

MARCH 23, 1959



ROCKETDYNE'S HOFFMAN

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

Interview with Dr. York	21
Langsten Uses Growing	22
Rocketdyne's Manager	26

AN AMERICAN AVIATION PUBLICATION

Now at Astrodyne...



OUTSTANDING CREATIVE OPPORTUNITIES IN THE FIELD OF SOLID PROPELLANT ROCKETRY

Astrodyne now is offering outstanding opportunities to qualified engineers with experience in solid propellant rocketry or related fields.

On the foundation of its recognized background in superior solid propellant JATO units, gas generators, and large boosters, Astrodyne is developing advanced concepts and new solid propellant applications. New expanding long range research programs involve studies in structural analysis, propellant processing, polymer chemistry, combustion technology, high temperature materials, and lightweight structures and components.

Qualified applicants will find immediate openings on programs calling for the highest order of creative and imaginative thinking. They will be teamed with Astrodyne's elite corps of experienced rocket research and production specialists.

Investigate your future with Astrodyne today by contacting:

Ralph E. Woodburn, Chief, Personnel Section, Room #3-B, Astrodyne, Inc., McGregor, Texas

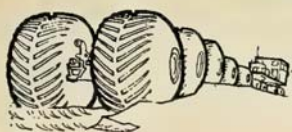
ASTRODYNE, INC.

AN AFFILIATE OF NORTH AMERICAN AVIATION, INC. & PHILLIPS PETROLEUM COMPANY

Does your weapon system need fuel “on the double”?



Here — from Goodyear — are ingenious new rubberized containers that offer double dividends: lightweight liquid storage plus unmatched all-weather mobility.



NEED FUEL THAT ROLLS WITH YOU?

These big Rolli-Tankers hold 500 gallons each, can be towed in long “fuel trains” over roughest terrain. Tire-like containers roll so easily a man can pull one.



—OR FLOATS WITH YOU?

Filled with fuel, Rolli-Tankers have natural buoyancy — ride through water, roll right up the beach! Eliminates long-line hoses and pumping.



—OR COMES BY AIR?

Delivered by air, Rolli-Tankers can be attached to waiting trucks —and rolling—in matter of minutes. Fully loaded tankers survive free falls of 15 feet.



HOW ABOUT A PORTABLE FUEL FARM?

Called “Pillow Tanks,” these tough, rubberized fabric containers can be set up, filled and pumping in 45 minutes. Great where temporary or emergency storage of bulk liquids is needed.



LOOK! FLOATING FUEL STATION

“Pillow Tanks” in the water serve as “fuel islands” — eliminate stringing of long-line hoses or pumping from remote point. Tanks available in sizes up to 50,000 gallons.



WANT TO SAVE FUEL SPACE?

Goodyear has pioneered the development of spacesaving fuel cells and tanks for aircraft, boats, vehicles, missiles. This experience can best answer your fuel storage problem.

FOR COMPLETE INFORMATION on these and other new developments in fuel storage and transport, write Goodyear, Aviation Products Division, Akron 16, Ohio, or Los Angeles 54, California.

AVIATION PRODUCTS BY

GOOD YEAR

Rolli-Tanker—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

**extended range
primary
pressure standard**

...floats on air to minimize static friction



This flexible gage or absolute-type instrument is a true primary pressure standard that depends only on fundamental measurements of mass, length, and time for its accuracy. As a pneumatic dead-weight piston gage, it offers the advantages of air rather than oil as the pressure medium.

For extreme accuracy of 0.015% of full range, even at pressures of less than 1 psi... for cleanliness and portability... for extended range of measurements not available in any other similar equipment... specify CEC's 6-201 Primary Pressure Standard.

The 6-201 will calibrate any pressure-measuring device within the pressure limits of 0.3 to 500 psi. Six standard pressure ranges are provided starting with a range of 1.5 psi full scale.

For information, call your nearest CEC sales & service office, or write for Bulletin CEC 1581-X19.

Transducer Division

CEC

CONSOLIDATED ELECTRODYNAMICS / 300 N. Sierra Madre Villa, Pasadena, Calif.

FOR EMPLOYMENT OPPORTUNITIES WITH THIS PROGRESSIVE COMPANY, WRITE DIRECTOR OF PERSONNEL

Circle No. 17 on Subscriber Service Card.

Executive EditorCLARKE NEWLON
Managing EditorDONALD E. PERRY

EDITORIAL STAFF

Military & DefenseWILLIAM O. MILLER
Electronics and Support EquipmentHAL GEDDINGS
Electronics EngineeringCHARLES LAFOND
Missile ManufacturingWILLIAM E. HOWARD
Congress & GovernmentERICA M. KARE
Missile BusinessREED BUNDY
ARPA & NASAPAUL MEANS
Los AngelesFRED HUNTER
RICHARD VAN OSTEN
FRANK MCGUIRE
LondonK. W. GARLAND
G. V. E. THOMPSON
ParisJEAN-MARIE RICHE
GenevaANTHONY VANDYK
Art DirectorWILLIAM MARTIN
Ass't Art DirectorCOLLIS CAMPBELL

CONTRIBUTORS

Propulsion EngineeringMICHAEL LORENZO
IndustryJAMES J. HAGGERTY, JR.
Soviet AffairsDR. ALBERT PARRY
Space MedicineDR. HUBERTUS STRUGHOLD
AstrophysicsDR. I. M. LEVITT
ResearchHAYWARD CANNEY, JR.

ADVISORY BOARD

DR. WERNHER VON BRAUN ROBERT P. HAVILAND
DR. PETER CASTRUCCIO DR. ARTHUR KANTROWITZ
KRAFFT EHRLICHE DR. EUGEN SAENGER
R. F. GOMPERTZ ALEXANDER SATIN

BUSINESS STAFF

Assistant PublisherE. D. MUELFELD
Advertising Sales ManagerW. E. BROWN
Circulation DirectorL. L. BRETTNER
Promotion ManagerS. A. RYNAS
Research ManagerD. T. FOSSELL
Advtg. Service ManagerMRS. G. BUSSELL
Production ManagerJ. F. WALEN
Ass't Production Mgr.ELSIE GRAY
New York17 East 48 Street
Eastern Advtg. Mgr.P. B. KINNEY
Detroit201 Stephenson Bldg.
K. J. WELLS
Chicago139 N. Clark St.
G. E. YONAN
Los Angeles8929 Wilshire Blvd.
J. A. CLAAR
C. R. MARTZ, JR.
Miami208 Almeria Avenue
R. C. HAGER
Toronto12 Richmond St. E.
ALLIN ASSOCIATES
London28 Bruton St.
NORALL & HART

m/r Volume 5 Number 12

Published each Monday by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C.

WAYNE W. PARRISHPresident & Publisher
LEONARD A. EISENERExecutive Vice President
& General Manager
E. J. STACKPOLEVice President
FRED HUNTERVice President
ERIC BRAMLEYVice President
ROBERT A. PARRISHVice President

Printed at the Telegraph Press, Harrisburg, Pa.
Second class postage paid at Washington, D.C.,
and at additional mailing offices. Copyright
1959, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal
Union Nations—1 year, \$8.00; 2 years, \$12.00;
3 years, \$14.00. Foreign—1 year, \$20.00; 2
years, \$30.00; 3 years, \$40.00. Single copy
rate—\$.75. Subscriptions are solicited only
from persons with identifiable commercial
or professional interests in missiles and
rockets. Subscription orders and changes
of address should be referred to Circulation
Fulfillment Mgr., m/r, 1001 Vermont Ave.,
Washington 5, D.C. Please allow 4 weeks for
change to become effective and enclose
recent address label if possible.



missiles and rockets, March 23, 1959

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

MARCH 23 HEADLINES

DOD'S R&R Chief Outlines His Views

Dr. Herbert F. York believes weapons should be given priority in relation to their mission, plans to push industry research 21

Research for Greater Tungsten Use

Fansteel expands production techniques and sees vastly increased applications in missiles and space vehicles 22

Who Should Own the Moon?

Man finds little precedent for meeting problem which must soon be dealt with; U.N. ownership may be best hope 24

Manager of Rocketdyne's Engine Empire

Sam Hoffman traces company's growth to leadership in booster-building, reports some future plans 26

ASTRONAUTICS ENGINEERING

Metals Congress Discusses Missile Problems

Los Angeles meeting hears progress reports on new approaches to strength and fabrication puzzles 29

USSR Will Miss World Flight Congress

Las Vegas "off limits" to Soviets, but more than 40 nations should benefit from technical exchange at April 12-19 meeting 49

MISSILE ELECTRONICS

Plasma-Jet Testing at Huntsville

Prototype facility achieves temperatures up to 50,000°F program initiated by Dr. Thomas A. Barr, Jr. 39

DEPARTMENTS

Editorial	11	West Coast Industry	48
Washington Countdown ..	15	Contract Awards	50
Industry Countdown	19	Book Reviews	51
Missile People	47	When and Where	52



COVER: The power behind Rocketdyne's phenomenal growth is Sam Hoffman (p. 26).



NEW fabrication techniques for tungsten use in missiles have been developed (p. 22).



VARIAN Associates has developed this 12-foot, 900-pound klystron tube for missile tracking.



FIRST Talos to be fired at sea leaves the deck of the guided missile cruiser USS Galveston.



PLASMA jet test facility is in prototype operation at ARGMA, giving new capabilities for AOMC (p. 39).



a comparison:

4 MAGNESIUM ALLOYS for elevated temperature service

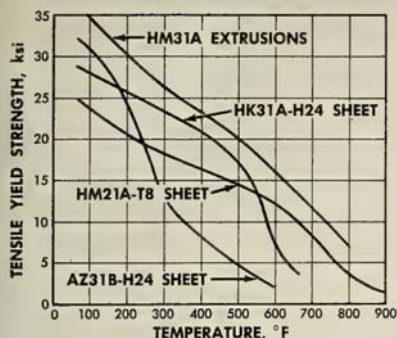
A wide variety of elevated temperature alloys extends the use of lightweight magnesium into the critical 300°-800°F. temperature range.

Name your weapon—Jupiter C, Polaris, Talos, Discoverer, Falcon or Bomarc. All make extensive use of elevated temperature magnesium alloys. Improved resistance to creep, increased stiffness and strength and exceptional shop characteristics are the long suit of these materials. At elevated temperatures they maintain a high ratio of fatigue strength to static strength. (About the same ratio as standard magnesium alloys at room temperature.)

SHEET AND PLATE

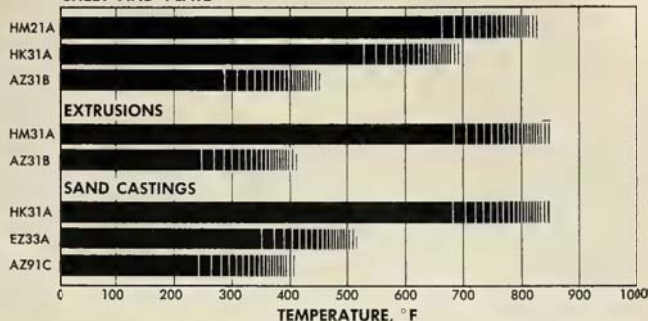
Alloys HK31A and HM21A have been widely used for many different parts in missiles, rockets and aircraft. Some of the most common applications include body skins, engine air inlets and ducts, nose cowlings and cones, external and internal skins on control surfaces. HK31A extends the usefulness of light-

missiles and rockets, March 23, 1959



New alloys have extended magnesium's useful service temperature range.

SHEET AND PLATE



A comparison of short-time tensile yield strength exhibited by a standard magnesium alloy and the commonly used elevated temperature alloys.

weight magnesium to a temperature of 500°F. and above. HM21A withstands temperatures up to 700°F. and higher for short time periods. And it exhibits better creep resistance above 350°F. and better static properties above 550°F., than does HK31A.

FORGINGS

At operating temperatures up to 800°F., HM21A offers excellent mechanical properties, optimum creep resistance. HK31A has better room and elevated temperature properties up to 400°F. Both have good forgeability.

CASTINGS

Engine air inlets and ducts and housings for electronic guidance systems are examples of the many applications of cast magnesium alloys HK31A and EZ33A. EZ33A has good general properties in the 350°-500°F. range. HK31A is recommended up to 700°F. and above. Components of military systems weighing as much as 105 lbs. have been cast in one piece with HK31A. A new elevated temperature alloy for die casting is now in development and will soon be available.

EXTRUSIONS

Alloy HM31A has put the many benefits of elevated temperature magnesium into extrusion form. This alloy is used as ribs and horizontals in missile bodies, instrumentation booms and external tunnel fairings for wiring and plumbing, etc. HM31A maintains high elastic modulus, excellent creep resistance and strength at elevated temperatures. Elevated temperature exposure at 600°F. for 1,000 hours causes no change in room temperature properties and only a slight drop in creep strength.

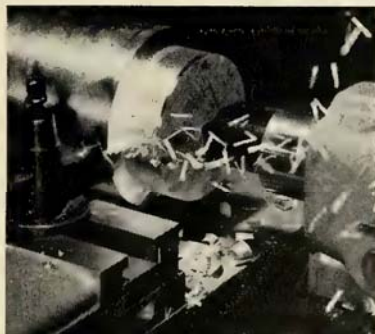
ELEVATED TEMPERATURE MAGNESIUM EXCELS IN PRODUCTION

The elevated temperature alloys possess the best welding characteristics of all magnesium alloys. Arc welded joints can be easily made and welding compatibility of magnesium alloys is excellent. For example, HK31A sheet can be welded to HM31A extrusions.

Weld efficiencies at room temperature range from 70% to 80%. At temperatures above 400°F., HK31A has a weld efficiency of 100%. The same goes for HM21A above 500°F. In general, preheating and stress relieving are unnecessary with these alloys. They can be readily spot welded and are not subject to cracking.

Machining operations can be carried out at extremely high speeds, with heavier depths of cut and higher rates of feed than are possible with other metals. All chemical treatments used to finish standard magnesium alloys are

applicable to the elevated temperature alloys, with the exception of Dow 7, which does not coat satisfactorily on magnesium-thorium alloys. For extended service above 400°F., the anodic treatments are preferred.



Elevated temperature alloys possess the same excellent shop characteristics—such as machining, forming and welding—as the standard magnesium alloys.

MAGNESIUM ALLOYS FOR ELEVATED TEMPERATURE APPLICATIONS

SHEET	HK31A HM21A
PLATE	HK31A HM21A
FORGINGS	HK31A HM21A
CASTINGS	HK31A EZ33A
EXTRUSIONS	HM31A



WRITE TODAY for this new 27-page illustrated brochure on magnesium alloys in aircraft and missiles. THE DOW CHEMICAL COMPANY, Midland, Michigan, Magnesium Sales Dept., 1301CL3-23.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

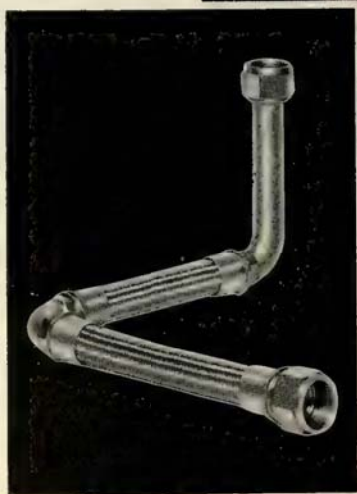
Stratoflex assemblies help fuel THE MIGHTY ATLAS

Every time a Convair Atlas intercontinental ballistic missile lifts from its Cape Canaveral launching pad, fantastic demands are made of the fueling system and powerplant.

A touch of the blast-off button triggers hundreds of simultaneous chain reactions in the giant ICBM's fuel system. Under tremendous pressure, liquid oxygen is delicately and precisely force-mixed with a kerosene-like fuel and flashes through the lines as vapor to feed the fires burning in the combustion chamber. This blend, mix, fire sequence must commence in a split second and continue at tremendous speed if the launch is to be successful. Fuel line plumbing on the Atlas must be absolutely leakproof, immune to strong vibrations, and able to withstand continuous temperature variations.

Despite the infinite possibilities for human mistake and material malfunction, the Air Force, aided by Convair technicians, has successfully launched the Atlas ICBM time after time at Cape Canaveral. (In the spectacular December 18, 1958 firing, the 85-foot Atlas was placed in orbit around the earth.) Stratoflex is proud that its specially-designed Teflon* hose and metal tubing assemblies are vital parts of the Atlas fuel line system.

* A DuPont trademark



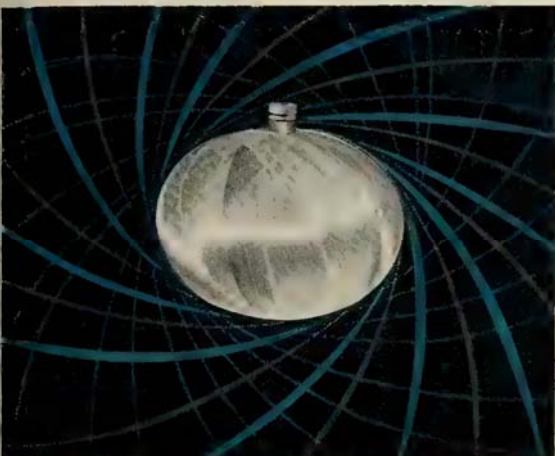
STRATOFLEX Inc.

P.O. Box 10398 • Fort Worth, Texas
Branch Plants: Los Angeles, Fort Wayne, Toronto
In Canada: Stratoflex of Canada, Inc.

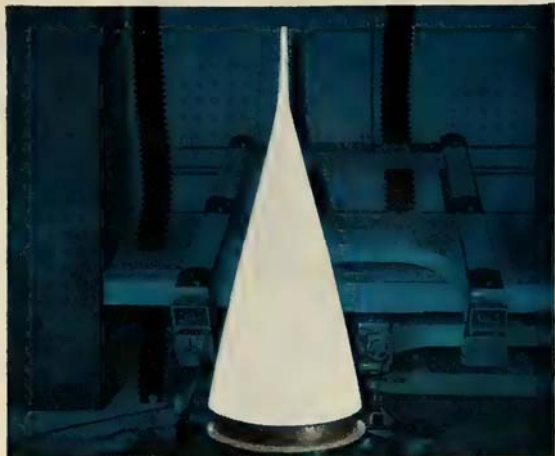


SALES OFFICES:
Atlanta, Chicago,
Cleveland, Detroit,
Fort Wayne,
Fort Worth, Houston,
Kansas City, Los
Angeles, New York,
Philadelphia,
Pittsburgh, San
Francisco, Seattle,
Toronto, Tulsa

Brunswick technology leads the way in three critical space-age components



PRESSURE VESSELS AND MOTOR CASES, fabricated by Brunswick's exclusive Strickland "B" Process, now have the highest strength-to-weight ratio ever obtained in filament-wound components. Brunswick is *now* producing these virtually leak-proof pressure vessels. Brunswick also fabricates motor cases capable of withstanding extremely high pressures and temperatures.



RADOMES AND NOSE CONES, created by Brunswick's outstanding research and development efforts and filament winding process, are being used on supersonic aircraft such as the advanced Convair F-106 and McDonnell F4H, as well as on missiles such as the Boeing Bomarc, Lockheed Q5 and similar missiles. And, of course, Brunswick capabilities include complete electronic design and test facilities.



HONEYCOMB ASSEMBLIES, now developed by Brunswick can support two million times their own weight. Brunswick research has created honeycomb assemblies of paper, fiber glass, aluminum and stainless steel as well as conventional forms. Using the most advanced adhesive systems, these assemblies can be formed in compound curvatures with extremely close tolerances.



RESEARCH, DEVELOPMENT AND TESTING—carried on by Brunswick teams have contributed heavily to space-age technology . . . most notably in solving problems of increasingly high operating temperatures (600°—4,000°F.) for critical components and new heights in strength-to-weight ratios. For full information on how this leadership can help you, write or call Brunswick today!



BRUNSWICK

DEFENSE PRODUCTS DIVISION • 1700 MESSLER STREET • MUSKEGON, MICHIGAN



STRAIGHT TALK FROM

TEMCO

AIRCRAFT DALLAS

QUESTION: What is Temco's experience in the fields of electronics, aircraft and missiles contracts?

ANSWER: During the past 14 years, Temco has successfully completed 35 major programs requiring solutions to engineering design problems in all technical fields involved in the aeronautical sciences. It has produced more than 5,000 components of high performance military weapons systems.

QUESTION: What is the scope of management's knowledge and participation?

ANSWER: Programming under top management is initiated at the earliest project stage and maintained throughout the existence of the job. Overall progress is reviewed at periodic check points, to permit timely corrective action if necessary, and to keep management and the customer informed on the program status.

QUESTION: What are Temco's plant facilities?

ANSWER: Temco has three major plants, comprising over 2,000,000 square feet, fully equipped for the development and manufacture of complete aircraft, missiles and major components. Included is a new Engineering Center with ultra-modern laboratories and experimental design area. Construction is scheduled early this year on vastly increased production facilities.

QUESTION: What are Temco's engineering capabilities?

ANSWER: Temco has over 1,200 engineers whose combination of skills and unique capabilities has established Temco as a leader in advanced technology.

QUESTION: What is the range of Temco's product familiarity and production know-how?

ANSWER: Temco is prime contractor and weapons system manager for the Navy's Corvus air-to-surface "stand-off" missile; it has designed, developed and produced the TT-1 "Pinto" jet trainer and the XKDT-1 "Teal" rocket powered target drone. In the component field Temco products range from integrated antenna systems to high production major assemblies for such advanced aircraft and missiles as the F3H, F-101, F-104, B-52G, Hawk, jet engines and work on classified ballistic missiles. In the modification and overhaul field, activities have spread all the way from "PARC" overhaul of C-97s to development and installation of advanced electronics systems.

QUESTION: What plus does Temco offer?

ANSWER: Temco is known by its customers as a "follow-through" company, from design to production... a partner on the job... a company that delivers quality products on schedule at the lowest possible cost.

SYSTEMS MANAGEMENT

DIRECTED RESEARCH

DEVELOPMENT

PRODUCTION



ELECTRONICS • AIRCRAFT • MISSILES

Six Lines for the V-2

Dr. Walter Dornberger, dean of the famous German "paperclip" scientists who have contributed so much to this country's missile and satellite programs, tells this story (paraphrased) of building the V-2, the world's first operational ballistic missile:

"The specifications consisted of six lines. Those lines directed me to build a missile which would do so-and-so. They didn't tell me how to build—just what to build."

In last week's issue of M/R, Managing Editor Don Perry reported that there is grave danger that our military "spec" writers may be endangering the nation's defense system by over-particularizing their orders to industry, particularly in the field of transistors. The report Perry wrote was discussed with M/R's electronics staff and checked in detail with the magazine's editorial board.

It said that in some cases the military contract writers were pushing the state of the art too far by demanding—in weapon systems—complete transistorization of electronic equipment before these relatively new items of electronic hardware have been proven; that the non-solid state devices—transducers and diodes—still require more research in one most important field before they can be cleared for complete operational work. That field is the determination of nuclear radiation effects upon them.

In other words, can our missiles and satellites as they are presently equipped pass through primary and secondary radiation and perform effectively?

The truth is that we do not know. We are not completely sure of it whether they are equipped with transistors or with vacuum tubes, which have been around a great deal longer. In some areas the transistor has been pretty thoroughly tested; in other fields the vacuum tube has been. But there are other fields in which neither is certain.

We have no quarrel with either transistors or tubes. Both are products of the large missile electronics fields which this magazine serves. But we do feel we are doing the nation a service by pointing out industry's viewpoint that neither the transistor nor the vacuum tube is the answer to all evils nor the perfect tool for every job.

Nor do we feel that it is the job, normally, for the gentlemen sitting in the Pentagon, who frequently are a little further away from realism than industry's workmen, to specify in arbitrary detail the minute hardware components comprising space systems. We feel sure there are times when a combination of transistors and tubes, say, might produce a better instrument and that no one is better qualified to say this than the man responsible for building that instrument.

There are evidences that the military's insistence on use of the newer and perhaps more glamorous transistor, with its undeniable advantages of smaller size and less weight, has delayed certain of our military programs. There is evidence in others that revised specifications now call for using whichever device can do the job better, the transistor or the tube.

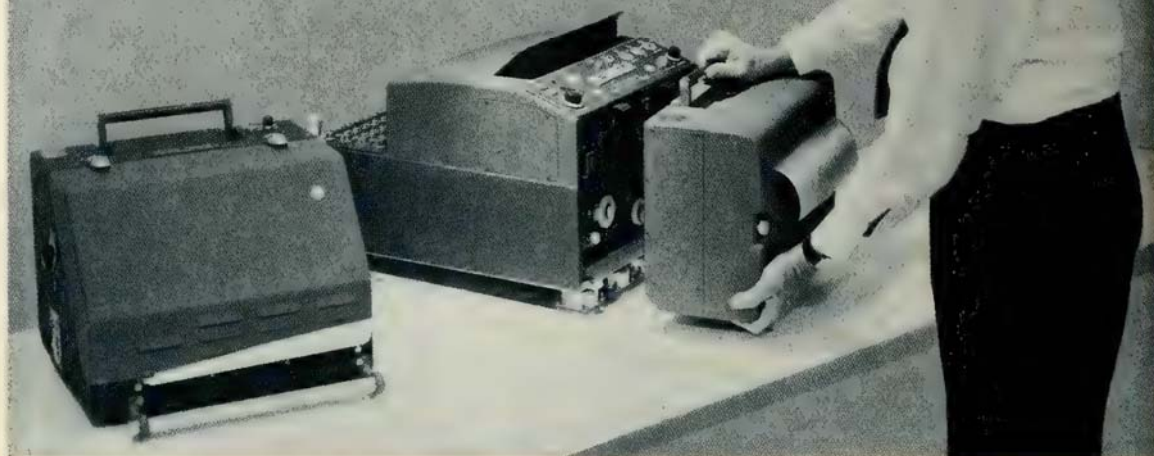
Again, it is not our purpose to decry either of the two systems, to say that either is better. But we do think it is our job to point out the situation and to point out further that in these days of racing against time for both space supremacy and defense capability, this is no time to be playing tic-tac-toe with destiny.

Every missile and space project this country has achieved has been the product of U.S. industry. No military service really builds an engine or a nose cone or a guidance system. The service job is to foresee the need, come up with the requirement, levy on industry and supervise. In some cases the Army has assembled. But largely it has and always will be industry which produces the detailed hardware.

In doing this industry must have latitude to use the device which will best perform the mission, not suffer under specifications which are both arbitrary and so finely detailed that they can and probably do affect the final performance of the product. The specifications given Dr. Dornberger may have been a little too general. (In those days there wasn't any state of the art; there wasn't any art.) But somewhere between his six lines and the detail of today must lie a reasonable and happy medium.

Clarke Newlon

CEC's 5-119 Recording Oscillograph...
First Practical Approach to a UNIVERSAL
Oscillograph... Now Available for
Use With DIRECT-PRINT Materials.



New recording versatility with 3 interchangeable magazines

With a new high-actinic light source and Slot-Exit Magazine, the 5-119 now becomes one of the most truly universal tools of data processing available. Addition of the direct-print process and new magazine to the 5-119 now brings you three uniquely different recording processes, enabling engineers to select the process best suited to specific test requirements.

PROCESS 1 DIRECT-PRINT... Clearly resolves writing speeds to 100,000 ips. High-actinic light source 5-119 P4-36V (or -50V) and new 5-051 Slot-Exit Magazine produce records on standard direct-print papers without chemical processing of any kind. Records emerge from the magazine slot continuously, and latensification takes place in ordinary room fluorescent light.

PROCESS 2 RAPID-ACCESS... Provides the shortest access time of any known process, and yields records of higher trace contrast and greater per-

manency than afforded by direct-print materials. Process employs the 5-036B DATARITE Magazine which automatically develops and dries oscillogram as quickly as data are recorded. Provides ready-to-read test results almost simultaneously with the occurrence of events under study.

PROCESS 3 CONVENTIONAL... Used where the finest available recording trace and contrast with highest writing speed are paramount requirements. Records are contained by the 5-006A Standard Magazine which uses conventional 12-inch films or papers. Records are processed following the record run.

The 5-119 provides 36 or 50 independent data input channels... Wide record-speed and frequency-ranges... Flash-Timing System to synchronize timing lines of 2 to 100 remote oscillographs. For complete details call your nearest CEC sales and service office, or write for Bulletin CEC 1536-X5.

Electro Mechanical Instrument Division

CEC

CONSOLIDATED ELECTRODYNAMICS 300 N. Sierra Madre Villa, Pasadena, Calif.

FOR EMPLOYMENT OPPORTUNITIES WITH THIS PROGRESSIVE COMPANY, WRITE DIRECTOR OF PERSONNEL

new Pesco accessories...

- *advanced design*
- *missile-quality*
- *high reliability*

new

AXIAL FLOW FANS



New Pesco fan designs are constantly being developed for new applications, environments, requirements. Built-in Pesco electric motor, custom-designed for each application, assures maximum efficiency and reliability. Capacities from 5 to 5000 cfm, in 27 volt d-c, 400 cycle a-c and special designs for cooling airborne and ground electronic equipment, helicopter engine oil, missile support systems.

These new accessories exemplify the advanced production models available to meet today's aircraft/missile performance demands. Undivided responsibility for component design and production enables coordination in the development of each new system or accessory. True systems engineering assures matched component performance and maximum reliability.

When you need a fresh approach to accessory system problems, take advantage of Pesco's facilities and advanced designs.



new **ELECTRONIC COOLING PACKAGES**

Pesco electronic cooling packages are remarkably smaller, lighter, quieter, simpler. Integral, miniaturized design eliminates external tubing and fittings, avoids leakage problems. All components are Pesco—**assuring single source responsibility**, matched performance, less maintenance, faster delivery. Specially designed for ground and airborne applications.

**PESCO PRODUCTS DIVISION
BORG-WARNER CORPORATION**
24700 North Miles Road • Bedford, Ohio

new

INVERTERS



For d-c to a-c inversion in missile secondary power systems, Pesco Inverters provide maximum reliability, miniaturized package design and simplified, rugged construction. The Pesco electric motor, speed control and alternator are built integrally on the same shaft. Models are adaptable to applications within the 26 to 56 volt d-c input range. Output may be either single or three-phase, 400-cycle a-c up to 12 kva. Inverter maintains output voltage to $\pm 1.0\%$ with $\pm 2.5\%$ output frequency variation.

new



SERVO VALVES

High-fidelity Pesco Servo Valves are electro-hydraulic transducer type, feature unique flow-sensing principle. Meet toughest missile requirements with excellent system stability, insensitivity to operating variables and dirt, minimum null shift, fast response, faithful reproduction of smaller input signals, minimum threshold and dead zone. Miniaturized and designed for consistent, high-quality mass production.

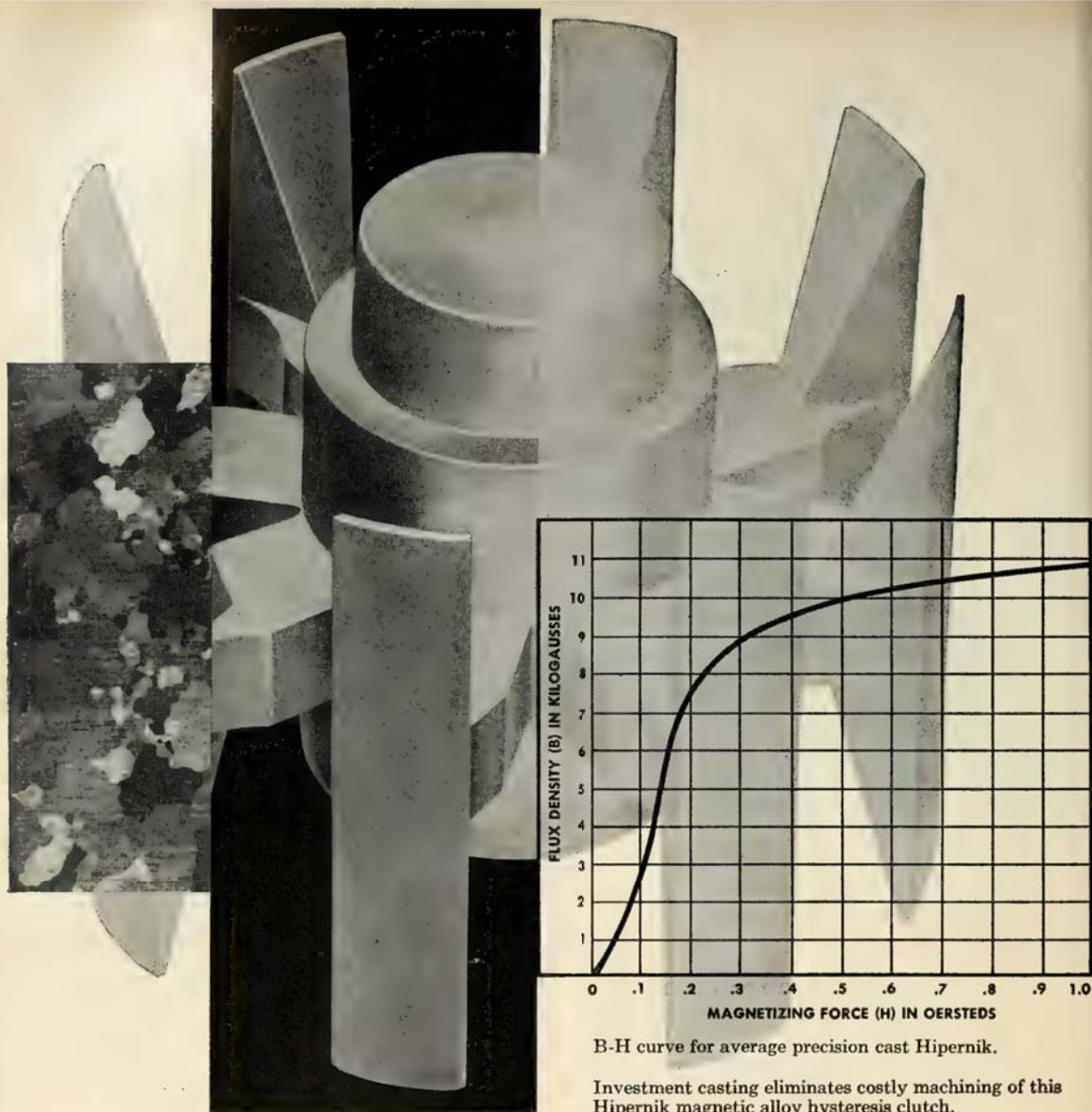
watch Pesco for continual new developments in:

- high-speed, high-temperature hydraulic pumps and motors
- fuel, fuel booster, cryogenic and propellant pumps
- power packages
- secondary power systems
- air pumps and motors

PESCO...



means progress in
aircraft/missile systems and accessories



B-H curve for average precision cast Hipernik.

Investment casting eliminates costly machining of this Hipernik magnetic alloy hysteresis clutch.

Westinghouse Hipernik Casting
... cuts costs,
retains
magnetic properties

The field of electronics has created special metal problems. The Westinghouse Metals Plant has accepted and solved some of these problems.

Cast Hipernik® is particularly adaptable to the requirements of missile control systems. Other applications in the electronic control and instrumentation fields are transformer cores, pole pieces, solenoids, torque motors, magnetic clutches and many special magnetic applications.

The Westinghouse Metals Plant may be able to cut your costs by eliminating unnecessary machining, yet delivering to you a completely finished component ready for assembly. This modern metals plant can furnish strip, sheet and bar stock in other magnetic and high temperature alloys. Write to: Westinghouse Metals Plant, Blairsville, Pennsylvania. Our latest bulletin on Hipernik will be sent to you by return mail.

J-05005

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS-TV MONDAYS

washington countdown

Three more ICBM bases . . .

have been announced by the Air Force. They are near Ellsworth AFB, S.D. and Mountain Home AFB, Idaho, for *Titan* and Schilling AFB near Salina, Kan. for *Atlas*. This brings to 10 the number of ICBM launch sites announced thus far.

Some 60 possible promotions . . .

retirements and reassignments of Air Force general officers are being considered by Defense Secretary McElroy, many of which must go to Congress and the White House for final approval. It may be some time before the list is finally decided upon but one promotion and reassignment may be pulled out and ahead of the rest. That would be the third star for present Maj. Gen. Bernard Schriever and his assignment to be commander of Air Research and Development. His present job is CG of the AF Ballistic Missile Division.

The mystery firing . . .

at Cape Canaveral a few days ago was another tryout of McDonald's two-stage, solid fuel air-launched ballistic missile, code named the *Draca*. McDonald is one of several companies in the ALBM competition.

Mail by missile . . .

is under consideration by the Post Office Department as an experiment sometime this year. A PO spokesman said in answer to questions that the project still is in the "think stage" but that the department is "most anxious to keep abreast of the times" in mail delivery. He said the test vehicles probably would be obsolete *Snark* or *Regulus* missiles.

Reconnaissance satellite program . . .

expected to change hands. Chances are good that NASA will take control of *Discover* and the follow-on but probably not WS-117L, *Sentry*. Transfer won't be made by ARPA until next fall. Idea is that State Department would like to convince Russia that satellite is for peaceful purposes only. Meteorological satellite will be transferred by

ARPA July 1. It is a 250-pound vehicle carrying an RCA television said to be so sensitive that it shows 500 lines to a millimeter.

Man of the hour . . .

In Washington last week was Dr. John P. Hagen, director of the Vanguard project. He received the Navy's Distinguished Civilian Service Award, and was guest of honor at a reception and dinner marking the first anniversary of the launching of the *Vanguard 1* satellite.

Carrying a source of energy . . . space . . .

into space is a major problem, Hagen said. One solution is seen in the solar cell still supplying power for transmissions from *Vanguard 1*. H. Leslie Hoffman, president of Hoffman Electronics Corp., said the cells, originally conceived by Bell Telephone Laboratories, and developed by Hoffman, had been increased in efficiency by about 400%. He predicted a broad use of the cells as a power source in space vehicles.

Compulsory competitive bidding . . .

for defense contractors got further support with the introduction of a bill by Sen. John J. Williams (R-Del.). Williams said the bill was prompted by reports from the General Accounting Office. It provides contracts must be awarded to lowest bidder except when unfeasible from a national security standpoint.

Major weapons system managers . . .

can expect summons from House Armed Services subcommittee. Chairman F. Edward Hebert (D-La.) said last week a comprehensive procurement investigation "is long overdue." He said some critics of weapons system procedure call it a "blank check." The "administered price" will come in for a lot of attention in the new investigation, he said. At least four manufacturers have been advised by the committee exactly what kind of information the subcommittee wants regarding financial arrangements, performance rates, facilities, termination costs and cost allowance. Hearings are scheduled to begin after the Easter recess ends April 6.



solving today's problems today: Burroughs 220 Computer

In scientific computation and business data processing, the new Burroughs 220 is delivering tangible results today. Linking a powerful digital computer to equally powerful input-output subsystems, the 220 offers balanced performance at the lowest application cost. Its expandable core memory, built-in floating decimal arithmetic, vast Datafile magnetic tape capacity and the multiple-card processing ability of Cardatron make this the most powerful system available in the medium price field. The 220 is just one part of a complete line of advanced Burroughs electronic data processing equipment...now in production...now at work in hundreds of installations...supported by an outstanding team of computer specialists. Write today for 220 brochure, ElectroData Division, Pasadena, California.



Burroughs Corporation

"NEW DIMENSIONS/in electronics and data processing systems"

Research: opens the door to space



Space Technology Laboratories is responsible for the over-all systems engineering, technical direction, and related research for the U.S. Air Force Ballistic Missile Programs. To carry out the fundamental investigations of those physical phenomena related to very advanced and long-range problems of space technology, STL established the Physical Research Laboratory.

This laboratory is making significant contributions in experimental and theoretical research in the fields of controlled fusion and associated plasma physics, magnetoaerodynamics and low temperature solid state physics.

Dr. Milton U. Clauser, Vice President of the Company and Director of STL's Physical Research Laboratory, draws upon a rich background of industrial, as well as academic, experience and achievement in charting the areas of research that will be important to the space technology of the future.

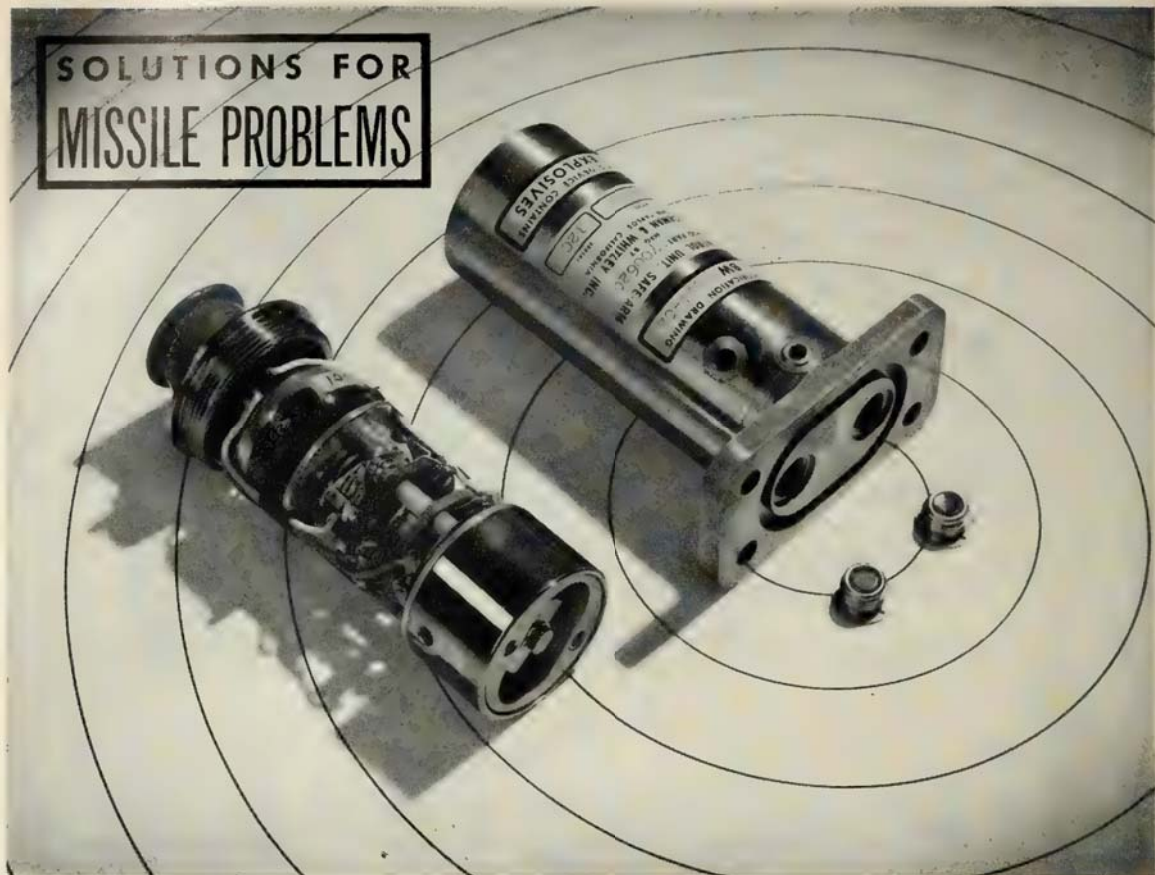
The professional staff of the Physical Research Laboratory, the majority of whom hold the Doctorate, are supported by unusual shop facilities and a complete staff of technicians. Also available is an outstanding digital computing center within the STL complex. Scientists and engineers with competence and imagination in fields related to advanced cryogenics, fusion physics and magnetohydrodynamic investigation, are invited to inquire about Staff positions.

Space
Technology
Laboratories,
Inc.



P. O. BOX 95001, LOS ANGELES 45, CALIFORNIA

SOLUTIONS FOR MISSILE PROBLEMS



safe/arm initiators

Ten years of pioneering in the missile component field has made possible this new line of Beckman & Whitley solenoid-operated safe/arm explosive initiators. Unit on the left has cover removed to show internal arrangement.

Weighing only 1.85 lb loaded, this model is 5 in. by 3 in. by 1 $\frac{3}{4}$ in. It was designed to military requirements. It can be armed or disarmed by remote electrical signal and includes both visual and electrical telemetering facilities for indication of armed or disarmed condition. On reception of a

command firing signal, the unit will initiate associated primacord, low-energy detonating cord, (LEDC) or bulk charges.

This may be just what you need. On the other hand, Beckman & Whitley can provide the engineering capability, the production facilities, and perhaps most important, the speed necessary to give you anything you *do* need in the line of propellant-actuated devices.

Just tell us your problem.

Beckman & Whitley INC.

SAN CARLOS 16, CALIFORNIA

industry countdown

NASA will control . . .

design and development of all space-missile propulsion projects after June 30. On that date, the space agency will take over control of *Centaur*, second-stage liquid nitrogen-propelled rocket being worked on by Convair and Pratt & Whitney.

Centaur's second-stage . . .

incidentally, consists of two 15,000-pound-thrust rocket engines using liquid hydrogen. It may also have a third stage same as *Vega* with 600-pound thrust under development at JPL. The combination reportedly is 50% more powerful than *Vega*.

Work with new HILAC . . .

atom-smasher at University of California's Lawrence Radiation Laboratory points toward revising the belief that cosmic radiation will damage humans in proportion to the weight of each type of atomic nuclei. An AEC-sponsored program indicates that damage increases with nucleus weight only up to a certain point, then levels off.

Fluorine-based liquid fuels . . .

will out-perform proposed boron-based solids in payload-orbiting ability even if the latter come into being soon, according to a Rand Corp. research engineer. The expert, Martin Goldsmith, says in a report that this is true even though the boron-based fuels may give higher specific impulse than present LOX hydrocarbon combinations. He added that solids will always require heavier vehicles than liquids for a given job of orbiting.

Frame contract bids . . .

for Project *Scout* should be opened on Monday, March 23. Between 20 and 25 bids are expected.

Titanium prices will drop . . .

to about \$1.50 per pound ultimately, in the opinion of metals experts. The say a large commercial market for the metal has yet to be tapped.

Tensile strength of 750,000 psi . . .

in some steel alloys is "within reach," according to metals people. The ultra-high-strength steels have far surpassed their former characteristics and are now considered "new" metals.

Snark production is programmed . . .

through calendar 1960, despite misleading statements to the contrary, Production models, painted grey, continue to roll out of Northrop's facility at Hawthorne, Calif. Checkout before delivery to SAC is being done at the Norair Division.

About \$1,770,000 will be spent . . .

on initial construction of limited *Minuteman* test facilities at Edwards AFB, Calif., the Air Force says. The construction, now underway, will include buildings for instrumentation and control, assembly and shop-work. Additional component testing will be done at Holloman AFB and the complete system eventually will be flight tested at Patrick AFB.

Secode Corp. of San Francisco . . .

a developer of electronic communications equipment, has acquired a "substantial" interest in C. A. Rypinski Co., Southern California producer of regulated power supplies for missiles.

Polaris exhaust nozzle liners . . .

have been contoured by forming molybdenum forgings into the desired shape by hydrospinning at 1000° F. The advanced process was carried out at the Wright Aeronautical Div. of Curtiss-Wright and described recently in C-W's annual report. The report also noted that the division was involved with development of inert components of propulsion for *Minuteman* and *Pershing* as well as *Polaris*.

A weapons system management . . .

proposal for an Air Force ASM is being prepared by Northrop-Norair. Team members include Nortronics, ITT, AVCO and Aerojet-General.

One of the most modern . . .

printed circuit manufacturing facilities opens on April 15 when the U.S. Engineering Co., a division of Litton Industries, moves into a new plant at Van Nuys, Calif. It will be the "only fully integrated printed circuit operation in the country," according to Jack Gentry, USECO's general manager. The plant should be in full production by the end of April.



T/I combat surveillance

Stay 'home' and see more

Aggressor terrain and positions are open secrets to TI-equipped recon drones and snoopier aircraft. Field commanders can now reconnoiter "in person" far behind aggressor lines *without leaving field HQ*. Instant, accurate, continuous data on thousands of sq mi of hidden territory can flow into headquarters *in the time one foot patrol could complete its mission*. Hundreds of targets can be spotted, evaluated and brought under fire in the same time interval . . . most of them within seconds after detection.

● *This capability exists now at Texas Instruments.* For detailed discussion, military and industrial personnel with need to know please write or call: SERVICE ENGINEERING DEPARTMENT.

RESEARCH/DESIGN/DEVELOPMENT/MANUFACTURING of systems for: Air traffic control • Airborne early warning • Antimissile • Antisubmarine warfare • Attack control • Countermeasures • Missile systems Navigation • Reconnaissance • Space electronics; and on detector cells, engine instruments, infrared, intercom, microwave, optics, sonar, telemetering, time standards, timers, transformers and other precision equipments.

APPARATUS DIVISION

TEXAS



INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE
DALLAS 9, TEXAS

Some Views of DOD Research Chief York

Pentagon's first R&E director gives priority to weapons system on basis of importance of its mission and

encourages industry to do more research on its own. He will add new offices to bolster the development present set-up.

by Paul Means

WASHINGTON—Dr. Herbert F. York, first man ever given the power to direct the Department of Defense's entire research and engineering program, has told M/R he intends to:

- Assess the importance of a new weapon in relation to its' mission and not its components and environment.

- Engage industry to do more research . . . with less of it becoming systems work.

What goes on behind door 3E-1006, Pentagon has been a question of great curiosity and concern to Congress, the military, industry, the press and the entire nation ever since Dr. York was assigned this room in December as the first Director of Research and Engineering.

Recruiting with a big R is one of the major activities conducted behind the door. An interview which took months to schedule will be interrupted constantly while the new Director talks long-distance to a scientist or engineer he feels is needed to carry out the task of the new office.

The recruiting will continue until Dr. York's team has a few more than 100 members whose duty it will be to direct the expenditure of \$5 billion that will be spent on the thousands of DOD R&E projects in fiscal '60.

- **Problem of priorities**—One of the big problems that has plagued centralized Defense planning is: Where should the money go? Which new service project or weapons system is the most important?

Dr. York hopes to resolve this problem by evaluating the new weapon in relation to its mission instead of its environment or components.

He uses the early warning, navigational, and communications satellite projects as examples of what he means. The importance of these projects should be evaluated primarily in relation to the entire air defense, navigation and communication systems, and not solely

in relation to the space program or in relation to their boosters.

"How does the communications satellite fit into the entire communications Program?" This is the question Dr. York's office will ask in evaluating the need for such a satellite, and in deciding how fast its R&E should progress. The questions of where it fits in the space program and where it fits in the booster development program are secondary to the importance of its mission.

Dr. York intends to apply the same analysis to missiles, aircraft, ship propulsion, nuclear and conventional weaponry, propulsion, ground support, ground transportation, better bullets, materiel, food, blood preservation, and all of the major Defense R&E projects.

- **New offices**—To implement the evaluation of R&E projects in relation to their mission, Dr. York intends to augment the present offices dealing with the specific technical fields of aeronautics, electronics, atomic weapons, fuels, and guided missiles, with offices which will deal with overall military missions, such as air defense, tactical weapons, strategic weapons, communications, etc.

Dr. York considers these new "mission" offices important enough to be headed by Assistant Directors.

Under such a system, Dr. York should be able to assess with greater reliability which new project is most important, needs the most money, and should progress at the faster rate.

- **Industry research**—Another problem which Dr. York hopes to correct is the time and expense wasted on R&E for weapons systems which it is found later do not work or are not needed.

Dr. York said that he was going to see that industry does "more exploratory work, and that less of that kind of work becomes systems work."

He hopes to cut the tremendous cost of industry weapons development by supervising industry R&E, and cancelling projects when it is determined

that it will not result in a workable or needed component or weapons.

"We have to explore as many areas as possible, but it is difficult to limit exploratory efforts," Dr. York said. "When a contractor carries on extensive exploratory work on one project, he tends to think that his way is the only way to solve the problem."

Much of this evaluation is already done by the Systems Evaluation Group, whose scope of activities Dr. York intends to expand.

- **Selective approach**—Direct supervision by his office will be limited to the major projects. Dr. York points out that there are thousands of R&E programs and his small office could not hope to direct the spending of \$5 billion in detail. He said his office will pick those projects which he feels are important, and will keep track of the others.

Dr. York feels that his relationship to the Advance Research Projects Agency, which has the job of tying the military space program together, is identical with his relationship to the service R&E offices, and that ARPA projects will warrant the same type of direction from his office.

Besides evaluating R&E projects as to their relative importance in relation to the mission they perform, Dr. York feels his department must fight for those programs which are not as glamorous as others.

"Most of what we are doing is not shooting things up into the air. An important part of our job is to see that programs not as glamorous receive sufficient planning. We must make sure that no important projects are left out—or that none are left out because they are only half-important to two services," Dr. York said.

- **No conflicts**—Dr. York sees no conflict in goals, confusion, or duplication in the present science and military space programs. There are different programs he said, because different organizations have different missions in space.

(Continued on page 36)

Fansteel research opens new applications for missile electronics, propulsion and structures



RECTANGULAR PIECES are "boats" for containing small parts in furnaces, and round cups could be gyroscope rotors.

'Breakthrough' in Tungsten Fabrication

by Donald E. Perry

CHICAGO—Tungsten—twice heavier than iron but with the highest melting point of the refractory metals family—should assume important applications in missile and space vehicles if research in pure tungsten fabrication by the Fansteel Metallurgical Corp. is an indication.

Until last summer, tungsten was being fabricated in relatively simple shapes. Today, Fansteel has reversed the fabrication picture. Here's what the company is doing:

- A deep drawing process has been developed. To the company's knowledge it is entirely new within the last six months. It gives about a 20% increase in density over tungsten alloys now being used.

- Parts, while small to be sure, have been fabricated from tungsten sheet by spinning the almost unworkable metal.

- Self-financed—Fansteel's research to explore use of tungsten for rocket nozzles, electronic components and re-entry nose cones is self-financed. Most of today's government-sponsored research for rocket applications is going into molybdenum, with half the weight of tungsten and a melting point of 4752°F, compared with tungsten's higher 6152°F.

But Fansteel feels that expanding present limits of tungsten fabrication will make possible an endless stream of component parts for the missile industry.

For example, deep-drawn tungsten boats will make it possible to fire electronic tube components to higher temperatures so that better tubes can be manufactured. And, there is the possi-

bility of designing continuous metal evaporating equipment which in turn would reduce processing costs.

Most important, design engineers can consider deep drawing of tungsten sheet metal parts for vector control of rockets. Since the rocket nozzle is one of the most severely stressed parts, Fansteel believes there are tungsten requirements.

As rocket performance requirements increase, flame temperatures will become higher than molybdenum can withstand. Tantalum is being tried, but Fansteel thinks maximum performance will not be possible until tungsten is used.

While Fansteel is generally regarded as the leader in the tungsten field, it—like many other companies—is in deep with other refractories: tantalum, moly, and columbium.

- Binding challenge—One possible use of tungsten in rocket nozzles would

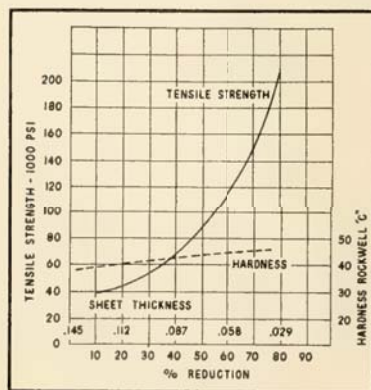
be to bind it to stainless steel in the throat section and allow the tungsten to take the punishment. However, this would add weight and pose a tremendous—but not impossible—binding problem. Use of nickel with tungsten probably would be a logical step.

Fansteel points out that deep drawing and machining can extend the use of pure tungsten for gyroscope motors. With about a 20% increase in density over tungsten alloys now being used, a drawn rotor may make it possible to decrease the size of gyro controls and yet retain their operational integrity. Tungsten has the lowest coefficient of thermal expansion of any of the metals presently used in rotor construction, Fansteel says.

- Brazing—Using gold, which has the same density as tungsten—19.3 grams per cubic centimeter (lead is 11.3)—as the brazing agent, Fansteel has come up with a miniature-sized container made from two drawn tungsten cups which can hold radioactive materials.

R. W. Yancey, consulting metallurgist in the metals and fabrication division, cites an interesting possibility for this process. He envisions two drawn tungsten cups brazed together at angles with gold that would be about the size of a potato. By drilling a hole in the bottom of one of the cups prior to assembly, it could be used as a radioisotope container.

In the SNAP III (secondary nuclear auxiliary power) project, decay of a Polonium 210 isotope created heat energy which was captured by thermocouples and produced five watts of power. Yancey believes tungsten could well serve as the casing for such power packages.



TUNGSTEN STRENGTH increases with work. Curves show effect of roll-reduction.



APPROXIMATE LIMITS of tungsten fabricability as of six months ago. All of this forming, of course, is done hot.



PARTS FABRICATED from tungsten sheet by spinning, an art dating back to Middle Ages but new to refractory metal.

• **Background**—Within recent years there has been a tremendous increase in interest and use of pure tungsten products or alloys containing a high percentage of tungsten.

While powder metallurgy has resulted in many high density products, the mechanical properties of these alloys have depended on the nature of the cementing agent, the weakest link. Melting point, density, high-temperature strength, modulus of elasticity of the alloys and other properties have been inferior to those of pure tungsten. Another drawback has been the difficulty of working the powder metallurgy product except by machining.

Another important reason why pure tungsten has not been used more extensively is the ratio of cost to economical performance. This has left little incentive to develop new manufacturing techniques in wrought tungsten, Fansteel feels.

However, the emphasis has changed rapidly in recent months. Today the military is emphasizing performance rather than cost. Factors influencing this emphasis are greater reliability and longer life in electronic components; processing materials at higher temperatures; and manufacturing of sturdier components and assemblies which can operate at high temperatures.

• **The tungsten problem**—Fabrication is exceptionally hard because it must be heated to temperatures at which stainless steel and some of the super-alloys would melt. Its working has to be done at a high temperature and must be done quickly.

After preliminary working, continued working is less severe. But here another problem enters the picture: As tungsten cools to a temperature approaching 800°F, it rapidly loses much of its ductility and rapidly gains in strength. Working tools have to be fabricated from an alloy that has good

high-temperature strength, plus an ability to withstand considerable wear.

Forgings are made in a series of steps, taking advantage of more ductility as the metal is worked further.

Another new Fansteel development is seamless tungsten tubing produced by hot extrusion. A tube was reduced by 70% of its original area, showing the extent that hot tungsten would flow under proper conditions. The extruded tube possibly could be used for drawing thinner-walled tubing, or it could be hot upset to make a special shape.

Materials for space vehicles—not only in power plants but in skin surfaces as well—pose uncertainty and difficulty. The requirements are basic: they must be easily formed into large sheets, welded, cast, or wrought to the desired contour.

Tungsten by its very nature is trying difficult, but Fansteel believes its research into new fabrication processes is crossing a metals frontier.

Plenty of Work for Small Firms, MIT Forum Is Told

NEW YORK—Convair's chief engineer predicts that a few companies with "demonstrated capabilities" will be given the responsibility for developing major systems in America's space program.

However, Mortimer Rosenbaum, head of the Convair technical staff that developed the *Atlas*, said here recently that other companies would have plenty of opportunity for subcontract roles.

Rosenbaum was a principal speaker at a forum on "Conquest of Outer Space" held at the annual technical dinner meeting of the MIT Club of New York.

The 300 attending also heard:

1. A top test pilot declare that qualified pilots lack enthusiasm for the

Project *Mercury* man-in-space plan because it is so automatic that the pilot has no control over his destiny.

2. An industrialist call for more research in metal strengths.

• **Sharing in *Atlas***—Rosenbaum said subcontractors handled 50% of the job General Dynamics' Convair Astronautics Division did on the *Atlas* major system. Of this subcontracting, 36% was done by small businesses.

There is room for small companies to do specialized work, too, Rosenbaum continued. As an example, he cited McDonnell Aircraft's victory on the Project *Mercury* capsule contract, bidding against G-D and other large companies.

• **Pilots balk**—Ralph Cokely, engineering test pilot for Boeing Airplane Co., told the forum he had yet to find a qualified test pilot who wants to test the Project *Mercury* capsule.

"A man should be given alternate means of manned control," Cokely declared.

The test pilot said there had been a trend in recent years toward building of aircraft with red and amber lights rather than gauges to indicate actual conditions.

"It is better to have a temperature gauge that predicts the problem before it arises than a flashing light, that tells you when it's too late," he asserted.

• **Metals work urged**—Everett T. Welmers, assistant to the president of Bell Aircraft Corp., told the audience that space technology requires considerable basic research in the reaction of metals to temperatures measured in the thousands of degrees.

"We have made considerable progress recently in chemistry, particularly in plastics," he remarked, "but we haven't gone so far in the field of metals. With many metals, we still are using techniques thousands of years old."

World Must Solve Brand New Problem of Moon Rights

Authorities seeking answers find few precedents to work with and most consider U.N. control the most feasible.

by Donald Cox*

BALTIMORE—Now that the Soviets have sent their *Mechta*—dream rocket—within 4600 miles of the moon on its way to solar orbit, we are suddenly aware of the problem of the ownership of our lunar orb.

Who owns the moon anyway? God? ... Gamal Abdel Nasser? ... The Soviet Union? ... The United States? ... All mankind? ... This question was academic before October 4, 1957, and was semi-dormant before January's *Lunik*, but now it is a pressing matter which in the very near future may be causing our State Department, Department of Defense and United Nations legal representatives loss of sleep.

For at the moment that the U.S. or the U.S.S.R. splashes the instrumented nose cone of a rocket on the dusty surface of our moon, the controversy over ownership will flare up into major proportions. For this reason, it is important that the various alternatives on ownership and control of the moon be examined now, calmly, so that we will be prepared for a better understanding of the problem when it becomes a stark reality ... which it should someday this year!

• **Staking claim**—This problem will be complicated further in a few years when the first man lands alive on the moon or circumnavigates it in a close-in orbit. Will the nation who sends the first man safely to the vicinity of the moon gain sovereign rights over its territory? Will the old rules of exploration which were applicable in the great days of the discovery of the New World still apply to the moon?

The precedents of international law would tend to lead one to believe that

planting an unmanned radar beacon in some lunar crater or mountain top might be a sufficient basis for a national claim to sovereignty by the nation which put it there. Fortunately, however, international law is a living organism and is subject to change, having passed through many stages of growth in the past.

Now, in its greatest moment of ascendancy, international law will probably have to look elsewhere than to the past to learn who should own and control celestial bodies like the moon. Since the moon undoubtedly will be the first focal point of man's space exploration, it will serve as a "live" guinea pig in the struggle for ownership and control of other bodies—the planets and their moons.

• **Four leading theories**—It is fairly obvious that we will not turn our backs on the ticklish subject of lunar ownership or conquest whether it be under a military or scientific banner, or both. If we did put our heads in the sand like the proverbial ostrich we would be burying our chances to participate in the last great adventure of mankind—the exploration of space.

But in facing up to our destiny and continuing our national plans to land on the moon, we will run the risk of meeting some "other national" lunar explorers head-on in some well-known lunagraphic terrain feature. Before that moment arrives, we might well spend some time examining four theories of possible lunar ownership and control and their consequences.

1. **National lunar subdivision concept**—As various nations send their human "space" representatives to the moon, some theorists believe, less friction will evolve up there and back here on earth if the moon is sliced up like a giant pie, subdivided into massive triangular real estate holdings and doled out to the interested nations by some previously-agreed-upon international lunar real estate corporation. This "lunar

suburb" theory holds that a subordinate body of the United Nations could be set up to divide the moon in advance, with the size of the slices being determined by population and relative power here on earth.

Each earth nation could indicate those areas or pie-slice parcels that it desired to explore and colonize. The large, underdeveloped nations of Africa and Asia—not yet technologically ready to participate in a mass colonization attempt—would have their plots held in escrow by the U.N. body.

This theory has many loopholes, including a considerable doubt that the nations of the earth would agree to such a plan. It is further complicated by the fact that mapmakers here on earth along with lunar real estate salesmen and legal experts might have trouble deciding which wall of which crater belongs to one nation rather than to another.

This concept probably is the least workable of the four.

2. **First come-first served**—Some experts feel that the first nation to reach the moon and establish a claim with an unmanned rocket or a manned lunar base could theoretically claim the whole of the moon as its own "seventh continent" of the earth. Although the Soviets did not say so at the time, the official photos of the *Lunik* sphere showed it liberally adorned with the hammer and sickle and "USSR" painted all over its surface.

This can only be interpreted one way: had *Mechta* impacted on the moon's surface while it was still called *Lunik*, the Soviets might have claimed the entire moon. Only when it was obvious that *Lunik* would miss the moon by several thousand miles did the Soviet propagandists slyly change the name of their instrumented payload to "Dream."

Even though *Mechta* missed its target, it emphasizes the coming problem of recognition or non-recognition

* Donald Cox, a frequent contributor to m/r, is the co-author of the book, *Spacepower*.

for the nation that first "plants its flag" on the moon. Whether recognition is granted by individual nations, like the Soviet satellites, or an international body, like the UN, is a minor point, if such an event occurs in the very near future.

What is more important is the ability of the nation that first lands an object on the moon to deny landing rights to other nations. Unless the first nation establishes many manned lunar military bases, it probably will find that it is almost impossible to prevent others from landing at will.

Because no one nation is so far ahead in the missile art, it appears unlikely that such unilateral denials will ever occur. This leads some theorists to propound the theory that the moon should be considered as *res nullius* ("Free for occupation"), like the undiscovered parts of the Antarctic continent. In this way, different governments could stake out non-conflicting, peaceful claims to various parts of the moon wherever they happened to land, provided someone else hadn't gotten there first.

Long before it was applied in Antarctica, this "first come-first served" approach was the unwritten—but thoroughly understood—basis for the exploration and conquest of the New World in the 16th and 17th Centuries.

In evaluating this theory, as it is working out in the Antarctic, it must be noted that none of the claims staked out there by the various earth nations before, during or after the IGY have been recognized by any international body.

3. Lunar national corridors—As manned spaceships travel over the moon's crust from close-in orbits, it is possible that their navigators will lay claim to wide corridors on the moon for their home countries. They could back these claims by presenting photographs before some international "space real estate" body on earth.

If such a system comes to pass, in advance of actual landing claims, disputes might arise over conflicting claims where space-photo mapping corridors overlap later moon tractor-explored corridors.

The Antarctic overland corridor surveyed by Sir Edmund Hillary and Dr. Vivian Fuchs on their dashes to the South Pole in 1957-58 theoretically could be claimed by both New Zealand and Britain.

But what about the supply aircraft which flew over the same territory? Couldn't they claim it? Weren't some of the planes used to supply the Hillary-Fuchs Snocat team flying the American flag? Therefore a conflicting claim in theory already exists in the Antarctic. If such methods were applied to the

moon, similar problems would arise.

At this writing, none of these Antarctic corridors have been recognized as sovereign to one nation. Similar moon claims may well be ignored in the same way.

4. A United Nations concept—The most feasible theory for future ownership of the moon is one that envisions putting our satellite under the control and jurisdiction of the United Nations. This presupposes that no staked land outposts or national corridors could be claimed by any earth nation. Rather, all of the lunar surface and its natural resources would be owned by the United Nations and leased by that body to groups of nations for peaceful exploration. The Trusteeship Council of the U.N. is the logical agency to undertake such a task, having had considerable experience with similar problems on earth.

Cooperation among the various nations during the IGY (1957-58) in the Antarctic offers some hope that similar cooperation could be undertaken on the moon. To make it work, the U.N. will have to have enough power to enforce and carry out such a mandate.

This means that the nations must give up more sovereign rights to that body than they have in the past. It applies mainly to the major world powers in the Security Council—and Red China—since the smaller powers have already given up much of their rights.

A new IGY applied to the moon, termed a "Lunar Graphical Period" (LGP) would be in order to set the framework for such an enterprise. Calling it a "period" instead of a "year" would eliminate the time-factor stigma, which has already caused a let-down among IGY scientists. It is fairly obvious that the moon is not going to be colonized in a year or eighteen months, anymore than launching small artificial earth satellites was restricted to the IGY.

• **Which concept?** Of the four concepts examined, each has its virtues and liabilities. Granting ownership of the moon to the U.N. is the most logical for the long run, but man doesn't always act by reason alone, and the result may well be a combination of the "corridor concept" and the "first-come" concept.

A titanic battle in space may be waged between the major earth powers for control of the dark side of the moon, which hasn't been discussed here. The outcome of such a battle could dictate ownership and control not only of the light side of the moon . . . but of the earth as well.

Time is short, and decisions on the ownership of our only natural satellite must be made before it is too late.

WHO OWNS THE MOON?



LOGICAL BUT difficult is to set up U.N. control of entire moon.



ONE SUGGESTION is division among the Earth nations.



SOME EXPERTS look for "first come-first served" area division.



OR THERE could develop a national corridor concept.



HOFFMAN

... the power behind Rocketdyne

by Erica M. Karr

WASHINGTON—Unless the Russians get there first, a Rocketdyne engine probably will put the first man on the moon—an event that could occur within six years.

In Washington this week, Rocketdyne's mild-mannered Sam Hoffman, the power behind the powerhouse of the U.S. missile effort, told the story of his company's historic record in creating the boosters for *Atlas*, *Thor*, *Jupiter* and *Redstone*.

He downplayed his own role in the company's growth from a small section in North American Aviation Co. to one of the top rocket engine producers in the country. But Sam Hoffman unquestionably had more to do with it than anyone else.

As manager of the Rocketdyne engine empire, Hoffman rules plants in Canoga Park, Calif., and Neosho, Mo., and extensive field test laboratories in California's San Susana Mountains.

• **Aircraft background**—Hoffman, 56, former university professor, joined North American as chief of the Aerophysics Department's Propulsion Section in 1949. Looking back, he says "I have spent almost my entire life in aircraft companies of one kind or another."

He has been design engineer for Fairchild Aircraft Co., Lycoming Manufacturing Co. and the Allison Division of General Motors Co. At Lycoming he was chief engineer from 1936 to 1945. Christmas, 1943, he was involved in an accident that led him out of the aviation field. He was one of two survivors of a DC-3 crack-up which killed 25 people.

"I was in and out of hospitals for six months and had plenty of time to think. The crash, I knew, would slow me up for a while. The life of a college professor looked good."

But it wasn't until two years later

that he was offered a professorship of aeronautical engineering at his alma mater, Pennsylvania State University. He stayed there until North American beckoned in 1949.

• **Work on Navaho**—An old-time North American employee recalls that the company was "forced into the engine business—we had the prime contract for the *Navaho* and couldn't find a subcontractor who would tackle the engine for it. So we decided to build it ourselves." The only large liquid propellant engines were those that powered the V-2. A small team set to work disassembling the V-2 and rebuilding it to fit the *Navaho*.

When Hoffman came to North American, its Aerophysics Department was made up of four sections: frame, guidance, nuclear and propulsion. His job as head of the propulsion department was to design and develop the rocket engine for the *Navaho* booster.

North American was charged by the Air Force with developing an air-breathing, cruise-type missile, brought up to speed and altitude by a liquid propellant rocket engine, more powerful than anything before conceived.

Work on the *Navaho* resulted in a number of steps toward achievement of the large rocket engine such as use of lightweight tubular-wall thrust chambers instead of bulky double-wall chambers. Significant advances in use of JP fuel were accomplished. Most important was the background of experience which was accumulated during the early days of development on high-thrust rocket engines.

• **In other missiles**—The engine was later repackaged and sold to Redstone Arsenal to fire the *Redstone* missile. "This is the same basic engine," Hoffman says, "which put up our first satellite." Newer and larger versions went into the *Thor*, *Jupiter* and *Atlas*.

The basic *Navaho* engine became the building block for a two-chambered

engine in the second phase, and finally the three-engine cluster in the final phase. Its first firing in January, 1956, resulted in the highest thrust ever achieved in a ballistic missile engine. The three-barrel cluster concept of the *Navaho* had approached flight status when the Air Force program was cancelled in 1957.

The experience was accompanied by exploration in fluid dynamics, thermodynamics, chemistry and metallurgy unlike any encountered previously in the field of rocketry. An outgrowth was the development of high-performance turbopumps for forcing propellants from tanks into rocket engine chambers at high pressures. The high flow attained is sufficient to empty an average-sized swimming pool in a few minutes.

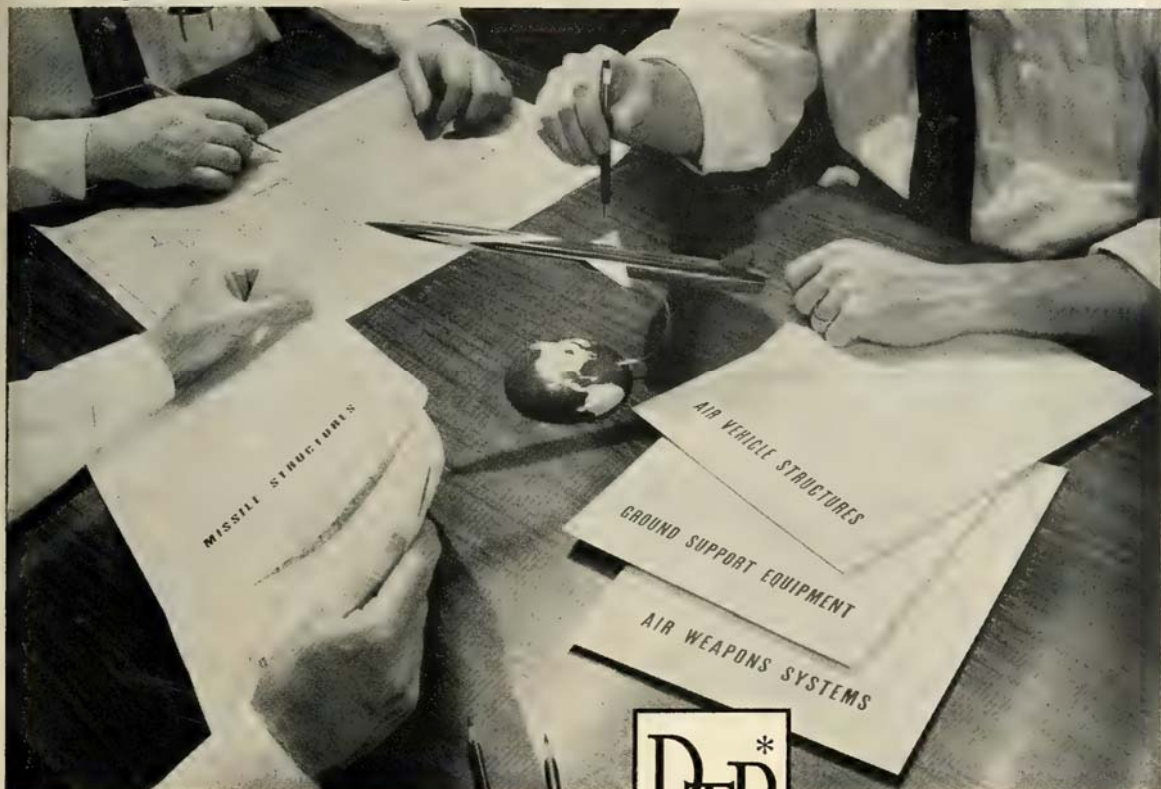
Propellant research resulted in development by Rocketdyne scientists of Hydne, the fuel used in the Army's 1958 *Jupiter C* satellite launching. A blend of chemicals based on a derivative of hydrazine, it matched the physical properties and combustion characteristics of the alcohol fuel used in the Rocketdyne-developed *Redstone* engine which powered the first stage of the *Explorer* satellite. It gave additional thrust, with a substantial increase in vertical range.

• **New horizons**—In 1956 Rocketdyne began studies on ion propulsion. This Air Force-sponsored program will ultimately send vehicles through space by a light-giving current of charged particles a million times greater in number and weighing 350,000 times as much as the stream of electrons in a television picture tube.

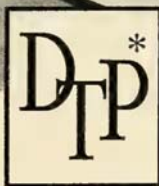
In 1957 research toward a nuclear rocket engine was started at Rocketdyne under Air Force sponsorship although North American had been conducting studies in nuclear energy as early as 1946.

missiles and rockets, March 23, 1959

Just give us the "envelope". . . we'll do the rest!



AERONCA'S



PACKAGES

ASSURE MAXIMUM RESULTS ON PRIME AND SUB-CONTRACT PROJECTS

Contemporary weapons systems, because of their complexity, necessitate sub-contracting of major components, sub-systems and structures. And versatile capabilities . . . theoretical, technological, mechanical and managerial . . . are required to produce these "envelopes" efficiently and economically.

Aeronca has these integrated facilities. That is why we can provide a *Co-ordinated Design, Tooling and Production Service*. This packaged service begins with evaluation of basic environmental data and culminates with "on schedule" deliveries. It has been eminently successful in supporting current operational weapons systems.

Aeronca's leadership is evident in its existing facility for designing and producing . . . in quantity . . . a complete range of brazed stainless honey-comb structures. This specialized capacity is one of the few *in actual operation* in the industry today.

With extensive background in proprietary and sub-contract programs, Aeronca is prepared to work with you on air vehicle, missile, ground support equipment and technical consultation projects. And we can say with confidence . . . *just give us the envelope and we'll do the rest.*

*
*Design
Tooling
Production*



AERONCA manufacturing corporation

1716 GERMANTOWN ROAD
MIDDLETOWN, OHIO

8443-AC

ATLAS

The myth and the missile

THE MYTH: Because he warred with Zeus, Atlas, in classical mythology, was punished by being made to support the entire world on his shoulders.

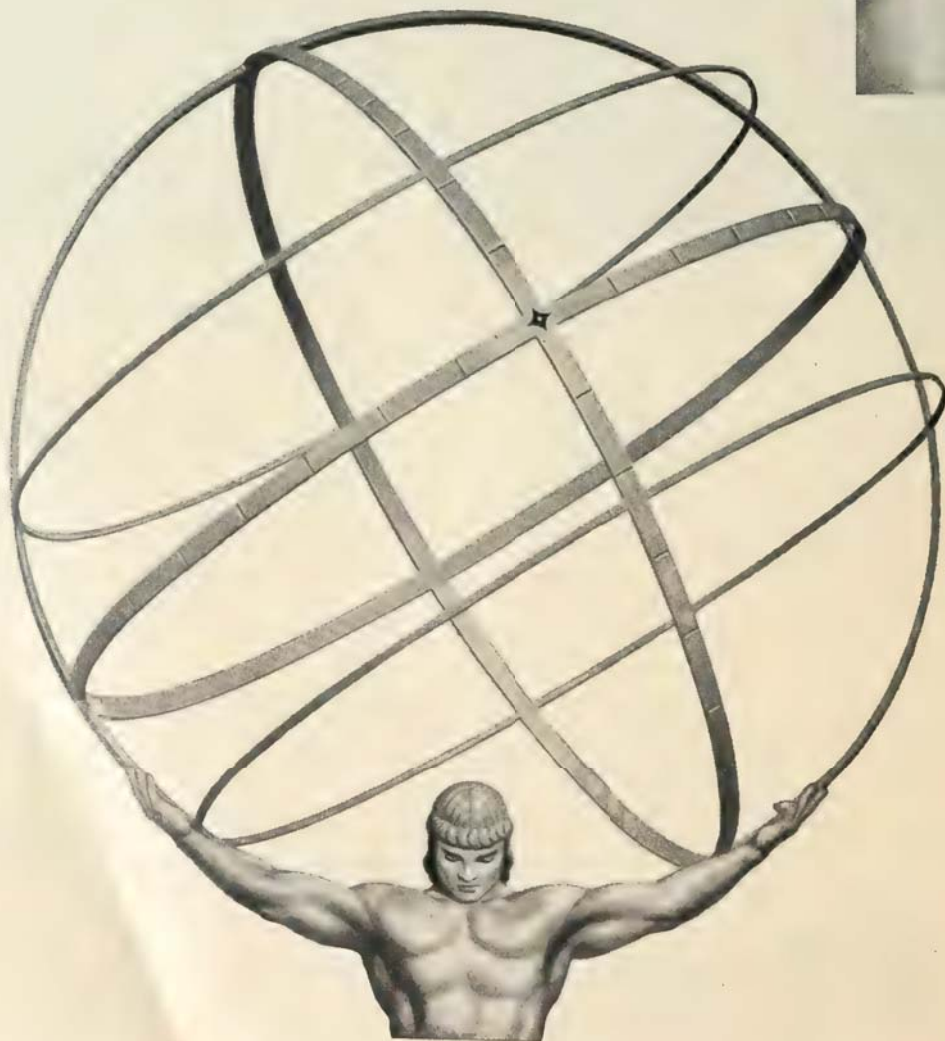
THE MISSILE: Today's Atlas ICBM bears a symbolic relationship to its classical namesake. For the future course of world events may well depend in large part on the role of the mighty Atlas. **ARMA** provides the guiding spirit for the Atlas; the inertial navigation system which guides it to its destination. Brain of the system is

ARMA's airborne digital computer, operational under severest conditions of vibration, temperature, noise, acceleration and deceleration. Heart of the system is **ARMA's** inertial platform, the stable reference table from which data is fed to the computer.

ARMA also provides a comparable all-inertial guidance system for the Titan ICBM, companion-in-arms of the Atlas. **ARMA** . . . Garden City, New York. A Division of American Bosch Arma Corporation.

6416

AMERICAN BOSCH ARMA CORPORATION



6416

Metals Congress Discusses Problem Solutions

Great strides reported in such fields as increasing metal strength and test methods.

LOS ANGELES—The 11th Western Metal Congress met here recently to explore a wide range of strength and fabrication problems relating to missile and rocket development. Industry representatives told how some of these problems are being solved.

Lewis E. Zwissler of Aerojet-General said that, "One of the major sources of failure in solid rocket motor cases has been the result of defects associated with welding in the fabrication process." Zwissler, head of Aerojet's applied studies department in solid rocket research and development, said that is why so much development work is aimed at fabricating motor cases with minimum welding.

Zwissler also commented on the problem of obtaining steel strong enough for ultra-high strength pressure vessels. "Present mill practices are not adequate to give sufficient control of chemistry and cleanliness," he said. This, combined with welding drawbacks, results in lower-than-desirable motorcase quality.

• Porosity cured—Virtual elimination of porosity and cracking in X-200 high-silicon, high-carbon steels for skins of pressure vessels was claimed by United States Steel Corp. Porosity was eliminated, spokesmen said, by employment of a new "two-pass" technique, welding from one side on an inert gas backup. The first weld laid down filler wire of the same material as the steel involved. The second weld fused in and compacted the adjoining material. Both welds were performed with a heliarc tungsten torch.

Hughes Aircraft Co. announced development of an automatic welding process for hemispherical sections of a pressure vessel proof-stressed at a pressure creating internal wall and weld stresses approaching 87% of the metal's ultimate tensile strength. Direct current equipment and the non-consumable tungsten electrode inert gas process were used. The rejection rate due to welding alone is held below 1% in high-rate production, Hughes said.

But burst tests indicate that while many alloys can be welded and heat treated to ultra-high strength levels, many lack sufficient ductility in the weld zone area to permit practical use.

• Testing alloys—Solar Aircraft Co. reported testing alloys capable of heat treatment to ultimate tensile strengths in the 220,000 to 300,000 psi range. Solar said it was recognized that standard tensile and bond tests were inadequate for evaluating the potential performance of welds in pressure vessels where imposed stresses are multi-axial.

After welding parameters had been established by conventional methods and dozens of small pressure vessels were broken in tests, the conclusion was reached that each alloy has a maximum usable strength level beyond which reliability is lost.

General Electric cited its experience in fabricating vessels and tubing for nuclear applications as an example of stainless steel welding. The company uses tungsten-arc cutting of austenitic stainless steel wrought materials to prepare the 300 Series of stainless for welding. The firm notes that excellent quality cuts can be made in austenitic stainless steel, cast iron, copper and aluminum pipe by using heliarc cutting and "mechanical draftsman" units together.

• Yield strengths—Great emphasis was placed on increasing yield strengths of aircraft/missile metals through heat treatment and other methods and producing lighter gauges, wider widths and better flatness in structural metals.

As an example of the results of better use of existing continuous rolling facilities, Republic Steel Corp. cited Type 301 stainless steel, an austenitic grade with good work-hardening characteristics. It has been rolled on a 27-inch Sandzimer mill to .006 inch gage strip with as-rolled yield strength of over 250,000 psi. After aging, Republic says, the yield strength increased to more than 300,000 psi, with gage variation held within .0005 inch.

Douglas Aircraft engineers said

4340 ultra-high-strength aircraft steel has been heat treated to attain an ultimate tensile strength of 260,000 to 280,000 psi. Proper cleaning and plating, followed by baking and painting, will avoid hydrogen and corrosion embrittlement, they said. (Hydrogen penetration or corrosion can occur in aqueous or acid cleaning, electrolytic plating and exposure to natural atmosphere.)

Acid cleaning, which produces severely embrittling conditions, was rejected in favor of controlled plating. Adequate control involves only mild embrittlement, which can be relieved by baking. Instrumentation to achieve carbon control in heat treating processes has been considerably advanced. Lindberg Engineering Co. said "... more R&D time is being given to problems of carbon potential control than to any other furnace problem."

• Test methods—New methods for non-destructive tests of materials were revealed at the Congress. Instrumentation used included radiation, ultrasonic, magnetic, various electrical devices, and eddy current testing.

Eddy currents, induced by a radio frequency field, explore the part for flaws, chemical properties and internal metallurgical dislocations. They do no damage to the part. A graph shows findings of the test.

Another recently developed method uses pulse beats in the form of echo patterns to determine metal flaws. The metal is subjected to 1000 beats per second during the test, known as "pulse echo ultrasonic flaw detection."

Both thick and thin walled casings can be inspected. Corrosion and erosion are detectable, as well as delamination in multi-layered structures.

B. F. Brown, head of physical metallurgy at the National Research Laboratory, disclosed that removal of embrittlement-causing hydrogen from steel in the molten state is practical with vacuum degassing. Brown said the process may be favored over zone refining of large solid forgings.

Coming Mid-May 1959

Second Annual

MISSILE MARKET AND PRODUCT GUIDE

You'll find it pays to tell your *complete* sales story to the Missile Industry . . . in addition to your free company listing . . . in the mid-May Second Annual MISSILE MARKET AND PRODUCT GUIDE.

Because the Guide (formerly the Missile Market Guide and Directory) contains *all* the necessary information the buyers in this \$7 billion market need, it is referred to over and over by approximately 30,000 MISSILES AND ROCKETS subscribers who will receive this issue . . . in addition to those missile men who purchase this special issue as a year round buying guide.

Last year's enthusiastic response proved the value of this unique publication to the Missile Industry . . . and once again the Guide will provide such important information as

- A Missile Purchasing Directory . . . an alphabetical listing of almost 4,000 missile companies.
- A Missile Catalogue Section . . . divided into 10 major missile categories with classified listings of all major items that go into a missile.
- Army, Navy, and Air Force Personnel Organization Charts
- Directory of Armed Forces Personnel
- Special Advertisers' Product Index

plus a new section in the 1959 edition

- Glossary of Missile Terms

APRIL 15 CLOSING DATE
Place your advertising in a publication where missile market buyers seek and find the answers to their buying problems . . . in the Second Annual MISSILE MARKET AND PRODUCT GUIDE.

For additional information, contact the MISSILES AND ROCKETS regional advertising manager nearest you.

NEW YORK: 17 EAST 48TH ST., NEW YORK 17, N. Y., PL. 3-1100 • WEST COAST: 8929 WILSHIRE BLVD., BEVERLY HILLS, CALIF., OL. 5-9161
• CHICAGO: 139 N. CLARK ST., CHICAGO 2, ILL., CE. 6-5804 • CLEVELAND: HANNA BLDG., 1427 EUCLID AVE., CLEVELAND, OHIO, PR. 1-2420 • DETROIT: 201 STEPHENSON BLDG., DETROIT, MICH., TR. 5-2555 • FLORIDA: 208 ALMERIA AVE., CORAL GABLES, FLA., HI. 4-8326
• PARIS: 11 RUE CONDORCET, PARIS 16E, FRANCE, TRU 15-39 • GENEVA: 10 RUE GRENUS, GENEVA, SWITZERLAND, TEL. 321044
• LONDON: NORALL & HART, LTD., 28 BRUTON ST., LONDON W. 1, ENGLAND, GR. 8336 • TORONTO: ALLIN ASSOCIATES, 12 RICHMOND ST., EAST TORONTO, CANADA, EM. 4-2001 • MONTREAL: ALLIN ASSOCIATES, 1487 MOUNTAIN ST., MONTREAL, CANADA, VI. 5-6898

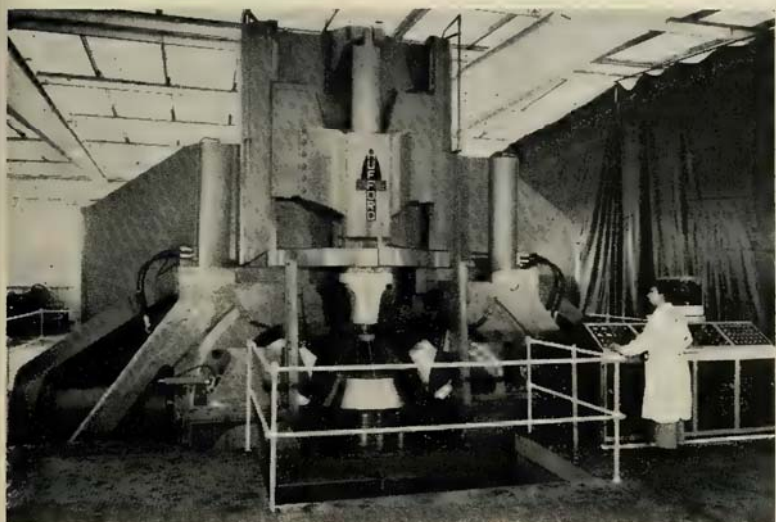
MISSILES AND ROCKETS

American Aviation Publications, Inc.

World's Largest Aviation Publishers • 1001 Vermont Avenue, N.W. • Washington 5, D. C.

missiles and rockets, March 23, 1959

Spin Forge Forms Steel One Inch Thick



A new space age machine tool that reportedly can form a one-inch-thick piece of stainless steel or other hard metal into an aircraft or missile part has been produced by the Siegler Corporation.

In forming the metal part, the manufacturer says, the machine increases the strength of the material used up to 100% and the machine cuts the production cycle by more than 50% over the metal now used for making such items as rocket engine cases.

Known as the "Spin Forge," the tool is claimed to be capable of applying a total work force in excess of one million pounds to form parts up to 60 inches in diameter and 10 feet in height. The machine tool is 25 feet wide, 24 feet high, including its base, and weighs more than 450,000 pounds.

In operation the Spin Forge utilizes a combination of rolling and shearing principles to produce mechanically spun "surface-of-revolution" sections such as conical, tubular or parabolic configurations with varied wall thicknesses.

In forming a component, the metal to be formed is placed on the Spin Forge's mandrel, a form that is shaped as the desired part, and held tightly in place by a vertical tailstock or hydraulic ram that can exert 200,000 pounds of force. The mandrel is then

rotated at speeds up to 400 rpm, and two massive working rollers, set across from each other at either side of the mandrel, come in to force the metal over and around the form.

Quality of finished product and shorter, lower-cost production cycles, plus elimination of a portion of the weldments normally required in the fabrication of such parts as pressure vessels or rocket engine cases, may be realized with the new tool.

• **Grain refined**—Quality of the finished engine component is achieved during the Spin Forge's roll forming through orientation and refinement of the grain of the metal. In effect, the grain is caused to flow, with the flow line and characteristics changed in such an extent that there is superior alignment. Metallurgically, the grain condition of forging is obtained with close tolerances that eliminate the need for finish machining.

A part made from 4130 steel, with the metal in fully spheroidized annealed condition, had prior to being roll-formed a tensile strength of 80,000 psi with a hardness of 90 to 96 Rockwell B. After being formed on the Spin Forge the material in the part had 160,000 psi tensile strength, grain elongation of 4-6%, and 35 to 37 Rockwell C hardness. The surface finish of a roll-formed tubular part

will be approximately six micro-inches inside and 40 to 60 micro-inches outside.

A key factor from the standpoint of both cost and finished part quality is the elimination of the longitudinal weldments and the decrease in the number of transverse welds generally associated with components made by the wrap and weld method. By eliminating major weldments in the tubular sections the Spin Forge eliminates possible points of failure.

Circle No. 225 on Subscriber Service Card.

Binary Counter Gives 100 Channel Analysis

A new transistorized 10-state indicating reversible binary counter has been announced by Navigation Computer Corp. The unit features both serial and parallel read-in and read-out.

Eighteen-volt dc levels are available from either side of the counter stages; and they may be directly loaded by other transistor stages. Internal amplifiers may be added to operate relays, low impedance busses, etc.



The Model 111B reversible binary counter has completely automatic internal switching. Pulses may be fed into the forward and reverse inputs, and the sum of the two inputs is made

NOTE: For additional information about any product mentioned in this section of Missiles and Rockets use the attached prepaid reply cards. Circle numbers shown on the reply card that correspond with numbers appearing beneath items described. If no circle number accompanies the article or advertisement, give page number (and advertiser's name) on line provided at bottom of card.

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

The Editor



AMPEX:

turning point for tape

Magnetic recording has reached the point where a better tape, by itself, can significantly improve the performance of your equipment. Anticipating this, Ampex has developed its Instrumentation Tape to assure the highest capability that the state of the art requires.

Precision tape reliability comes principally from the properties of its coating. And Ampex combines oxide preparation and careful coating techniques with the exclusive Ferro-Sheen process to produce the smoothest, most cohesive, most uniform of precision tapes. The result is measurably higher signal-to-noise ratios, and much less tape wear.

This, with its squared-up hysteresis curve, makes Ampex Instrumentation Tape ideal for all recording systems: direct, FM-carrier, PDM, and NRZ-digital.

Ampex Instrumentation Tape is available on hubs, NAB-type or die-cast magnesium-alloy Precision Reels. Widths of 1/4", 1/2" and 1" are standard on either Mylar* or acetate base, in the following lengths, reel diameters, and base thicknesses:

AMPEX STANDARD TAPE LENGTHS (feet)

REEL DIAMETER	BASE THICKNESS (mils)	
	1.0	1.5
7"	1800	1250
10 1/2"	3600	2500
14"	7200	5000

*DU PONT TRADEMARK

For complete specifications or additional tape literature, write

AMPEX MAGNETIC TAPE

934 CHARTER STREET, REDWOOD CITY, CALIF.

Circle No. 18 on Subscriber Service Card.

... new missile products

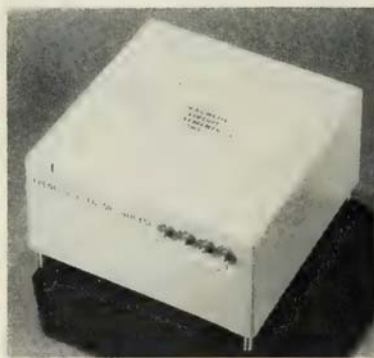
visible with neon indicators.

The units operate up to 200 KC with a single 20V supply voltage. Both push-button and electrical presetting are available and any number of units may be cascaded.

Circle No. 226 on Subscriber Service Card.

Sensor Helps Eliminate Missile Countdown Errors

A new type of frequency sensor, employing magnetic and static elements throughout, and operating on the "go, no-go" principle, has been introduced by Magnetic Circuit Elements, Inc.



The device, one of a family of magnetic "instrument sensors," is said to offer several important benefits over conventional dial indicators, among which are greater accuracy, reliability, reading ease and installation flexibility. Read-out is achieved by means of green and red lamps, denoting "within tolerance" or "out of tolerance" respectively.

The elimination of all movable and corrodible parts has resulted in an insensitivity to extremes of temperature and vibration, as well as to large over- and under-tolerance conditions. Tolerance limits are "built into" the sensor, enabling it to achieve accuracy of 1/4% or better.

The sensor is said to make the missile countdown engineer's job much easier, since chances for reading error are, for all practical purposes, eliminated. Not only do red and green lights supplant the needle dial, but several sensors may be connected to a logic circuit in such a way that a single read-out will indicate the "no-go" condition if any one of the readings is out of tolerance.

The sensor may be mounted remotely from the read-out lamp—in wing, tail or other areas where space is not so critical as in the control area. Remote installation also minimizes danger of damage to the circuit being measured, by allowing the sensor

to be mounted, for example, right next to the frequency generator.

The new unit is said to relieve the busy operator of a considerable amount of high-pressure, high-speed decision-making which, up to now, has been increasingly troublesome.

The C-400FS1 frequency sensor operates at 115 volts. Nominal frequency and tolerance limits are made to customer specifications. The 2-watt output drives 24-volt lamps or relay drives. If desired, it will work in connection with an annunciator system. Temperature limits are -65° to +185°F; vibration specifications are 20 g's; 2- to 2,000 cps.

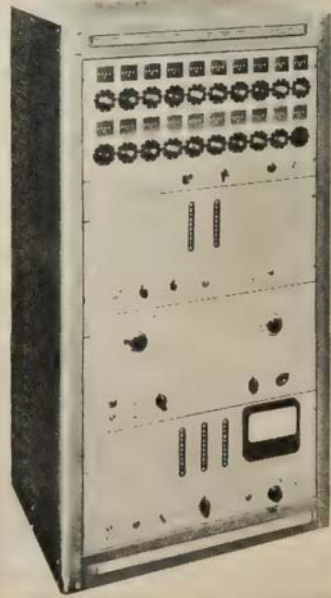
Circle No. 227 on Subscriber Service Card.

Pulse Height Analyzer Has 20-Channel Storage

A new 100-channel pulse height analyzer with 20-channel storage is announced by The Victoreen Instrument Co.

Designed by Tullamore Electronics Corp., recently acquired subsidiary of Victoreen, the PHA-120 analyzer is the latest Tullamore instrument designed specifically for moderate and low counting rate spectroscopy work.

Because a full 100-channel analysis is made and read in five steps of 20 channels, the manufacturer claims the unit is inexpensive in addition to being precise and reliable. Other features include analog-to-digital conversion for pulse sorting which provides uniform channel widths and makes individual



missiles and rockets, March 30, 1959

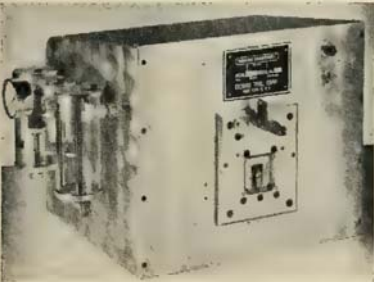
channel width adjustments unnecessary, exact alignment of end channels of 20 channel groups, no data distortion for counting rates up to 6000 cpm per channel, and "zero level" adjustment to allow a particular peak to be centered in a particular 20 channel group.

The PHA-120 analyzer comprises five basic assemblies: preamplifier, amplifier, amplitude digitizer, storage unit and decade scaler.

Circle No. 228 on Subscriber Service Card.

New Unit Straightens, Cuts, and Preforms Leads

The Electro-Machinery Division of Design Tool Corp., has introduced a new radialead straightener, model AL3NS, an all-purpose machine for automatically straightening, cutting and performing the leads of transistors.



The unit straightens and aligns transistor leads, or straightens, aligns and cuts transistor leads to specific lengths, or cuts and notches to stand above the board for heat dissipation.

From a specific job, a rapid change of head will adapt the machine to serve a new job function. It will automatically straighten and align leads to the proper center distance so that the components will always exactly match the holes in the printed board.

Circle No. 229 on Subscriber Service Card.

Small Synchro-Timing Motors Are Produced

The A. W. Haydon Co. has announced the introduction of a new line of extremely thin synchronous timing motors for 25, 50 or 60 cycle operation in five standard voltage ratings.

Main features of these motors are: thin design with available torque equivalent to much thicker motors, and completely electrical operation.

Only 7/8" thick, these motors were designed to occupy considerable less space than other available motors. Mounting dimensions conform to The A. W. Haydon Co.'s standardized di-

missiles and rockets, March 23, 1959

fiberglass HARCO CONTAINERS cut return shipment space 1/2...



End sections reverse and telescope into center section for return shipment.

for transport, storage and ground handling of
in-flight refueling stores, missiles,
rockets, jet engines and accessories



Harco Containers with integral Harco stores trailer can be return-shipped in 1/2 the space required for conventional containers.



Three steps of loading in-flight refueling stores into Harco Container; after unloading, Harco trailers are returned to container for re-use.

THE ONLY FIBERGLASS IN-FLIGHT REFUELING STORES CONTAINER APPROVED

by BuAer, cuts 60% of weight, speeds loading and unloading of stores through unique Vee-band fastening of end sections to center section.

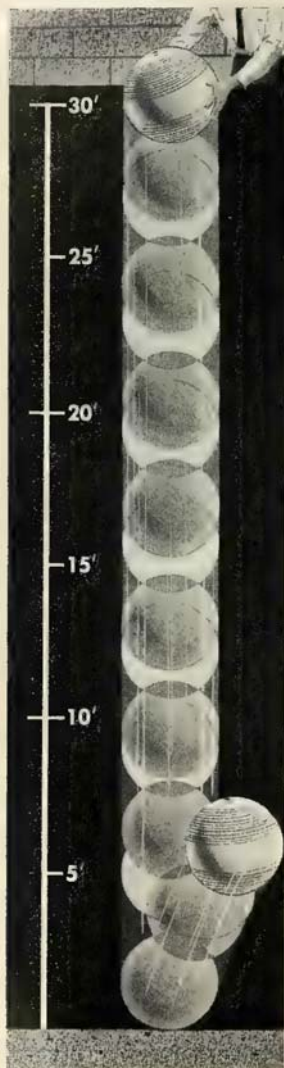


write for literature and quotations on your container and ground handling equipment requirements.
EMPLOYMENT OPPORTUNITIES FOR TRAINED MECHANICS.

Harco Containers
A DIVISION OF HARBOR BOAT BUILDING CO.
258 CANNERY STREET, TERMINAL ISLAND, CALIFORNIA

Circle No. 19 on Subscriber Service Card.

GAS OR LIQUID—STORED SAFELY IN LIGHT, SHATTERPROOF BOTTLES



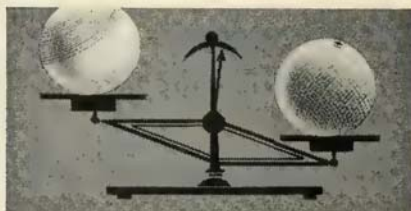
SHATTERPROOF—Charged to 3,000 PSI, these Bendix bottles withstand a 30-foot drop to a concrete floor without damage. Absolutely no flying particles to damage personnel or equipment! Tests show even 50-caliber bullets can no more than rupture the material.

Exceptionally light as well as safe, Bendix fibre glass bottles qualified for government and industrial applications are in mass production.

Developed originally as a high-pressure air reservoir for jet aircraft, this new type lightweight container offers exciting possibilities if you have a problem in storage of either high-pressure gas or liquid.

PROVED SUPERIORITY

Proved superior in pressurized operation on missiles and turbine-engine aircraft, Bendix light, shatterproof storage bottles by Apex are made from continuous windings of fibre glass yarn impregnated with epoxy resin. The bottles are wound on a precision machine designed to place yarn so it utilizes the greatest strength. The result is safe, non-corrosive bottles—with a temperature range from minus 65°F. to plus 200°F. and a built-in thermo-lag.



UP TO 40% SAVINGS IN WEIGHT over steel containers for same volume and pressure.

Operating pressures of present units vary from 3,000 to 4,500 PSI and burst pressures from 6,000 to 10,500 PSI; can be designed for other pressures as required. Most bottles are for 10,000-cycle life; bottles with shorter cycle life have been built. A variety of sizes is available.

Our Sales Engineering Department will welcome an opportunity to review your requirements for either spherical or cylindrical shaped containers and submit a proposal for your specific application.

West Coast: 117 E. Providencia, Burbank, Calif.
Canada: Aviation Electric, Ltd., 200 Laurentian Blvd., Montreal, Que.
Export Sales and Service:
Bendix International, 205 E. 42nd St., New York 17, N. Y.

Bendix Utica Division

UTICA, NEW YORK



Circle No. 20 on Subscriber Service Card.

... new missile products

mensions for timing motors, and those of the industry in general.

The design of these motors has eliminated the need for mechanical devices to control the direction of rotation of the motor.

The 22100 series motors meet all significant requirement of specification MIL-E-5272A, and are designed for applications where high performance, reliability and immunity to rugged environments are required. Also available is a non-military version (42100 series) for high volume industrial and commercial applications.

Over 125 standard output speeds from 300 rpm down to one revolution in six hours can be supplied with either standard or heavy duty gear trains. With a nominal 30 oz-in running torque at 1 rpm, these motors can be used in a wide variety of applications.

Circle No. 230 on Subscriber Service Card.

Low Noise Amplifier Has 11 Fixed Gain Steps

A chopper-stabilized, low noise and drift amplifier, designated Model 512-A, and featuring eleven fixed gain steps with continuous variable gain between each gain setting, has been produced by the Allegheny Instrument Co., Inc.



The Model 512-A is used for the amplification of signals from wire strain gage transducers, thermocouples or other low-level, low and medium output impedance signal sources. It can be used to drive pen-motors, light beam galvanometers, and cathode ray oscillographs, as well as modulators used in magnetic tape recording.

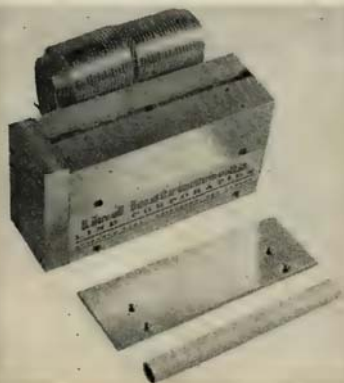
With a simple circuit change, this amplifier may be made operational or can be provided with a floating input. It is well suited for operations such as voltage summing, integration differentiation, etc.

Circle No. 231 on Subscriber Service Card.

missiles and rockets, March 23, 1959

Commutator Features Long Life, Reliability

A thermocouple and strain gauge millivolt telemetering commutator produced by **The Linde Corp.** is said to have 300 times the life and reliability of circular sampling switches.



The two pole, 60 contacts per pole switch takes only $11\frac{1}{4}$ cu. in., and weighs 12 oz. It samples 3 millivolt signals with $\frac{1}{2}\%$ accuracy, and has contact resistance of less than 5 ohms. Redesign reduces wear by a factor of 300:1.

There are paired contacts and wipers for each channel, giving $1/60$ th the wear per contact, $1/5$ th the diameter for travel-produce, and $1/300$ th the wear and movement.

The commutator has a low mass system and self-cleaning, time-shared collector ring. The unit also has long motor brush life because negligible torque requirements mean low current drain by low-speed motors.

The unit will operate on 2/3rds watt power, and will operate from 36 to 2500 cps @ 25g's applied vibration, and withstanding 150 g's shock for 11 millsec.

Spiral helix provides a new approach to low-level switching. The unit is precision-machined to tolerances of $\pm .0001$ inch. Phases to $\pm 5\%$, and has a life at 10 rps in excess of 1000 hours.

Circle No. 232 on Subscriber Service Card.

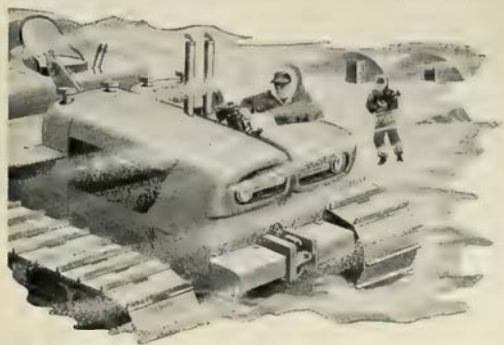
Billet Heater Features Improved Control System

A new induction billet heater which provides an improved control system for accurately heating aluminum billets to precise temperature for extrusion is offered by the High Frequency Heating Division of the **Lindberg Engineering Co.**

The "metered BTU's" system measures watt-hour input to the billet with an integrating watt-hour meter and de-

missiles and rockets, March 23, 1959

HEAT in military applications



HUNTER INSTANT LIGHTING TORCHES

for spot heat
at sub-zero temperatures

Developed in coordination with Engineer Research and Development Laboratories, Ft. Belvoir, Va., Hunter Instant Lighting SPX

Torches are unpowered, open-flame burners which can be lighted instantly with a match at temperatures down to -90°F . They burn any type gasoline or JP-4 fuel. Output range at variable pressures is from 15,000 to 200,000 BTU/Hour for a wide variety of sub-zero, spot heat applications — small engine starting, start-aid for bulldozers, snow plows, earthmovers, special purpose equipment, de-icing bogie wheels and tracks, heavy-duty control equipment, etc. Also available as Portable Radiant Heaters equipped with radiant burner cone and polished reflector for field heating requirements in emergency situations such as tire changing, adjusting brakes, operating mobile consoles for fire control, etc.



Space and personnel heaters, engine heaters, refrigeration and air conditioning units are other Hunter products designed for military applications.

• • •

Hunter personnel and facilities are available for all types of R & D for military heating and air conditioning.

MODEL SPX 2

Meets field requirements for small and medium size engine starting, etc. • Weighs only $3\frac{1}{2}$ lbs., less than 7" wide, $7\frac{1}{2}$ " long, $9\frac{1}{4}$ " high • Output range 15,000 to 50,000 BTU/Hr. • Fuel capacity, 1 pint • Cold start as low as -90°F .



get these brochures TODAY!



MH-167
"Military
Torches"

MH-162
"Space
Heaters"

MH-166
"Engine
Heaters"

HUNTER

MANUFACTURING CO.

HEATING AND
REFRIGERATION SYSTEMS

30533 AURORA RD. SOLON, OHIO

Circle No. 21 on Subscriber Service Card.



Bench-Top Proving Ground for Missile Controls!

Directional controls for guided missiles . . . tracking and scanning devices . . . cameras . . . range finders—how well they work depends greatly on the efficiency of their optical systems.

Recognition Contrast Rendition equipment at B&L completely eliminates human error in measuring optical efficiency. Its direct-reading scale automatically rates how well an optical system can "see" under lighting conditions of variable intensity, as experienced in actual use. Accuracy: 1/40th of a wavelength of light!



WRITE FOR COMPLIMENTARY
COPY OF LIMITED EDITION,
"OPTICAL COMPETENCE"

(on official letterhead,
please, indicating title.)
Bausch & Lomb Optical
Co., 87039 St. Paul St.,
Rochester 2, New York.

This instrument is not for sale. It is part of the unique quality control system that has made Bausch & Lomb the dependable optical source.



... new missile products

termines, with a totalizing timer, the amount of energy absorbed by the billet. A means of compensating for the starting temperature of the billet is provided.

Thus, with a billet of known weight and known initial temperature, a predetermined amount of energy can be selected to heat the billet to the desired extrusion temperature. No prod type thermocouple (with its inherent inaccuracy and maintenance) is required.

With low-voltage power sources, stepless power control can be obtained by the use of saturable core reactors. This eliminates high contractor maintenance cost as well as providing control of the billet heating rate.

Circle No. 233 on Subscriber Service Card.

... York Interview

(Continued from page 21)

"Space is a place, not a program," he said.

His understanding of the nation's space set-up is that the National Aeronautics and Space Administration has the primary role in the field. It is charged, according to Dr. York, with not only the scientific applications in space but also the overall development of the means for exploring space.

"It has the overall exploratory responsibility, and we exploit their results. There is no reason to combine these. We do not need a new booster for every communications experiment we run," he said.

Dr. York pointed out that the military has been given certain space work, but only "by exception." DOD's function, Dr. York said, is to apply the NASA projects to military needs—"We can do what amounts to putting a requirement on them."

Does this affect lead times on military space systems? Dr. York's answer was, "In principle, no." In practice, "there are a lot of people on both sides of the fence. I myself feel neutral. I mean to (a) cooperate, and (b) make the best use of the system."

Nor does Dr. York see any great problem in defining each service's role in space. The criteria is whether the space application will benefit the service's needs, and Dr. York foresees navigational satellites for Navy, communications satellites for Army, early warning satellites for the Air Force, etc.

"Anyone should be able to use space if it benefits his mission," he declares.

missiles and rockets, March 23, 1959

TUBE DISTRIBUTORS BALANCED SERVICE

can improve your steel tubing profit picture!

Important? Of course. If you buy steel tubing regularly, you can improve profits by cutting production costs, handling and inventory costs, minimizing your inventory investment...without paying a premium, when you buy in warehouse quantities.

1. Personalized Inventory Plan custom-tailored to your requirements*.
2. TD's complete quality control program.
3. Extra warehouse services.
4. Technical assistance from steel tubing specialists.
5. Thousands of sizes in all standard specifications and analyses in stock.
6. Systematic handling that insures on-time delivery.

*PERSONALIZED INVENTORY PLAN CUSTOM-TAILORED TO YOUR REQUIREMENTS! A reserve of tubing is held in your name—at no additional cost. TD inventories, handles and ships it, according to your scheduled requirements—as a customer service. You invest no money, take no risks, and pay nothing extra for this exclusive service.

Call TD for—stainless, alloy and carbon steel tubing, both aircraft and commercial quality.

Write Dept. M-34 today for your copy of "Eighteen Ways to Save Money in Your Steel Tubing Purchasing," and the name of your nearest TD representative.



TUBE DISTRIBUTORS CO., INC.

GARDEN CITY, NEW YORK • TWX: G-CY-NY-4695 • CABLE: TUBEDIS

**B.F. Goodrich**

At B.F. Goodrich the space age started in 1934

That was the year B.F. Goodrich developed the first rubber stratosphere flying suit for attempts at setting altitude records. Through the years this suit has been constantly improved to meet the needs of higher-flying pilots. And when the first man sets foot on the moon he will probably be wearing a modification of today's B.F. Goodrich Full Pressure Suit.

B.F. Goodrich engineers are working in many ways to help man break the bonds of earth—and return safely. Missile nose cones, improved solid fuels, propellant heaters, missile battery box heaters, instrument heaters, printed and etched circuits, stronger metal and plastic structural materials, insulating materials, precision rubber seals and gaskets, blind fasteners—these are only a few of the items that may help solve *your* space age problems. For specific R & D information, write: *B.F. Goodrich Aviation Products, a division of The B.F. Goodrich Company, Dept. MR-39, Akron, Ohio.*

1958 Lightweight Full Pressure Suit

1934 Stratosphere Suit

B.F. Goodrich *aviation products*

ARGMA's Plasma Jet Test Facility in Operation

Prototype model for aerodynamic heating tests reaches 50,000° Fusing argon gas with 13,000 fps flow rate



CARBON model undergoes test in plasma jet high temperature arc.

HUNTSVILLE—A new plasma-jet test facility is now in prototype operation at the Army Rocket and Guided Missile Agency here. Construction of the final version of this hyperthermal unit already has begun.

Temperatures up to a maximum of 50,000°F have been achieved with the prototype, and the final test facility, scheduled to be in operation sometime this spring, is designed for even greater capability.

The man behind this research program is Dr. Thomas A. Barr, Jr., a physicist and chief of the Magneto-hydrodynamics Unit in the Agency's Ordnance Missile Laboratories Division. Dr. Barr, formerly a professor at the University of Georgia, initiated the program two years ago.

Using electric current to heat a gas, the test facility produces temperatures much higher than can be achieved through any chemical combustion process. At these temperatures, gases decompose, rather than combust. That is, following molecular breakdown, the atoms are dissociated into ions and electrons. Gases in this extreme state are referred to as plasmas.

• **Plasma-jet process**—The process for achieving such tremendous temperatures is simple in concept. The test facility consists essentially of three sections: the arc chamber, the test section, and a low-pressure chamber.

In the arc chamber are a water-cooled carbon electrode and a carbon nozzle, or ring. The electrode fits into, but does not touch, the nozzle. An external dc generator, connected between the electrode and the nozzle, provides the necessary energy to develop an electric arc in the gap between the two assemblies.

Pressurized gas introduced into the missiles and rockets, March 23, 1959

arc chamber moves through the electric arc stream and into the low-pressure area in the downstream chamber where a vacuum pump is employed. As the gas passes through the electric arc it undergoes tremendous heating, to a degree depending on the amount of electric power sent through the arc.

In the prototype, argon gas has been used principally since it is inert and has good electrical properties for conducting high currents. The gas flows through the arc in a supersonic jet, with a maximum flow rate of 13,000 feet per second. Thus the term plasma-jet test facility has developed. Characteristics of the new jet flow are regulated by adjusting the arc column, or electrode, in its position in the nozzle.

• **Material testing**—The high temperatures achieved by plasma-jet facilities are invaluable in testing materials which must withstand the extreme heat developed in missile flight—largely resulting from aerodynamic heating as a missile passes through the atmosphere.

The method also is useful for test-

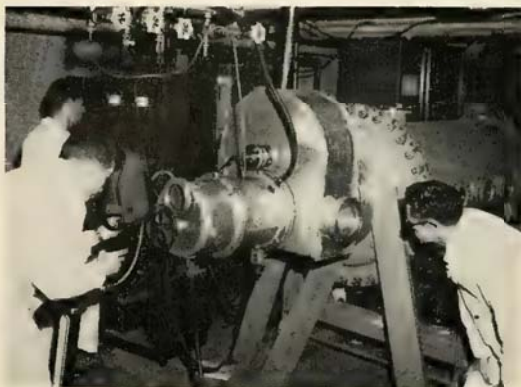
ing the high-temperature properties of various gases which may be used or encountered in missile development and flight, or in simulating stellar atmospheres.

Testing conducted in the prototype has been confined largely to that related to developing the final facility, rather than any testing related to a specific missile project.

• **New facility**—Like its prototype, the final test facility now being built will be unique in both design and functions. Electric power will be provided by six generators of the type used for main propulsion in World War II destroyer escort vessels. These generators will be capable of producing up to 8 million watts of electric power as opposed to the 75,000-watt capability of the single generator now in use in the prototype.

This increase in power will make it possible to heat a much larger body of gas. A number of operations, such as the controlling of arc power and regulation of the arc column, will be ac-

IN CARBON hemisphere test, 22 kw was delivered to the arc with an ambient pressure of 0.5 cm Hg. Heat transfer to a cooled (300°K) probe was 1.0 kw/cm².



complished automatically.

Thus, the new facility will be used for aerodynamic testing as well as high-temperature testing and properly can be termed a hyperthermal wind tunnel. When completed, it will serve the testing needs of all elements of the Army Ordnance Missile Command.

• **Preliminary research**—When Dr. Barr initiated the program in 1956, he reviewed literature in the high-temperature field to determine the best method for developing the required test facility. He selected the electric arc

method as the easiest for producing sustained high temperatures. He put his first arc into operation in June, 1957, and the prototype facility now in use was completed six months ago.

He has been aided in his research by three highly experienced assistants: Walter LaVaughn Hales, Thomas G. Roberts and Charles M. Cason III.

In addition to the hyperthermal wind tunnel, Dr. Barr is developing a second facility designed to produce transient high temperatures up into the millions of degrees in low-density gases.

Narmco Project

Radar Reflector Said To Sharply Cut Weight, Cost

LA MESA, CALIF.—The unique design principle of Narmco Manufacturing Company's recently announced radar reflector reportedly cuts weight and costs to a fraction of that of any other current construction method for large-scale paraboloidal-reflector antennas.

Dubbed TETRAC (Tension Truss Antenna Concept), the design is adaptable to antennas of from something less than 100' to over 400' in diameter.

The TETRAC antenna consists of nine components, basically identical in design, but size-scaled in relation to antenna dimensions. Backing for the antenna "dish" is a series of five concentric, sectional-honeycomb, sandwich compression rings, supported and stabilized by pre-stressed radial inter-ring tension rods fitted like bicycle spokes.

The other four components are honeycomb sandwich sections which form the paraboloidal reflector surface. Total number of panels varies with antenna size as does the individual panel size, but design is identical for each of the four types.

The sandwich construction panels offer high rigidity with low weight. This appears to offer a considerable advantage for solid face surfaces used with high microwave frequencies. Acceleration and deceleration inertia loads are relatively low due to inherent light weight of the honeycomb structure—an aid in maintaining close contour tolerances of reflector surface.

It is claimed that an antenna of approximately 120' diameter would be capable of holding a surface accuracy of ± 0.125 in. in a 45-mph wind. Larger antennas of about 450' diameter can be designed to hold surface accuracy of ± 0.50 in. in a 35-mph wind.

The pre-stressed construction feature also permits relatively high resonance (from 15 cps up), due to low deflection under loading conditions. As a result, forces applied to mechanical and functional components are also low. Combined with the light overall weight, the two features make it possible to simplify the antenna pedestal and other related system components—both in function and cost.

Modular construction of panels and ring sections permits an installation or move of the antenna to a remote site with a minimum of difficulty. Ring sections could be jack-assembled on the ground and easily erected into position

Metal forms, housings, containers for Aircraft, Rocket & Missile Manufacturers

by **Ellisco**
REG. U. S. PAT. OFF.



ITEMS SHOWN ARE SOME OF THE MANY THINGS WE DO WITH STEEL, AND MOST NON-FERROUS METALS 20-GAUGE OR LIGHTER, USING TECHNIQUES DEVELOPED IN THE MANUFACTURE OF TIN CANS.

Ellisco offers you...

- Items spun, lock-seamed, welded, soldered or drawn.
- Special tooling to your specifications.
- Standard tooling to make containers from $\frac{1}{2}$ " dia. x $\frac{1}{4}$ " high to 16" dia. x 60" high—plain or coated—lithographed or silk-screened.
- Small or large lots.
- 115 years of experience.

ELLISCO NOW SERVES NEARLY EVERY INDUSTRY INCLUDING:

Chemical Fuel Manufacturers • Aircraft Industry • Fuze Manufacturers
• U. S. Government • Special Instruments Manufacturers • Atomic Energy Installations • Missile Tracking Instruments Manufacturers

let Ellisco serve you, too—write, wire or call today. Send specifications for quotations.

PHONE: Baldwin 3-3405

GEORGE D. ELLIS & SONS, INC. PRODUCT DEVELOPMENT DEPT. P-7
AMERICAN & LUZERNE STREETS • PHILADELPHIA 40, PA.

in the field. Same technique might be applied to surface panels. Optical instrumentation could be used for precise alignment of components prior to erection. Rings are fitted with standoff pads for fine alignment of reflector-surface panels.

Cost-wise, the Narmco approach will vary considerably in relation to antenna size and surfacing materials used. However, it is claimed that system savings of several hundred thousand dollars can be achieved in antennas of around 100' in diameter. The company also states that overall systems savings would be much greater in very large diameter installations.

Some work has been done on the prototype of such an antenna to be used in target tracking as part of the Nike-Zeus system. An additional contract is expected shortly. The company hopes also to apply the TETRAC principle to radio astronomy fields, satellite tracking, and concentration of solar energy.

Sylvania Offers Measuring Unit for Solid State Devices

WALTHAM, MASS.—Faster and more accurate orientation of silicon and germanium crystals for transistors, diodes and other semiconductor devices may be possible with a new measuring instrument developed by Sylvania Electric Products, Inc.

The company says the new instrument is superior to conventional and more complicated reflection, microscopic and X-ray methods.

Transistors have as their center a tiny die of silicon or germanium with "zones" or layers of differing electrical properties. These zones are formed by allowing or diffusing minute quantities of special metals, such as indium or antimony, into the crystal structure.

Accuracy in the formation of these zones depends on precise alignment of the die surfaces with the molecular structure of the germanium and silicon.

The Sylvania measuring device uses a converging beam of light projected upon microscope etch pits on the surface of the material. The beam is reflected from the facets of the etch pits and split into a number of component rays equal to the number of planes comprising a single pit.

The planes behave like tiny mirrors which reflect these component rays to a screen in the form of a light pattern which can be interpreted by the operator immediately as to orientation.

Proposed price for the new orientation instrument complete with accessories and power supplies is \$1500 per unit.

missiles and rockets, March 23, 1959

New Amplifiers Extend Missile Tracking Range

WASHINGTON—The recent use of newly-developed low-noise parametric amplifiers is largely responsible for new records in space communications. Highly successful tests of these amplifiers were conducted independently by two distant missile-tracking stations during the space probe flight of Pioneer IV.

General Electric engineers, at the

company's test tracking station in Schenectady, N.Y., received signals from the probe at distances of more than 410,000 miles (m/r, March 16). Allan D. French, a consulting engineer from G.E.'s Heavy Military Electronics Department, was in charge of the tracking project.

The G.E. parametric amplifier was connected between the receiving system and a horizontally-polarized 18-ft. paraboloidal-reflector antenna having a 32-db gain. Operated in the L-band (1000 mc) region, it is a straight-through

The further we progress,
the more important
experience becomes in solving
today's most urgent problems.



One company actively and continuously
engaged in advanced ECM research
and development
since 1952 is ...

hallicrafters

4401 W. Fifth Ave., Chicago 24, Ill.

SERVICES—research and development

- electronic equipment production
- reliability evaluation

EQUIPMENTS—communications • radar

- countermeasures • reconnaissance
- infra red devices • heat exchangers
- pulse generators • antennas

amplifier with a pump frequency in the X-band. It uses a specially-designed parametric diode having a 1-db noise figure. The amplifier was developed by the G.E. General Engineering Laboratory.

A similar device in a system using a 14-ft. dish antenna enabled Army Ballistic Missile Agency crews at Redstone Arsenal to conduct experimental long-range tracking of *Pioneer IV*. Here, too, a parametric amplifier, de-

veloped by International Telephone and Telegraph Laboratories at Nutley, N.J., added more than 150,000 miles to the tracking-equipment range. The 13-lb space probe was tracked for a total of 37 hours to a distance of 215,000 miles before the test was discontinued.

Fred Kupersmith, test supervisor, stated that the received signal intensity, at the end of the test period, was weaker than -158 dbm. The strongest

signal received was -143 dbm.

The ITT device functions much as other amplifiers, but it employs a small diffused silicon diode to produce a 90% reduction in interference resulting from static electricity and heat forces.

It was established at both stations that by employing either of the two tracking systems, without the support of its respective parametric amplifier, the faint signals would have been lost at around 50,000 miles and certainly long before the *Pioneer IV* batteries expired.

No matter which **FINISH** you like—you can buy it in

MicroRold® QUALITY STAINLESS STEEL



2D—A silvery white, but non-lustrous, surface produced by annealing and pickling cold reduced material. Steel sheets & strip in this condition are most ductile and the surface holds lubricant well for severe drawing operations.



2B—Steel in the 2D condition which is subsequently rolled on a "skin pass" or temper mill. The surface acquires a bright finish from the polished rolls. This surface is somewhat more dense and hard than 2D and is a better starting surface for later finishing and buffing operations.



No. 3—This surface is made by grinding 2B steel with a No. 100 abrasive. This surface is smooth but not as reflective as 2B.



No. 4—A finer finish than No. 3 made by grinding 2B steel with a No. 150 abrasive. Like No. 3, this surface is easily blended with hand grinders after forming, drawing or welding.



No. 7—Good reflectivity and brilliance made by polishing a No. 4 surface with a No. 400 abrasive. This semi-mirror finish must be protected during fabrication by adhesive paper or stripable plastics lest the finish be marred beyond repair.



BRIGHT—A highly reflective surface made by cold reducing with highly polished, glass-hard rolls. This finish is only available in Type 430 stainless.

These are our standard surface finishes that are regularly supplied in all stainless grades (including 18-8 chrome-nickel and 430 straight chromium), with the exception of 430 Bright which is Type 430 exclusively.

These finishes are regularly supplied in sheet and coil form in widths up to 48 inches.

Since No. 3, 4, 7 and 430 Bright are smooth reflective surfaces, they are not recommended for severe drawing without special precautions as the mill finish may be marred. Applications such as dairy ma-

chinery, kitchen and restaurant equipment and architectural decorative work require only local forming, so these highly polished surfaces are not greatly disturbed. All mill polished sheets are carefully packed to avoid handling imperfections. Protective adhesive paper can be specified by the buyer when needed.

For specific information on recommended surface characteristics for a particular stainless steel sheet and strip application, address your request to our Product Development Department.

WASHINGTON STEEL CORPORATION
3-H Woodland Avenue Washington, Pennsylvania



Circle No. 25 on Subscriber Service Card.

Rheem Co. and Baldwin Group Forming R&D Firm

SAN FRANCISCO, CALIF. — The Rheem Manufacturing Co. and a scientific and engineering group headed by Dr. E. M. Baldwin have announced plans to form a company for research, development and production in the field of semiconductors including silicon diodes, transistors and other devices.

Rheem will hold a majority interest in the proposed company, which will be operated as a subsidiary.

Plans call for a new plant at a site to be selected in the peninsular area south of San Francisco.

Heat Exchangers Are Used for Atlas and Thor Tests

LOS ANGELES—In-flight conversion of liquid oxygen to its gaseous state and controlled expansion of gaseous helium and nitrogen reportedly has been accomplished by a series of new heat exchangers manufactured by Waste King Corp.'s Technical Products Division here.

The heat exchangers are required to permit pressurization of liquid fuel tanks and structure during missile flights. Prototypes of the new heat exchanger are presently used on the *Atlas* and *Thor*.

The heat exchangers are made entirely of stainless steel in order to withstand the high-temperature rocket exhaust gases which are the heat source for the units.

The stainless steel design is a cylindrical shell which functions as an exhaust duct and through which a coiled tubing is passed.

The hot exhaust gases pass over the oils and convert the liquids flowing through the coils to a gas by the time they emerge at the other end of the exchanger.

Each unit is strength-tested with hydrostatic pressures up to 7500 psi

missiles and rockets, March 23, 1959

for the tubing elements and 25 psi with nitrogen for the shell structure.

The heat exchanger's operational life expectancy is rated at more than 2000 seconds.

The four basic types of missile heat exchangers produced by Waste King are: for liquid oxygen only (with twin tubing coil structure); liquid oxygen and liquid nitrogen; large size liquid helium only, (with triple tubing coil structure), for booster engines; and small-size liquid helium only, used on the sustainer engine.

Avco Pyrometer Measures High Surface Temperature

WILMINGTON, MASS.—An optical recording pyrometer capable of measuring material surface temperatures between 1400°C and 3000°C with millisecond response time has been announced by Avco.

Developed by their Research and Advance Development Division here, it is called the Auto-Optic Recording Pyrometer.

Employing a high-vacuum phototube, the device focuses monochromatic light, having a wavelength of 0.65



micron, on an opaque plate. A small aperture in the plate admits the radiant energy to the phototube. After amplification of the phototube output, the final output level can be observed directly in microamperes on a built-in meter at the rear of the pyrometer.

Measuring surface changes over a 3/8-in. diameter area, sample brightness temperatures with $\pm 20^\circ\text{C}$ can be obtained.

A remote recorder can be con-

nected to the output of the pyrometer to provide a continuous record of temperature versus time. Using a recorder, the pyrometer may be operated unattended.

FIRETRAC System Proves Accurate Miss-measurer

FREDERICK, MD.—A highly reliable missile-tracking system for measuring "near-misses," developed here by Aerojet-General's Atlantic Division for the Navy Bureau of Aeronautics, has successfully completed recent operational evaluation tests at Point Mugu, Calif.

A *Sparrow III* air-to-air guided missile was used during the test firings at a target drone.

Designated FIRETRAC, the tracking system is essentially comprised of a four-channel receiver and standard-type telemetry transmitter, carried in a target drone, and a receiver and recorder installed in a ground station.

Four dipole antennas on the drone receive pulses from the approaching missile and the signal is automatically transmitted through a telemetering antenna to the ground recording station.



TOP FLIGHT RESULTS

... when you place your classified advertising in **MISSILES AND ROCKETS** Magazine. Every week you can reach about 30,000 top men in the booming missile and rocket industry. If you want to buy ... sell ... seek employment ... send your classified message today to

MISSILES & ROCKETS

1001 Vermont Avenue, N. W.,
Washington 5, D. C.

NOW AIRCRAFT TYPE SWIVEL JOINTS



**LOW TORQUE
PLANE
SWIVEL JOINT—**
360° rotation in a
single fixed plane.



**NEW SELF-ALIGNING
SWIVEL JOINT—**
360° rotation plus
15° side flexibility.

BARCO Offers Two Standard Types

Here are the newest designs in the field! SEND TODAY FOR BARCO CATALOG 269A. Since 1941 Barco Swivel Joints and special Flexible Assemblies have met the precise requirements of in-flight and other types of military equipment ... conforming to MIL-J-5513A and other specifications. Barco's wide experience is yours to call upon in the development of your particular project—aircraft, missile, track vehicle or special installation—for hydraulic, pneumatic, oxygen, fuel, gas or liquid service. Barco Representatives are at your service in the specification of standard or specialized adaptations of standard designs.



BARCO MANUFACTURING CO.
566D N. Hough Street • Barrington, Illinois

Serving Industry Since 1908

Circle No. 26 on Subscriber Service Card.



The representative from
'missiles and rocket
offers you the
most exciting
half hour
of your week



Here is a man who knows the \$7 Billion Missile Market the missile audience. He's constantly briefed by the largest editorial staff exclusively serving this field and by the m/r research department. The editors of Missiles and Rockets—all specialists—keep him posted on rapid changes in the market—changes that bring big adjustments in both manufacturing and marketing.

In just thirty minutes this man from m/r can reveal what's in a missile for you. (3,000 subcontractors and vendors alone supply over 40,000 parts for just one Atlas ICBM.) If you are already active in the missile field, he can explain how you can sell more in Missiles and Rockets—the main source of accurate information in the missile field. Contact your nearest m/r regional office and prepare yourself for the most exciting half hour of your week.

missiles and rocket
 AMERICAN AVIATION PUBLICATIONS, INC.
World's Largest Aviation Publishers
 1001 VERMONT AVENUE, N. W., WASHINGTON 5, D. C.

... missile electronics

The system utilizes phase comparison and operates in the VHF telemetry frequency band.

The system is highly sensitive within a "near-zone" of from four to five missile lengths. Within this zone, relative trajectory, velocity, and miss-distance of a missile with respect to a target drone can be computed within 5%. Until the drone is hit, any number of near-misses can be recorded intelligently as long as a finite time lag exists between missile approaches.

The ground station tape recordings provide a permanent history of all firings.

Data obtained from the FIRE-TRAC system could contribute to the development of better missile systems and more accurate guidance fusing subsystems.

Pioneer IV Had Ceramic Tube for High Frequency

OWENSBORO, KY.—Part of the credit for the successful tracking of *Pioneer IV* beyond 400,000 miles belongs to a small ceramic transmitting tube produced by the General Electric plant here.

The tube—a receiving type 7077, a half-inch long and a half-inch in diameter—allowed the probe to transmit with an output of 200 milliwatts at 960.05 megacycles. The higher frequency, as compared with the previously-used transistor transmitting frequencies of 108 megacycles, permits more accurate tracking.

The higher frequency signals are less subject to bending and reflection by the ionized layers of the upper atmosphere and also require less cumbersome tracking antenna.

Commerce Dept. Says Sputnik IV May Be Up

The Soviets may have orbited *Sputnik IV*.

This and other information about the Russian IGY program from Soviet and other foreign publications is contained in a Department of Commerce bulletin prepared by the Office of Technical Services.

The bulletin quotes an article appearing in *La Libre Belgique*, a Brussels newspaper, on Jan. 31, reporting that the Bochum Public Observatory in West Germany picked up radio signals on 20.5 megacycles at 7:46 on Jan. 31.

These signals, which differ from those of *Sputnik III*, were heard three times in the space of 104 minutes and always began several minutes after the signals from *Sputnik III* were heard.

missiles and rockets, March 23, 1959



QUARTERBACKING THE EAGLE PROJECT

Bendix Aviation Corporation will be prime contractor for the Eagle missile—and Bendix Systems Division will quarterback the project.

Latest in a series of important defense projects to be assigned Bendix Systems, the Eagle will be a long-range, air-to-air missile designed for fleet air defense and interception missions.

Responsible for systems management and engineering in connection with the project, Bendix Systems Division will also direct the development of the Eagle missile, electronic guidance, and fire control equipment in the launching aircraft.

Engineers and scientists with missile experience may find that their talents are suited to the special-

ized work involved in the Eagle project and other important system programs at Bendix Systems Division.

Located adjacent to the Engineering campus of the University of Michigan, Bendix Systems Division offers the better man an outstanding opportunity to join an organization with full facilities for encouraging his finest work. Ann Arbor is a wonderful place to live and raise a family, a town which combines life in a college community with the nearby advantages of a large city.

If you are interested and qualified in weapons system planning, research and development, you are invited to write to Bendix Systems Division, Dept. K3-23, Ann Arbor, Michigan.



Bendix Systems Division

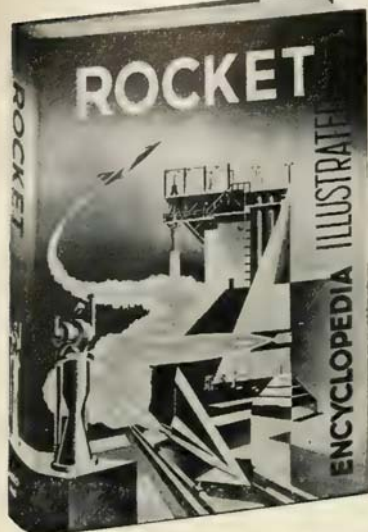
ANN ARBOR, MICHIGAN

Circle No. 27 on Subscriber Service Card.



JUST PUBLISHED!

PICTORIAL ENCYCLOPEDIA OF THE
WORLD'S ROCKET KNOWLEDGE



ROCKET ENCYCLOPEDIA ILLUSTRATED

John W. Herrick, Chief Editor
Member of Technical Staff, Space Technology
Laboratories, Inc., subsidiary of Thompson Ramo
Wooldridge, Inc.

Eric Burgess, Associate Editor
Member of Technical Staff, Telecomputing Corp.,
and internationally known author.

Foreword by
Dr. Theodore von Karman
International authority on rockets and missiles.

Large 600 Page Book!

Authentic Definitions of rocket technology . . .
research, engineering, production, testing.
Complete Explanations of each term in basic,
easy-to-understand language . . . very profusely
illustrated.

Details of the illustrations are identified by
captions, and are cross-referenced in the text by
bold-face type.

450 Photos & Drawings

Many never published before!

Principles, Developments & Operations. Rocket
power, propulsion applications, propellants,
engines, assemblies, components, accessories, sys-
tems engineering . . . including missiles, proc-
essing and production methods, test and ground
equipment, Military and industry facilities.

**Abbreviations, symbols, engineering data, his-
tory of outstanding events, biographies.**

Large 7 1/2 x 10 3/4 size. Only \$12.50.

OBTAIN FROM YOUR
BOOKSTORE or MAIL COUPON TODAY
FREE EXAMINATION!

Aero Publishers, Inc., Dept. MR323
2162 Sunset, L. A. 26, Calif.

Rush me the new Rocket Encyclopedia for 10
days free examination. Within that time I
will either remit \$12.50 plus postage, or return
the book with no further obligation.

☐ Bill me ☐ Bill my company.
☐ Send Free 1959 Aviation Book catalog.

Name

Firm

Address

City Zone

State

☐ SAVE! I am enclosing my check or money
order for \$12.50. I understand Aero Publishers
will pay delivery postage, and that I have the
same return privilege.

AERO PUBLISHERS, INC.

Aviation Books since 1939

Circle No. 28 on Subscriber Service Card.

propulsion engineering

NATO will look at propellant chemistry during a June meeting in Paris. The discussion shouldn't embarrass U.S. representatives since it is not classified. However, during NATO classified meetings on strategy or advances in weapons, our people are often lost. A major gripe: meetings are run as if each delegate had read all the papers in advance and was prepared to ask questions. NATO headquarters marks the papers "NATO Classified" before sending them to member countries. In the U.S., that means "Secret." Many times, U.S. representatives do not see the reports until they are presented, which gives little opportunity for discussion.

Navy lost its only source of one type of high-temperature gyroscope floating oil used in missiles in the Lehigh Chemical plant, Chestertown, Md., fire . . . Trouble in the USS Seawolf was not in the reactor. Shutdown was caused by leaks in the external sodium loop, not in the reactor which operated over two years without maintenance.

Titanium may be in for a comeback after more than a year of near obscurity. NASA reveals that titanium will play a leading part in McDonnell's manned space capsules. Tonnage-wise, this will not be significant. However, it can be regarded as "proof of the titanium pudding" for potential users. JPL used titanium instead of stainless steel in the final stages of the *Explorers* and *Pioneer III*, cutting weight by two pounds to permit additional instrumentation. In *Mercury*, titanium will be used as a covering and in critical spots. Major structural materials will be nickel-steel alloys. Ceramic-metal combinations probably will not be used in the capsules at all. Beryllium will be used for the re-entry heat shield.

Beryllium will be available from British sources before the year is over. Imperial Smelting is putting up a thermal reduction plant at Avonmouth. It will produce nuclear-grade beryllium for canning fuels used in high-temperature reactors. Although the company will not reveal the plant's capacity, officials say another plant will be built if British demand for beryllium reaches the almost undreamed figure of 100 tons/yr by 1965.

Red fuming nitric acid apparently has met defeat in its war of destruction. The conqueror: Compound 18007. Not too much has been said, but Precision Rubber Products, Dayton, reveals that the new material can handle all missile applications involving RFN.

More research is coming on special materials for missile and atomic energy uses. Calumet & Hecla's Wolverine Tube Division is tripling its facilities at Allen Park, Mich., to intensify studies on titanium, molybdenum, zirconium, niobium, vanadium, tantalum, and tungsten. Some of the fabrication techniques will include hot and cold extrusion, high-velocity forming and spin forming.

Retiring Atomic Energy Commissioner Willard F. Libby tells friends he hopes AEC will act on one bit of parting advice: Go more into basic high-temperature materials research needed to backup critical programs particularly in reactor projects.

Nitrogen tetroxide is now available from Hercules Powder's California plant, completed in December. N₂O₄ is being shipped in one-ton cylinders and tank cars.

The rubber vs. plastic propellant feud continues in full swing, with no hope for an early government specification which would say in effect "This is our choice." The first two stages of NASA's project *Scout* underline this. The Aerojet *Senior* is urethane; the improved Thiokol *Sergeant* is polysulfide rubber; and the scaled-up *Vanguard* third stage by ABL may feature an entirely new type of fiberglass case.

State Department no longer controls export licenses for silicon transistors. Department of Commerce has taken over licensing because of its increasing industrial use. Until recently, silicon transistors were primarily military items. They still require individual export licenses—under Bureau of Foreign Commerce's positive list, Schedule B, No. 70848—for shipment to anyplace except Canada.

missile people

The Defense Department has named **George P. Sutton** to be chief scientist of the Advanced Research Projects Agency, succeeding **Dr. Herbert York**, who has moved up to become the Pentagon's director of research and engineering.

Sutton is a professor of aeronautical engineering at the Massachusetts Institute of Technology. Earlier, he was an engineer with the Rocketdyne Div. of North American Aviation and the Aerojet Engineering Corp. At 38, he has had 16 years' experience in rocket-missile work. He was a founder and first president of the Southern California Section of the American Rocket Society.



Sutton

Dr. Hector R. Skifter has been named Assistant Director of Defense Research and Engineering, under York. He will be responsible for technical evaluation and integration of weapon systems and planning and supervision of the development of new systems. He is on leave of absence as president of Airborne Instrument Lab., Div. of Cutler-Hammer.

Lockheed's former chief scientist,

Dr. Louis N. Ride-nour, has been named to head its new Electronics and Avionics Division. The new division, according to the company, was set up "to further diversify operations and expand participation in the



Ridenour

military and industrial electronics markets," and will launch Lockheed into quantity production and marketing of electromechanical products.

Ridenour was chief scientist of the U.S. Air Force in 1950 and 1951, assistant director of the Radiation Laboratory at Massachusetts Institute of Technology during World War II, and served as chairman of the U.S. Air Force Scientific Advisory Board committee that led to establishment of the Air Research and Development Command. He joined Lockheed in 1955.

Dr. D. B. Duncan, manager of advanced engineering for the Autonetics Division of North American Aviation, will serve as a member of NASA's Advisory Committee on control, guidance and navigation.

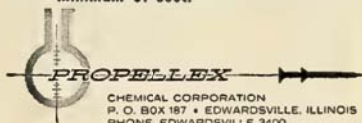
missiles and rockets, March 23, 1959

from research, design, development and manufacturing
from **PROPELLEX**

A NEW SOURCE OF FLIGHT TESTED COMPONENTS



Whatever you need in the way of propellants, explosives and cartridge actuated devices, Propellex can deliver in a minimum of time at a minimum of cost.



serving as prime contractor to the U. S. Government and to the nation's aircraft and missile manufacturers.

Engineers and scientists with vision and ability are invited to investigate the opportunities at Propellex.

Circle No. 29 on Subscriber Service Card.



solid propellant rocket motors

emergency landing gear actuators

explosive bolts, frangible studs

Write today for free booklet describing our facilities. "This is Propellex".

INERTIAL GUIDANCE

Represents one of many applications of

Autocollimation

to solve Alignment Problems of a highly precise nature.



The KERN DKM2

When equipped with the new No. 356 Autocollimating Eyepiece, this famous one-second theodolite has a total magnification of 23x and an operating range from zero to at least 100 feet for autocollimation.

Write for technical data and specifications.
No. 12



The FINEST in SURVEYING EQUIPMENT
KERN INSTRUMENTS INC.
120 Grand St., White Plains, N. Y.

Circle No. 30 on Subscriber Service Card.

By Fred S. Hunter

high temperature PLASTICS



Continuing research in the field of high temperature plastic molding has enabled Olympic to create fiberglass missile components such as nose cones, radomes and heat reflective shields.



High strength, heat resisting structural parts and exhaust deflectors, insulators and nozzles have been produced that perform as high as 5000° F.



Standard electrical terminal strips now adopted as NAS 1066, as well as special design terminal blocks, have been developed to withstand continuous service to 600° F.

OLYMPIC
Plastics Company, Inc.

3471 S. La Cienega Blvd., Los Angeles, Calif.

Circle No. 31 on Subscriber Service Card.

Among the larger West Coast companies, look for Marquardt Aircraft Corp., the ramjet producer, to be the next to change its name, removing the word "aircraft" and reducing it to Marquardt Corp. This is scheduled to take place in May. There will be others following the trend started by Whitley Collins when he decided to change Northrop Aircraft, Inc., to Northrop Corp.

We have heard that Lockheed Aircraft Corp., has discussed changing its name to more properly reflect its diversified activities, but so far as we know there has been no decision. However, the Lockheed Missile Systems Division recently changed over to Lockheed Missiles and Space Division, so you can see that they are name-conscious at Lockheed.

We rather doubt that any change is imminent at the Douglas Aircraft Co. Donald W. Douglas takes a great deal of pride in the airplanes his company has turned out over the last 35 years, and we don't think he will be in any hurry to disassociate the family name from the product it has been producing so successfully, no matter how the company may diversify.

It is also safe to predict that North American Aviation will stick to its present name. There are many companies in various fields using the "North American" name (North American Van Lines, North American Life Insurance Co., etc.), and a few years ago NAA went into court to protect its exclusive right to the name in the aviation field, winning a restraining action against a non-scheduled air carrier which had called itself North American Airlines. From a legal standpoint, it is much simpler for NAA to stay as it is.

If the directors of North American Aviation decide at the close of the year that the company's Fiscal 1959 earnings justify sweetening the regular 40¢ quarterly dividend with a year-end extra—and the way things look now, we would say this is very likely to happen—it will be paid in cash—not in stock. While NAA's dividend policy has been reasonably liberal, it has never embraced the payment of extras in stock.

Two stockholders took to the floor at the recent annual meeting to urge NAA to declare stock dividends because of the tax advantage. President J. L. Atwood replied that the directors would give consideration to such an action, but he indicated that if NAA could afford a higher dividend, the board undoubtedly would vote to make the distribution in cash. "A stock dividend is just something you already own," observed Board Chairman J. H. Kindleberger.

Marquardt Aircraft Corp. recently announced that two of its vice presidents, W. H. Schwebel and Don L. Walter, had been elected directors of the company. Generally overlooked was the fact that they have replaced two directors who had represented Olin Mathieson interests on the Marquardt Board—William C. Foster and Harry A. Sosnoski, both vice presidents of the Olin Mathieson Chemical Corp.—thus formally ending the former close affiliation between the companies.

Olin Mathieson, at one time, was Marquardt's biggest stockholder, with its holdings amounting to 25%. This distinction now belongs to the Nelson Rockefeller interests, with holdings amounting to 20%, which, it might be added, Rockefeller is retaining.

Lockheed Missiles and Space Division has developed its own airborne magnetic tape recorder to answer its need for a lightweight, versatile communication unit for scientific space missions. It says its Palo Alto research laboratory developed the recorder in one-fourth the time and one-fifth the cost asked by an outside manufacturer for the same job.

The 1959 Western Space Age Conference and Exhibit was better managed, more orderly and, we believe, more profitable to the participants than the first show held last year.

missiles and rockets, March 23, 1959

40 Nations To Be at World Flight Congress

LAS VEGAS—The United States will be staging a virtually one-nation missile and space show at the first World Congress of Flight. Russia isn't coming.

No invitation to participate was extended to the Soviet Union because reciprocal State Department travel restrictions post Nevada "off limits" to citizens of that country.

Hence, Russian scientists will miss a scheduled first public unveiling of the *Mercury* manned space capsule, showing its retro-rocket installation and pilot control monitor.

Conversely the Soviets will miss an excellent opportunity to show off some of their own space hardware to the free world. More than 40 of 77 invited nations, including Czechoslovakia which is not barred from Nevada, have signified they will send delegations to the Congress here April 12-19.

Lack of Russian representation may cloud somewhat the high aims of the conference, but not its effectiveness as a massive clearinghouse for exchange of technological information. The project is dedicated to the "belief that greater world knowledge of aircraft, missiles and spacecraft—in realistic perspective—will help bring the world closer to permanent peace."

A spokesman for the sponsoring Air Force Association said Las Vegas was picked before invitations went out in January. Proximity to the desert over which air shows will be staged, availability of nearby Nellis AFB, hotel and meeting accommodations determined the choice. "We wanted to invite the Russians, but found we couldn't because of the ground rules," AFA told m/r.

In scope, the exposition is the most ambitious undertaking of the AFA since it inaugurated Jet Age Conferences in Washington a few years ago. Executives of 1000 or more American companies, hundreds of scientists, engineers and technicians representing all components of the missile-space and aircraft industries are expected to attend.

At least 150 companies have taken exhibition space. In the international array of aircraft and space hardware will be a "walk-in" display of the 85-ft. *Atlas* ICBM. There will also be a military firepower demonstration.

Six of 11 symposiums to be conducted in the new Las Vegas auditorium, a saucer-shaped 7500-seat structure just off the gambling "Strip," will be devoted to space, missiles and R&D. They include:

—Aircraft and Space Communica-

tions sponsored by the Electronics Industries Associations. Papers will be presented by D. M. Cutler of ITT Laboratories, satellite communications; M. Berkowitz of GE, space cabin communication system design; and Stanley Plass of Packard-Bell Electronics Corp., pre-flight radiation test equipment.

—International Air Force Research sponsored by the Air Research & Development Command. Presenting papers on basic research required by military aeronautics and astronautics will be Brig. Gen. B. G. Holzman, AF office of scientific research; Col. Nathan L. Krisberg, commander of ARDC European office; Dr. B. K. Lundberg, director, aeronautical Institute of Sweden; Dr. Samuel S. Steinberg, rector, Instituto Tecnológico de Aeronautics Sao Jose Dos Campos, Sao Paulo, Brazil; and Prof. Itiro Tani, Institute of Science & Technology, University of Tokyo.

—Missile Management, including presentations and panel discussions on weapons management, industrial problems of limited production, industry's future in space age R&D and the

Prime-Sub contractor relationship.

—Advanced Air Traffic Control and Navigational Aids Concepts, including presentations on possible use of space platforms and satellite for traffic control; advanced navigational aids, such as Doppler systems, inertial guidance and hyperbolic systems, and their aircraft applications.

—Space Age, including progress reports on space exploration, presentations and discussions on the impact of science and technology on military posture and economic activity and a panel presentation on the interaction between scientific progress and man's philosophical problems and outlook.

As m/r went to press, the full program had not been completed. However, the AFA said other speakers definitely would include ARPA Director Roy Johnson, Dr. W. Randolph Lovelace, chairman of NASA's Man-In-Space Committee; Dr. Abe Silverstein, NASA director of space flight and development; Col. Carlo R. Tosti, special assistant to commander, ARDC; and Dr. Edward Teller of the University of California Radiation Laboratory.



IAC
Your Standard of Silence

**controls
jet and
rocket
noise**

**from
jets and
missiles**




At Republic Aviation, IAC's new ground muffler features a tail enclosure for complete and effective silencing of J-75 jet engines in F-105 aircraft.

The trailer mounted MDU Ground Run-Up Silencer, adaptable to any aircraft or engine field operation offers a highly maneuverable unit for both military afterburner and commercial equipment.




IAC's proven DURA-STACK All-Steel Silencing Systems are effectively controlling noise of jet and rocket engines in test cells at both military and commercial installations around the world!

IAC offers the most complete line of noise suppression equipment engineered for jet and missile engines of today and tomorrow. Send for complete details.

INTERNATIONAL AEROACOUSTICS DIVISION
INDUSTRIAL ACOUSTICS COMPANY, Inc.

341 Jackson Avenue
New York 54, N. Y.

REPUBLIC VALVES

FOR EVERY INDUSTRY

EXTRA HIGH PRESSURE FINE METERING



HIGH PRESSURE NEEDLE VALVE

10,000 psi hydraulic service. Forged stainless steel one-piece body. Panel mounting. Good flow characteristics, fine metering, easy to turn. Water, gas, oil and vacuum service, $\frac{1}{8}$ " to $\frac{1}{2}$ " pipe or straight thread tube connections.

MICROMETER ADJUSTMENT NEEDLE VALVE

Best for extra fine metering. Micrometer adjustment, precision taper stem. 5000 psi service -65° to 350°F., oil, water, etc. Brass, aluminum alloy, steel, or stainless steel body. $\frac{1}{8}$ " and $\frac{1}{4}$ " sizes. Premolded or O-ring packing. Panel mounting.



5000 psi THROTTLE-FLO VALVE

Accurate throttling up to 5000 psi. Finger tip control. Pilot operation of large dynamically balanced piston. Full flow, yet accurate to 1/100 gpm through entire range. Positive seal. Low pressure drop. Aluminum alloy, $\frac{1}{2}$ ", $\frac{3}{4}$ ", 1" internal straight thread connections. Hydraulic seals — others available.

HYDRAULIC BLEEDERS

Primarily used for bleeding air from hydraulic systems, for working pressures to 3000 psi at temperatures from -65° to 180°F.



Fluid control valves of many types have been developed and are manufactured by REPUBLIC. A wide line of quality standard valves includes needle, globe, check, plug, selector and relief valves, as well as other units for industrial, chemical, aircraft, missile and ground handling equipment.

Specialists in valving and manifold design to meet your specific application. Write for catalog.

Distributors in principal cities coast to coast

CHECK



RELIEF



SELECTOR



GLOBE NEEDLE



PLUG



RM

REPUBLIC MANUFACTURING CO.

15655 BROOKPARK ROAD • CLEVELAND 35, OHIO

contract awards

Boeing Airplane Co. reportedly has a government contract to study the question of placing an observatory on the moon.

George H. Stoner, general manager of Boeing's *Dyna-Soar* program, recently described the observatory as an example of the type of program Boeing is working on. Speaking in Seattle, Stoner did not identify the government agency for which the company is undertaking the studies, but he said it is many years away.

Martin has a team analyzing moon base requirements. One segment of their study was finished in August, 1957.

Other awards:

ARMY

\$12,419,415—**Blount Bros. Construction Co.**, Montgomery, Ala., for construction of *Titan* and *Atlas* launch facilities and utilities at Warren AFB.

\$1,455,197—**Aerojet-General Corp.**, for R&D.

\$1,142,476—**Douglas Aircraft Co., Inc.**, for *Nike* repair parts and launching area items.

\$714,070—**R. E. Clarson, Inc.**, St. Petersburg, Fla., for construction of Azusa facilities at Patrick AFB.

\$660,230—**Warner Construction Co.**, San Angelo, Tex., for special weapons assembly facility at White Sands.

\$660,000—**Telecomputing Corp.**, for overhaul of *Nike-Ajax* rate gyros and amount gyros.

\$620,472—**Rocketdyne Div., North American Aviation**, for classified contracts.

\$500,000—**General Electric Co., Missile and Space Vehicle Dept.**, for R&D of warhead arming and fusing system for *Little John*.

\$477,883—**Chavis Construction Co., Inc.**, Pensacola, Fla., for construction of missile facilities at Eglin AFB.

\$351,287—**Gilfillan Bros., Inc.**, for *Corporal* repair parts.

\$296,901—**Electro-Optical Systems, Inc.**, for R&D.

\$166,049—**Western Electric Co., Inc.**, for *Nike* spare parts and components.

\$165,823—**Fred A. Arnold**, Los Angeles, for R.I.M. Building at Vandenberg AFB.

\$143,650—**The Firestone Tire & Rubber Co.**, for *Corporal* repair parts and ground equipment.

\$141,335—**Western Electric Co., Inc.**, for engineering services and training aids for improved *Nike-Hercules* system.

AIR FORCE

\$18,681,124—**Sperry Gyroscope**, for radar sets, spares, data, installation and report.

\$3,313,488—**Raytheon Mfg. Co.**, for electron tubes (four contracts).

\$1,283,095—**Convair Div., General Dynamics**, for increase in funds (two contracts).

\$725,000—**Republic Aviation Corp.**, for research.

NAVY

\$3,329,797—**Packard Bell Electronics Corp.**, for integrated electronic central equipment.

missiles and rockets, March 23, 1959

book reviews

THE SCIENTIFIC REVOLUTION, edited by Gerald W. Elbers and Paul Duncan, Public Affairs Press, Washington, D.C., 275 pp., \$6.00.

This book puts in print the periodic cry for drastic changes in our scientific age. In this case, the clarion call comes from 34 of the leading participants in the 1958 Yale conference on "America's Human Resources to Meet the Scientific Challenge." Each of them has contributed a chapter to the book.

While it probes varying aspects of the problem deeply, it offers few promising solutions. Agreed: we need better teachers, better courses, a better educational system that would cull the brightest students into separate classes, better understanding between scientists and the public, better use of research and development funds and more of them, and better pay for government scientists.

While varying solutions are offered, consensus seems to be that before any effective answers are possible, there must be a dramatic change in attitude on the part of the American people.

Anthropologist Margaret Mead calls for a new kind of education beginning in the nursery "which will make children not into a mass of non-scientists and a few scientists, but into citizens of a civilization in which everyone has a stake in understanding the meaning of science."

She gives examples of the mistrust some young minds entertain about the field by quoting compositions submitted by high school girls on the subject, "My Neighbor Who is a Scientist." A typical excerpt: "I wouldn't want a scientist living next door to me because anything might happen."

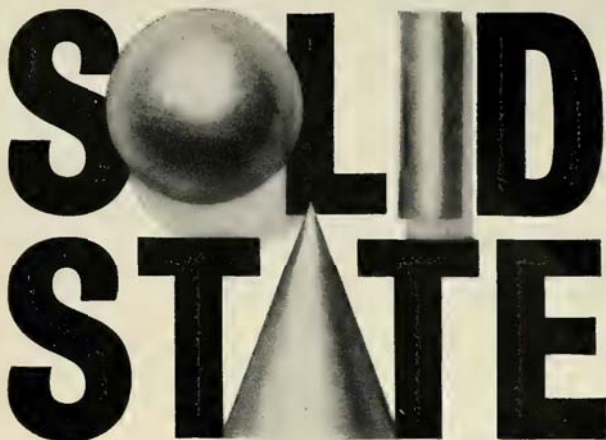
Another one, which has been echoed from other quarters and which scientists might well consider: "He should know how to get along with people that aren't as smart as he is."

PROGRESS IN METAL PHYSICS, edited by Prof. Bruce Chalmers of Harvard University, Pergamon Press, 408 pp., \$16.

A seventh annual review of published material in the field, with selected chapters dealing with equilibrium, diffusion and imperfections in semiconductors, physical metallurgy of titanium alloys, thermodynamics and kinetics of martensitic transformations and the storage of energy in cold-worked metal.

missiles and rockets, March 23, 1959

*Explore new areas
at IBM in*



The IBM solid state program ranges from basic research to product development. In order to develop new laminar materials for overlaying solids, IBM is studying the behavior of molecules adhering to a surface in an ordered array. Other projects involve a new ferrite core which will function normally at 500°C. and a one-million bit magnetic memory drum weighing only five pounds. Assignments are now available in such related areas as circuit design, cryogenics, inertial guidance, logic, magnetics, optics, radar, semiconductors, and transistors.

A career with IBM offers excellent advancement opportunities and rewards. You will enjoy professional freedom. Comprehensive education programs are available as well as the assistance of specialists of diverse disciplines. Working independently or with a small team, your contributions are quickly recognized. This is a unique opportunity for a career with a company that has an outstanding growth record.

Qualifications: B.S., M.S., or Ph.D. in E.E., M.E., Physics, Mathematics, or Physical Chemistry—and proven ability to assume a high degree of technical responsibility in your sphere of interest.

For details, write, outlining background and interests, to:

Mr. R. E. Rodgers, Dept. 604C4
IBM Corporation
590 Madison Avenue
New York 22, N. Y.

IBM®

INTERNATIONAL BUSINESS MACHINES CORPORATION

AERODYNAMIC ENGINEERS



NEW CONCEPTS IN COMBAT SURVEILLANCE OFFER YOU A MORE PROMISING CAREER

Over \$25 Million in New R&D Contracts for SWALLOW Awarded Missile Systems Division of Republic Aviation

It has been the dream of every combat commander to possess *accurate* information concerning tactical disposition of enemy troops and materiel, *before, during and after the battle*. One of the telling answers to this vital problem is the Swallow SD-4. Career aerodynamicists have the opportunity of joining this and other important programs in the challenging fields of:

- longitudinal stability and control
- supersonic and transonic aerodynamics
- lateral-directional stability
- airloads and basic aerodynamic analysis
- optimum aerodynamic solutions for high velocity, ground controlled vehicles

The Swallow SD-4 and SD-3 Surveillance Drones are two of the many expanding programs that offer the following opportunities:

AERODYNAMIC SPECIALIST 8-14 years' major airframe stability and control exp. required to lead guided missile design and analysis programs

PRINCIPAL AERODYNAMICIST 5-8 years' experience in stability and control required for guided missile design work

SENIOR AERODYNAMICIST 3-5 years' experience in airloads and basic aerodynamic analysis

Other openings exist for **ELECTRONIC, HYDRAULIC, SYSTEMS & MECHANICAL ENGINEERS & DESIGNERS**

Send resume in complete confidence to:

Mr. Paul Hartman, Engineering Employment, Dept. 4C-4



MISSILE SYSTEMS DIVISION

REPUBLIC AVIATION

223 Jericho Turnpike, Mineola, Long Island, New York

New Opportunities for SYSTEMS ENGINEERS ELECTRONICS ENGINEERS and MECHANICAL ENGINEERS

with 2 to 7 years' experience
(EE, ME, AE or Physics)

These positions are with General Electric's Ordnance Department, contractor for some of the most complex weapons systems ever conceived—including POLARIS project fire control and guidance systems and TALOS handling and launching equipment. Based in Pittsfield, Massachusetts—heart of the Berkshire fishing and skiing country—the Ordnance Department offers professional advancement in a winter and summer vacation paradise.

IMMEDIATE OPENINGS IN THESE AREAS

- Systems Development Design and Development
- Fire Control Engineering Gunfire and Missile
- Electronic Circuit Development
 - Inertial Components
- Field Service and Evaluation
 - Quality Assurance
 - Field Testing (Positions in Florida)

Send resume in confidence to:
Mr. W. Fielding, Div. 43-WL

ORDNANCE DEPARTMENT
OF THE DEFENSE ELECTRONICS DIVISION

GENERAL ELECTRIC

100 Plastics Avenue,
Pittsfield, Mass.

Advertisers' Index

Aeronca Mfg. Corp.	27
Agency—Penn and Hamaker, Inc.	
Aero Publishers, Inc.	46
American Bosch Arms Corp.	28
Agency—Doyle, Kitchen & McCormick, Inc.	
American Potash & Chemical Corp.	55
Agency—The McCarty Co.	
Ampex Corp.	32
Agency—McCann-Erickson, Inc.	
Astrodyne, Inc.	2
Agency—Batten, Barton, Durstine & Osborn, Inc.	
Barco Mfg. Co.	43
Agency—Armstrong Adv. Agency, Inc.	
Bausch & Lomb Optical Co.	36
Agency—Wolff Associates, Inc.	
Beckman & Whitley, Inc.	18
Agency—Gerth, Brown, Clark & Elkus of San Francisco, Inc.	
Bendix Aviation Corp.	
Bendix Systems Div.	45
Utica Div.	34
Agency—MacManus, John & Adams, Inc.	
Brunswick-Balke-Collender Co.	9
Agency—McCann-Erickson, Inc.	
Consolidated Electrodynamics Corp.	12
Agency—Hixson & Jorgensen, Inc.	
Dow Chemical Co., The	6, 7
Agency—MacManus, John & Adams, Inc.	
ElectroData Division of Burroughs Corp.	16
Agency—Carson/Roberts, Inc.	
Electro Instruments, Inc.	56
Agency—Clyde D. Graham Adv.	
George D. Ellis & Sons, Inc.	40
Agency—John B. Ferguson, Jr. Adv.	
Engelhard Industries, Inc.	53
Agency—Stuart Sande Adv.	
B. F. Goodrich Aviation Products, a Div.—The B. F. Goodrich Co.	38
Agency—Batten, Barton, Durstine & Osborn, Inc.	
Goodyear Tire & Rubber Co., Inc.	3
The	
Agency—Kudner Agency	
Hallcrafters Co.	41
Agency—Henry B. Kreer & Co., Inc.	
Harco Containers, Div. of Harbor Boat Bldg. Co.	33
Agency—Richard Pennington Adv.	
Hunter Mfg. Co.	35
Agency—Meerman, Inc.	
Industrial Acoustics Co., Inc.	49
Agency—Ritter, Sanford, Price & Chalek, Inc.	
Kern Instruments, Inc.	47
Agency—Richmond Adv. Service, Inc.	
Olympic Plastics	48
Agency—The Rouse Co.	
Pesco Products Div.	13
Borg-Warner Corp.	
Agency—The Jayme Organization, Inc.	
Propellex Chemical Corp.	47
Agency—Al Maescher Adv., Inc.	
Republic Mfg. Co.	50
Agency—J. N. Patterson & Associates	
Space Technology Laboratories	17
Agency—Gaynor & Ducas, Inc.	
Stratoflex, Inc.	8
Agency—Magnussen	
Temco Aircraft Corp.	10
Agency—Rogers & Smith Adv. Agents	
Texas Instruments, Inc.	20
Agency—Don L. Baxter, Inc.	
Tube Distributors Co., Inc.	37
Agency—Duncan-Brooks, Inc.	
Washington Steel Corp.	42
Agency—Cabbot & Coffman, Inc.	
Westinghouse Electric Corp.	14
Agency—Fuller & Smith & Ross, Inc.	
EMPLOYMENT SECTION	
Bendix Aviation Corp.	
Bendix Products Div.	53
Agency—MacManus, John & Adams, Inc.	
General Electric Co.	52
Agency—Deutsch & Shea, Inc.	
International Business Machines Corp.	51
Agency—Benton & Bowles, Inc.	
Republic Aviation Corp.	52
Agency—Deutsch & Shea, Inc.	

CLASSIFIED

Undisplayed Advertising: \$1.50 per line, minimum charge \$4.50. Cash with order. Estimate 30 capital letters and spaces per line; 40 lower-case letters and spaces per line. Add two lines if Box Number is included in lieu of advertiser's name and address.

Displayed Advertising: \$15.00 per column inch. Space units up to full pages accepted in this section for classified-type advertising.

Forms close three weeks preceding date of issue. Address all correspondence to: Classified Advertising Department, Missiles & Rockets Magazine, 1001 Vermont Ave., N. W., Washington 5, D.C.

EXECUTIVES ENGINEERS



CONTACT 978 MAJOR FIRMS

Openings \$5,000 to \$60,000

Get the Best Job in Your Field Rapidly and Confidentially This New Proven Way! Protects Identity. Explores Your Markets to Get you Top Pay. Opportunities and Benefits. **INDIVIDUAL JOB CAMPAIGNS WHEN DESIRED.** Send resume in Confidence for Review and Action Plan by an Engineer (BSEE and Ex-WBMT from 1924) and Seasoned Executive with Experience with Bendix, Kellogg, Webcor, and 28 years of Top Level Nationwide Contacts. All inquiries handled in complete confidence.

Call or Write Now—Dept. MR-3
Mr. Wm. V. Baker, Mich. 2-2532

National Electronics
Executive Exchange
14 W. Elm St., Chicago 10, Ill.



Management Consultants for
Engineering and Executive Procurement
and Placement Since 1942

Missile Photos—For your office, den or collection. We produce B&W and color prints, slides, murals, and display photographs. For catalog and sample slide send 35¢ to—Camber Company, Box 1051, Cocoa, Florida.

when and where

MARCH

American Rocket Society, 1959 Sectional Meeting, Daytona Plaza Hotel, Daytona Beach, Fla., March 23-25.

Institute of Radio Engineers, National Convention, Coliseum and Waldorf-Astoria Hotel, New York, March 23-26.

Society of the Plastics Industry, 16th Annual Conference, Pacific Coast Section, Hotel del Coronado, San Diego, March 25-27.

American Society of Mechanical Engineers, Instruments and Regulators Division Conference, Cleveland, March 29-Apr. 2.

Society of Automotive Engineers, National Aeronautic Meeting, Hotel Commodore, New York, March 31-Apr. 3.

APRIL

Conference on Electrically Exploded Wires, sponsored by the Thermal Radiation Laboratory of the Geophysics Research Directorate of the Air Force Cambridge Research Center, Somerset Hotel, Boston, Apr. 2-3.

American Society for Quality Control, Portland Chapter, Oregon Museum of Science and Industry, Portland, Apr. 3-4.

1959 Nuclear Congress, Municipal Auditorium, Cleveland. For information: Engineers Joint Council, 29 West 39th St., New York, Apr. 5-10.

American Welding Society, 1959 Welding Show and 40th Annual Convention, International Amphitheatre and Hotel Sherman, Chicago, Apr. 7-10.

Air Force Association, World Congress of Flight, Las Vegas, Nev., Apr. 12-19.

Aeronautical Training Society, 17th Annual Meeting, Las Vegas, Apr. 16-17.

American Society of Tool Engineers, Annual Meeting, Schroeder Hotel, Milwaukee, Apr. 18-22.

American Rocket Society, Man-in-Space
(Continued next page)

RELIABILITY ADMINISTRATOR

To work on classified Ordnance projects in Honeywell's modern Suburban Minneapolis facility.

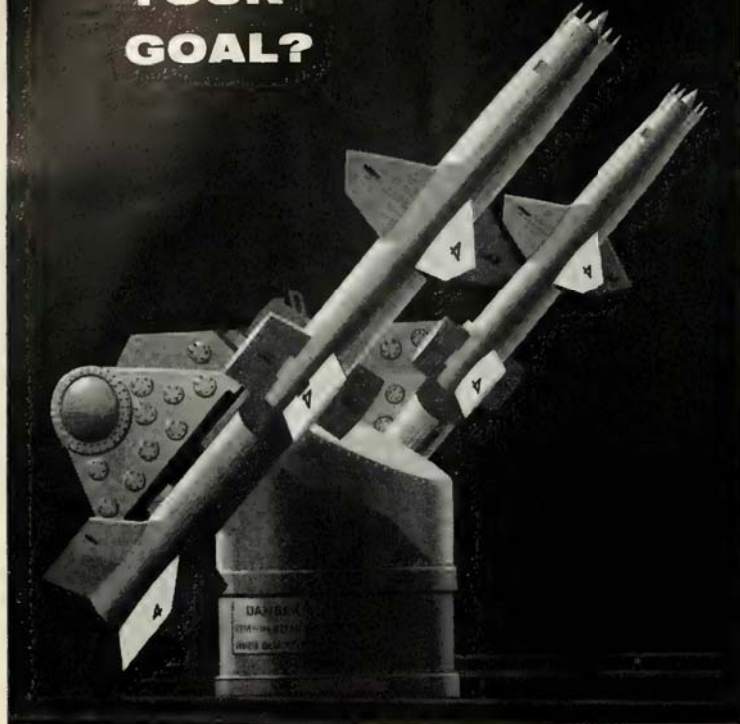
Minimum of 3 years experience in Reliability field. B.S.E.E. with advanced degree in Mathematics required.

This position will lead to supervisory responsibilities as a Divisional Reliability Administrator.

For information and application write to B. T. Caswell, Dept. MR-3 Personnel Department, Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue South, Minneapolis 8, Minnesota.

HONEYWELL
First in Control

MISSILES YOUR GOAL?



Get into a key missile program at BENDIX —prime contractor for the Talos missile

Engineering can be a really satisfying career—and within engineering one branch stands out. That's Guided Missiles. If the missile field is the one you want—hear this. We need engineers with exceptional ability who can handle responsibility.

At Bendix you work with men who are outstanding in every phase of engineering. You use facilities second to none. You do work that's challenging and important—work that offers exceptional opportunities to build your professional standing.

You will enjoy Midwestern living at Bendix, too. Fine, four-season climate and excellent recreational facilities are close at hand. In addition, Bendix offers you a liberal personal benefit program.

If this interests you and you want additional information, mail the coupon below for your copy of "Opportunities Abound at Bendix Missiles". You can read it through in half an hour—and it may prove to be the best half hour you've ever spent in your life.

Bendix PRODUCTS DIVISION Missiles



Bendix Products Division—Missiles

4128 So. Beiger St., Mishawaka, Ind.

Gentlemen: I would like more information concerning opportunities in guided missiles. Please send me the booklet "Opportunities Abound at Bendix Missiles".

NAME _____

ADDRESS _____

CITY _____ STATE _____



RX FOR INTERNAL INSPECTION

● **0.10" AND UP** . . . That's the point of entry requirement . . . to provide your inspectors the chance to use the outstanding National Fontar Borescope and thus give them the brightest, distortion-free, close-up view of the defect in "in-accessible" interior surfaces of the cast, drawn, welded or molded product . . . from inches deep to many feet.

Find out how its use can be a time and cost saver while it up-grades your Quality Control. Just send for our "Borescope Catalog."

ENGELHARD INDUSTRIES, INC.
NATIONAL ELECTRIC INSTRUMENT DIVISION
92-21 Corona Avenue • Elmhurst 73, New York

Circle No. 34 on Subscriber Service Card.

. . . when and where

(Continued from page 52)

Conference, Hotel Chamberlain, Hampton, Va., Apr. 20-22.

Institute of Radio Engineers, Spring Technical Conference on Electronic Data Processing, Cincinnati Section, Engineering Society Bldg., Cincinnati, Apr. 21-22.

Institute of Environmental Engineers, 1959 Annual Meeting, La Salle Hotel, Chicago, Apr. 22-24.

American Rocket Society, Controllable Satellite Conference, Massachusetts Institute of Technology, Cambridge, Apr. 30-May 1.

MAY

Institute of Radio Engineers, 11th National Aeronautical Electronics Conference, Dayton, Ohio, May 4-6.

Instrument Society of America, 5th National Instrumentation Flight Test Symposium, Seattle, May 4-7.

International Scientific Radio Union, Spring Meeting, Willard Hotel, Washington, D.C., May 5-7.

1959 Electronic Components Conference, Benjamin Franklin Hotel, Philadelphia, May 6-8.

missiles and rockets, March 23, 1959

SUBSCRIBER SERVICE

missiles and rockets

For additional information about any product or service advertised or mentioned in the editorial pages of this issue of Missiles and Rockets:

Use the attached prepaid reply cards. Circle numbers shown on the reply card that correspond with numbers appearing beneath items described. If no circle number accompanies the article or advertisement, give page number (and advertiser's name) on line provided at bottom of the card.

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

NEW PRODUCT BRIEFS

POWER AMPLIFIER. Designed to extend the effective range of standard telemetry transmitters in the 215-260 mc cycle band, the Model A-25 RF power amplifier features miniature construction, stabilized circuitry, and improved thermal characteristics. A full watt output is claimed with a 200 ohm input drive; input and output nominal impedances are 50 ohms. Circuitry and sectionalized mechanical construction permits full power operation without the usual requirement for blowers or other forced cooling. Only 42 cubic inches and 10 pounds, the supply requirements are 100 volts plate, 225 volts screen and heater 6.3 or 12.6 ac/dc filament. The amplifier is primarily designed for FM systems, however, it is adaptable to AM with slightly reduced power output. All tuning controls and monitoring test points are located on the front panel so that alignment can be accomplished without removing the cover. Model A-25 is designed for operation under the usual environmental conditions specified for missile telemetry.

Circle No. 240 on Subscriber Service Card.

POWER SUPPLIES. A series of high voltage power supplies providing unusual compactness at higher currents and less ripple have been developed and produced by the Condenser Products Co. With a simplified circuit design, the Model PS15-5M60S requires input voltage of 118 VAC-60 cycles, with output of 15 KVDC at 5.0 MA. Ripple is less than 1% at full rated output. Only 16 x 3-3/4 x 9 inches in height, the unit is hermetically sealed in an oil-filled housing and is operable in temperatures up to 85°C. Either silicon or vacuum tube rectifiers may be used in assembly. Circuit configuration ranges from half wave to full wave doubler or full wave tripler. This power supply, because of its small size, is particularly useful in such applications as airborne radar, electrostatic precipitators, infrared, irradiation and x-ray machines.

Circle No. 241 on Subscriber Service Card.

CONTACT INSERT. A push-in contact insert designed for high-speed termination of high reliability applications is introduced by the Pyle-National Company. With the inserts, contacts are terminated automatically or semi-automatically to wires outside of the connector,

with ample space for working and inspecting the secureness of the crimp. A cross-hole in each contact permits ready inspection of the termination joint to determine the depth of the wire engagement. A hand tool developed especially by Pyle-National for use with the new inserts is available for inserting the contacts into the pre-mounted resilient insulation within the connector barrel shell. Retention ability of the resilient insulation exceeds the requirements of MIL-C-5015C, even after many reassemblies. Failures due to heating or faulty wire termination are said to have been eliminated by the crimped joint which actually is stronger than the wire itself. Push-in application of the contacts reduces the possibility of circuitry errors because contact positions are plainly identified. Should a placement error occur, it is corrected by removing the contact and relocating it in its proper position. Identified as Pyle Mod. 2 insert, the new two-piece units can be furnished with up to 100 poles for wire sizes 16, 12, or 10, with no sacrifice of environmental resistance. They can be used interchangeably with the Pyle Mod. 1 three-piece inserts within standard Pyle-Star-Line connector barrels.

Circle No. 242 on Subscriber Service Card.

MAGNETRON. A new fixed-frequency K-band magnetron, ruggedized for missile applications, has been announced by Sylvania Electric Products Inc. The new tube, type M4154, delivers a minimum peak power output of 20 kilowatts. The tube is given a 30 g vibration test at 20 to 2000 cps, and shock tests which simulate missile conditions. The tube's adaptability to missile applications is said to have been achieved in part by cathode ruggedization, and special high pressure windows.

Circle No. 243 on Subscriber Service Card.

SEQUENCE INDICATOR. The Opad Electric Co.'s model VA7 phase sequence indicator provides a means of rapidly determining the order in which the voltage peaks occur in a three-phase power source. This panel mounting instrument has been designed for "built-in" applications and can be used for integration in test stands, panel boards and special equipment whose satisfactory operation is dependent upon proper phase sequence.

Circle No. 244 on Subscriber Service Card.

MISSILES AND ROCKETS

MARCH 23, 1959

Expires Three Weeks After Above Date

NAME _____ TITLE/POSITION _____
 COMPANY _____
 Product Mfg./Service Offered _____
 ADDRESS _____ CITY _____ ZONE _____ STATE _____
 Card cannot be processed unless all information is given.
 Please limit requests to ten items.

CIRCLE NUMBERS BELOW FOR INFORMATION ON PRODUCTS, LITERATURE OR ADVERTISEMENTS

CIRCLE NUMBERS BELOW FOR INFORMATION ON PRODUCTS, LITERATURE OR ADVERTISEMENTS									
● Advertisements									
1	2	3	4	5	6	7	8	9	10
26	27	28	29	30	31	32	33	34	35
51	52	53	54	55	56	57	58	59	60
76	77	78	79	80	81	82	83	84	85
101	102	103	104	105	106	107	108	109	110
126	127	128	129	130	131	132	133	134	135
151	152	153	154	155	156	157	158	159	160
● Missile Literature									
200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219
220	221	222	223	224	225	226	227	228	229
230	231	232	233	234	235	236	237	238	239
240	241	242	243	244	245	246	247	248	249
250	251	252	253	254	255	256	257	258	259
260	261	262	263	264	265	266	267	268	269
270	271	272	273	274	275	276	277	278	279
280	281	282	283	284	285	286	287	288	289
290	291	292	293	294	295	296	297	298	299

For Other Information Also See Numbers:



BUSINESS REPLY CARD

First Class Permit No. 2455-R (Sec. 510 P.L.&R.) Washington, D.C.

MISSILES and ROCKETS

17 EAST 48th STREET

NEW YORK 17, N.Y.

SUBSCRIBER SERVICE DEPT.



NO
POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED
STATES

MISSILE LITERATURE

CERAMICS. The Electro Motive Mfg. Co., Inc. has published a new six-page folder, describing the tough qualities of El-Menco Ceramic Disc Capacitors. The folder includes complete specifications data, charts, and graphs on the performance capabilities of the following capacitors: TS—Temperature Stable—designed for applications where a minimum capacitance change with temperature is required; SS—Semi-Stable—general purpose with stability; GP—general purpose units by bypassing, coupling or filtering applications often referred to as the "space-saving" capacitors since they provide very high capacity in relation to size; TC—Temperature Compensating—for resonant circuit applications where stability of capacitance characteristics is essential.

Circle No. 200 on Subscriber Service Card.

COAXIAL CABLES. Full information on its line of miniature coaxial cables—both military and commercial specifications—is supplied in a 4-page catalog issued by The Rex Corp. It contains temperature-rating data for each type jacket Rex supplies, minimum tensile strength and minimum O/O elongation standards—to which Rex coaxial cable conductors conform, and a table covering Rex standards for miniature coaxial cables insulated with a uniform wall of extruded polytetrafluorethylene (Teflon) and shielded with a minimum of 40 micro-inches of silver plating on copper. Information on electrical characteristics also is included. Rex manufactures and stocks as standard items miniature coaxial cables with all types of plastic insulation which meets or exceeds all relevant military specifications and comparable commercial specifications.

Circle No. 201 on Subscriber Service Card.

GAS SERVO SYSTEM. Publication GEA-6846, 4 pages by General Electric Co., discusses the design of the system and its application to flight control surface actuation, rocket thrust vector control, or nuclear control rod actuation. Its light weight, reliability, high-temperature capability, flexible performance capabilities and energy sources are also described and illustrated.

Circle No. 202 on Subscriber Service Card.

CAPACITORS. A technical publication on what to expect from tantalum capacitors of the wet electrolytic type has just been released by Farnell Metalurgical Corp. The 16-page booklet discusses their capabilities and limitations under various electrical and electronic service conditions and shows representative applications. In addition, the two-color publication includes tables, charts and curves.

Circle No. 203 on Subscriber Service Card.

LIQUIFIED GAS. A new six-page folder, describing a complete line of small containers for the transport and storage of liquefied gases, is available from Linde Co. Its folder includes descriptions, design features and performance data for containers ranging

in capacity from 1 to 100 liters. It includes the new 25-liter aluminum container, which has a special insulation minimize evaporation losses.

Circle No. 204 on Subscriber Service Card.

PHOTO REPRODUCTION. A new 6-page illustrated folder describing features and accessories of Keuffel Esser Co.'s micro-master 105 mm photo reproduction system for engineer drawings is available for distribution. The folder describes how the micro-master system reproduces almost 1 size drawing, restores smudged or worn originals to almost perfect legibility, guarantees distortion-free accuracy, and by producing permanent negatives archival quality allows economical establishment of a disaster storage file, in addition to a brief technical description of the micro-master camera components, the folder explains the micro-master concept as a totally integrated system for photographing, film processing and final reproduction or project printing.

Circle No. 205 on Subscriber Service Card.

RACKS. Stone & Smith, sheet metal fabricators for the aircraft and missile industry, has issued a brochure describing the company's new line of 1 modular electronic racks and cabinets. Seven sizes of vertical racks in height from 26 1/2" plus 3" pedestal to 82 7/8" plus 3" pedestal in choice depths from 22" thru 30". The catalog illustrates means of combining parts form any given console, lists part numbers and gives working dimensions.

Circle No. 206 on Subscriber Service Card.

TECHNICAL DATA. McCormack Sel Associates has published and is now releasing their New Technical Data Book. The book will contain product specifications, performance data, description of illustrations on all Mc/S/A explosive ordnance products—explosive bolts, generators, pressure cartridges, igniter squibs, initiators, destructors and other explosive systems and devices.

Circle No. 207 on Subscriber Service Card.

MICRO PROBES. A literature list of micro probe research is available gratis from the Instruments Div., Philips Electronics, Inc. The tabulation of published papers includes 73 articles which appear in domestic and foreign publications.

Circle No. 208 on Subscriber Service Card.

COMPUTER TEXT. A new textbook on the basic principles, language and characteristics of electronic computers has been issued by the Radio Corp. of America. The 114-page book, entitled "The Language and Symbolism of Digital Computer Systems," explains many of the basic characteristics of computers. It discusses Boolean algebra in practical terms, and contains a cross-reference of logic diagrams and symbols used by various computer manufacturers and a dictionary of computer terminology.

Circle No. 209 on Subscriber Service Card.

BUSINESS REPLY CARD

First Class Permit No. 245PR (Sec. 510 P.L.A.R.) Washington, D.C.

MISSILES and ROCKETS

17 EAST 48th STREET

NEW YORK 17, N.Y.

SUBSCRIBER SERVICE DEPT.

POSTAGE
WILL BE
PAID BY
ADDRESSEE

NAME

TITLE/POSITION

COMPANY

Product Mfg./Service Offered

ADDRESS

CITY

ZONE

STATE

Card cannot be processed unless all information is given. Please limit requests to ten items.

CIRCLE NUMBERS BELOW FOR INFORMATION ON PRODUCTS, LITERATURE OR ADVERTISEMENTS

Advertisements

- 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
- 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
- 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
- 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
- 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
- 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
- 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175

Missile Literature

- 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224
- 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
- 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
- 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299

New Missile Products

MISSILES AND ROCKETS

MARCH 23, 1959

Expires Three Weeks
After Above Date

A stylized illustration of a rocket nozzle firing. The nozzle is dark grey and black, with a large plume of white and orange flames and smoke coming out of the bottom. The background is a mix of orange and brown, suggesting a fiery environment.

**giving
the
"breath of life"
to
solid propellants!**

TRONA® ...first and
foremost
source of supply
for **AMMONIUM
PERCHLORATE**

Advances in solid propellant technology have depended on AMMONIUM PERCHLORATE from American Potash & Chemical Corporation since the very beginning. First in the field with this essential oxidant, AP&CC was for many years the only domestic producer of ordnance-grade NH_4ClO_4 . Today, with a growing network of strategically located plants and increased technical knowledge, Trona still leads the industry. Supporting the big tonnage production of AMMONIUM PERCHLORATE at Henderson, Nevada is the new SODIUM CHLORATE plant at Aberdeen, Mississippi, making AP&CC the free world's largest producer of NaClO_3 . If a guaranteed source for AMMONIUM PERCHLORATE and the very latest in technical developments, gained through years of experience in this field, are important to your process and products, contact your nearest AP&CC sales office today.

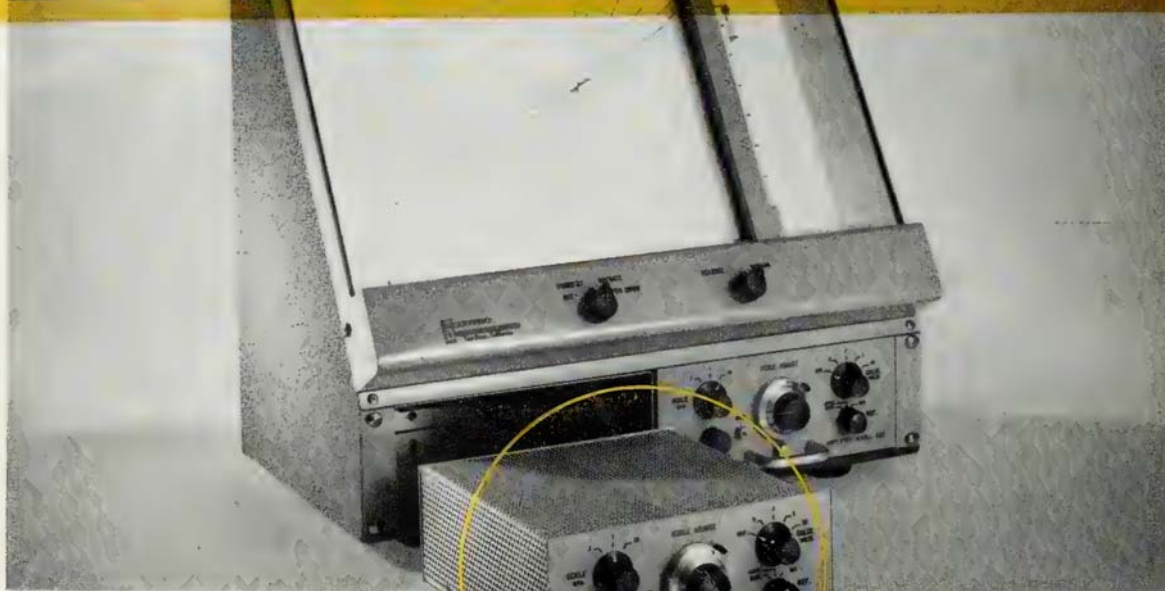
American Potash & Chemical Corporation

3000 WEST SIXTH STREET, LOS ANGELES 54, CALIFORNIA
99 PARK AVENUE, NEW YORK 16, NEW YORK

SALES OFFICES: Los Angeles • New York • San Francisco • Portland (Ore.)
Chicago • Atlanta • Shreveport • Columbus (O.).

NEW! Electro Instruments totally-transistorized, modular

XY recorders!



NEW INCORPORATING IMPROVEMENTS THROUGHOUT

- Faster slewing speeds—Pen: 30"/sec.; Carriage: 30"/sec.
- Greater accuracies—Static: 0.1%; Dynamic: 0.2%.
- 0.05% internal calibration.
- High precision internal Zener diode reference.
- New improved vacuum hold-down system.
- Vernier control between ranges.
- Input function modules in rack mountable case can be removed from plotter for remote operation.
- Calibrated scales on both axes.
- Front panel gain control.
- Vacuum release on front panel.
- Visible ink supply.

One basic plotter with input modules available for general purpose, computer, low level differential, time base, curve following and other specialized functions.

	Model 410 Computer Module	Model 420 General Purpose Module	Model 430 Low Level Differential Module	Model 450 Curve Follower Module	Model 460 Time Base Module
Input	Single Ended	Single-Ended	Differential	Single-Ended	Single-Ended
Ranges	0.1, 1.0, 10v/in. calibrated vernier	16 steps, 1m v/in to 100 v/in, plus vernier	16 steps, 1m v/in to 100 v/in, plus vernier		0.1, 0.2, 0.3, 0.6, 1.0, 2.0 in/sec
Accuracy: Static	±0.1% F/s	±0.1% F/s	±0.15% F/s	±0.25% F/s	(time) ±1.0% F/s
Dynamic	±0.2% F/s	±0.2% F/s	±0.2% F/s	±0.1% F/s	(sweep) ±0.5% F/s
Linearity					
Input Resistance	2 megs, all ranges	1 meg to 3 megs Depending on range	1 meg to 3 megs Depending on range		
Zero Adjust	Full scale X and Y plus 9" offset	Full scale X and Y plus 9" offset	Full scale X and Y plus 9" offset		
Reference	Internal Zener diode and external ±100v computer	Internal Zener diode	Internal Zener diode		Internal Zener diode
Calibration	Internal 0.1, 1.0, 10v Accurate to ±0.05%				
Common Mode Rejection			DC, 120 db AC, 100 db at 60 cps 50 v dc or peak ac		
Max. Common Mode Voltage					
Principle of operation				60 cps magnetic induction	Electronic integration
Zero Drift				None	

Dimensions All Modules: 8 1/2" W x 3 1/2" H x 7 3/4" D

Model 400 Plotter

Recording Size: 10" x 15"
Slewing Speed: X, 40"/sec; Y, 30"/sec
Inputs: X and Y inputs, and computer reference
Power: 115 ±10 v, 60 cps
Dimensions: 19" W x 19 1/2" H x 11 3/4" D
Ambient Temperature Range: 0-55°C
Controls: Power off, standby, operate, pen; vacuum release;
curve follower, amplifier; local, remote.

3540 Aero Court
San Diego 11, California



Electro Instruments, Inc.