Space TECHNICAL INFORMATION DIGEST

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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IN THIS ISSUE

	Page
※ HIGH-ACCURACY SUN SENSOR DEVELOPED	1
※ MAN-MADE NAVIGATION SYSTEMS AND THEIR ANIMAL COUNTERPARTS	2
※ NEW TELEMETRY RECEIVING SYSTEM ANNOUNCED	3
※ MALFUNCTIONS HIT GEMINI LANDING SYSTEM	5
※ PHYSICAL FITNESS DURING LONG SPACE FLIGHTS	5
※ MICROSCOPIC TV PICTURES FOR FINDING CONTAMINANTS	6
※ VACUUM CHAMBER FEATURES 60 OPTIONS	7
※ TECHNICAL REPORTS AVAILABLE	8

HIGH-ACCURACY SUN SENSOR DEVELOPED. A Sun sensor has been demonstrated that is "at least 10 times more accurate than the present standard," according to its developers at Space Technology Laboratories. The sensor is claimed to have an absolute accuracy greater than 2.4×10^{-5} rad (5 arc sec), and a field of view ±0.09 rad (±5 deg). Development of the sensor proceeded as part of the Orbiting Solar Observatory mission (NASA); further applications are seen for stellar or planetary guidance in similar devices.

The device has a simple pinhole lens that focuses the Sun on a null detector. Input radiation, modulated at the pinhole, provides detector signals that may be ac-amplified. Two prisms

in front of the pinhole can be situated to provide angular offsets anywhere within the field of view relative to the sensor's center axis. Sunlight passing through the prism is deflected by an amount proportional to the prisms' positions. Then, as the light passes through the pinhole, it is "chopped" by a vibrating reed to give an electrical output in terms of the Sun's image displacement. This information is used to control spacecraft jets and reaction wheels. (Source: Data supplied by Space Technology Laboratories)

MAN-MADE NAVIGATION SYSTEMS AND THEIR ANIMAL COUNTERPARTS. Man-made navigation systems employ systems similar to their animal counterparts. For example, infrared detection and tracking is similar to the "guidance system" used by pit vipers, and sonar for underwater tracking is analogous to the method used by porpoises in underwater travel. A comparison of animal navigation methods with some that have already been applied by man presents several new possibilities for future man-made systems.

One method that was borrowed from animals--the pit viper's detection system--is widely used in infrared-seeking missiles. Systems for echo-detection are used in many ways by both man-made devices and animals. Sonar and depth sounding are perhaps the most familiar man-made uses of underwater sound echoes. Many analogous systems are used by such creatures as bats and porpoises; underwater experiments with the latter have shown a very highly developed echo-location sense.

Electric eels have degenerate and useless eyes, perhaps caused by the dark, dirty waters of their usual habitat; until 1951 their sense of navigation was unknown. Then, through the research of Dr. H. W. Lissman of Cambridge, it was found that these eels generate electric pulses, from 1 to 20 per sec, as they move through water. This primitive underwater radar gives the electric eels their "guidance system." There is presently no known man-made underwater guidance device of this type.

Celestial navigation has been used by man for centuries; most recently, it has been applied to space vehicle guidance. This type of navigation is now believed to be used by migrating birds for the determination of their proper flight paths. E. G. F. Sauer,

at the University of Freiburg, has studied the behavior of warblers that were caged and placed in a planetarium. The birds showed no directional preference when the dome was illuminated with diffuse light; however, when the dome was illuminated with a star pattern that matched the night sky over their migration route, the birds faced the correct direction.

Inertial navigation by man "began in 1908 with the first marine gyro compass." However, this type of navigation is of great antiquity in the order of diptera (e.g. the West African horse fly). In all winged members of this order, the hind pair of wings has club-shaped appendages, or halteres, that form part of their flight stabilization system. A rapid vertical vibration of the halteres at their natural resonant frequency provides an inertial reference for the reflex nervous system of the fly. (Source: Discovery, February 1963)

NEW TELEMETRY RECEIVING SYSTEM ANNOUNCED.

A new predetection, diversity-combining telemetry system (Fig. 1) has been announced by Vitro Electronics, a Division of Vitro Corporation of America. This system is designed to combine two 5-Mc i.f. signals from two telemetry receivers of the same type.

The i.f. center frequency of the combiner output is 750 kc and can be fed directly to an existing wideband tape recording machine. Other center frequencies can be supplied. The combiner has a bandwidth of 1.2 Mc and can handle most telemetry signals.

The predetection diversity combiner shows an improvement of signal-to-noise ratio of 3 db when used as a dual channel combiner and equal signal-to-noise ratio in each channel when compared with single channel reception. In addition to this signal-to-noise ratio improvement, there exists an improvement of threshold of 2 db to 3 db when compared with postdetection combining techniques.

The combiner can be used simultaneously with a suitable postdetection diversity combiner in the same system, using the same receivers, for direct readout. (Source: Data supplied by Vitro Corporation of America)

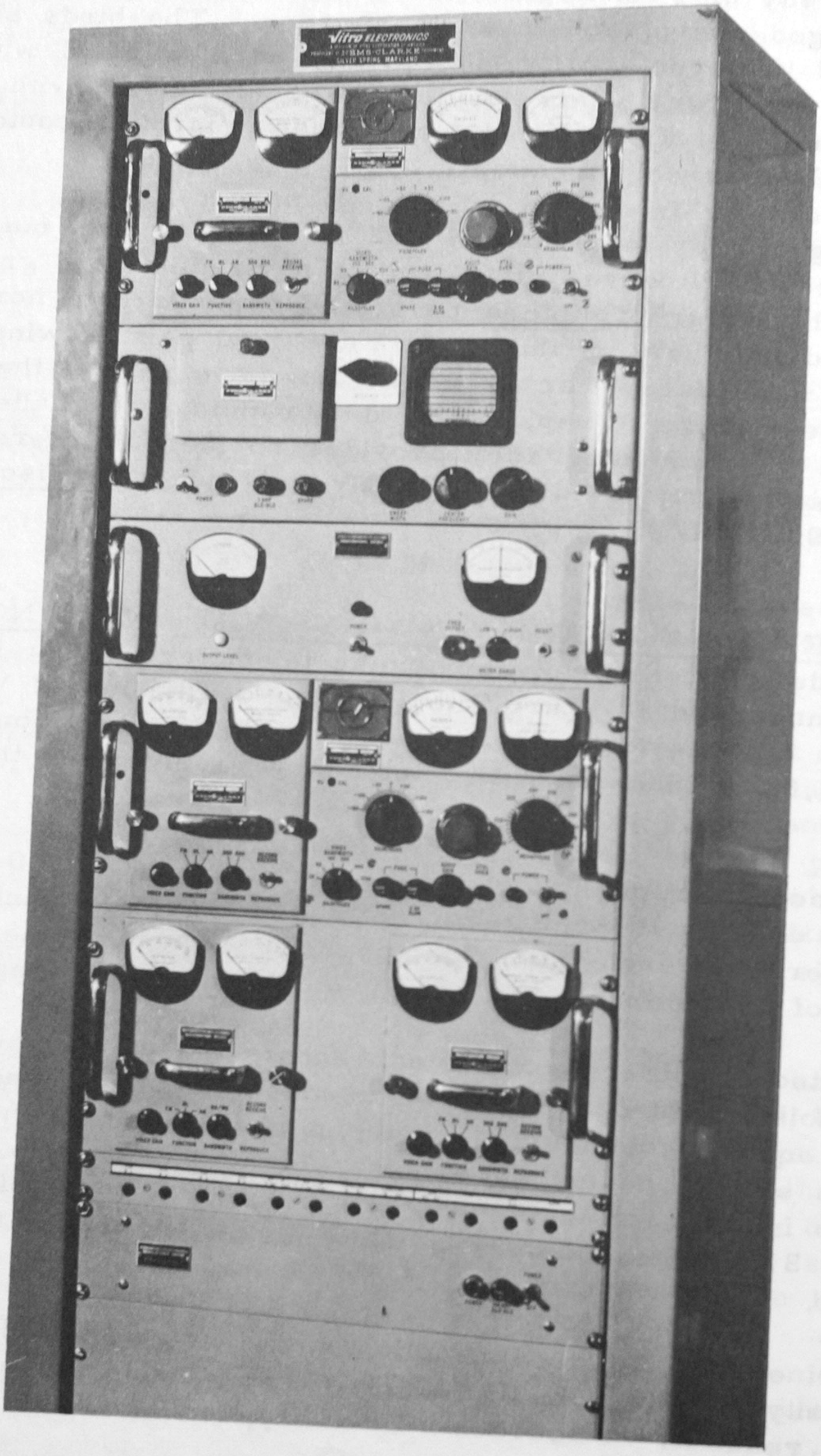
Vitro ELECTRONICS
A DIVISION OF VITRO CORPORATION OF AMERICA
FORMERLY ELECTRONIC COMMUNICATIONS, INC.
SILVER SPRING, MARYLAND

FIG. 1

MALFUNCTIONS HIT GEMINI LANDING SYSTEM. Recent malfunctions in the paraglide landing system for the Gemini spacecraft have NASA project chiefs considering parachute recoveries (Project Mercury water landing technique) as a back-up.

The paraglide project will not be dropped, however, according to Col. Daniel McKee, project chief for Gemini at NASA headquarters, since it is hoped that the complications can be worked out. Parachutes will be used if necessary to avoid further delays, but only until the paraglide project is a success. Gemini has already slipped its original flight schedule three or four months.

When one test vehicle was dropped from an airplane, it tumbled and descended too quickly, causing excessive dynamic pressure to rip the paraglide. Another vehicle was badly damaged when mechanical difficulties caused a cable to deploy improperly.

Paraglide has the features of both a parachute and glider wing and resembles a folded paper airplane. It consists of a triangular piece of reinforced cloth 40 ft in length from apex to base. When deployed during reentry, it is inflated for structural strength by means of air bottles. Cables connecting the paraglide to the top and bottom of the spacecraft, and a control mechanism, allow the pilot to actually fly the craft to a landing on a conventional runway. (Source: The Washington Star, January 27, 1963)

PHYSICAL FITNESS DURING LONG SPACE FLIGHTS. A recent issue of New Scientist contains an article by Prof. Erich Müller in which he compares the effects of prolonged weightlessness with an experimental study of a "patient" who was sent to bed for a fortnight. The "patient" in the study was not allowed voluntary movements, but was completely cared for during his stay in bed. At the end of this period, he had gained 1.35 kg (3 lb) in weight, but he had lost 20 per cent of his muscular power. Within a two-week recovery period, the fat remained, but the lost protein and the muscular power were restored.

The author says that "physical work capacity is based on four factors: the strength of muscles; the blood and oxygen supply to the muscles during work; the ability to withstand a high acid content of the blood and to remove acids quickly from the blood; and...the degree of coordination of movements during work (in other words, the level of skill)."

To maintain muscle strength, a minimum of muscle contraction may be achieved by a single, brief, exercise per day; one such maximum contraction per week for each important muscle group can maintain maximum strength. Further, one maximal contraction of 5 to 6 sec duration daily results in even more strength.

For an astronaut in a weightless environment, some of these "isometric exercises" may apply; for example, it is possible to contract one muscle against another. However, weightlessness makes difficult the adequate provision of oxygen to the muscles. Static contractions cannot replace some Earth-bound exercises (e.g., knee bends) that increase the oxygen intake to the muscles sufficiently. Exercise performed on ergometers, such as bicycle-types or hand-cranks, would maintain the necessary oxygen utilization level.

Dr. Müller writes that "Skill can only be trained and kept at a high level of training by the performance for which it has been acquired." Although this would be a difficult problem during space flight, skill showed the lowest rate of loss when not used.
(Source: New Scientist, January 24, 1963)

MICROSCOPIC TV PICTURES FOR FINDING CONTAMINANTS. Television-like pictures of objects one-hundredth the size of a human hair are helping to track down possible film contaminants at an Eastman Kodak Company laboratory. Electron microprobe equipment, in one of the first industrial installations of its kind, performs a multitude of identification tasks at the company's photographic film, paper, and chemicals plant.

The microprobe is a giant X-ray tube. Like an ordinary X-ray tube, it focuses a beam of electrons on a target; the beam is only 0.001 mm (a micron) in diameter. The target or sample to be identified, which may be contained in a small piece of plastic film base, is inserted through a port in the X-ray tube. The port is then closed, the tube is evacuated, and the electron beam is turned on.

The beam may scan the sample at various rates to provide a greatly enlarged television-like picture, or the operator can move the beam at will with a microscopic, needle-sharp light to spot impurities in the plastic sample. When struck by the electron

beam, the target emits X-radiation at wavelengths characteristic of the elements in the sample. Three X-ray spectrometers inside the tube itself receive the radiation and identify the microscopic target. The instrument's screens show visually what is seen by the spectrometers.

The operator can control the system so that only one element will appear on the screen. If the operator is to search for copper, for example, he can scan the sample and adjust a spectrometer so that only particles containing copper appear on the screen. Alloys can also be identified in this way. If the particle is bronze, it will appear in the same place during scans for both copper and tin. For targets of unknown composition, the spectrometers can be moved through wavelengths corresponding to all elements above sodium in the periodic table; the emission at each wavelength is recorded.

The three spectrometers give the operator versatility to select the detection system with the best characteristics for the particular target material. They also make it possible to search for three elements simultaneously. (Source: Data supplied by Eastman Kodak Company)

VACUUM CHAMBER FEATURES 60 OPTIONS. A new vacuum chamber 46 cm (18 in.) in height, has been announced by Consolidated Vacuum Corporation. Called the CV-18, it has an ultimate pressure of 4.6×10^{-5} newton/m^2 (3.5×10^{-8} torr) with a liquid nitrogen baffle, and 3.3×10^{-5} newton/m^2 (2.5×10^{-7} torr) with an ambient cooled baffle. It has a 15-cm (6-in.) diffusion pumping system and is able to pump from ambient atmosphere to 1.2×10^{-4} newton/m^2 (9×10^{-7} torr) in 10 min. Plateau pumping speed measured directly over the baseplate is 300 liters/sec (0.392 yd^3/sec).

The new vacuum chamber (Fig. 2) is modular in design and features 60 accessory options, including 7 mechanical pumps, 5 baffles, 7 gauge combinations, 5 heater and filament supply accessories, baseplate feed-through accessories, glow discharge and electron beam units, and a full complement of redesigned baseplate accessories. It is a completely integrated package with pumping system, gaging, valves, and controls in one cabinet 107 x 114 x 86 cm (42 x 45 x 34 in.). The four sides and top of the cabinet are easily removable for maintenance.

The pyrex bell jar, 46 cm in diam x 76 cm high (18 in. in diam x 30 in. high), is raised and lowered by an electrically controlled pneumatic-hydraulic hoist. The baseplate is elevated above the cabinet top and is enclosed in a sliding shroud for maximum accessibility to electrodes. The front of the cabinet has a valve control center including a schematic diagram. A central control console atop the cabinet features lighted pushbuttons for the electrically operated components.

The vacuum chamber is also available in a smaller version (CV-14) that features a 36-cm (14-in.) bell jar and a 10-cm (4-in.) diffusion pump system. (Source: Consolidated Vacuum Corporation)

TECHNICAL REPORTS AVAILABLE. The following listed technical reports can be requested through the NASA library, M-MS-IPL, Bldg. 4481.

NOTE: Those reports with an AD number may be on file in the local ASTIA branch in Bldg. 4484. Readers can save time by calling 876-6088 and inquiring if such reports are available before ordering them through NASA.

1. THE SECOND SYMPOSIUM ON THE PLASMA SHEATH-ITS EFFECT UPON REENTRY COMMUNICATION AND DETECTION. AD 275 251
2. TWO NEW SPEECH COMMUNICATION SYSTEMS, J. L. Stewart. AD 278 711
3. METALLURGICAL PROPERTIES OF SOME EXPLOSIVELY WELDED METALS, G. A. Haynes and J. Pearson. AD 278 354
4. DETERMINATION OF CAUSES OF CRACKING IN WELDING AGE HARDENABLE HIGH TEMPERATURE ALLOYS, B. S. Blum. AD 278 259
5. SHOCK AND VIBRATION ENVIRONMENT - A REPORT BIBLIOGRAPHY, W. L. Hercules. AD 277 392
6. DEVELOPMENT OF A METHOD FOR THE INSTRUMENTAL DETERMINATION OF OXYGEN IN ORGANIC COMPOUNDS CONTAINING NITROGEN, SULFUR, AND HALOGENS, H. S. Haber and K. W. Gardiner. AD 276 472

FIG. 2

7. A RAPID METHOD FOR THE MICRO DETERMINATION OF CARBON AND HYDROGEN IN ORGANIC COMPOUNDS, H. M. Rosenberg and others. PB 181 339
8. STUDY OF ELECTROLYTIC REDUCTION OF CARBON DIOXIDE, H. Chandler and W. Oser. AD 282 938
9. RESEARCH ON HYDROGEN EVOLUTION AND DISSOLUTION, M. Breiter and others. AD 277 211
10. INVESTIGATION OF NOTCH FATIGUE BEHAVIOR OF CERTAIN ALLOYS IN THE TEMPERATURE RANGE OF ROOM TEMPERATURE TO -423 F, D. N. Gideon and others. AD 286 480
11. FATIGUE AND DYNAMIC CREEP OF HIGH STRENGTH STEELS, R. F. Brodrick. AD 286 832