DECEMBER 29, 1958

DR. WILLIAM H. PICKERING
Satellite Instrumentation

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Engineering and Electronics Edition

AN AMERICAN AVIATION PUBLICATION

-4

ENGINEERS . . . FOR IDEAL WORKING CONDITIONS WITH A DYNAMIC, CREATIVE ORGANIZATION, ADDRESS RESUME TO CHIEF ENGINEER.

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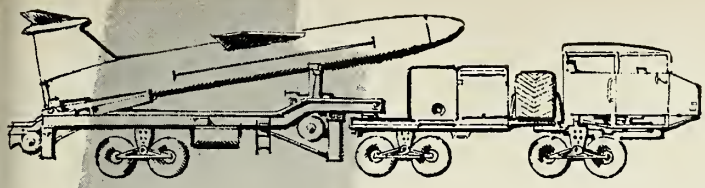
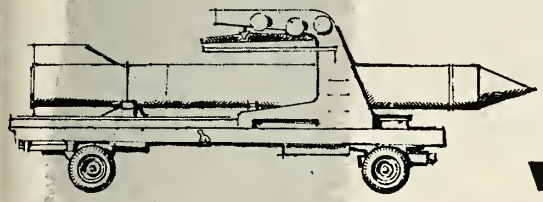
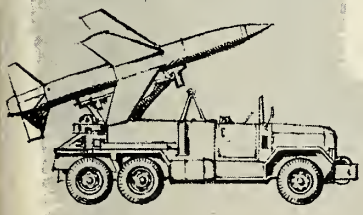
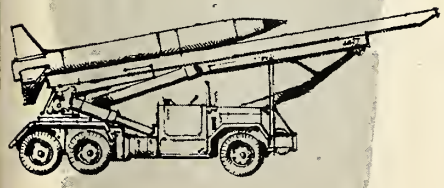
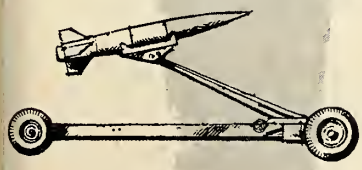
HALLAMORE



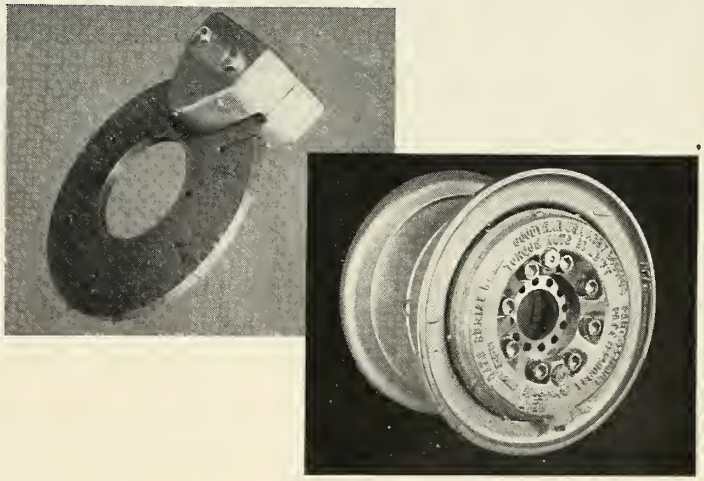








Got a brake or wheel problem?



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Space-age openings at Boeing

Advanced projects under contract at Boeing include Minuteman, a solid-propellant intercontinental ballistic missile, and Bomarc, America's longest-range area-defense supersonic guided missile system. Also underway at Boeing are studies for orbital, lunar and interplanetary systems.

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There are openings at Boeing, now, in research, design, manufacturing and development, in such advanced areas as celestial mechanics, glide vehicles, space trajectories, high speed drag and heating effects in space flight and re-entry, anti-submarine warfare techniques, gas dynamics, nuclear physics, solid-propellant rocket engines, infrared techniques, anti-missile missiles, advanced electronics, and ion and plasma production and manipulation.

Boeing's space-age orientation, exemplified by advanced studies now underway in ballistic, orbital, lunar, interplanetary and advanced defense systems, has already laid a foundation for continuing leadership in the future. Engineers and scientists of all categories find at Boeing the kind of forward-striding environment that means dynamic career growth. Drop a note now to Mr. Stanley M. Little, Dept. R-83, Boeing Airplane Company, Seattle 24, Washington.

BOEING

COVER: *Dr. William Pickering, head of Jet Propulsion Laboratory, has new assignments awaiting him with transfer of the California facility to the National Aeronautics and Space Administration. (Page 17)*

missiles and rockets Vol. 4, No. 26, Dec. 29, 1958

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in this issue

DECEMBER 29 HEADLINES

ASTRIONICS ENGINEERING

MISSILE ELECTRONICS

NEW MISSILE PRODUCTS

DEPARTMENTS

DESTRUCTIVE TESTING MISSILE MOTOR CASES

These rondom somples of Falcon motor coses were tested to destruction os proof of product reliobility. In oddition to extensive Scoife "in-process" quality control procedures—beginning with metollurgicol exomination of incoming moteriols ond subsequent hardness-testing, harmonic thickness gauging, mognetic porticle ond dye penetront inspection, rodiogrophic exominotion and hydrostotic testing—Scoife "proof-tests" rondom product somples, where practicol, to insure product reliobility. In supplying missile motor cases for nearly a decade, Scoife's primory considerotions hove been to produce coses which meet controct obligotions with o maximum of safety, performance, ond design. For further informotion on Scoife "know-how" for opplicotion to your missile progroms write, or phone EMerson 2-2100.

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washington countdown

A portable atomic warhead . . .
for use by infantry now is near final feasibility studies. Sometimes referred to as **Davy Crocket,** the weapon is a mortar type. A three-man team will employ the weapon whose warhead yield is below one kiloton. It will fill in the Army's battlefield mobility concept arsenal between the 155mm howitzer and nuclear weapons of 20 kilotons, such as was used at Hiroshima. **Davy Crocket,** one Army spokesman said, "is the greatest thing to come along since they gave the Army wheels."

Navy tests of packaged liquid . . .
power plant recently in an air-to-air missile—possibly *Sidewinder,* are reported highly successful. Tests were carried out at the Naval Ordnance Test Station, Inyokern, at China Lake, Calif.

Defense requirements, not budget . . .
should be the deciding factor in military spending, according to Senator Stuart Symington, former AF secretary. Commenting on the cancellation of *Rascal* and *Goose,* he claimed the public is being misled as to the reasons for some of the cutbacks.

To cut excessive lead time . . .
Senator Leverett Saltonstall will reintroduce legislation calling for major procurement changes in weapons systems programs and in renegotiation. One provision would extend the management system to all major weapons system projects, with a manager assigned responsibility for development. A second provision would be to exempt from renegotiation all incentive, fixed-price contracts.

Increase importance for PMR . . .
is seen by Senator Francis Case (R-SD), because of geographic limitations of the Atlantic Missile Test Range. Case, while at Vandenberg AFB, predicted a $41 billion defense budget for fiscal 1960, and said Congress will take a very close look at all elements of the U.S. missile program.

Briefings for Congressmen . . .
are being prepared by all military services. Army's modernization argument will lean heavily on the word "mobility." Current trouble finding overseas bases for *Thor* and *Jupiter* squadrons, Army believes, is sounding the death knell for non-mobile systems.

France may balk at IRBM bases . . .
but the French Consultative Committee for Scientific and Technical Research, made up of government members and scientists whose function it is to guide and coordinate national efforts in scientific research, recently moved to create a Commission for Space Research.

"Monkey business" is a serious affair
in Washington. Navy and Army medics say recent sending of first primate into space was 98% successful from a biological research viewpoint. The monkey, was in a negative gravity environment for 500 seconds. Telemetered data was received on temperature, pulse, heart, breath, and animal motions.

Pressure from the "troops" . . .
was one big reason President Eisenhower decided to reverse himself on an earlier plan to transfer ABMA to NASA. Pressure from Army Secretary Brucker or Chief of Staff Taylor was conspicuous by its absence—for the good reason that Ike had warned them not to oppose the move, publicly, that is. A powerful ground swell from the ranks reportedly was a major factor in the change of mind.

Pentagon circles . . .
are saying production money for *Nike-Zeus* will be held in abeyance for at least a year, despite some tough opposition from Army.

RAND did not scuttle *Titan* . . .
despite reports that the AF Research & Development Corporation recommended against the missile. On the contrary, RAND gave it an excellent rating in the AF's missile family.


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industry countdown

Atlas SCORE satellite . . .

was responsible for a major boost in stocks. Rocket and missile companies made tremendous strides with some firms scoring gains as high as 7 points. Greatest upswing was with Thiokol, Eastman Kodak, North American Aviation, General Dynamics, Burroughs, Reichhold Chemicals, Goodyear and General Tire.

Texas missile industries . . .

have suffered a major setback with the missile and aircraft contract cancellations at Chance Vought Aircraft. Cancellation of the *Regulus II* contract will alone cause an immediate layoff of 1,500 workers. Losing out to McDonnell on the all-weather fighter competition put another 1,500 employees out of work with eventual layoff as a result of the contracts loss expected to total 5,000. Fred O. Detweiler, president of Chance Vought, charges, . . . "Budgetary rather than technical considerations dominated the decision to retire these two outstanding weapon systems."

Chance Vought's backlog . . .

of approximately $500 million includes study and research and development contracts on the Boeing team for the *Dyna-Soar* competition, anti-submarine systems, and nuclear and rocket-powered space vehicles. It also has teamed with Boeing on a manned space capsule.

McDonnell's F4H-1 all-weather fighter

selected over Chance Vought's F8U-3 *Crusader* will be armed with four *Sparrow III* air-to-air missiles. It can also be equipped with the *Sidewinder* air-launched weapon. The F4H-1 is scheduled for operation in the fleet by early 1960. J. S. McDonnell, president of McDonnell Aircraft, said the Navy award will prevent an immediate layoff of 6,000 employees, an employment figure that will rise to 10,000 by the end of 1960.

One million-pound rocket . . .

engine contract to the Rocketdyne division of North American Aviation could easily make NAA first on the list of industries holding military research contracts for fiscal year 1959. Following top contract holder General Electric by approximately $15 million at the end of past fiscal year, NAA may easily take the lead in the next few months with the latest $200 million rocket engine contract. Although the contract covers a 4-6 year period, major spending is expected during the first year's operation.

Rocket engine companies . . .

are deeply concerned over rumors that the recent 1-1.5 million-pound thrust single chambered engine contract has given some NASA officials a new interest in canceling the contract for the clustered 1.3 million-pound thrust system under development by the Army and Rocketdyne.

Clustered engine proponents . . .

point out that the 8-engine package could be ready for flight years ahead of the single chamber. In addition, even the single unit must eventualy be clustered if profitable manned payloads are to be put into space. Meanwhile, clustering of the already proven engines would pave the way for grouping the one million plus units when they are available.

Titan launching system . . .

will be developed by American Machine and Foundry Company at its Cheektowaga, N.Y. plant. About $37 million will be expended on the *Titan* system at Cheektowaga where the launch complex will be produced after the development program is completed.

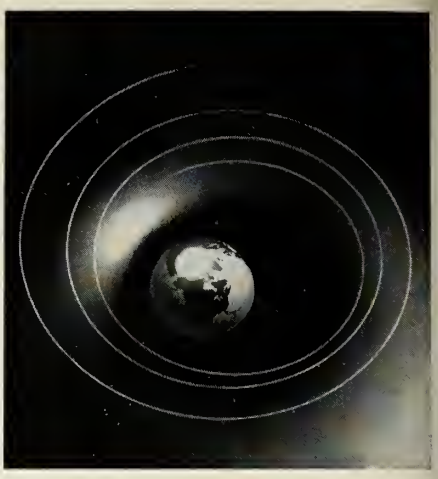
First *Bomarc* training site . . .

became operational last week at Eglin AFB in Florida. It is the first manned by ADC personnel for teaching Air Force missilemen to handle and fire the surface-to-air missile. Operational and engineering evaluation of the missile and launching complex will start in a few weeks.

Cooperation in development . . .

and production of missile equipment will result from an agreement between the Dana Corp. and Aircraft Armaments, Inc. The agreement will combine Dana's production, production engineering, and mechanical manufacturing experience and facilities with Aircraft Armaments' systems engineering, electronic and electro-mechanical manufacturing facilities. Dana's contributions to the rocket and missile field include JATO assists for the *Matador, Lacrosse* solid propellant motor cases, and special drop forgings. Aircraft Armaments' most recent product is the *Redstone* missile trainer. Other products include rocket sleds, cartridge-actuated devices, aircraft and missile ground handling equipment, and missile electronic test equipment.

For Peaceful Purposes and the Benefit of All Mankind The National Aeronautics and Space Administration Announces its Authorization by the Congress of the United States



To Direct and Implement U.S. Research Efforts In Aeronautics and the Exploration of Space

"The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment..."*

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Please address your inquiry to the Personnel Director of any of the following NASA research centers. Your inquiry will be answered immediately, and will be treated in the strictest confidence.

Langley Research Center, Hampton, Virginia
Ames Research Center, Mountain View, California
Lewis Research Center, Cleveland, Ohio
High-Speed Flight Station, Edwards, California

*Quated from the National Aeronautics and Space Act of 1958.

(Positions are filled in accordance with Aeronautical Research Scientist Announcement 61B)

NASA National Aeronautics and Space Administration

DECEMBER 29, 1958—VOL. 4, NO. 26

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Atlas Scores Again in Project SCORE

WASHINGTON—After several days in orbit the *Atlas* satellite has proven itself as an instrument to measure U.S. technological break-throughs and victories.

The major triumphs probably are those of in-flight guidance and the use of satellites for communication. Experts claim that *Atlas*' performance "to a great extent balances the argument that the project is a big boxcar with a small load."

• **Guidance**—Maj. Gen. Bernard A. Shriever, head of USAF Ballistic Missiles Division, says the *Atlas* space program scored a first in the field of in-flight guidance of an artificial moon. No previous U.S. satellite has had this type of guidance, and industry spokesmen say the lack of in-flight guidance caused the lunar shot to get off course.

The ARPA satellite carrier was under continuous electronic guidance the entire time the engines were burning, by means of radio signals transmitted back and forth between the missile and ground stations. Correction could be made immediately when the vehicle veered off course.

General Electric Co. and Burroughs Corp. jointly developed the radio command guidance system. The system was checked out by new equipment developed by Varo Manufacturing Co., Inc.

• **Communication System**—The most significant gain from ARPA's project SCORE is the break-through in the use of artificial moons for communication relay stations. Although the system in *Atlas* is only an experimental relay station, it undoubtedly will go down in the history of communication as one of the greatest achievements to date.

Three or possibly four such relay station satellites spaced in an orbit 22,500 miles high could service every point on earth through radio communications.

At this altitude, the satellites would appear never to move, for their periods would be the same as the earth's, 24 hours.

If orbits at this altitude cannot be achieved with current satellite carriers, then nine satellites placed in a 257-mile-high orbit would suffice to ring the globe. World-wide radio coverage would still be assured, with signals being relayed from one satellite to another until every receiving was serviced.

Circling the earth every 101 minutes at a velocity of 17,000 mph, the SCORE communication package can receive messages from earth and return them to ground stations on command. And communication is not limited to single channel operation. On the 40th pass around the globe, the satellite payload was fed seven teletype messages simultaneously. On the 41st pass, it return them to earth, on command.

This marks the first successful multi-channel teletype transmission by the delayed repeater technique on a ground-satellite-ground relay system, according to Pentagon sopkesmen.

The satellite relay system was developed for SCORE by the Army Signal Corps' research and development laboratory at Fort Monmouth, N.J., in cooperation with a series of electronics companies. Some of these are:

Communications components: Radio Corporation of America

Atlas antennas: Convair-Astronautics

Ground station antennas: Radiation, Inc.

Communication system batteries: The Eagle-Picher Co.

Special relays: Potter and Brumfield, Inc.

Teletype multiplex (ground stations): Radio Frequency Laboratories, Inc.

• **Future SCORE Plans**—According to the Pentagon, the military have plans for a permanent communication system involving ground stations and satellite relay stations. Such a system would greatly reduce the crowding of the nation's airwaves. The military now occupy approximately half of all available airwaves.

Although no plans have been revealed regarding commercial use of space relay stations, such plans will come before long.

M/R Welcomes New Members to its Staff

Dr. I. M. Levitt

M/R enters the new year with several staff additions and changes which we believe will both broaden and increase our coverage of the entire field of missiles and space projects. The major items:

Reed Bundy, formerly with the Washington staff of the United Press joins the staff as Assistant Editor for business news.

Paul Means, formerly with the Northern Virginia Sun, is added as Assistant Editor to cover NASA and ARPA.

Top British rocket and astronautics writers K. W. Gatland and G. V. E. Thompson join as Contributing Editors for more extensive coverage of Britain and NATO.

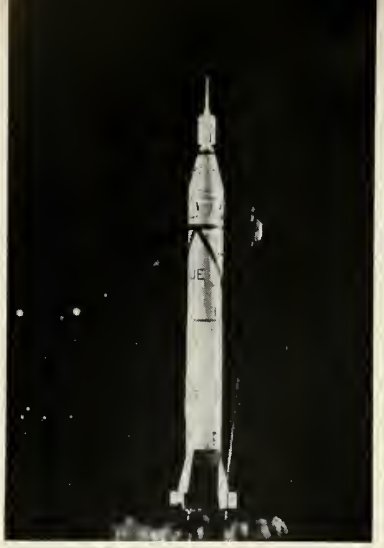
Well-known Astronomer Dr. I. M. Levitt, Director of Fels Planetarium, Franklin Institute, Philadelphia, becomes Contributing Editor for astrophysics.

Within the present staff, Frank McGuire, formerly assistant editor for Legislature and International news, moves to our Los Angeles office as Regional Editor to strengthen our West Coast coverage.

Erica Cromley is promoted from Assistant Editor to Associate Editor to cover Legislative Affairs.

Associate Editor Peer Fossen will continue to cover the fields of tracking and communications but will broaden his coverage to include missile support equipment of all categories.

And, with that news . . . very best wishes for the new year from the staff of m/r to all of our 30 thousand-plus readers.



Jupiter-C **vehicle which launched the Western nation's first satellite.**

1958 Was Year of Space Awakening for Nation

After a somewhat creaking start the U.S. has made a great start in the world competition for space supremacy

by Norman L. Baker
and
Raymond M. Nolan

WASHINGTON—In the missile and space business, 1958 was the year of awakening. Following the rude shock of *Sputnik,* the U.S. began to creak slowly into gear on a broad array of programs. Within the year, new missiles continued to be authorized, ARPA and NASA were formed, and satellite and space programs took on new importance.

As the year closes—for better or for worse—there are three ICBM and three IRBM programs, two agencies calling the shots for outer space experiments, and a "space-minded" Congress and national administration.

But while no one can deny that the U.S. made progress in 1958, there is still a prevalent thought that perhaps the nation did not come as far as capabilities would have permitted. Let us review the year.

ICBM Program

Atlas—The year began with U.S. military planners and Convair jubilant over the first limited success flight of December 17. There were two disheartening failures earlier in 1957. But then it still was impossible to estimate —with any degree of reliability—an operational date.

To date, *Atlas* has completed 15 missions—the last the most important of all—a full-range flight of 6325 miles. Now it appears that the missile will be operational by the end of 1959, barring any major set backs in the testing program.

Air Force will attempt to fire at least one missile a month throughout the remainder of the development program. But most important, *Atlas,* before the end of next year, is expected to be sufficiently advanced to allow transfer of some vehicles to ARPA's man-in-space program. First evidence of this is Project *Score.* The second phase of Project *Discoverer,* will utilize the *Atlas* as the first stage of a two-stage vehicle for eventually orbiting man and a total satellite weight of 10,000 pounds.

Titan—The back-up ICBM, *Titan,* several months ago was reported to be only one year behind the *Atlas.* Now the time is reportedly 18 months, if the date for initiating the test program is used as a guide line. But the first flight vehicle is at Cape Canaveral waiting launch. A static-test vehicle has been on the pad for several weeks.

The first operational site for *Titan* probably will be available long before the missile is ready to be installed. Construction on this "hard" site is progressing at Vandenberg AFB.

Minuteman—On February 27, DOD Guided Missile Director William Holaday announced the second generation ICBM would be powered by

'Top' 1958 Space Achievements

These missile and satellite launchings, in order of their importance, are considered by m/r editors to be the United States' most outstanding research and development achievements during the first year of the space age.

1) *Explorer I*—The U.S. entry into the space age. Launched at 10:48 P.M. January 31, it discovered the Van Allen radiation belt. Still in orbit and silent.

2) Project SCORE, 8700-lb *Atlas* satellite total payload, launched into 20-day orbit on December 18 from Cape Canaveral. One hundred fifty pound payload investigation of satellite relay communications.

3) *Vanguard I*—Launched at 7:16 A.M. March 17. The 3.5-pound baby satellite has an estimated orbit life of 200 years. Solar batteries still supplying energy to a transmitter which is broadcasting temperatures and pressures.

4) *Atlas* full range shot launched November 28. Highly successful. Traveled 6325 miles and impacted in pre-selected target area.

5) *Pioneer I* reached 71,300 miles from the earth in an attempt to orbit the moon. Launched October 11. Success reported in relaying transoceanic radio signals via *Pioneer* from Cape Canaveral to Jodrell Bank in England.

6) *Pioneer III*—Army's *Juno II* rocket vehicle—launched in an effort to hit or bypass the moon on December 6. Reached 65,000 miles. Payload landed in Africa.

7) *Explorer IV*—Launched into an estimated six-year orbit at 11 A.M. July 26. Loaded with radiation counters for investigating the belt sampled by *Explorer I* and *Explorer III.*

8) First successful launching of *Atlas* with full propulsion system. Launched August 2. Traveled 2500 miles.

9) *Pioneer* attempt of August 17. First recorded attempt to reach the moon Fired within 14 minutes of the optimum launch time. Failed after 77 seconds of flight time.

10) Nose cone of operational *Jupiter* recovered after completely successful full-range test. Launched May 18.

solid propellants. On March 3, Air Force received DOD approval to start development and requested that the Navy's *Polaris* configuration be used as a design criteria.

Minuteman, which may be available in late 1960, should be a relatively inexpensive system (one-seventh the cost of *Titan* or *Atlas*). Launch sites will be in hard positions and the lengthy countdowns of liquid rockets should be eliminated.

Dyna-Soar—With a deliberate look at the future, Air Force backed up *Minuteman* by awarding competing design study contracts to Boeing and Martin for *Dyna-Soar* the third generation missile system, or the last manned aircraft.

This boost-glide rocket system will put man into the missile and bring the first true space weapon system into reality. Study contracts for the systems were awarded June 16, an R&D contract probably will be let before a July 1 deadline.

• **Missiles with strategic capabilities**—Drastic changes were made in the strategic air-to-surface missile systems during 1958. *Rascal*, a short range (100 miles) rocket-powered bird designed for drop from B-47 and B-52 was given the economy axe a few weeks ago.

The Bell Aircraft developed *Rascal* was dropped while in the final stages of R&D, undoubtedly in favor of *Hound Dog*, the successor.

NAA's *Hound Dog*, unlike the *Rascal*, will have a jet sustainer and longer range. By year's end *Hound Dog* was weeks away from flight testing. But, Boeing too is in the picture, reportedly on a successor to *Hound Dog*.

Latest missile to be cancelled, was the Air Force *Goose*, designed for decoying the enemy's air defenses away from strategic bombers. *Goose* was in advance development when the slash came with a few successful flights to its credit, and a first base under construction. *Green Quail*, an air-launched decoy still under development will probably fill the gap left by the *Goose* cancellations.

• **End to IC cruise missiles?**—*Snark*, the nation's only intercontinental missile, starts the new year with an uncertain future. The missile still continues its flights down range from Cape Canaveral with reasonable results. Meager production awards and site construction indicates the missile will not get past the one squadron now planned.

IRBM Program

The year 1958 has been one of great achievement in the IRBM program. After three years of development *Jupiter* and *Thor* reached the big pay-off—operational deployment.

Both of the liquid-fueled IRBMs have remained neck-and-neck throughout their development programs and it is almost impossible to properly assess the relative merits of the two systems.

Although both systems are in production and crews are in training, only *Thor* is actually being deployed in operational sites. Deployment of *Jupiter* must await agreements from France and Italy—two countries slated to receive the weapon.

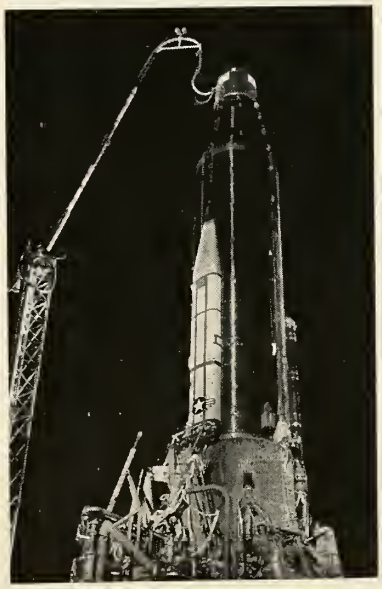
The first firing of an operational *Thor* by a SAC crew was from Vandenberg AFB on December 16. It was also the first IRBM launch by service personnel.

Jupiter and *Thor*, two of the costliest weapons systems in existence, may not survive beyond *Atlas* and *Titan* operational dates. The capabilities of the ICBMs, plus the possible existence of foreign IRBMs at the same time (Britain has an IRBM under development), will probably cancel the operational value of the systems.

The flight records of *Jupiter* and *Thor* have been beset with disappointments, but in the final tally, successful missions overshadow the failures. Operational nose cones have been flown on both weapons while nose cone recovery has been made only with *Jupiter*.

Polaris—The Navy's IRBM, the *Polaris* fleet ballistic missile, suffered two disheartening failures in the closing months of 1958 after an impressive flight record that began late in 1957.

The missile flight test program conducted at Cape Canaveral has chalked up an impressive score. Out of 24 test flights, 21 have been termed successes. First 22 flights were modified *Sergeant* missiles equipped with the eight-nozzled second stage power plant.



***Atlas* went 6352 miles; later boosted self into orbit.**

Surface-to-Surface

Except for the ICBM and IRBM areas, the Army dominates in the surface-to-surface missile picture. They begin (in size and range) with the *Pershing* and continue down through the artillery rockets. Air Force entries are the *Matador* and *Mace*, and Navy surface-to-surface unit is the *Regulus*.

Pershing marks the Army's first departure from the arsenal concept of procurement with the Martin Company as prime contractor. Prototype and test vehicle components have reached the hardware stage and component test of some hardware is in progress. If the program continues, and there have been no rumors to the contrary, this will probably mark the last effort of the Army into longer-range missiles.

In the longer-range birds, *Redstone* continues to plod along and rack up almost incredible firing records. Latest information is there were two failures in 41 firings over a period of five and one-half years. Production of *Redstone* continued throughout 1958 and the missile became fully operational.

Production models of the *Sergeant* began to appear this year but it seems like it will be a while before *Sergeant* replaces the *Corporal* and reaches troops. The Army is banking on its inertial guidance and solid motor to give a commander the storability, mobility and accuracy considered necessary.

In the 10-to-20 mile range, Army has the *Lacrosse*, *Little John* and *Honest John*. Production of the *Lacrosse*, started in 1957, continues and the weapon is now considered operational by the Army. The capability of being airlifted is considered one of its outstanding features.

In the artillery rockets, the most spectacular achievement of the year was the *Chopper John* exercise carried on at White Sands early last summer.

Cancellation of the *Dart* leaves the Army without an anti-tank weapon, but Army may purchase the Vickers 891 or the German Kobra.

The Air Force has two entries in this category—the *Matador* and the *Mace*, the *Mace* being an advanced version of the *Matador*. The *Matador*, operational for the last four years, is being supplied for use in the TM-61B version. Two versions of the *Mace* are now in production—the TM-76A, an ATRAN (map-matching) guided missile and the TM-76B, an inertial guided unit. The *Mace* is in production and troops are now being trained

ILL-FATED *Pioneer I*, **probably first attempt to reach earth's natural satellite.**

in its use.

During 1958 the Navy began its switchover from *Regulus I* to *Regulus II*. However, the Navy now has cancelled the *Regulus* program at Chance Vought. First firings were made during the year from a submarine and another from the LST King County, operational mockup of a *Regulus II* launching submarine.

Surface-to-Air

The *Nike-Hercules-Bomarc* controversy was the big news during 1958 in the surface-to-air category. Actually, most of the controversy was in the newspapers and not in DOD. DOD stopped most of the talk with the clarifying announcement that 400-mile *Bomarc* B would be used for area defense and the *Nike-Hercules* for point defense.

Nike-Hercules continued replacing the *Nike-Ajax* during the year at the various city defense sites and will soon be installed at all *Nike* bases. *Nike-Zeus*, the anti-missile missile of the *Plato* anti-missile system, seems to have a clear field in missile defense—at least for the forseeable future. Development is coming along on schedule and some hardware testing is being done.

The Army's *Hawk* made quite a showing at the Army Missile Mobility Orientation show in White Sands this year, blasting off and making a target kill exactly as programmed. Raytheon is showing a model of the 36-missile emplacement which is soon to be installed in the Washington D.C. and New York City areas. Status of the missile during 1958 was listed as development production.

The Navy lists four missiles in this category—*Terrier I* and *Terrier II*, *Tartar* and *Talos*. *Terrier I* is being supplied to the fleet and *Terrier II* is planned for replacement. The second version will be larger than the first and will have radar homing installed. The first is listed as "service use" and the second is listed as "development."

The *Tartar* is smaller than the *Terrier*, but otherwise somewhat similar. It is in development production with the Applied Physics Laboratory of Johns Hopkins having systems responsibility. Convair-Pomona is the prime contractor.

The *Talos* was installed this year on the newly-commissioned USS Galveston, the first of five missile cruisers to be *Talos*-equipped by 1960. The missile is in production and will be available as each of the missile cruisers are available. Army cancelled its *Talos* program during 1958.

Air-to-Surface

In the air-to-surface category, the Navy has a bewildering array of missiles either operational, in development or planned.

Outstanding missile in production is the *Bullpup*. Martin reportedly is going on in *Bullpup* development to a new version with a nuclear warhead and a packaged liquid engine. This is the same missile as the recently-announced USAF *White Lance* soon to be in use with the Tactical Air Command. Other Navy missiles still in the development cycle are the *Corvus*, the *Crossbow*, the just-awarded *Eagle*, the *Hopi* and the hot-gas propelled *Raven*.

The Air Force has another air-to-surface bird called the *Wagtail*. Reportedly in development production by Minneapolis-Honeywell, it employs a new concept in air warfare, being fired over mountains and other obstructions.

Air-to-Air

In the air-to-air category, the Navy apparently is leagues ahead because of the outstanding performance of the *Sidewinder* used with such devastating effect during the off-shore islands crisis. However, the Navy is not resting. A successor to the *Sidewinder*, called the *Diamondback*, is now under development by NOTS at China Lake, California. The Navy has two other air-to-air missiles in production,—the *Sparrow III* and the unguided *Zuni*.

Air Force efforts in this area have concentrated on the *Falcon* and the *Genie*. Two models of the *Falcon* are in service use, the GAR-1D and the GAR-2A. However, there are reports that Hughes Aircraft is now up to GAR-9 in their designations. The *Genie* is also listed as in service use. The present model is unguided but a guided version is in development.

Space Experiments

While the United States' experiments in space research were meager weightwise, when compared with Russian satellites, results obtained and diversification practiced were perhaps more significant and impressive. Experiments ranged from cosmic ray, solar power, and magnetic field investigation to animal flights and feasibility tests of space probes. Here is a chronological listing of the United States 1958 space research efforts.

1) *Explorer I* satellite launched on January 31. Discovered radiation belt. Still in orbit.

2) *Explorer II* launched on March 5 failed to achieve orbit due to failure of last stage to ignite.

3) *Vanguard* baby satellite launched into 200-year orbit. Equipped with solar batteries.

4) *Explorer III* launched into orbit on March 26. Fell to earth on June 27.

5) *Thor-Able* re-entry test vehicle launched on April 23 with mouse in nose cone. No recovery made.

6) *Vanguard* 20-inch satellite failed to orbit on April 28.

7) Two men rode balloon on May 6 to 40,000 feet to study stars and planets.

8) *Vanguard* launched on May 28 failed to orbit.

9) *Thor-Able II* with mouse in nose cone traveled 6000 miles on July 9. Recovery failed.

10) *Thor-Able III* with mouse in nose cone traveled 6000 miles on July 23. Recovery failed.

11) *Explorer IV* launched into six-year orbit on July 26.

12) First Air Force lunar probe failed after 77 seconds on August 17.

13) Army failed on August 24 to launch *Explorer V*.

14) Navy failed to orbit *Vanguard* on September 26.

15) *Pioneer I* reached 71,300 miles in unsuccessful attempt to orbit the moon on October 11.

16) Army failed to launch *Explorer VI* on October 23 balloon satellite.

17) Air Force *Pioneer II* on November 8 failed to achieve sufficient velocity to leave the earth's gravity field.

18) Army failed to reach the moon with *Pioneer III* attempt on December 6. Payload traveled 63,000 miles.

19) Squirrel monkey traveled 300 miles out and 1500 miles distance in nose cone of *Jupiter* IRBM on December 13. Recovery failed.

20) ARPA Project SCORE *Atlas* satellite launched into orbit on December 18 from Cape Canaveral.

Dr. Pickering Takes His JPL Team to NASA

With CalTech he will continue to operate laboratory, to include designing instrumentation for future space probes

by Frank G. McGuire

WASHINGTON—Dr. William Pickering and his team, the Jet Propulsion Laboratory of the California Institute of Technology, will finish the second year of the space age under NASA and thus will carry out "a step well calculated to advance the best interests of the nation." JPL, responsible for the instrumentation in the *Explorer* satellites, will continue under contractual arrangements with the Army throughout 1959.

Programs underway at JPL relating to military operations will remain under Army jurisdiction. This includes the *Sergeant* program and "special intelligence investigations" plus communications, aerodynamic testing and research.

Dr. Pickering and CalTech will continue to operate JPL under existing contracts, utilizing the laboratory's potential to design instrumentation for future space probes. JPL designed the payload instruments for the Army's *Juno II* lunar shoot of December 5 and the instrumentation for the *Explorer* satellites.

One question remaining unanswered is this: now that JPL is an official agency of NASA, who will design and produce payloads for future space probes (under NASA cognizance) assigned to USAF—JPL or Space Technology Laboratories? Past instrumentation in AF probes has been by STL, and NASA may either continue to utilize that firm, or may prefer to have its own arm, JPL, work on future projects.

It has been estimated by NASA Administrator T. Keith Glennan that if NASA constructed its own research facility comparable to JPL, it would cost $60 million and require a staff of 2000 to 3000. JPL is now valued at $55 million and employs about 2300.

Since Army funding of JPL has been on a calendar year rather than a fiscal year basis, Army funds amounting to $4,078,250 will be turned over to NASA to finance the laboratory until the beginning of FY 1960, when it will be funded through the NASA budget.

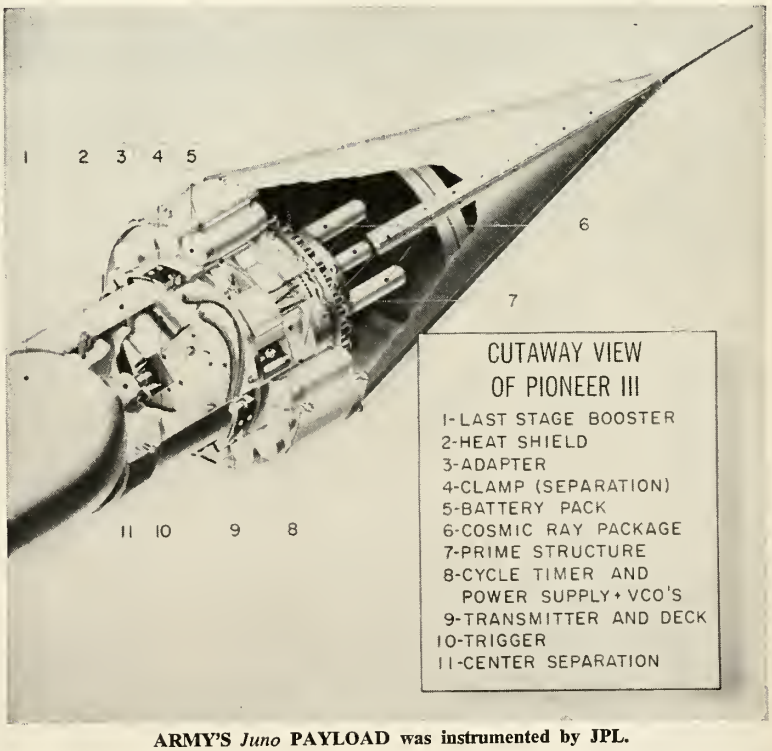
While looking forward to a productive association with NASA, Pickering and his team "view with some nostalgia the termination of a long and happy association with the U.S. Army." The *WAC Corporal,* the *Bumper WAC,* the *Corporal* missile, the *Explorer* satellites and the *Sergeant* are but a few of the products of this association.

NASA is expected to request, and the Army has agreed to furnish, administrative and logistical support on a non-reimbursable basis for servicing contract activities at JPL for calendar year 1959. This includes such assistance as pre-award contractual activities like negotiation, price analysis, financial and legal services, contract clauses and conditions.

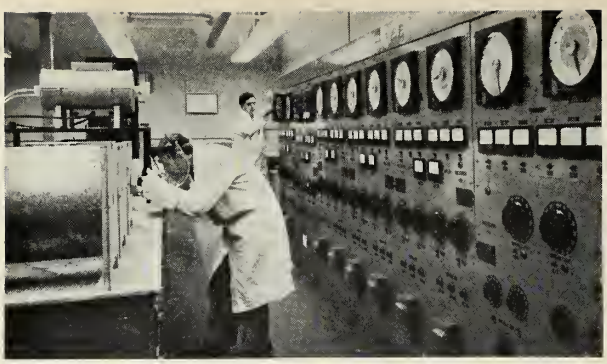
The Army may also establish a liaison group at JPL to provide an exchange of information on supporting research in the missile and space fields. This should enable Army to carry out its responsibility for various projects by providing a continuing flow of data from JPL.

The agreement on the transfer sets a target date of December 31, 1959 for completion of the switchover. Army and NASA have designated Maj. Gen. John H. Hinrichs, Chief of Ordnance, and Albert F. Siepert, Director of Business Administration for NASA, to form necessary teams to effectuate the agreement.

NASA has accepted the Army's invitation to place a staff in residence at the Army Ordnance Missile Command in Huntsville in connection with NASA's need for direct and continuing access to AOMC, for technical contact.



ARMY'S *Juno* PAYLOAD was instrumented by JPL.



HEAT TREATING furnaces at Nuclear Metals, Inc., where "exotic" metals are investigated for high temperature resistivity.

STAFF METALLURGIST makes precision optical alignment of uranium speciment before crystal study with X-ray.

METAL POWDERS, ceramics and cermets are compacted in hooded 270-ton vertical hydraulic presses in R&D laboratory.

Wanted: 20,000 Degree Metals

by Norman L. Baker

WASHINGTON—Space vehicles of the future may require the development of materials that will withstand temperatures as high as 20,000° F for short periods of time—temperatures with a factor of 10 above those commonly encountered in structural applications.

These temperatures exceed the melting point of any single material known, forcing an intensive search for new material fabrication metals and techniques.

Engineers are hopeful that space vehicles can be designed so that the highest temperatures encountered at critical phases of flight will not exceed 5000° F. Even this temperature requires extension of present engineering knowhow for the highest melting points of any substances now known to exist are only about 7000° F. These materials are still behind in fabrication development.

One of the largest and most diversified research and development organizations to accept the high temperature materials challenge is Nuclear Metals, Inc., of Concord, Mass. The company, originally constituted as the Metallurgical Project at MIT, is striving to bring many of the rare and exotic metals into usage for the Atomic Energy Commission and the missile weapon program.

Nuclear Metals has handled or investigated almost every metal in the periodic table. Some of the metals, and alloys and compounds of the metals, have been researched and developed are beryllium, aluminum, va nadium, chromium, gallium, yttrium, zirconium, niobium, molybdenum, hafnium, tantalum, tungsten, thorium, uranium, and a number of the rare earth metals. One assignment has been the development of materials for ballistic missile nose cones.

• **Solution in composite materials**—Nuclear Metals reports that the development of a single material which will provide all the desired properties is highly improbable. Successful solutions to the problems, therefore, lie in the development of composite materials.

Composites could either take the form of a combination where one material provides a protective surface layer against corrosion while the underbody supplies the necessary strength. Another combination would be the lamination of various materials with varying temperature levels. Materials of this latter combination may be constructed by mixing metals and refractory compounds. Such mixtures, of which several are known, is commonly described as cermets.

• **Metal compounds**—High-melting oxides are expected to be useful in the 2000° to 4000° F temperature range, with a combination of carbides and borides with high-melting metals for still higher temperatures.

Graphite, a material lacking in strength and ductility at low tempera-

RADIOPLANE RP-76 SIMULATES NEAR-SONIC ENEMY ...ARMY MISSILEMEN SCORE HIT IN FIRST FIRING!

Place: Red Canyon Range, New Mexico. Time: minutes after an RP-76 high-altitude air-launching by Radioplane personnel. Event: Army missilemen sight RP-76 simulating an enemy weapon system approaching at Mach 0.9. They fire—for the first time against an RP-76—score a direct hit.

Responsible: the men of Battery C, 1st Missile Battalion (Nike-Ajax), 56th Artillery, U.S. Army Defense Command; the men of Radioplane's contractor-operated flight service program, backed by the more than 2,500 Radioplane drone specialists who designed and produced the RP-76.

This Army-Radioplane achievement typifies the result of Radioplane teamwork with all of the U.S. Armed Forces. Other current examples in development: the supersonic USAF-XQ-4A weapon evaluation target drone and the U.S. Navy's XKD4R-1 rocket target, two more members of Radioplane's complete drone family.

RADIOPLANE

VAN NUYS, CALIFORNIA, AND EL PASO, TEXAS
A Division of Northrop Aircraft, Inc.

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tures, becomes increasingly attractive at temperatures above 3000° F. Oxidation at the high temperatures is the major problem confronted with graphite structures.

There are many metals, such as tungsten, molybdenum, and tantalum, which remain solid to much higher temperatures than most of the ceramic materials but need extensive development in order to reach the high temperatures required. In addition these metals and their alloys will be needed in large sheet and bar stock sizes not available at the present time.

• **Beryllium in demand**—The properties of low weight and high temperature resistance has focused increasing attention on the metal beryllium. Although it has the short-coming of being relatively brittle, it has many attractive properties for structural applications.

Currently, beryllium's major missile application is providing re-entry shields for ballistic missile nose cones. Warheads of the *Thor* and *Atlas* are examples of this application.

The AEC has supported work on beryllium for a number of years, although government agencies interested in space weapons and vehicles are now supporting research on the metal to a greater extent.

AEC is interested in the metal for reactor structures. For instance, materials having melting points up to 5000° F are needed in nuclear rocket engines. For such applications, the high-melting metals and compounds mentioned may be required in special regions of the reactor. For example, *Kiwi-A*, the first nuclear rocket reactor, is reported to be a graphite core loaded with uranium and surrounded by a beryllium oxide reflector (m/r, Nov. 17, 58, p. 40). Temperatures in the *Kiwi-A* reactor are expected to be in the 4000° to 5000° F range.

Nuclear Metals recently dedicated a new research and development laboratory at Concord for expansion of its metallurgical program. The $2 million structure is reported to be the largest metallurgical research and development laboratory in the world.

An example of the research and development projects continuously being conducted at Nuclear Metals is illustrated by its fabrication activities. A partial list includes:

1) Development of original melting and casting techniques for beryllium and uranium alloy systems.

2) Primary hot and cold working techniques for beryllium, uranium, and zirconium.

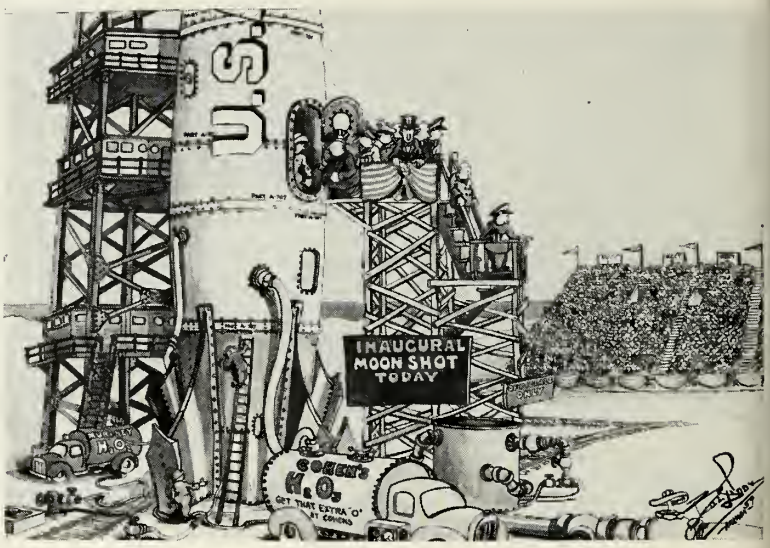
3) Gathering of basic extrusion data on the refactory metals including tungsten, columbium, vanadium, and chromium.

The Space Age—Viewed satirically

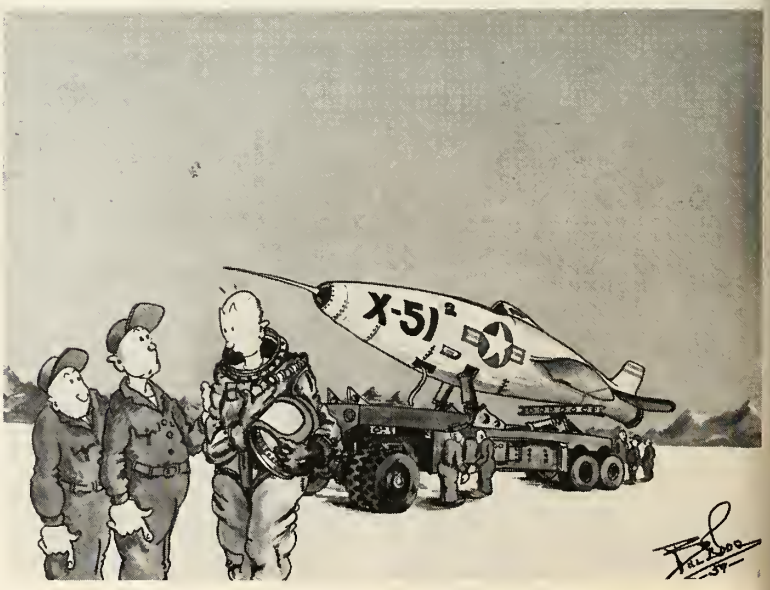
Bill Eddy, who has been coming up with satirical cartoons for the Brown Instrument Division of Minneapolis-Honeywell since 1938, has turned out a new batch of twelve for the annual calendar, two of which are reproduced here.

Eddy's lampoons are always kindly, his characters the victims of a machine age fate. He pokes gentle fun at his colleagues, space suits, moon shoots and electronic brains with equal facility.

Cartooning is a hobby for Eddy, executed in the spare time from his own business, Television Associates, Inc. in Michigan City, Ind. One of those shown here was drawn in Karachi and another in Ankara. M-H distributes more than 70,000 of the calendars each year.



"Frankly, Ludlow, this is no time for you to come down with mumps."



"Lieutenant—you should have done *that* before you got into your space suit."

contract awards

ARMY

By U.S. Army Engineer District, Los Angeles, Calif.:

$345,765—**Amco Electric,** Altadena, Calif., for expansion of 70 KV transmission system at Vandenberg AFB.

$569,413—**Fredericksen & Kasler and Stolte Inc.,** Sacramento, for test tracking station, Phase II, Vandenberg AFB.

$374,267—**Robinson & Wilson,** San Bernardino, for technical supply warehouses and contractor's maintenance facility at Vandenberg AFB.

By U.S. Army Engineer District, Mobile, Ala.:

$182,487—**Aerojet-General Corp.,** for architect-engineer services for missiles systems test facility, solid propellants, at Redstone Arsenal, Huntsville.

By District Engineer, U.S. Army Engineer District, Albuquerque:

$561,231—**J. W. Rateson Co., Inc.,** Dallas, for shock and vibration laboratory, White Sands Missile Range.

$216,000—**C. H. Leavell & Co.,** El Paso, for *Hawk* prototype, White Sands Missile Range.

$38,127—**George A. Rutherford,** Albuquerque, for *Hawk* prototype, White Sands Missile Range.

$1,874,780—**C. H. Leavell & Co.,** El Paso, for guided missile range training facilities, Fort Bliss.

$966,232—**Farnsworth & Chambers Co., Inc.,** Houston, for guided missile range training facilities, Fort Bliss.

By U.S. Army Ordnance District, Philadelphia, Pa.:

$12,393—**National Electric Products Corp.,** Pittsburgh, Pa. for development and fabrication of rocket research vehicles.

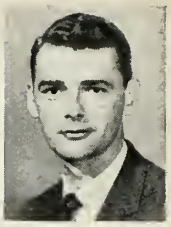
$1,014,550—**Western Electric Co., Inc.,** New York, N.Y. for *Nike* spare parts and components.

$11,487—**Douglas Aircraft Co., Inc.,** Charlotte, N.C., Ordnance missile plant, for *Nike* spare parts and components.

By U.S. Army Signal Supply Agency, Philadelphia:

$260,000—**National Academy of Sciences,** Washington for materials research.

astrionics



by Raymond M. Nolan

Officials in AMBA's Guidance and Control Laboratory were upset by the interpretation of Dr. Wernher von Braun's remarks during the American Rocket Society convention in New York.

Von Braun was quoted as saying the U.S. does not have guidance adequate to hit the moon. What he really meant, say laboratory spokesmen, is that the size of the instrument packages we are sending aloft precludes installation of internal guidance, and probes must be spun to achieve stabilization.

Propulsion, not guidance, is the limiting factor here, ABMA personnel say. If a vehicle large enough to boost a sizeable object into space is developed, the internal guidance necessary to stabilize that object is available.

When guidance is installed internally by ABMA, you can bet that the first sets will be LEV-3s with probably an AB-7 air bearing gyro on the pitch axis. The versatile LEV-3 has been used by Redstone's Germans since *V-2* days and is produced by Waste King Corp. on a production line similar to its appliance production lines. In U.S. missile programs, it has been used on the *Redstone* and *Jupiter,* and is programmed for use on test models of the *Pershing.*

Pershing, **by the way,** will use a guidance and control set similar to the *Jupiter,* except that components will be considerably smaller. The Eclipse-Pioneer division of Bendix, sub-contractors for *Pershing* guidance, expect to miniaturize the slant-range and lateral guidance computers. Stabilizing gyros will be the same size as the accelerometers on the *Redstone* and the accelerometers should be the smallest air bearing instruments yet manufactured. Bendix will become the second U.S. manufacturer of air bearing gyros and accelerometers, along with Ford Instrument, manufacturer of the guidance and control for *Redstone* and *Jupiter.*

In a recent space symposium at Parks Air College of St. Louis University, one speaker made the interesting point that, as we progressed from earth and near-earth flight to ballistic flight the emphasis shifted from excellent gyros and good accelerometers to good gyros and excellent accelerometers. Now, as we enter the realm of space flight, the emphasis will again shift—this time to extreme reliance on the computer in the system. Reason, of course, is that the memory device in a guidance system will become important because of the near-zero accelerations to be measured over long periods of time.

Another point made was that, although the near absence of gravity in space would reduce gyro drift, the drift on the complete platform (caused by frictional torques) could best be minimized by locking its coordinate system to the planets through the use of line-of-sight optical trackers. Thus, it was reasoned, foreseeable space vehicles will have guidance systems that will include a balanced combination of inertial and line-of-sight components. Having both systems will create a redundancy in the navigational equipment which is desirable from a reliability standpoint.

And an official of a top defense agency made the comment about manned space flight: "If we send a man into space over a ballistic course, at the end of 30 minutes he'll either be dead or on-board ship." After a moment of thought, he added, "or both."

WORK WITH THE MEN

WHO WROTE THE BOOK!

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who have the background
—and are anxious to share it.

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Astronautics Tests

Dec. 16—*Thor* launched from Vandenberg AFB. Traveled 1,500 miles. Landed within five miles of pre-selected impact area. Flight was 28th firing.

Dec. 16—*Thor* launched from Cape Canaveral. Traveled 1500 miles. Landed within pre-selected impact area. Flight was 29th firing.

Dec. 16—*Snark* launched on successful 6,000-mile round-trip flight from Cape Canaveral. More than 60 *Snarks* have been fired since test program began.

Dec. 16—*Bold Orion* WS-199B ASM tested for second stage ignition at Cape Canaveral. Martin project went 700 miles.

Dec. 18—WS-199C ASM tested at Cape Canaveral. Convair-Lockheed project launched from B-58.

Dec. 18—6:02 PM, *Atlas* SCORE satellite launched into 20-day orbit. Payload weight—150 pounds. Total satellite weight—8,500-8,700 pounds. Flight was 16th *Atlas* firing.

Dec. 19—*Bomarc* makes successful intercept with jet drone after 9th launch of SAGE series of tests.

Dec. 20—*Titan* failed to clear pad on first attempt to launch the two-stage ICBM. Second stage was a dummy configuration. First stage engine shut off after 15 seconds of burning.

Norway Speculates on *Sputnik*-Relayed TV

WASHINGTON — *Aftenposten*, Norway's largest daily newspaper, has published reports from its correspondent in the small coastal town of Larvik, that the Soviet Union possibly may be receiving television transmissions or relayed transmissions from an artificial satellite. The story was reported in this country by the Office of Technical Services at the Department of Commerce.

The correspondent, Kaare Pettersen, who has seen the suspected image, says the signals always appear on Channel 2, are twice repeated at 0830, 0930, and 1230 hours, and are of varying strength, increasing to a maximum, and then decreasing gradually. No sound accompanies the poor quality pictures.

Up to five "ghosts" appear at times on the screen, which is not the case with other Soviet transmission received in Larvik. For reception of the signals, the antenna must be turned toward the west, also in contrast to what is the case with other Russian broadcasts.

Test patterns and letters of the Cyrillic alphabet appear between the two short films in the transmissions.

west coast industry

by Fred S. Hunter

Some viewpoints on missile management as they were expressed by a panel of Southern California industry executives monitored by Dr. Lee DuBridge, president of Caltech:

Dr. E. B. Doll, project director, Space Technology Laboratories—Supervision of technical personnel should be by technical personnel, and the use of nontechnical personnel skilled in administration to supervise engineers and scientists cannot be called a good arrangement . . . We are eating up our storehouse of basic research and there should be more government funds for fundamental research, but not necessarily for companies producing the hardware.

W. M. Hawkins, assistant general manager, Missile System Division, Lockheed Aircraft Corp.—Let competition work in the R&D effort. Give people more freedom. Set up milestones to measure performance on R&D projects, but monitor them for evaluation in the early stages. Discard those which do not measure up. Let a guy go broke, if he can't do the job. In that way, we can have more projects of a competitive nature, and make more progress.

S. K. Hoffman, vice-president and general manager, Rocketdyne Division, North American Aviation—Better profit incentives would be a better way to encourage more basic or fundamental research, necessary to bring about the technical "break-throughs," than the allocation of a certain percentage of development contracts (for example, 5%) for this specific purpose. The best way to improve the profit incentive for companies capable of performing basic research would be through tax reform . . . It's a horse race between liquid and solid propellants, but both have applications. The future will depend upon the effort put into each.

W. L. Rogers, vice-president-Azusa Operations, Aerojet-General Corp.—More integration of skills both within a company and between companies is needed to make more effective use of our technically and scientifically-trained people. Remember, company policy is making a profit, and a company has to establish manpower policies on this basis . . . Rotation of personnel, wherever it is possible, provides the opportunity to better appreciate the other fellow's problems . . . Better communications are necessary . . . We have a long way to go to truly control projects.

Don L. Walter, vice-president-engineering and Van Nuys operations, Marquardt Aircraft Co.—It is difficult for nontechnical personnel to lead technical personnel, so if we are to have leadership in management, we must have supervision of technical personnel by technical personnel rather than nontechnical personnel skilled in administration . . . Managements do all they can to keep from over-burdening technical personnel. But a "standard" overhead or burden rate for all companies in a similar business would be quite impossible because no two accounting departments are able to agree on methods or policies. It is general management's job to get the most out of all of its manpower.

Elmer P. Wheaton, vice-president-Missile and Space Aircraft Systems, Douglas Aircraft Co.—The function of a reliability group in engineering is to assist the design group, just as a stress group does, and it should not be set up with the same status and power inspection departments have in manufacturing . . . Outfits capable of performing basic research often are forced into product development because this is where funding is available . . . One of our biggest problems management-wise is handling our customers. Keep the fringe kibitzers out and we can do a better job . . . A revision of our nomenclature for technical personnel is in order. A janitor is a maintenance engineer.

Regulus Cancellation Ends 10-Year Program

WASHINGTON—Termination of the *Regulus II* program brought an end to the Navy's missile work on this series which began with Chance Vought over 10 years ago with the *Regulus I.*

The termination of the production of *Regulus II* has resulted in changes in the weaponry to be utilized on a number of the fleet's ships and submarines.

The Navy presently has on hand some 250 *Regulus I* missiles which will be utilized on four submarines. These are the Tunny and the Barbero which have been equipped with the missile for several years, and the Growler and the Grayback which originally were planned to handle both *Regulus I* and *II.* The Halibut, which would have been the first nuclear submarine to employ the *Regulus* missiles will be completed as a fleet type submarine without missiles. Plans also had called for employment of the *Regulus* missiles on other nuclear-powered boats, but these also will be completed as fleet type boats.

The only surface ship scheduled to use *Regulus II* was the Long Beach, the Navy's first nuclear-powered cruiser. Long Beach now will be completed to use only the *Talos* and the *Terrier* systems.

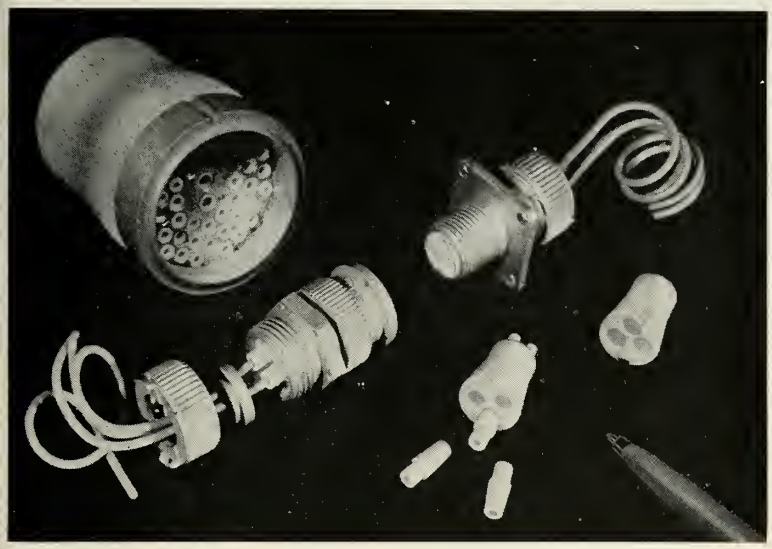
Secretary of the Navy Thomas S. Gates, Jr., explained that the *Regulus* program was being ended because of the rapid strides which have been made in the ballistic missile field which he said has a greater growth potential in the overall military effectiveness than do the air-breathing missile. This would indicate a heightened optimism in the success of the *Polaris* system and that the Navy is putting full emphasis on *Polaris* for submarine launchings.

The Navy said it anticipated saving more than $100 million by the cancellation of the program. This money, the announcement continued, will be applied to the newer Navy weapon systems, ships and aircraft.

The last *Regulus II* missile, in which the Navy has invested about $78 million, rolled off the Chance Vought lines this month.

Cancellation of *Regulus* on the heels of the dropping of the Crusader III aircraft touched off a series of economic and political shock waves. Senatorial and Congressional representatives from Texas protested while Chance Vought announced it was furloughing employees, bringing what may be a critical employment problem to the Fort Worth-Dallas area.

Connectors Operate in Acids up to 450°



A new missile connector design, developed by **Tri-Point Plastics, Inc.,** reportedly prevents invasion of contact cavity even when lead-in wire disintegrates. Each individual wire has its own, tapered "packing-gland."

Compact Titeflex connectors operate submerged in fuming nitric acid fuel, ignitors and at temperatures up to 450° F. on HF systems. Male and female insulating parts are machined to precision tapers, and become a sealed, integral unit when compressed on installation.

Tri-Point Plastics has machined some parts to tolerances of less than .001", from high-density "TSI" TFE resin stock to provide the required performance.

One connector is a "standard" three-wire type; while another special connector handles 50 leads. Both connectors utilize the "taper-compression-seal" design based on precision-machined TFE insulators. Pencil point gives approximate size of parts.

Circle No. 225 on Subscriber Service Card.

Compact Encoder For Precise Reporting

Precise, multi-positional reporting can be accomplished with a new, miniaturized, 10-bit shaft position-to-digital encoder manufactured by **Librascope Inc.,** Glendale, Calif. The new encoder translates analog shaft position to true binary digital information.

Ten-bit resolution is obtained with only a 3½ inch disc that yields 1024 discrete position representations per turn.

The overall size of the encoder is 4 3/16 inches in diameter by 1¼ inches thick. The shaft is fitted with a synchro-type mount to facilitate precise location of the input shaft. Voltage requirements for the transistors are –6 volts DC. Life of more than one million revolutions can be expected with an input shaft speed of up to 25 rpm. The instrument will operate over a temperature range of –50 to 150°F.

Circle No. 226 on Subscriber Service Card.

Absolute Pressure Regulator Developed for Fuel Tanks

A high-flor pressure regulator for fuel and hydraulic tanks which maintains pressures from 18½ to 20 psia with wide variations in inlet pressure and flow has been developed by the **Clary Dynamics Div.** of **Clary Corp.**

The valve is able to maintain absolute outlet pressure with variations in flow rate from 3 to 32— scfm under 3— to 100 psia inlet pressure and minus 65 to plus 350 degrees Fahrenheit.

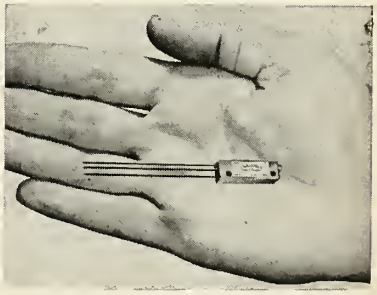
Weighing 2.1 lbs. and 8.55 inches in length, the valve has a 1½-inch tube-size inlet and 2-inch outlet.

Circle No. 227 on Subscriber Service Card.

Miniature Trimmer Rated at 2 Watts

A new super-miniature wire wound trimmer potentiometer, designated the "750", rated at 2 watts up to 70°C. ambient, has been announced by **Dale Products, Inc.,** Columbus, Nebraska.

The new "750" is a precision trimmer potentiometer with rugged construction and completely sealed case. One model has wire leads terminating from the end; the other has leads terminating from the side for printed circuit application. This trimmer has been



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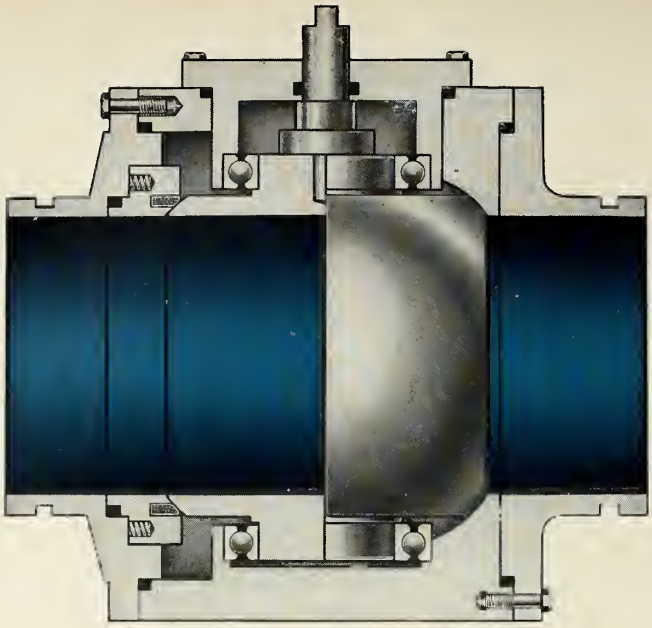
Your requests for information will be forwarded promptly to the companies concerned.

The Editor



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Circle No. 9 on Subscriber Service Card.

designed to meet applicable paragraphs of MIL-R-19A, MIL-R-12934A, Mil-E-5272A and Mil-STD-202A.

The "750" has an 18 turn trimming adjustment screw. Clutch arrangement prevents breakage due to over-excursion. Shaft torque: 5 inch/ounces maximum. Eleven standard resistance values provide a selection from 100 ohms to 30K ohms. Standard tolerance is ±5%, closer tolerance available.

Resolution is .1% to 1%, depending on resistance value. Temperature coefficient of wire is ±20 parts per million, standard. Temperature coefficient of trimmer unit is within ±50 parts million. Operating temperature range is –55°C. to +175°C. with outstanding stability.

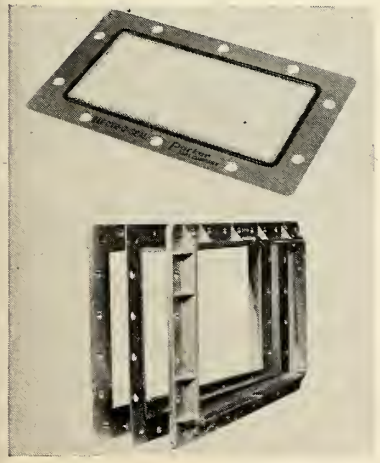
The case measures .180 x .300 x 1,000 inches and the complete unit weighs only 2 grams.

Circle No. 228 on Subscriber Service Card.

New Seals Provide Mechanical Operation

A complete line of seals for Wr-series and X-brand wave guides, which provide no-leakage fluid sealing, prevent R/F leakage and eliminate burning and/or arcing, has been developed by **Parker Seal Co.**, a division of **Parker-Hannifin Corp.**

Called Electr-O-Seals, the new seals are made to fit EIA (RETMA) standard



guides and, in addition to positive sealing, provide savings by making special machining of flanges unnecessary. The inside metal mating edges of the seal are knurled to assure positive electrical contact. They are also reuseable.

The design is an extension of the company's Gask-O-Seal, which consists of a formed seal ring surrounded by the metal retainer. A proper mass to void ratio is maintained, which gives controlled confinement of the seal "gland", with metal to metal contact.

Circle No. 229 on Subscriber Service Card.

Vacuum Pump System For Silicon Deposition

This pumping system, designed by **Bon-De Electronic Labs,** is used primarily for silicon and germanium deposition and vacuum metalizing. It is

a 3 inch system throughout including: 3 inch diffusion pump, main valve, cold trap and port.

As soon as the Bell Jar is evacuated to 25 microns (approximately 5 minutes) the diffusion pump line may be opened. The roughing pump included has a free air capacity of 140 liters/-minutes. System will pump down to $1x10^{-5}$mm. Hg. within 20 minutes. Ultimate pressure of $5x10^{-6}$mm. Hg.

Gauging elements include, the Bon-De: BD-21, 2 filament ionization gauge, two thermo-couples, and one Borden Gauge. The Bon-De Amplifier, BD-20C, will accomodate two thermo-couples and one ionization gauge.

Overall dimensions are 54½" high x 22" wide x 18" deep.

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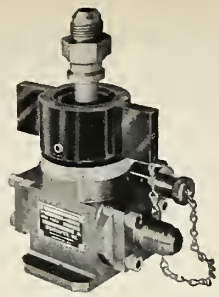

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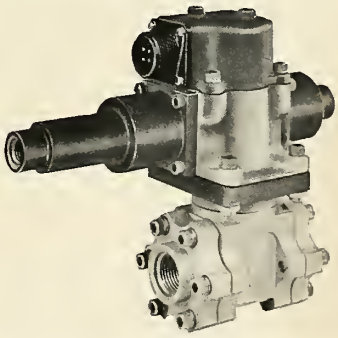
Available in line sizes fram ¼" ta ¾", discannect is leak-praaf at pressures up ta 3000 psi, temperatures fram -65 ta 200°F.



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Valve includes a sealed, ratary actian snap switch far remate abservatian af valve pasitian. The switch may be externally adjusted. Flanges, which are remavable and interchangeable, may be specified per AND10050, AND10056, NPT ar ASA.

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Test Engineer Must Be Make-Believe Artist

Devises equipment which simulates actual conditions under which apparatus would operate, such as heat rise at altitude

by Frank H. Gardner

WASHINGTON—Prior to the development of environmental test equipment, the component design engineer must determine the actual conditions that a component will encounter. Then, test specifications must be developed. Now, it becomes the test engineer's responsibility to make equipment specifications and procure a test facility capable of simulating the desired conditions.

Let us assume that a missile has been developed and specifications call for a test specimen rise of 100° F./min. to +1200° F. at altitudes from 80,000 feet to 250,000 feet.

From test specifications, the test engineer determines that existing test equipment is unsuitable and a set of equipment specifications are devised. These equipment specifications define the size and material of the test object, the types of instrumentation required, and the test program that must be simulated.

The environmental test equipment manufacturer must then design a reliable test facility capable of meeting the requirements of the equipment specifications.

Because of the high altitudes involved, the conventional means of heating by convection are disregarded and a radiant heat test facility is developed.

• **Selection of elements**—The key to the design of a practical radiant heat facility is the selection of the heating elements. Radiant heat is a function of the temperature of the element, and it is desirable to select a heater capable of operating at extremely high temperatures. Presently there are three commercially available types of heaters capable of operating at temperatures in excess of 2000° F. These are open wire nichrome V elements, silica carbide rod-type elements, and quartz tube-tungsten filament elements. The maximum temperatures are 2150° F., 2800° F., and 3000° F., respectively.

Frank Gardner, development engineer of Tenney Engineering, Inc., is one of the country's leading authorities on environmental testing. He is currently engaged in the development of a test chamber to simulate all conditions encountered by missiles in launching and flight. When completed some time next year, the chamber is expected to eliminate as much as 50 per cent of recurring missile failures and sharply accelerate our missile and space programs.

In this article Mr. Gardner discusses the basic considerations for the design of a high temperature-altitude test facility for missiles.

The criteria for the selection of a heater element are maximum heater surface temperature, reliability, initial cost, and ease of assembly and maintenance.

The reliability of the heater element is determined by its ruggedness, its resistance to oxidation, and its resistance to "boil off" at low pressure.

The ease of assembly and maintenance are primarily determined by the number of supports required and whether or not special design is necessary to cool the element terminals.

Nichrome V wire has an extremely high electrical resistance, and heater elements are constructed of inherently rugged heavy gage wire. The wire may be brazed to nickel terminals, eliminating water cooling. Nichrome V wire will oxidize at elevated temperatures, and the life of the wire under certain conditions is limited.

However, with proper design, wire life can be extended sufficiently to justify the consideration of Nichrome V heater elements.

• **Temperature is factor**—Prime factor in limiting the life of a Nichrome V heater element is the wire surface temperature. Other factors are the alternate forming and flaking of oxides as the element heats and cools, and the "boil off" of the element at reduced pressure.

Since maximum wire surface temperature is necessary only when rapid temperature changes are required, the element life may be extended by reducing the power input during steady state periods. The resultant lower surface temperature greatly extends the life of the wire.

A reduction in temperature from the maximum of 2150° F. to 1800° F. increases the wire life by a factor of 40. The reduced power input also permits control of test specimen temperature without on-off cycling of the heater elements.

This eliminates the alternate forming and flaking of oxides and further increases the wire life by a factor of 3. The vapor pressure of Nichrome V at temperatures to 2150° F. is sufficiently low to render negligible the "boil-off" at low pressure of the element on its life. In actual practice, the life of the wire increases at low pressures because of decreased amount of oxygen present and resultant reduced rate of oxide formation.

Wire elements have a tendency to sag at elevated temperatures, and suitable insulated supports must be installed on close centers. This hinders installation and removal of individual elements, but is more than offset by the simple terminal construction possible with wire elements.

Silica carbide rod type heaters, although capable of operating at higher surface temperatures than Nichrome wire elements, are extremely fragile

and have a high coefficient of expansion. Care must be taken in the design of the heater supports and terminal connections to allow heater movement during temperature changes. This loose construction and the fragility of the heater itself detracts from the overall ruggedness of the assembly.

• **Vaporization high**—Although oxides do not form at elevated temperatures to reduce the life of a silica carbide heater, the vaporization rate is high at reduced pressures because of the relatively high vapor pressure of the element. This results in shortened heater life.

Quartz tube heater elements utilizing tungsten filaments have the highest safe operating temperature of the three types of heaters considered. This temperature is determined solely by the tungsten filament melting point and the quartz softening point.

Tests have shown that as long as the quartz tube is maintained at or below the safe limit of 3000° F., the tungsten filament will have a life equivalent to that of the ordinary light bulb. The quartz itself is extremely stable at both high temperature and low pressure, and has no effect on the life of the element.

Commercially available quartz tube heaters have a limiting temperature at the terminals of 650° F., and water cooling must be utilized. This may easily be achieved by jacketing the unheated ends of the heater with water cooled tubes. These tubes may also serve as heater supports so that only a fixed and a floating clip at each terminal need be used to permanently fasten the heater in place.

Because of the few supports required, quartz tube elements may easily be removed and installed.

From the considerations of reliability and ease of installation and maintenance, Nichrome V open wire elements and quartz tube elements are selected as suitable for use on the project under discussion.

• **Safe temperature**—From an economic viewpoint, the Nichrome V wire elements are most desirable. However, before selecting Nichrome V wire heater elements, the facility design engineer must determine if sufficient heat can be concentrated on the test specimen to achieve the required rate of temperature rise without exceeding the maximum safe surface temperature of 2150° F.

With 16 gage Nichrome V wire, approximately 20″ of wire/kw is required to limit the surface temperature of the wire to 2150° F. with a test specimen temperature of 1200° F. A 10″ quartz tube will develop 1 kw without exceeding its maximum safe surface temperature of 3000° F. Assuming equivalent mounting centers, twice as much heat may be concentrated over a given area with quartz tubes as compared with Nichrome V elements.

The additional cost of the quartz tube elements could be justified if future requirements indicate a need for higher ultimate temperatures where a higher temperature heater would be necessary.

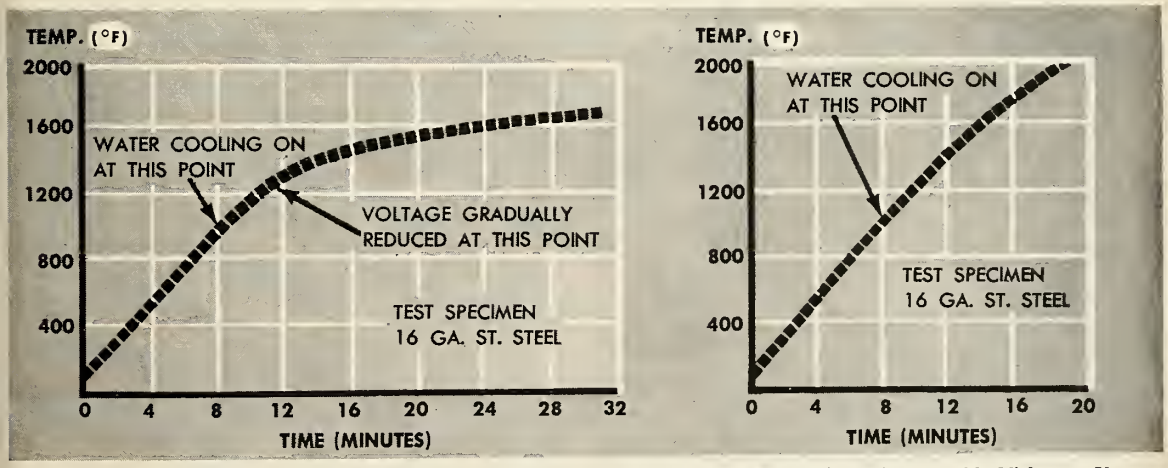
The second phase of design is the determination of a suitable arrangement of the heaters to insure the maximum concentration of heat to the test specimen.

• **Reflector panels**—The heat may best be concentrated on the test specimen by installing reflector panels between the heaters and the chamber walls. No reflector is perfect, and some heat will be absorbed and the reflector will heat up. The reflector material must then be capable of withstanding this temperature without losing its reflectivity, or be water cooled. If tests at sea level pressure are required, some convection heating will result and the reflectors will be relatively ineffective. Under these conditions, the chamber should be constructed to withstand the high temperature in question and the reflector panels eliminated. Additional heat must be installed to compensate for the convection losses to the chamber walls.

To be repeatedly efficient, the reflector must be of a material that will not oxidize at the elevated temperatures. Suitable materials such as gold and platinum are obviously extremely costly.

• **Aluminum as a reflector**—Polished aluminum is a suitable reflector but must be maintained below 600° F. If Nichrome V elements are utilized, this may best be accomplished by lining the chamber walls with the aluminum and cooling the exterior of the wall. If quartz tube elements are utilized, the reflector panel should be a part of the heater assembly and designed such that the terminals of the element are on the chamber wall side of the reflector. For simplicity, the reflector cooling circuit should be connected to the heater terminal cooling circuit.

The overall radiant heat test facility should be assembled from small panels so that test objects of varying shapes and sizes may be closely surrounded by the assembly. All connections should be simple and reliable. Water connections must be of the flange and "O"-ring type to insure repeated vacuum type joints. They should be located on the wall side of the reflector panels with flexible metallic tubing for panel inter-connection.



THESE CURVES illustrate the rate of test specimen temperature rise obtained in experimental tests with Nichrome V open wire (left) and quartz tube (right) heater elements. A cylindrical stainless steel test object was chosen as the test specimen.

. . . missile electronics

Nichrome V open wire elements have terminals exposed to the high temperature, and the interconnection of individual circuits should be accomplished by high temperature brazed wire joints. Each panel should terminate with nickel buss bars. Panel interconnection would be achieved by bolting the buss bars together.

The interconnected radiant heat facility is then connected to feedthroughs at the chamber walls with bolted nickel buss bars.

To avoid arc-over at low pressure, the voltage input to the heaters should not exceed 240 volts. To obtain a practical vacuum seal, the current per conductor through the chamber wall should not exceed 600 amperes. The number of conductors must be determined by the size of the test facility.

Once the radiant heat facility has been designed, there are several alternate means of control open to the design engineer.

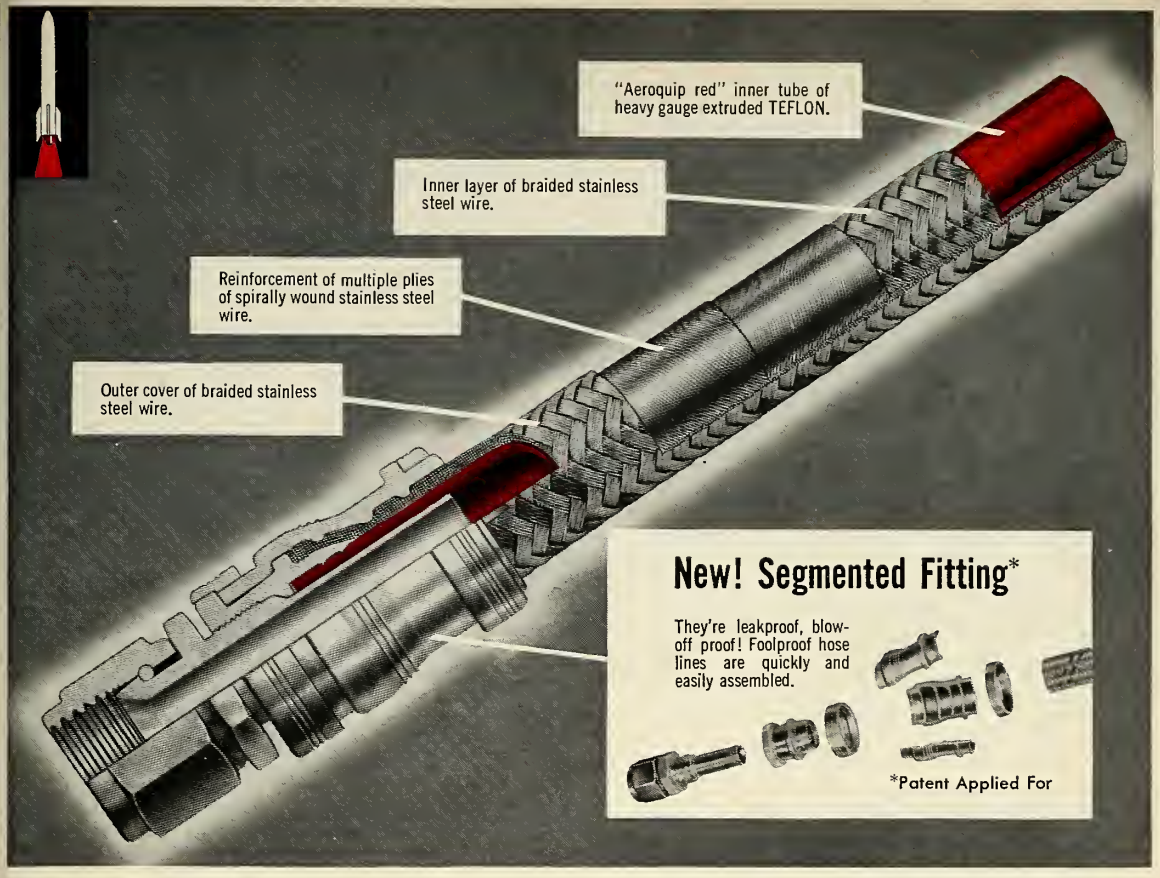
• **Cycling heaters**—The simplest means of merely cycling banks of heaters on and off in accordance with temperature demand is satisfactory if the facility is small. When the ultimate temperature is reached, the heaters should be switched into series circuits, then cycled on a percentage on basis with a suitable manual or automatic time-proportioning interrupter. This provides for uniform distribution of the heat and reduced operating heater surface temperatures.

On larger facilities, it becomes impractical to cycle on and off because of the high currents involved. Control should then be obtained by limiting the power input to the heaters with a suitable variable voltage device, such as a motor-positioned variable transformer, a motor-alternator set, or an ignitron assembly.

The most economical usage of either the variable transformer or the ignitron assembly can be obtained by limiting the maximum current to 300-500 amperes. The voltage supplied should be determined to limit the current to this range and a fixed transformer utilized to reduce the output voltage of the control device to the operating voltage of the heaters.

The primary control device should be a potentiometer controller utilizing a chrome-alumel thermocouple. The thermocouple should be brazed to the test specimen and suitably shielded so that actual test specimen temperature is measured and controlled.

In the near future, temperature far in excess of the 1200° F. requirement of this discussion will be required.



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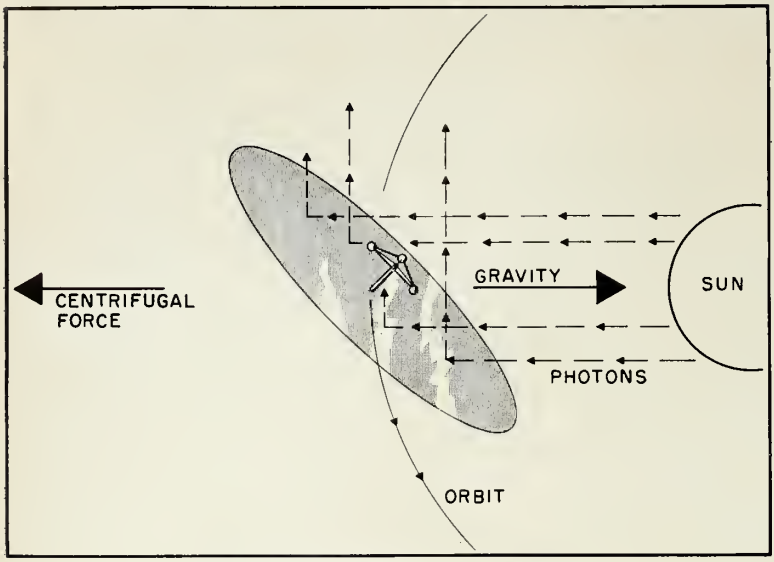
Los Alamos Scientists Study Solar Sail



HOW SOLAR sail utilizes photon propulsion.

LOS ALAMOS, N. M.—A space vehicle propelled through space by a solar sail, using photon propulsion, is being studied by the Los Alamos Scientific Laboratory of the University of California.

The idea of using pressure of solar radiation for extra-orbital propulsion is not new. However, a small group of Los Alamos scientists, headed by Theodore Cotter, have devised means for spreading the sail once in outer space, for holding the sail in place, and for maneuvering the space ship and sail in relation to the sun and gravitational force.

Solar sailing is based on the use of the pressure of sunlight (photons) reflected by a large thin sail in much the same manner as sailboats use the wind. Sun pressure is pretty small—about 1/100th pound per acre—but since space is almost a perfect vacuum, there is no resistance and the sun pressure is free.

• **Two parts**—The space vehicle devised by Los Alamos would be in two parts—a large flat sail of equal weight with the attached payload. The two parts would be connected by a universal-like gear for maneuvering. The sail would be made from an extremely thin material such as a mylar-aluminum combination and could be put into orbit by a vehicle about the size of a *Vanguard* launcher.

Total weight would be around 50 pounds—25 pounds for the payload and 25 pounds for a sail 50 yards in diameter. The resulting device should do what satellites can never do—sample space at all distances from the earth. Satellites can only sample space from fixed orbits.

A solar sailing space ship would first be put into orbit around the earth, then the sail opened. Constant pressure of the sun on the sail would increase the orbit of the space ship. This maneuvering would continue for a matter of months until the solar sailing vehicle had gained enough distance from the earth to go into planetary orbit, and thus navigate in space without worrying about the gravitational fields of the earth or other planets.

A solar vessel would not be able to tack into the sun as a sailboat tacks into the wind; rather the solar sailing vehicle, now in planetary orbit, would play the sun's gravity against the centrifugal force of the space ship in orbit. Return to the earth would be made in the same way. It would decrease its orbital speed, and thus decrease its centrifugal force, and allow the sun to pull the vehicle towards the earth.

• **Centrifugal opening**—The solar sail may be opened by centrifugal force from spin given to it on leaving the rocket and would need no structural support, or it may be opened by using foam plastic which would be formed in ribs of the sail once the space ship leaves the rocket. In either case, the sails would be extremely fragile, but there are no stresses in space, so they would actually be overly strong for the mission to be performed. Once in space, mere meteoritic punctures to the solar sail are insignificant to the sail's function. Los Alamos feels that this indicates that a solar sailing space ship might remain serviceable for many years.

Device Switches Current Fast as Speed of Light

Sperry-Rand's Semiconductor Division recently announced details of a tiny semiconductor device that switches current off and on faster than light can travel one inch.

Time interval for switching is equal to or better than the speed measured by the best instruments available today—about 0.1 milli-microseconds, according to the company. Sperry scientists estimate that the speed of the switch is something around 0.05 milli-microseconds. Semiconductors in use today as switches operate about 100 times slower.

Working element of the switch is a semiconductor alloy junction formed by fusing aluminum to a tiny piece of silicon. The entire switching action takes place within the junction layer's diameter of two-thousandths of an inch and a thickness of four-millionths of an inch.

The atoms in the junction layer provide the mechanism for the switch. Operation depends on controlling the conditions for penetrating the lattice of the atoms and knocking planetary electrons out of the atom's shells.

• **Electrons accelerated**—The atomic mechanism in the layer blocks the flow of current until triggered by a "bit" of computer information in the form of a voltage pulse. The slight increase in voltage accelerates one or more electrons to speeds sufficient to knock new electrons out of their atomic shells. These in turn accelerate and knock more electrons free and so on. Each electron creates a chain reaction or "microplasma" which almost instantly spreads throughout the layer and carries current across the junction. In this condition, the switch is "ON."

Sperry calls this phenomenon the "avalanche effect" because the first electron is like the pebble that starts a landslide.

A slight decrease in voltage reduces the speed of the electrons so that the avalanche effect stops and the current-carrying plasma is swept out of the layer. In this condition, the switch is "OFF."

when and where

JANUARY

Fifth National Symposium on Reliability and Quality Control in Electronics, Bellevue-Stratford Hotel, Philadelphia, Jan. 12-14.

Southwest Electronic Exhibit, Arizona State Fairgrounds, Phoenix, Jan. 21-23.

Institute of the Aeronautical Sciences, 27th Annual Meeting, Sheraton-Astor Hotel, New York. Honors Night Dinner, Jan. 27.

Fifth Annual Radar Symposium (classified), Rackham Bldg., University of Michigan, Ann Arbor, Jan. 27-29.

Society of Plastics Engineers, 15th Annual Technical Conference, Hotel Commodore, New York, Jan. 27-30.

Armour Research Foundation, Fifth Annual Midwest Welding Conference, Illinois Institute of Technology, Chicago, Jan. 28-29.

FEBRUARY

14th Annual Technical and Management Conference, Reinforced Plastics Division, Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago, Feb. 3-5.

IRE, AIEE 1959 Solid Circuits Conference, University of Pennsylvania, Philadelphia, Feb. 12-13.

1959 Engineering Exposition, Balboa Park, San Diego, Feb. 26-March 1.

MARCH

IRE, AIEE and Association for Computing Machinery, 1959 Western Joint Computer Conference, Fairmont Hotel, San Francisco, March 3-5.

Institute of the Aeronautical Sciences, Flight Propulsion Meeting (classified), Hotel Carter, Cleveland, March 5-6.

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Advertiser's Index

Pax Universum—More Than Latin Phrase

Our government has gone to considerable pains in the past months to separate our civilian and military space activities, but the fact remains that to date there have been no space projects attempted or proposed in this country which do not have conceivable military applications.

On this page two weeks ago, m/r observed that while the U.S. was rather frantically moving off in all directions toward hopeful space conquest, we were doing so with no defined goal, no established program and no clear leadership or organization. M/r suggested, clearly mindful that it had a militaristic ring, that the U.S. goal should be:

"Until the world is guaranteed that space occupation of our solar system is for peaceful purposes, the United States can take no chance on its being dominated by someone else."

It also has a realistic ring. If the Soviets, under any guise, should gain dominance in the space envelope around the earth, they could blackmail the free world into abject submission—and quite happily would.

General Thomas D. White is a tough-minded military man. With a few peers he shares the lonely responsibility of being certain that the United States never drops its guard for that fatal moment which would permit a successful attack. Quoting General White, AF Chief of Staff:

"The few relatively brief periods of universal peace enjoyed by mankind in the past have been underwritten by potent national instruments. The British Navy, in the days of Pax Britannica, guaranteed an era of peace and progress by commanding the world's oceans. Today, the United States maintains a similar decisive force which operates in the now decisive medium of air. The natural extension of this decisive force into space is upon us—and we must meet this challenge to assure peace in the future. We must grow apace with the possibilities before us or perish for lack of what it takes to survive."

Most certainly his colleagues on the Joint Chiefs of Staff would agree that we must grow apace with the possibilities before us (in space) or perish for the lack of what it takes to survive. For no matter what the extent of civilian control imposed over them, these military leaders today bear a responsibility that is perhaps as great as any similar group in history ever faced. The land and the sea and the struggles for the control thereof have always been with us. Combat techniques in the air immediately above us came gradually, during and between two world wars. Space and its foreboding—if fascinating—challenge burst upon us with the speed of a Russian *Sputnik* orbiting around the earth every two hours.

It is pretty doubtful that the civilian leadership of the country is giving the service chiefs and their organizations the help which might reasonably be expected.

The gentlemen of the budget normally cut too deeply into all government programs knowing that the agencies involved will find ways of circumventing some part of the incisions. In the old, well-established programs, these budget cuts can be finessed because the very momentum of bulk—the Air Force $18 billion program, for instance—will carry them along. In the budgets for space projects there is no bulk, no backlog and no room to maneuver. Cuts there dig into the muscle. (ARPA's budget is and probably will be for 1960, woefully inadequate).

Our attitude before the world that the U.S. exploration of space is for peaceful purposes is part wistfulness and part the creation of a national posture. We must not go into space swinging a sword.

But both Congress and the National Space Council, which is headed by the President, should never lose sight of the fact that this peaceful space exploration will only be possible if the United States and the world's other free nations make it free; if we have a military capability in space which will prevent its domination by anyone else.

Again, m/r proposes that we must have a goal, a program and an organization for our space operation. From this can come the strength to help create a PAX UNIVERSUM, which may help to solve some of the nation's problems.

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NEW PRODUCT BRIEFS

M PROCESSOR. A new, 35mm essor, second in a line of portable processors has been announced by Industrial Products Division of Fair- Camera and Instrument Corpora- . The "Mini-Rapid 35" will process m film automatically. It is designed perate at speeds up to six feet per ute. Four hundred feet of leaderless can be processed at one loading. unit is designed to operate under ight conditions and use any size spool.

e No. 231 on Subscriber Service Card.

ENTIOMETERS. A 4-page brochure marizing key information on trimpot trimit lead screw actuated potentiters has been published by Bourns oratories, Inc. The brochure features ecification table listing available reances, terminal types, end settings, er ratings, operating temperatures, dimensions of the models.

e No. 232 on Subscriber Service Card.

A-PROCESSING SYSTEM. Features Univac II data-processing system are ribed in a folder published by Remon Rand Division of Sperry Corporin. The Univac II computer offers a -speed memory system—the mage-core memory, which Remington first introduced. It provides access 4,000 alphabetic or numeric chars. It operates either on 80 or 90-nn cards, and provides direct reing of information on magnetic . It can also translate punched- tape directly to magnetic tape nput. Output can be either on mage tape, punched cards, hard copy aper tape. It reads and records inration at a pulse density of 250 acters per recording inch on mage tape. Univac II handles either nac I or Univac II programs.

No. 233 on Subscriber Service Card.

MPONENTS. A set of basis transisd digital computer circuit packe has been developed by the Com- Division of Aeronutronic Systems, Individual circuits include flip-flops, e logic boards, read amplifiers, amplifiers and blocking oscillators. component board contains two ical circuits except the logic board, contains 2-1, 2-2, 2-3, 1-4, 2-5 nion "and" gates, and nine "or" . DC pulse gating techniques peroperation of 75 pulse gates from output of the flip-flop and read fier, at frequencies up to 500 kc.

No. 234 on Subscriber Service Card.

RATIOMETER. An ac-dc digital ratiometer, model 1594, for computers and control system applications has been announced by Performance Measurement Co. Range of ratios that can be measured directly in numerical values is 0 to 1.000. Input voltages range from 0 to 6.3 volts ac and 0 to 6 volts dc. With a high impedance input, this instrument measures ac and dc voltage ratios with a rated accuracy of ±0.10% full scale. For measuring ac ratios, the digital ratiometer accepts input voltage at a nominal frequency of 400 cps. Frequency variations as high as ±20 cps and resultant phase shift have no effect on the ratiometer output reading. Readability of the model 1594 digital ratiometer is one part in 1000. Reference input impedance for both ac and dc ratios is 1000 ohms. The signal input impedance for the ac section of the ratiometer is 20 megohms minimum, and for the dc section it is 10 megohms. Power input to the instrument is 115 volts, 60 cps and 50 watts.

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TRANSISTOR. A germanium p-n-p alloy-junction transistor (RCA-2N331) for audio-frequency amplifier service has been announced by the RCA Semiconductor and Materials Division. The 2N331 has a current-transfer-ratio characteristic which is essentially constant over the useful operating current range for the device. This feature, in addition to low collector-and-emitter-cutoff currents, low base resistance, a typical power gain of 44 decibels, and a typical noise factor of 9 decibels, gives low-power audio-frequency amplifier service.

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ACCELEROMETERS. A line of 30, ungrounded piezoelectric accelerometers, designed to eliminate circulating ground currents, has been announced by Gulton Industries, Inc. The ungrounded units are produced in four classes including unidirectional, tridirectional, high temperature and extra high temperature. Normal temperature units, Series A, Glennite Accelerometers, operate from −65° to +250°F. Series AHT, high temperature units operate from −65° to +350°F. The AXT series, extra high temperature units operate from −100° to +525°F. Featuring extremely high sensitivity, small size and weight and wide temperature ranges, all units reportedly operate with an accuracy of ±5% or better and a linearity of ±1%.

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MISSILE LITERATURE

CERAMIC TRANSDUCERS. Publication of a technical brochure on the subject of a new series of Glennite high temperature, pizoelectric ceramic transducers, is announced by Gulton Industries, Inc. Described in the brochure ere the exceptionelly high Curie points of these transducers, that have made it possible to reach higher output voltages per unit input pressure than can be reached with conventional ceremics. Because no cooling is required, applications for the transducers highlight uses in ordnance systems and high temperature electromechanicel sensors. The eight-page, two-color, illustrated brochure also describes other applications.
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DATA SYSTEM. A brochure is now available from the Epsco Systems Division. It describes the new Mark I basic short delivery automatic PDM-to-Digital Computer Format Telemetry Data System. Among the meny features in this production type data system is the unparalled absolute accuracies in excess of 0.1%, and the fact thet the entire PDM data to computer format process is completely automatic.
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ALLOY. An elloy that combines the advantages of excellent resistance to corrosion with good strength at high temperatures is the subject of a new 12-page booklet. Latest information on hastelloy Alloy B, one of a group of nickel-base alloys bearing this trade mark, has been consolidated. The alloy was developed primerily to offer chemical processors and excellent resistance to hydrochloric acid over a wide range of concentrations and temperatures. In addition, Alloy B has become a valuable high-temperature material because it retains over two-thirds of its room temperature yield strength at 1600 deg. F. It is a product of Haynes Stellite Compeny, Division of Union Carbide Corp.
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DESKTOP COMPUTER. Data File 340 describing Donner Scientific Company's new Model 3400 desktop analog computer is now available. The model 3400 performs the functions of generel purpose enalog equipment. In design, anelysis, or control problems, it is a time-saving model of en erbitrary physical system. Easily measured varying voltages represent the physical variables of the problems. Measurement of the voltage yields complete information on the system. Parameters cen be altered with the twist of e dial.
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CARBON-GRAPHITE. A informetive reference on the composition, qualities and applications of carbon-graphite is offered by the Ohio Carbon Company in an 8-page brochure. The brochure serves as an idea book for carbon-graphite applications. Cherts end tables provide data on qualities of scelero-scope hardness, density, trensverse and compressive strength, oxidizing temperature limitetions, performance in sliding contact with various modern bearing metals, tensile strength-to-specific gravity, and thermal conductivity. Special development and testing facilities are outlined.
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BROCHURE. A 36-page brochure cov ering a complete renge of services i rocket and missile systems is availabl from Cooper Development Corporatio The brochure details the company work in propulsion, electronics, tel metry, instrumentation, ground suppor upper atmospheric research, meteorol gical studies, target systems and relate activities. Engineering, production, an quality control facilities are describe and a special section is devoted to sy tems and components.
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ANALYZER. Theoretical and practical a alysis of FM is the subject of the late issue of "The Panoramic Analyzer," publication devoted to application dat by Panoramic Radio Products, In Basic FM theory, moduletion, FM spec trum measurements, and combined AM and FM are discussed. This issue ou lines the uses of FM commercially a well as in the missile and aircraft fiel FM background, and methods of mon toring and maintenance. Common type of measurements are covered—FM de viation calibration, monitoring chann utilization, malfunction enalysis, etc.
Circle No. 209 on Subscriber Service Car

PULSE TRANSFORMERS. A technic bulletin describing a series of miniatur encapsulated pulse transformers woun on high permeability ferromagneti cores has been published by Techn trol Engineering Company. The bulleti describes the T series pulse transforme having a range of pulse widths from 0. to 25 microseconds for vacuum tube c transistor blocking oscillator and inte stage coupling applications. The bulle tin gives electrical and environment specifications and includes drawings c different case styles with dimensions.
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DUTY LIMIT SWITCHES. 16-page cata log, Number 84, covering a complet line of heavy duty limit switches, ha been published by Micro Switch, a di vision of Minneapolis-Honeywell Regu lator Company. The catalog gives de tails of three types of micro switc heavy-duty limit switches for industria uses—the plug-in "200LS" series, th "LS" series, end the "ML" switches
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MISSILE SYSTEM CAPABILITIES. An 8 page two-color brochure covers th firm's work and facilities in missile sys tem development end production. Th brochure illustrates and describes sys tems, subsystems and components fo many advanced missiles. It lists the com pany's current projects such as guidanc and control systems, missile-borne sub systems, ground support equipment, pro duction test equipment and specialize components.
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SERVICES AND FACILITIES. New 6 page Bulletin 5801 describes laborator and field testing facilities and service available from United States Testing Company, Inc. Included is a description of the company's engineering facilitie and services—environmental studies t electronics, instrument calibration, and reliability testing end failure analysis.
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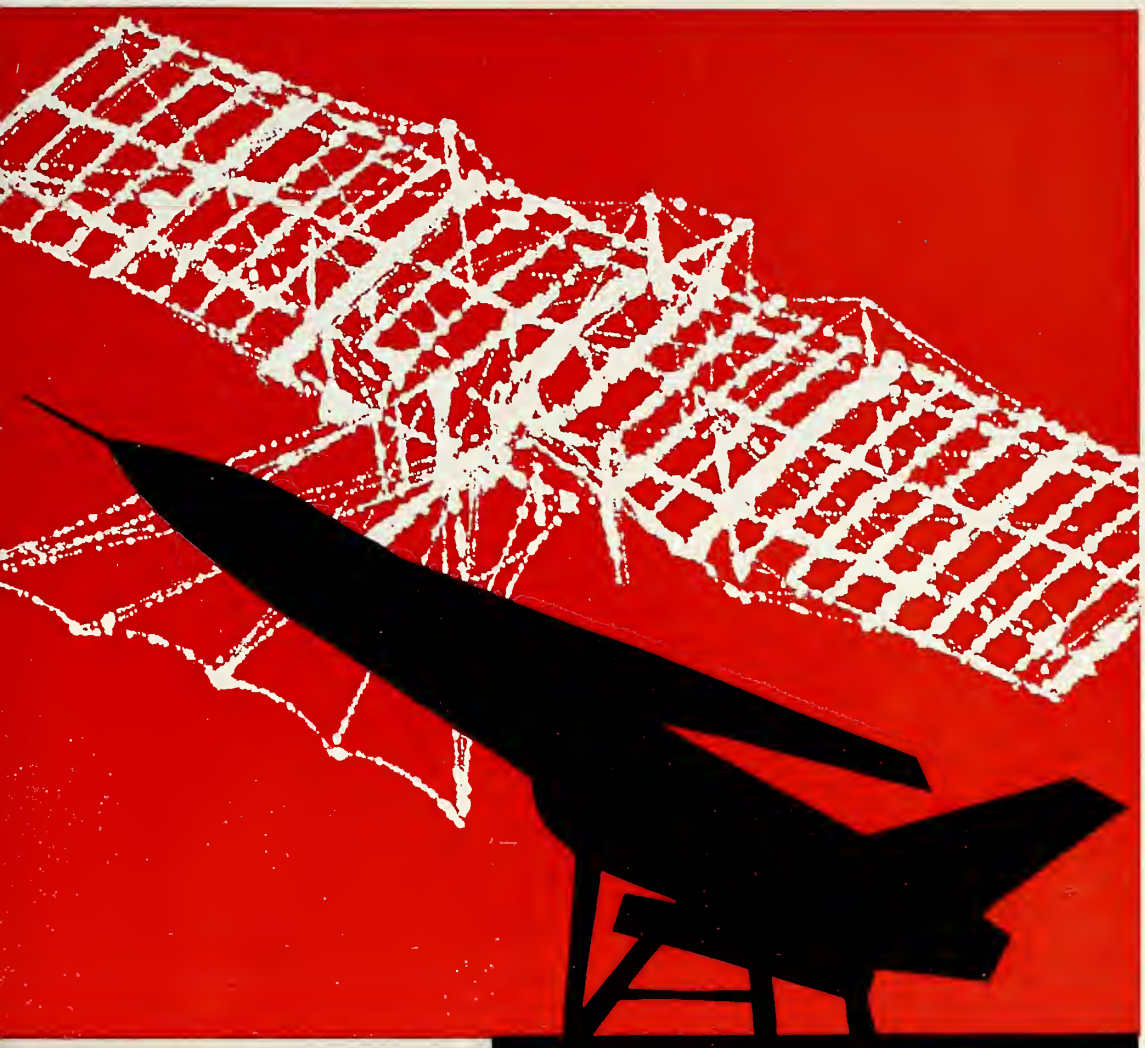

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