myself in the pulpit. While the title of this paper would most certainly be a convenient lead here into a sermonette on the timely importance of communications with our Creator and our brothers, that was not the original motivation for this paper.

"WHAT WE HAVE HERE IS A FAILURE TO COMMUNICATE"

In commenting on this subject, I am choosing to consider the impact of the physical forces of communication (vs tools of production or transportation) on our modern world rather than the metaphysical forces - though, by no means, do I feel one to be independently more significant than the other. My election to discuss the physical challenges in communications is dictated by the realities of my training and experience rather than any lack of motivation of the spirit. Perhaps a friend in the profession of metaphysical communication may someday provide the alter-finale to this venture.

So far we have traced the history of man in terms of the interrelationship of products of his inventiveness and his motivations. We have seen that our modern era is the complex product of new tools of production, transportation, and communication being used in varying degrees for various purposes. And we have noted that the sum total of man's inventiveness is now adequate to exterminate himself or to extend further his horizons. But what we have not noted is that there are many ways in which either choice may be achieved. Extermination is not synonomous with the atomic bomb - consider the problems of the largest cities - air pollution, water pollution, garbage, breakdown of life support systems, breakdown of law and order.

And extension of man's horizons may not be the product solely of space travel - consider oceanography, making inhabitable the previously uninhabitable, new means to contact the remotest peoples of the good earth, progress in medicine, food production, etc.

On one hand, man's inventiveness in tooling for production and transportation, stimulated by an apparent zest for efficiency but with underlying motivations of self-interest, is leading to social, economic and physical disaster. On the other hand, this same inventiveness channeled in other directions by those constantly seeking to part the curtains of current knowledge with an underlying motivation reflection a sense of stewardship for mankind, is keeping alive a spark of hope for mankind, is keeping alive a spark of hope for the destiny of man.

Man now finds his creative talents for efficiency in production and transportation to be virtually self-defeating. It is from this observation and premise that I suggest:

"WHAT WE HAVE HERE IS A FAILURE TO COMMUNICATE"

On the surface such a statement may seem to be quite unreasonable - particularly as we see all around us a fantastic explosion in capability to communicate from Mars, the Moon, around the world, etc. The opportunities are there in almost any imaginable dimension but I suggest we are failing to harness these tools into partnership with toold for production and transportation. Man's creative power could be directed to increase the effectiveness of his outreach to his fellow man and could ultimately develop bonds for community living just as effective as an evening with your neighbors. More effective and more available communications would certainly take the edge off narrow self-interest. History is full of illustrations where just the existence of impenetrable walls of silence between peoples has led to misunderstanding, jealousies, avarice and ultimately, meaningless conflict.

To achieve the kind of communications world I have in mind, there first must be common language. Then come books, magazines, papers. And finally come telephones and television - all untimately refined and coordinated into a sort of tele-presence. All the pieces to do the total communication job from the start to the foreseeable future are already on hand or in the laboratories. Our priorities, however, are elsewhere; we are failing to understand the opportunity, or, I should say, the absolute need to communicate if man is not to become the victim of his inventiveness.

For us in the United States, the suggestion that we are failing to use tools of communications might sound almost blasphemous. We certainly are blessed with the most extensive and best run telephone system in the world. We have more variety of video programming into more homes than anywhere in the world. We have more books published and more records pressed per capita. We have more art prints and photographs per capita - save perhaps the Japanese. One could hardly accuse us of ignoring opportunities to communicate.

But let's also realize that we lead the world in energy input per capita or in ton-miles of transportation per capita. Our inventiveness in each of these fields has been a handmaiden to progress in the others. Our progress in utilization of communications may seem adequate to our needs in relation to the rest of the world; but is it adequate for the survival of man? Do we need to reexamine our priorities? Do we need to reexamine those forces that tend to support one category of tooling over the others?

One of the more interesting studies that one could make about the economic development of this country would be the relative private and public support of efforts to create and install tools for production, transportation and communication. Without attempting to be quantitiative, there are some rather obvious observations one could make.

<u>Tools of production</u> have experienced relatively little public support. Private initiative and private enterprise have been the prime movers. And there always has been plenty of "fuel" - personal desire and ambition, motivations of self-interest have let no idea lay idle long. Tools of production produce material results clothes, cars, homes, pools - the accountrements of what we have come short sightedly to call the good life.

<u>Tools of transportation</u> have experienced a mixture of public and private support. To the extent they have offered an attractive opportunity for a return on investment that have been developed by private interests. There was never any problem in finding backers to transport coal, oil, or lumber - nor was there any need for public money in developing the automobile - a sort of personalized magic carpet by which we mark our status. But where transportation has been needed to provide a basic convenience for the movement of people to and from work or for transporting supplies and assistance of general public needs, it has been heavily subsidized by public funds. Consider our subsidy of:

roads
canals
airlines (initially in the interest of mail)
airports
passenger trains
commuting trains

These subsidies, coupled with other natural, economic forces in the development of transportation, have contributed their share of the urban crises. We have let our "ability to transport" accelerate once again the urban consequence of the industrial revolution. In the absence of other alternatives, we continue to presume that overall efficiency at work is improved by close physical interface with suppliers, banks, stores, restaurants and entertainment and that the excellence of such facilities is proportional to their size and that their size is in turn, proportional to the people working per square foot within a one mile radius. And so it is, an efficiency minded people ends up moving almost two tons of steel 40 miles round trip per capita and then bartering for the right to park the two tons of steel nearby. One of the best illustrations of the corner into which man's inventiveness has driven him is the fact that in 1900 one could go crosstown in New York City in a one horse carriage at about 9 miles per hour; today, with 300 horses on the rein, he can make the same trip at the same 9 miles per hour! And only in the past five years have we come to hear the semi-serious question:

"Shall we walk - or do we have time to take a cab?"

<u>Tools of communication</u> are almost entirely the product of private initiative. Only in their most basic form, oral and written language - or education, are "tools" of communication subsidized. Actually, the more advanced inventions are effectively discouraged by excessive regulatory practices. It's hard to attract capital for ventures in communications at 7% return on investment when there are far more lucrative opportunities in

tools for production or even transportation where the risk is reduced through a pattern of subsidy should financial failure be imminent in what is then found to be a public need. We should also note that basic personal motivations for accelerated development of tools of communications are secondary to those stimulating tools of production. Our social world does not yet value the intangible and fleeting experience of communications as high as the tangible luxuries.

About this time, people with whom I have discussed this subject, take on a gaze of wonderment, asking "Good grief - are you, a decentralist, proposing subsidies for communications or even perhaps government takeover?" At that point what had seemed to be an intellectual objective discussion becomes a missionary challenge - a missionary challenge to straighten Gifford out, he's gone too far!

Tonight I hold an advantage, for the procedure has been to grant the speaker freedom from dialogue for about the first 40 minutes. Maybe, if you will promise not to get "hung-up" on such an assumption regarding my political mental health, I can be very specific as to what conclusions I do draw - and which solutions I would avoid.

It is very important to realize the power of public subsidy of the development and installation of tools. One has only to consider the role of war in providing subsidies for tools of production - albeit in this case for efficiency in destruction. Similar results occur even when the subsidies are not as massive and may extend over considerable time. Our road system costing billions per year continues to provide the auto makers in Detroit with reason to build more cars, appeal to wider ranges of variety, push for two or even three cars per family - to load up that space built for their cars. We don't get across town any faster - but we do it fancier.

Yet, one cannot deny that much public benefit has been derived from sibsidy of canals, railroads and highways. Some might even claim that our fantastic thrust in transportation in the 19th century contains the key to our industrial leadership in the world today.

The modern tools of communication have not enjoyed any such special backing and have even been discouraged by national policy. Up to a few years ago, we have virtually ignored the role of communications as a tool for social progress for the common good. In their earliest days, new communication tools represented attractive opportunities for investment and the foresighted genius of a few men put together what is today the world's greatest telephone network. But today, we force tight regulation on the system thereby discouraging entry of entrepreneural capital to open up new system possibilities.

Consider this most recent example of a road block to progress in communication:

> Technology is available today to bring 20 channels of video information into the home with better definition and color than the best off-the-air reception. And the cost per home - to be paid either by the suscriber, the advertiser or the programmer would amount to about $5 per month per home - about one tankful of gas or a pack of cigarettes per day. Some channels would undoubtedly carry our present cultural level of advertised programs but others could carry a wide variety of evening adult education courses or bring the meetings of city council, school boards, or other activities of civic concern to our homes as we may wish.

Only a small segment of the public may at first avail themselves of such cultural or educational or civic opportunities, but for them consider the saving of time, avoidance of dangers and reduction in car expense by having their interests piped into the home. But, even more important, note that these bonds with culture can extend over wide areas. Once a cable is in, it costs no more to carry 20 channels than one. The rural retreat can be in touch with <u>all</u> types of worlds from highest culture to mediocre soap operas.

If cable TV is so great, then why isn't private industry installing it at once? There are many reasons - all related to regulation. The FCC is concerned lest this new mode compete unfairly with broadcast TV. They are also concerned lest the telephone companies extend their power by offering to install such systems and provide for some of the programming. The FCC dreams of setting up competition for AT & T by letting local firms - entrepreneurs - set up the cable <u>with</u> permission also to do programming, but only so long as nothing is done that will hurt the broadcasters! A communication tool that could have fantastic impact on our mode of living awaits a Government solution that would protect the status quo. Unfortunately, we don't seem to realize that change - innovation - must, almost by definition, lead to upheavals in existing systems and economic structures and the status quo.

Let's take a look at another example of communication roadblocks - something right here at home. For business reasons - namely, to attract and hold the best technical talent available - we have long sought some means to make post graduate work leading to a Doctorate in Engineering available to our technical staff. Courses for such a program are available only on a commuting basis to Blacksburg or Charlottesville - a dangerous, tiring and expensive solution (60-80 miles one way). Recently through discussions with officials and professors at VPI, we found that credit could be given on courses conducted on a <u>two-way</u> TV hook-up. This technique has been experimented with most successfully in at least two other states - and, I'm sorry to say, in behalf of our competitors. VPI is to be congratulated for wanting to forge ahead as one of the leaders in this new technique for expanding the geographic coverage of great universities. Based on VPI's response, we made arrangements with the C & P Telephone Company to lease the transmission facilities to do this job for about 8 hours of courses per week. At the start, we were willing to subsidize this program in the interest of research to the extent of assuming full time rental of the facility for the first year. But, since such a circuit is not covered by public common carrier tariffs, we found that we would also be obligated to pick up the tab for any unliquidated costs should we not want the facility next year.

Now, I am sure, and I assume the C & P Telephone Co. also has adequate faith in the future of this state to be sure, that time on such a facility would soon be needed by the Community College or Lynchburg College or Randolph Macon or other major industries in town seeking to establish a two-way classroom pipeline with the extensive variety of services and skills available at VPI. But since we would not be permitted to sub-lease time on the circuit, our confidence in assuming a risk investment is quickly erased. And the Telephone Company has to weigh such a risk investment vs the required investments they must make to meet growing public common carrier demands. So long as the Telephone Company is constrained on the percent return on its investments to figures only slightly better than those available in banking, it can give little but moral support to the riskier opportunities.

If we had the time, I could fill the whole evening with such examples of "discouragements" to seeing the innovations available in communications come into reality. There's a whole fantastic new world available via communications, if someone will say "go".

But why should we be concerned? Why do I observe: "WHAT WE HAVE HERE IS A FAILURE TO COMMUNICATE"? Should our political system tamper with the natural flow of development and implementation of tools of production and transportation and communication? Should we seek Governmental policy influence on certain tools vs others? Can we appreciate what might be the consequences of such tampering on the motivations of man?

If we had come to where we are today without any subsidy or tampering in behalf of any tools of production or transportation or communication, then such questions would merit serious debate. But the facts of history for the last 100 years make such an alternative academic. On a Government policy basis, we have already significantly influenced the role of tools of transportation and communication on the development of our modern day socio-economic and geo-economic systems. In the case of transportation, the influence has generally been positive - a stimulant to progress; in the case of communications, the influence has generally been relatively negative - a deterrant to potential progress.

The most serious consequence of this tampering has been what I choose to call the second urbanization wave in the industrial revolution. Constant stimulated progress in transportation and the theoretical efficiency of bigness have now brought us to the era of super cities - fantastic centers of everything in business, industry, merchandising, culture, entertainment, recreation. Those cities which can attract the largest population within an hour's travel can afford the biggest museums, the biggest universities, the biggest and most varied entertainment. Such cities become regenerative - by size they attract those seeking the biggest and the best in their own fields of interests; and as more people arrive, investors in the city are ready to provide still more facilities. As a consequence, cities attract people and then engorge themselves on their desires.

Cities also become most complex social systems. Living close in space and timing; living with views limited to the concrete and steel on the other side of the street; living entirely dependent on life support systems to be provided by others - these conditions mold people either into cold isolated conformity adjusted to the system or into violent, frustrated aimless rebellion, as though they feel trapped in the concrete canyons. It's darn hard to relate with your fellow man or with God when you can't see the sky, grass or trees (or even the horizon) or when you can't take a meditative walk down a back woods path or when you can't camp with your buddies in the backyard and wake up with dew in your hair.

Consider this contrast right here in the United States among people at approximately equal income levels. Last August, I attended a 4H Rodeo in Livingston , Montana. Inside there were the exhibits and contests in bakegoods, flower arrangements, vegetable growing, woodwork, jams, and even matchbook collecting. Outside there was a rodeo for and sponsored by teenagers - calf roping, heifer bulldogging, team roping, etc. And all over there were teenagers, plus older and younger sisters and brothers, and parents and neighbors and friends. Like all teenagers, they were going all the time at full speed. But in Livingston that night, the teenage storehouse of energy was expended on showing off their exhibits - or their buddys' - or talking with their cowboy heroes. It was pandemonium - but pandemonium not needing the sheriff. If he had been there, he would probably have been another center of attention - for out there he's still a hero.

On that same evening in August there were riots in progress in two cities - a different type of 4H activity where all the H's are unfit to print. There the spirit was to destroy, not enjoy - for what was there to enjoy? And there were sheriff's to control the pandemonium but they were hardly looked up to as heroes.

That very sensation of contrast struck me as I sat in the stands at the rodeo. Here under one political, economic system among peoples of approximately equal earnings there were two entirely different August evenings to be experienced. One in the city, breeding a bitter, narrow-minded almost inhuman society; the other in a small town breeding a friendly open-minded familial society. Oddly enough, it seemed as though those who live further from their neighbors were "in heart" closer. Try a trip to Montana sometime - with a 20 mile distant horizon for every view and a big sky overhead, it's downright challenging to think small, bitter or narrow-minded.

As one flies over this country, he cannot help but be impressed with the vast open spaces beneath. Why then do we insist on crowding into cities? 70% of our population inhabits only 2% of our land area. And one could observe that over 70% of our domestic problems are those arising from the impossibilities of urban living.

I contend that the real challenge of the last third of the 20th century is not in solving the existing disasters of our cities but in doing as much or more in seeing that we do not create any more such cities. We need to find ways to stimulate industrial development - that is, job opportunities - with fine living in relatively rural areas. Here is where tools of communications need to be released from their bonds.

Let's take an example. Let's suppose we have accepted deurbanization as a national goal. What would it take to attract industry into Southwest Virginia? Certainly it would take energy sources - power companies stand ready to do that job, the return on their investment would be quite sure. It will take people resources - many are already there wondering what big city their children will go to as farming now requires less labor; and the housewife now has more free time as a consequence of electric power and appliances. But how will a Southwest Virginia community attract the professionals - the engineers, the managers, the accountants necessary to operate a plant competing with others drawing on the trained and educated brain power available in the big city? These people want an educational environment, a cultural environment; they want schooling capable of challenging the most gifted as well as the slow learner; and they seek choices in buying and variety in entertainment and recreation. How can the resources for these needs and desires spring up overnight?

New tools of communication such as cable television - plus existing tools of transportation - hold a possible answer.

With cable television as a basic resource in the community it should be possible to:

- provide graduate courses in various fields from a variety of universities.

- strengthen local school and college curricula with special video tie-ins with other school and colleges; in other words, share specialties via video,
- provide a wide variety of current cultural entertainment from opera to debating,
- to shop by sight in the stores of the big"city" with overnight delivery,
- to hold a family video conference back home once a week,
- to access the most advanced computing facilities or most extensive data files,
- to "thumb through" a book at a distant library and order copies of pages needed.

In other words, coaxial cable into the homes plus coaxial cable and wave guide interconnecting facilities could effectively "transport" one into universities, libraries, stores, operahouses, auditoriums or one's family home without having to live right in the middle of them all. And if we someday find stereo, and three dimensional color and even smell essential to the suitability of such facilities, those features can and certainly will be added.

But will such services pay for themselves? To that I must reply with a question: "On what economic base will you measure whether they pay for themselves?" If one would measure the result in terms of the ability of such a community to support itself against its competitors, I think so.

I doubt if one could prove that highways pay for themselves. Oh yes, we pay for them in taxes; but do they pay us back in terms of some socio-economic advantages that are commensurate with those taxes? I don't know - but overall the system is working towards an improving economy.

We may have to adopt a similar attitude re public support of "highways" of communication.* The "highways" might still be provided by private interests but concessions on rates of depreciation that would affect the charges would have to be permitted to attract the necessary investment capital. Those rate increments would be the equivalent of the public interest taxes for concrete highways.

An up-to-date example of this type of thinking can be found in Canada. There are tremendous natural resources in the northwest where no "civilized" man would choose to live. In the interest of the general long term economic growth of Canada, development of those resources need to be encouraged. One of the tools they expect to use is a communication satellite to provide ultimately at least a dozen two-way video highways between those remote communities and current centers of cultures and commerce. They feel such a video bond is a minimal requirement for attracting professionals into such frontier territory.

HERE THEN IS THE SUM OF MY THESIS:

The history of man is the interplay of his inventiveness in tools for production, transportation and communication and his motivations.

In our modern history in the U. S. we have used governmental power relatively to encourage tools of transportation and discourage tools of communications.

*To bring this analogy close to home, consider that all the secondary and collegiate institutions of Virginia could be interconnected with two-way video highway for a cost about equal to 11 miles of modern superhighway. It doesn't take much imagination to determine which investment would have the greatest impact on the future destiny of our state.

One of the consequences of our economic system, supported by our talent for tools of production and our subsidy of tools of transportation has been a second wave of urbanization in the industrial revolution.

This second wave of urbanization is leading to social and physical disaster through catastrophic emergencies of increased crime, riots, air pollution and water pollution.

We cannot build a land for life, liberty, and the pursuite of happiness on such a base.

A national goal of deurbanization appears in order; towards this end tools of communications must not only be unleashed, but, in effect, publicly supported.

And finally - a warning. As noted earlier, tools provide only half the motive power for the history of man. His destiny is equally the product of his development of motivations beyond animal instinct. Ultimately man must live for brother man as our Father has asked of us. Expansion of tools of communication would appear to offer great opportunities for building the brotherhood of man. But it is <u>what</u> you and I communicate that will lead to success or failure - we would have an effective opportunity to be missionaries from our own homes. Or will what we have there, again, be a failure to communicate?

RPG
January 15, 1969

APPOINTMENT CALENDAR

JUNE/JULY/1970

SPACE NUCLEAR POWER — KEY TO LONG MISSIONS IN THE '70s

Dan Huebner, General Manager
Nuclear Systems Programs
Space Systems

"With 20 years of extensive nuclear experience, General Electric is uniquely qualified to participate in the major aspects of nuclear power systems for applications in space in the 1970s . . . onboard power for advanced satellites . . . power for manned and unmanned spacecraft journeying to distant planets."

"These two decades of nuclear experience are being applied in the areas of radioisotope power devices and systems, dynamic energy conversion components and systems, in-core thermionic reactor power plants, fast liquid metal cooled reactors, and development and integration of nuclear spacecraft power systems."

"Building on the highly successful operation of the AEC's SNAP-27, produced by GE and deployed by Apollo 12 astronauts as the first nuclear power on the moon, we are designing a Multi-Hundred Watt (MHW) radioisotope thermal electric generator for the AEC, for application on both manned and unmanned space missions. RTG's are currently planned for use on advanced ALSEP, TRANSIT, Viking, Pioneer, Lunar Roving Vehicle, and the Grand Tour spacecraft. A 12-year equipment life for the Grand Tour mission typifies the advance requirements to be imposed on the MHW RTG by future planetary missions."

"The need for multikilowatts of power in the 1970s and 1980s for space stations and space base and large planetary spacecraft will be served by nuclear heat sources and power conversion systems using Rankine Cycle, Brayton Cycle, or Thermionic principles. GE, with the sponsorship of NASA and the AEC, has considerable development underway on each of these space power systems at its Vallecitos, California, and Evendale, Ohio, locations."

"GE's Valley Forge Space Center has developed SNAP-27 and conducted studies of the interaction of nuclear power plants with both manned and unmanned spacecraft throughout the 1960s."

"GE's many years of proven developmental capabilities in providing nuclear power systems ranging from watts to megawatts is already at work meeting the challenges of the future."

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SAT.	SUN.
JUNE 1 FISCAL WEEK 23	2	3	4	5	6	7
8 F W 24	9	10	11	12	13	14
15 F W 25	16	17	18	19	20	21
22 F W 26	23	24	25	26	27	28
29 F W 27	30	JULY 1	2	3	4	5
6 F W 28	7	8	9	10	11	12
13 F W 29	14	15	16	17	18	19
20 F W 30	21	22	23	24	25	26
27 F W 31	28	29	30	31		

AUGUST NOTES

SPACE DIVISION

1970

JANUARY

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11	12	13	14	15	16	17
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FEBRUARY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MARCH

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APRIL

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

JUNE

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JULY

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUGUST

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

SEPTEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCTOBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOVEMBER

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DECEMBER

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

GENERAL ELECTRIC

VALLEY FORGE SPACE CENTER
BOX 8555, PHILADELPHIA, PA.

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