With one of the most useful research tools in the entire aero-space industry—The Hypersonic Shock Tunnel—Grumman engineers have been able to duplicate space vehicle performance. Air flows of Mach numbers from 6 to over 20, at the energies encountered by re-entering satellites or space vehicles, are achieved for brief but extremely useful periods of time.

Air flow to which experimental aerodynamic bodies are subjected is created by producing a reservoir of very high pressure, high temperature air at the end of a 130' long shock tube, and then expanding this air through a hypersonic nozzle. The flow duration is of the order of 2 to 4 milliseconds. The energy in the flow (which may approach that existing at the stagnation point of a vehicle traveling at Mach 50) is sufficient to cause dissociation and ionization of the air as it passes over the model in the downstream test section.

Experiments planned for the Hypersonic Shock Tunnel facility include: Investigation of various phenomena of conducting fluid flows and their interaction with electromagnetic fields (magneto-hydrodynamics); measurement of pressure distributions and heat transfer rates on various hypersonic aerodynamic shapes; and, utilizing the shock tube section, studies of an extensive range of gas dynamics problems and theories.

Grumman Research is active in expanding many spheres of man's knowledge. We invite your inquiry if your interest lies in fluid mechanics research or any of the following areas:

**MAGNETO-HYDRODYNAMICS, PLASMA PHYSICS.**

Theoretical and experimental research on such problems as hydromagnetic shocks, electromagnetic interaction, with hypersonic flows, and plasma generation, acceleration and stability.

**PHYSICAL CHEMISTRY-MATERIALS R & D.**

Research and advanced development in high temperature reactions, coatings, powder metallurgy, refractory composite structures, ceramics, fatigue and fracture.

**MATH-PHYSICS-ELECTRONICS-COMPUTING R & D.**

Basic research and development in areas such as: airborne and special purpose computing systems, combined analog-digital computation, simulation, programming, mathematical and numerical techniques.

**SOLID STATE, NUCLEAR, GENERAL PHYSICS.**

Theoretical and experimental research in broad areas of field theory, energy conversion, nuclear physics, acoustics, electromagnetic radiation (particularly, but not limited to, microwave and millimeter waves).

Send your resumé to Mr. W. Brown, Dept. GR-91, to arrange for a mutually convenient interview.

**GRUMMAN AIRCRAFT ENGINEERING CORPORATION**

Bethpage, Long Island, N. Y.
"Project Echo" satellite went into a near-perfect circular orbit 1000 miles high, circling the earth once every two hours. Its orbital path covered all parts of the U.S.

"Project Echo" foreshadows the day when numerous man-made satellites might be in orbit all around the earth, acting as 24-hour-a-day relay stations for TV programs and phone calls between all nations.

This experiment shows how Bell Laboratories, as part of the Bell System, is working to advance space communication. Just as we pioneered in world-wide telephone service by radio and cable, so we are pioneering now in using outer space to improve communications on earth. It's part of our job, and we are a long way toward the goal.

**Bell Telephone Laboratories Bounces Voice Off Sphere Placed in Orbit a Thousand Miles Above the Earth**

Think of watching a royal wedding in Europe by live TV, or telephoning to Singapore or Calcutta—by way of outer-space satellites! A mere dream a few years ago, this idea is now a giant step closer to reality.

Bell Telephone Laboratories recently took the step by successfully bouncing a phone call between its Holmdel, N. J., test site and the Jet Propulsion Laboratory of the National Aeronautics and Space Administration (NASA) in Goldstone, California. The reflector was a 100-foot sphere of aluminized plastic orbiting the earth 1000 miles up.

**Dramatic application of telephone science**

Sponsored by NASA, this dramatic experiment—known as "Project Echo"—relied heavily on telephone science for its fulfillment...

- The Delta rocket which carried the satellite into space was steered into a precise orbit by the Bell Laboratories Command Guidance System. This is the same system which recently guided the remarkable Tiros I weather satellite into its near-perfect circular orbit.

- To pick up the signals, a special horn-reflector antenna was used. Previously perfected by Bell Laboratories for microwave radio relay, it is virtually immune to common radio “noise” interference. The amplifier—also a Laboratories development—was a traveling wave “maser” with very low noise susceptibility. The signals were still further protected from noise by a special FM receiving technique invented at Bell Laboratories.
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2. The "Challenge to Science" evening with Sir Charles P. Snow, Theodore M. Hesburgh, and W. O. Baker; Warren Weaver, presiding.

3. On "AAAS Day," the three broad, interdisciplinary symposia—Plasma: Fourth State of Matter; Life under Extreme Conditions; and Urban Renewal and Development, arranged by AAAS Sections jointly.

4. The Special Sessions: AAAS Presidential Address and Reception; Joint Address of Sigma Xi and Phi Beta Kappa by Polykarp Kusch; the Tau Beta Pi Address; National Geographic Society Illustrated Lecture; and the first George Satton Memorial Address by René Dubos.

5. The programs of all 18 AAAS Sections (specialized symposia and contributed papers).


8. The four-session program of the Conference on Scientific Communication: The Sciences in Communist China, cosponsored by the AAAS, NSF, and ten societies.


10. The sessions of the AAAS Cooperative Committee on the Teaching of Science and Mathematics, and of the AAAS Committee on Science in the Promotion of Human Welfare.

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