JANUARY 11, 1960

CHEYENNE'S FIRST ATLAS LAUNCH PAD

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

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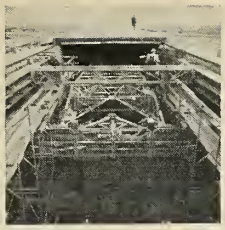
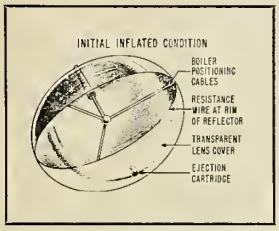
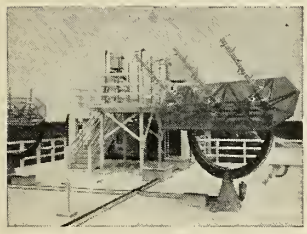


COVER: The first *Atlas* combat launching complex is nearing completion at Warren AFB, Wyo. A special report on this developing "first front" of defense begins on p. 15.



SOLAR ENERGY collector for satellite auxiliary power is envisioned in this artist's conception of one of the uses of modified Paraballoon Antennas. For a report on Westinghouse's research, see p. 21.



NEW FCA center set up by RCA at Cape Canaveral includes this varied collection of receiving antennas on its roof, to monitor and locate any signals that might interfere with missile tests. See p. 28.

THRUST CHAMBER stands on work base after brazing in GE hydrogen bell furnace at Aerojet General, which has turned out better engines with the method while sharply cutting production time. See p. 35.

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

30,600 copies of this issue printed

JANUARY 11 HEADLINES

ASTRIONICS

ASTRONAUTICS ENGINEERING

U.S. Reg. Pdg.

MISSILE SUPPORT

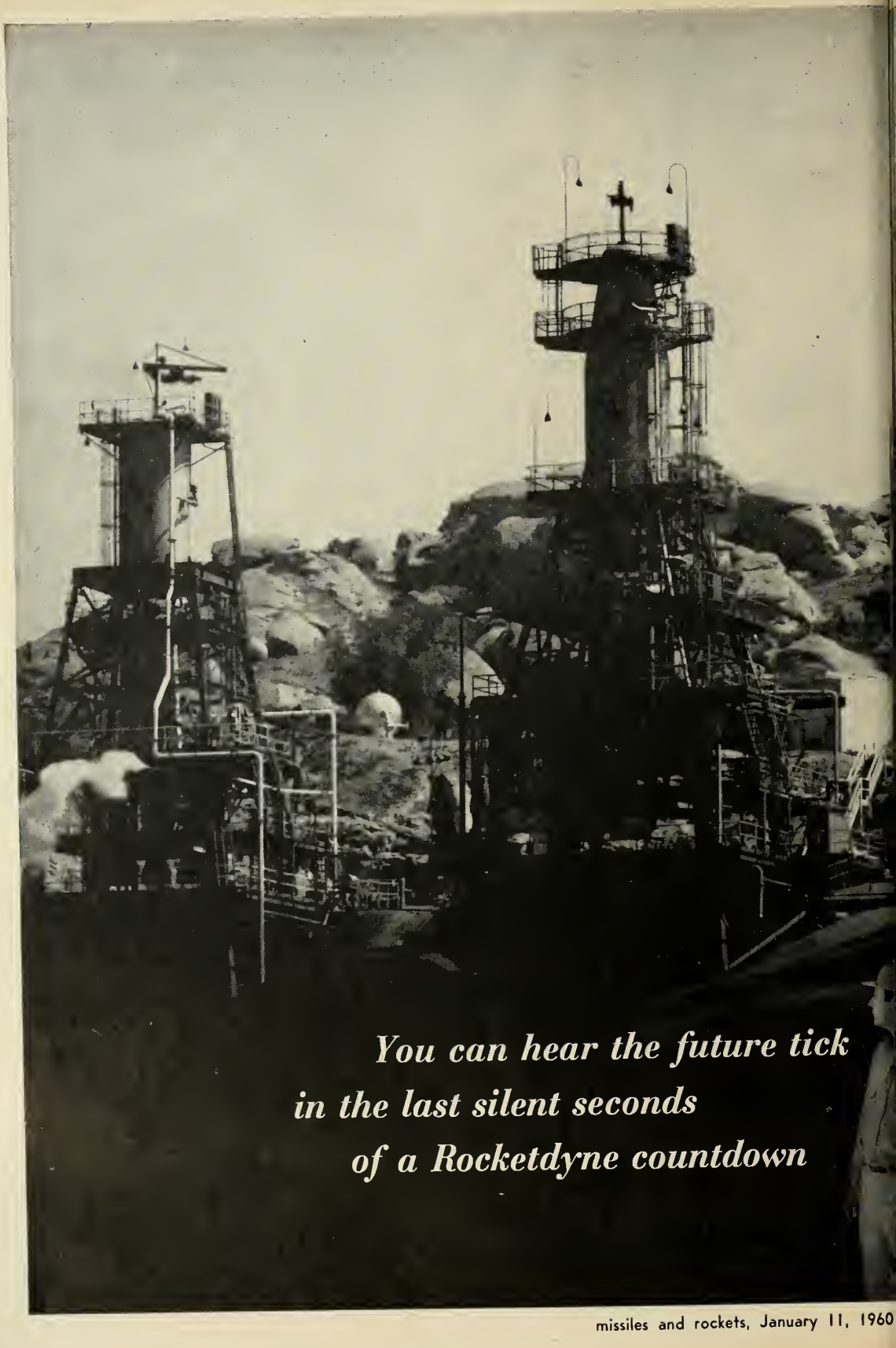
U.S. Reg. Pdg.

NEW MISSILE PRODUCTS

THE MISSILE WEEK

U.S. Reg. Pdg.

DEPARTMENTS


You can hear the future tick
in the last silent seconds
of a Rocketdyne countdown

FOUR...THREE...TWO...ONE... a moment of silence. Then a giant speaks—and a bolt of man-made lightning flashes.

Nearly every hour of every day, Rocketdyne technicians near that dramatic moment as they test and tune the space engines of today.

The best-equipped test facilities for high thrust rocket engines in the nation are at their command. Rocketdyne's finely instrumented test structures are located in California's Santa Susana Mountains; Neosho, Missouri, and McGregor. Texas.

Rocketdyne engines have powered most of the military and scientific projects conducted by the Air Force, Army, and NASA. Now huge boosters of one and a half million pounds of thrust are emerging from the technical heritage of Atlas, Thor, Jupiter, and Redstone.

And even while today's countdowns go on, plans for tomorrow's assault on space are being made. At Rocketdyne, engineers and scientists are investigating such advanced forms of propulsion as ion engines, nuclear engines, plasma jets, and magnetohydrodynamic engines. Meanwhile other groups are at work on high-energy liquid and solid propellants, and dramatic new devices for both liquid and solid propulsion systems.

Rocketdyne, a 12-year pioneer in rocket technology, was first with power for America's long-range ballistic missiles—first with power for Outer Space.

MEGABOOM—a giant solid propellant rocket motor produced at Rocketdyne's McGregor, Texas, solid fuel facility—delivers 100,000 pounds of thrust, boosts test sled to 1,200 mph.

FIRST WITH POWER FOR OUTER SPACE

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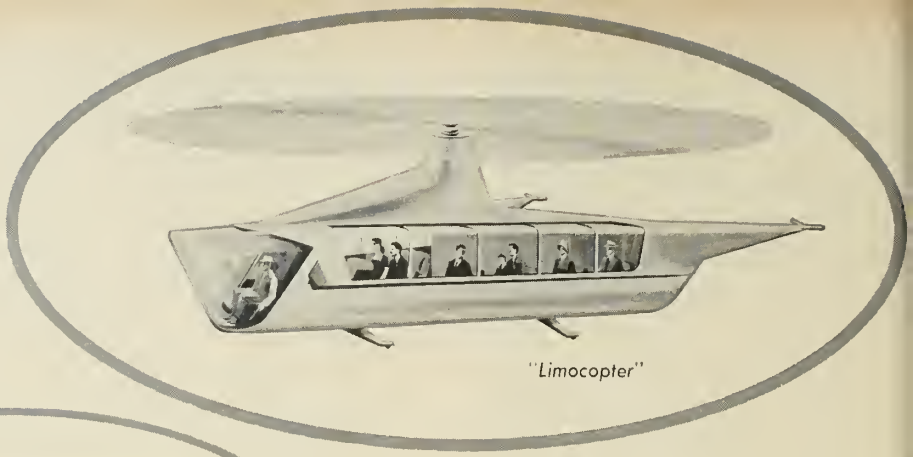

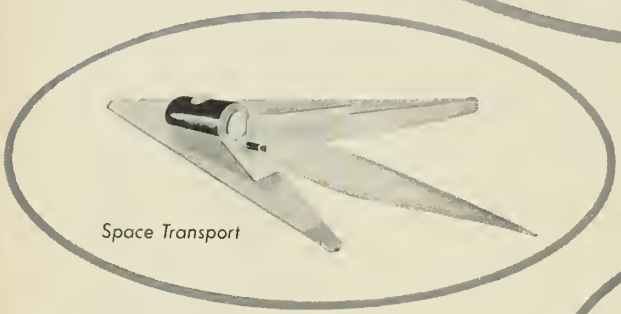

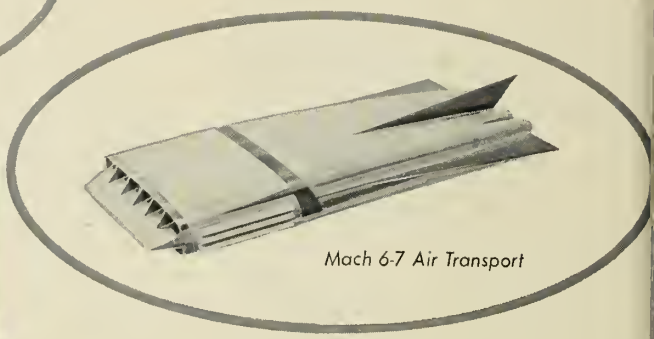

NEW FLIGHT FRONTIERS AND SPACE MISSIONS

Bold plans revealed in Lockheed's program of total flight technology

Air/Space travel, whether the vehicle is manned or unmanned, poses vast problems. To expand the total technology of flight, Lockheed's California Division proposes bold new concepts for both military and commercial vehicles. In line with this, the Company has assumed major responsibility for Research and Development on future space vehicles. This responsibility extends from development of advanced components to major complex systems.

Advanced projects to spring from this broad base of Air/Space travel include: Limousine-Helicopters designed for shuttle service between large cities and suburbs, or to transit terminals; Mach 6-7 Air Transports able to take off and land vertically; Space Transports capable of transporting, to an orbit of more than 1000 miles, a pilot and 1000 pounds of payload, or three passengers equipped to work in space; advanced Infrared Systems studies as an advanced detection method; and Solar Radiation studies.

This markedly expanded program into the total concept of flight creates urgent need for personnel with high-level skills. The concept ranges from subsonic to hypersonic speeds; from atmospheric to outer space vehicles.

High-caliber scientists and engineers are invited to take advantage of this need; to investigate the many career opportunities Lockheed offers.

Immediate openings are available in: Aero-thermodynamics; propulsion; armament; electronics — research, systems, packaging; servomechanisms — flight controls; sound and vibration; physics—infrared, acoustics, electrophysical; antenna and telemetry.

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Washington Countdown

IN THE PENTAGON

Four new basic missiles . . .
are now called for in the Army's long-range plans for development of surface-to-surface weapons:

. . . *Missile A*—a battle group short-range missile currently being designed.

. . . *Missile B*—a division missile that would replace *Little John*.

. . . *Missile C*—a corps missile that might be an improved *Sergeant*.

. . . *Missile D*—an Army missile that might be an improved *Pershing*.

• • •

Operational Advanced *Terriers* . . .
are expected to be first deployed about mid-1960. The **Convair** surface-to-air and surface-bombardment missile is about a 100% improvement over the presently operational *Terrier*.

• • •

Tracked missile carriers . . .
are under study by the Army. The Army is particularly considering use of the chassis of **American Food Machinery's** new M-113 armored personnel carrier. Unlike Soviet missiles, all mobile Army missiles move on wheels—not tank tracks.

• • •

An operational requirement . . .
for a new tactical missile is understood to have been drawn up by the Air Force. The missile would be designed for use against jungle-based guerrillas.

• • •

Project *Spad* . . .
is the generally-used code name for ARPA-Air Force studies aimed at future development of a space-based missile defense system. The studies are being conducted by Convair and other firms. However, *Spad*—a part of ARPA's *Defender* missile defense program—is not expected to get any R&D funds in the new budget.

ON CAPITOL HILL

Senate hearings . . .
on the overall missile-space race with Russia will begin Jan. 27. They will be conducted by the Senate Space Committee and Joint Preparedness Subcommittee sitting as a joint committee. Senate Democratic Leader Lyndon Johnson is chairman of both.

The two key points . . .
that the senators will hit in the initial eight days of hearings: The Missile Gap—and what are we doing about it? . . . The Space Race—and what are we doing about it? CIA Chief Allen Dulles will be the opening witness in a closed session. All other witnesses will be heard in open sessions.

• • •

The result . . .
of sweeping House and Senate hearings on the space-missile programs is expected to be:

. . . At least some increase in U.S. space activity.

. . . The creation of a hot campaign issue.

AT NASA

$50 million plus . . .
is the latest price tag that NASA and **Western Electric** are placing on the range tracking for Project *Mercury*. The figure does not include the cost of military ships and modification of military tracking equipment.

• • •

The white paper . . .
being prepared by NASA for the Administration on the U.S. space program is expected to say that the United States does not have to compete with Russia on a launch for launch basis. At the same time, the Administration is again expected to claim that a balanced budget and other scientific projects must be taken into consideration as reasons for not going all-out on space projects.

ALONG EMBASSY ROW

New Soviet IRBM bases . . .
are reported being planned in the satellite countries of Eastern Europe. The sites would be located in Thuringia and Pomerania, East Germany; Czechoslovakia; along the Polish border in Poland, and possibly in Albania.

• • •

The first Japanese test . . .
of a surface-to-air *TLRM-2* missile was conducted at the foot of Mt. Fuji by the Japanese Defense Agency. The 24,000-foot-range missile reached an altitude of about 3300 feet.

• • •

Yugoslavia will buy . . .
10 Japanese *Kappa 6* sounding rockets for stratospheric studies. The two-stage, 17.7-foot rockets and supporting equipment will cost about $280,000.

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Industry Countdown

MANUFACTURING

First attempt . . .
at developing a vertical *Titan*-like silo to launch *Atlas* ICBM's will be made at Vandenberg AFB. Corps of Engineers has just awarded a $3 million contract to **Bechtel Corp.**, an A&E firm which will design and build the single silo. If successful, it will enable the Air Force to harden future *Atlas* bases and eliminate present "soft" erector-type models (see p. 16). The test model at Vandenberg will be built near one of the training complexes and utilize its blockhouse and instrumentation.

• • •

Deal with Russia . . .
has been made by **Montecatini** of Italy to furnish the Soviets with facilities for producing titanium dioxide and acetylene—both extremely useful raw materials in the missile/space field. The contracts total $24 million.

• • •

Industry is running . . .
against interservice boundaries in the widely-publicized DOD effort to standardize missile support equipment. A recent example: the Tactical Air Command insisted upon purchasing a one-of-a-kind missile carrier-loader for a new bird even though it was told a multi-purpose loader was already in use by SAC and would do the job. TAC, it is said, "just wanted to be different."

• • •

Long-term leasing . . .
of production equipment appears to be on the upswing in the missile/aircraft industries. Those on the leasing end say that during 1959 the amount of equipment rented spurted to $21.2 million—63% ahead of the previous year. They believe their business will double this year.

• • •

New missile support . . .
directory will soon be available at the Office of Technical Services, Commerce Department. Called the "Technical Resources Directory—Ground Support Equipment for Guided Missiles," the publication lists 200 items of support equipment—most of them under development. It covers the problems of standardization, industry capability of meeting requirements and possible downgrading of specs to include commercially available equipment. The directory complements the Air Force's Technical Information File because it will provide a look-ahead at what will be available to designers and builders five years from now.

PROPULSION

Look for ion engine . . .
R&D contract proposal to be circulated by NASA in the next month or so. It will be primarily concerned with developing components, but it is believed NASA also will want an engine built under the one-year contract.

• • •

Fourth tether test . . .
of a solid-fueled *Minuteman* ICBM was successful from an underground silo at Edwards AFB, Calif.

• • •

Ultrapure hydrogen . . .
is now being produced under a low-cost diffusion process using gaseous ammonia and palladium. The developer, **Englehard Industries,** says its patented unit also will produce ultrapure hydrogen from by-product streams if the contaminants do not affect palladium.

ASTRIONICS

Jump of 37% . . .
in semiconductor sales during 1960 is forecast by industry marketing experts. Sixty per cent of the $550 million sales will be transistors—about equally split between the military and industrial consumer market.

• • •

Cross-license . . .
agreement for the manufacture and sale of semiconductors has been signed by **Philco** and **CBS Electronics.** The latter will start up two production lines to make Philco precision-etched transistors this spring.

WE HEAR THAT

Some engineering schools . . .
are worried that there will be a belt-tightening by industry this year and the demand for new graduates will fall off. . . . With new furnaces at its Omal, Ohio, plant, **Olin Mathieson Chemical Corp.** is joining the ranks of major producers of heat-treated aluminum sheet. . . . **Hexcel Products** reports it has developed an aluminum honeycomb core "15% to 30% stronger than any comparable product on today's market"—up to 100 psi/lbs./cu. ft. specific shear strength. . . . The umbilical tower for the ABMA/NASA *Saturn* vehicle may be 240 to 270 ft. high. A division of **Yuba Consolidated Industries,** Baton Rouge, La., is building the first 27-ft. section at Cape Canaveral under an $118,000 Corps of Engineers contract.

More About the Missile Week on Page 14

How satellites can give us low cost emergency telephone service

Launched by the Douglas-built *Thor* IRBM, satellites like this would relay telephone messages anywhere in the world without costly cables or towers.

Beyond their immediate military necessity, our present rocket and missile programs promise many vital peacetime benefits to us all...

Well past the drawing board stage are plans to use satellites as a low-cost emergency stand-by system to relay telephone calls around the world.

Your call would be beamed to a satellite, then bounced back to a receiving station on Earth. Cost is estimated at a fraction of what must be spent to install and maintain cables or radio relay towers.

While satellite telephone service is still in the future, *Thor*—the rocket that can put it into being—is thoroughly proved. Built by Douglas, maker of the DC-8 jetliners, *Thor* has been successful in more than 90% of its shots. It is key booster in the "Discoverer" firings and launched the first nose cone recovered at ICBM range.

Thor is another product of the imagination and experience gained by Douglas in 20 years of missile development.

MISSILE AND SPACE SYSTEMS
MILITARY AIRCRAFT • DC-8 JETLINERS
TRANSPORT AIRCRAFT • AIRCOMB
GROUND SUPPORT EQUIPMENT

25-ton payload in orbit . . .

Aerojet Working On 5-Meg Solid

SACRAMENTO—**Aerojet General Corporation** is proposing a huge solid propellant booster which could place 25 tons of useful payload in orbit within eight years. The booster system, on which the firm says it is now working, would have about five million pounds thrust and be in the neighborhood of 20 feet in diameter.

Approximately $250,000 in company funds have been expended in the past year in studying the feasibility of a large solid booster, and according to the firm, "the money was well spent." All technical barriers to development have been eliminated, following thorough evaluation of the company's theory.

The multistage system is claimed to have the capability of completely surpassing liquid chemical boosters for space applications due to lower unit cost per comparable system and higher reliability per unit. Progress in solid propellants has contributed greatly to the knowledge of such systems, the company says, emphasizing that "currently existing propellants have enough impulse to do the job and possess the needed physical properties."

R. F. Tangren, manager of AGC's Applied Mechanics and Systems division at the Solid Rocket Plant, told M/R that the next five years will see the perfection of advanced propellants enabling a large-thrust solid booster to be reduced in size while still performing the mission. He added that these propellants are already in the laboratory stage.

• **Materials problems reduced**—Metal parts problems also have been reduced to a minor status by the feasibility study. The cases under consideration would utilize steels having yield strengths of more than 300,000 psi, or titanium with yield strengths above 200,000 psi. Hot shear spinning would be used to fabricate steel cases, while strip winding would be applied in titanium case fabrication.

Thrust vector control, thrust termination and other problems solved by the *Polaris* and *Minuteman* programs would not present any great difficulty to development of a 5-million-pound solid rocket system, Aerojet says. Nozzle cooling techniques now under development for use in advanced solid rocket systems would be applied to the new project.

Facilities for test and production of the multi-stage system would not require extended effort. The company states, "we simply would have to scale up existing designs."

The military and scientific applications of the system have been pointed up by Aerojet, which suggests various uses, including: placement of 25 to 50 tons of useful payload in orbit with one massive shot; boosting a manned liquid or nuclear rocket into space for variable-thrust or start/stop requirements; boosting a vehicle larger than the currently-planned *Dyna-Soar* vehicle into orbit; launching of an entire fleet of ICBM warheads, instead of a separate vehicle for each warhead; and other missions to enhance the military and scientific posture of the nation.

AGC stresses that reliability is not a function of size in solid propellant rockets, noting that field operations of 100,000 SPR units ranging from 35,000 to 115,000 pounds thrust have established a reliability rating of .9996. *Polaris* and *Minuteman* vehicles have not been included because they are still under development.

Russian *Dyna-Soar* Flying?

WASHINGTON—Russia is believed to be already flight-testing its own version of a *Dyna-Soar* space bomber.

If true, it could mean the Soviets are seven to eight years ahead of the U.S. in the development of a boost-glide space vehicle.

Disclosure of the existence of a Russian "antipodal semi-ballistic missile"—called the T-4A—was made by European military sources. These sources say the vehicle is in the advanced testing and evaluation stage. It is not yet operational, and presumably when it is, the T-4A will be manned.

There was no word as to whether the vehicle is being piloted in the tests.

However, the T-4A is said to be quite similar in design to the manned missile proposed during World War II by rocket pioneer Dr. Eugen Saenger. The Germans worked on this *Dyna-Soar* forerunner until 1942 when they abandoned it because it appeared unlikely the program would be finished in time to affect the outcome of the war.

The T-4A is described as having a maximum range of 9936 miles. The semi-ballistic course is obtained by leveling off at an altitude of 186.3 miles with a sustained velocity of 11,178 mph for 4968 miles. Maximum speed ranges up to 13,910 mph.

Payload of the T-4A is reported to be a little over one ton. The guidance system is unknown. But the vehicle is launched from a catapult propelled along a steel track by a booster of 300,000 lbs. to 360,000 lbs. thrust.

The first stage is comprised of three LOX and kerosene fueled rockets with a specific impulse of 27,000 lbs./sec. There are also two solid-fueled motors with a total of 240,000 lbs. of thrust. The sustainer develops 60,000 lbs. of thrust.

Overall length is 121.02 ft., including a main stage engine measuring 60.68 ft. in length with a diameter of 6.88 ft. Span of the wings on the reentry vehicle is 65.6 ft.

Saenger, who first envisioned his space bomber in 1933, proposed a vehicle with a take-off weight of 220,500 lbs., 92 ft. in length with a span of 49 ft. Maximum velocity was to be 13,660 mph at an altitude of 93 miles. Thrust would be 100 tons for eight minutes.

He also proposed a catapult launcher to develop a Mach 1.5 velocity before cutting in the rocket engines. Take-off weight was to be 100 tons with a 0.3 ton payload.

U.S. Air Force only last November received Defense Department permission to move ahead with the long-delayed *Dyna-Soar* program on a significant scale. Funding, however, is not on an all-out level.

Boeing Airplane is developing the spacecraft and is integrating major components. **Martin** is developing the boosters—modified *Titans*.

The Air Force regards *Dyna-Soar* as the first major step toward manned military operations in space. The U.S. version is designed to skip-glide around the entire globe on the upper layers of the atmosphere. It would be able to launch missiles or gather military intelligence and land at a site of its own choosing.

Funding at the present rate is expected to result in development of an operational U.S. system by about 1967 or 1968. However, more money could accelerate the program considerably.

Meetings Cost $21.5 Million A Year

NEW YORK—Attendance at technical meetings is costing the missile/space industry about 258,000 man-days of working time and an estimated $21,500,000 each year. And there is a serious question whether the attendants are getting enough information to make their trip worthwhile.

This is the gist of a report prepared for the Daniel and Florence Guggenheim Foundation by Pendray & Company of New York. The report also concludes that there is relatively little, if any, overlapping of specific subject matter in the meetings of the many technical societies, even though many industrial managements, and even some society executives, feel differently.

• **Other costs**—The figures still do not take into account other economic costs (arranging meetings, preparing papers, publishing programs, creating and installing exhibits, setting up hospitality suites, etc.). The report doesn't attempt to compute them because of "imponderables," but says it's "reasonable to suppose" that such additional costs might be another $1 to $3 million annually.

The report calls for the creation of a new Center for the Improvement of Technical Communications in the Flight Sciences to find "new, faster and more effective" methods of getting technical information to those who need it.

The study dealt with meetings held during the last three years by eight major technical societies: The American Rocket Society, the Institute of Aeronautical Sciences, the American Society of Mechanical Engineers, American Society of Electrical Engineers, Society of Automotive Engineers, American Institute of Chemical Engineers, and the Institute of Radio Engineers. It said that 43 national meetings by these societies in 1959 cost about $25,000 per hundred attendants, or a total of more than $21,500,000.

Two-thirds of the industrial companies queried said there were too many meetings; 85% said there was considerable overlapping and duplication. The study showed that the number of national meetings is increasing but it did not support the belief that widespread overlapping and duplication occurred. In 1959, for example, in only five instances out of 241 technical sessions (in which 986 papers and panel discussions were presented) did the same speakers appear on the programs of two or more societies with apparently the same or very similar material.

Here are some highlights of the report:

• **Attendance**—Sixty-two companies replied marking one of more of three categories: 59% *assign* technical personnel to attend; 50% *encourage* attendance; 36% *permit* attendance. No company reported that it *did not* pay travel and expenses for personnel attending.

• **Benefits**—Major benefits of attendance cited by the companies involve exchange of information, keeping up with the state of the art, etc. However, companies also pointed out that appearance by their top people enhances company prestige, allows introduction of new product ideas and concepts, calls attention to new developments, advances in company thinking, etc. Company technical groups are stimulated to better work and company morale is often improved. Many firms feel that such meetings are a handy and economical way to meet and socialize with customers in an atmosphere far different from that of the usual sales call.

• **Improvements**—Company suggestions for improving programs included: consolidating material to reduce time; eliminating duplicate subjects; more careful screening of papers to cut down the number delivered; eliminating company sales propaganda; making papers less technical; presenting only significant developments; adding more of the open forum-type sessions; making preprints available far in advance; discontinuing survey papers on space sciences by so-called "big name" speakers; and speeding up publication in society journals to reduce need for oral presentations.

——more about the missile week——

• **Denville, N.J.**—**Reaction Motors** reported advances in the development of a hybrid liquid fuel and solid oxidizer rocket engine. Company spokesmen said the results of current test programs being conducted under an Air Force contract show liquid-solid engines have high performance and controllability. They said shutdown and restart capability also has been demonstrated with the hypergolic propellant combination.

• **Washington**—Defense officials indicated that the FY 1961 defense budget would contain about $100,000 for Project *Samos*—the Air Force reconnaissance satellite program. They made clear that the failure to recover capsules from orbit in the *Discoverer* program is delaying progress on *Samos*.

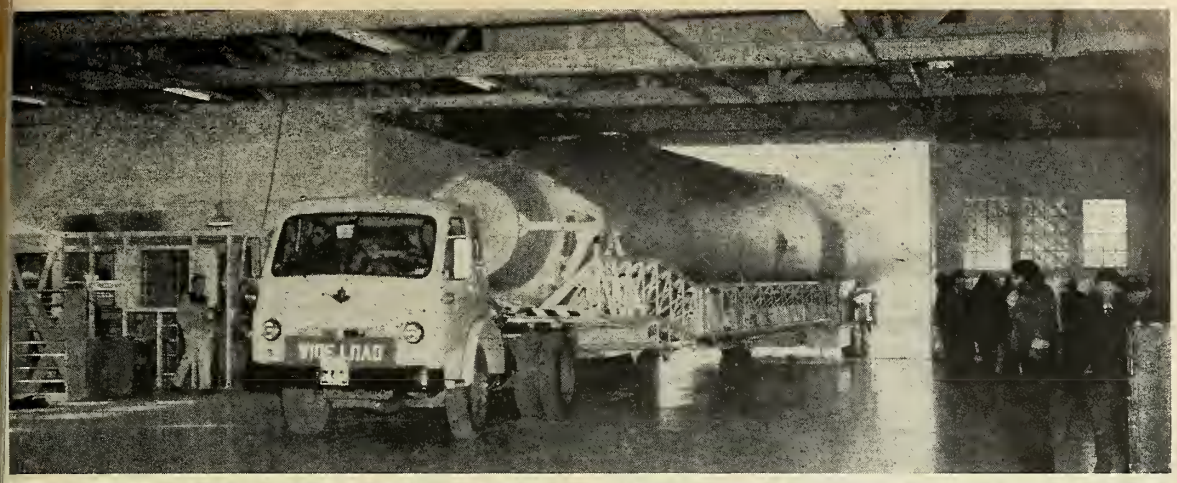
• **Huntsville, Ala.**—The Army streamlined the management of its *Nike-Zeus* program and placed it under one man—Col. John G. Zierdt, chief of staff of the Army Ordnance Missile Command. At the same time, USAF Gen. Laurence S. Kuter, NORAD commander, urged the Defense Department to reverse its decision not to begin production of the big **Western Electric** anti-missile missile.

• **Washington**—Mergers & Expansions: **Kaiser Industries Corp.** has acquired **National Steel and Shipbuilding Corp.,** a San Diego shipyard and missile parts maker . . . **Electro-Plex Corp.,** a developer of FM multiplex receiving equipment, has merged with **Nuclear Electronics,** Philadelphia . . . In its fourth acquisition in as many months, **Atlantic Research Corp.,** Alexandria, Va., has purchased **Desomatic Products,** Falls Church, Va.

• **Dayton**—ARDC's Wright Air Development Division will manage its own weapon system contracts, using computers to do most of the job. First two systems involved are the *Dyna-Soar* space bomber and WS-138A —ALBM.

• **Moscow**—Soviet "fantastiki"—Communist science fiction writers—are under attack for allowing a manned trip to the moon to fail in a recent novel. The *Literaturnaya Gazeta*—official organ of the Union of Soviet Writers—said that "fantastiki" were guilty of haboring "old mistaken concepts" since Soviet real-life rockets are already reaching the moon and beyond.

• **Washington**—Rep. Emilio Q. Daddario (D-Conn.) proposed that America's seven project *Mercury* astronauts be given government-paid $100,000 life insurance policies. He introduced the astronaut insurance bill on the opening day of Congress.



BIRDS ARRIVE at Missile Assembly Building at Warren AFB before being delivered to the combat launch sites dispersed for miles around Cheyenne. Three *Atlases* are already on the base as first sites near completion.

'from the arrow to the Atlas' . . .

The New Front—ICBM's Rise on Prairie

by James Baar and William E. Howard

(Fourth and last of a series of special reports.)

CHEYENNE, WYO.—This old cow town in the next six months will become America's front line in the Missile Age.

The nation's first truly combat ICBM base is rapidly nearing completion 22 miles to the northwest on a windswept, lonely stretch of prairie.

A century ago the principal inhabitants were Indians and buffalo. The area looked much the same until construction of the base began two years ago.

Today the first complex of three launchers at Site "A" is all but complete. The second complex of three at the same site is not far behind. Consoles and wiring are being installed in the blockhouses.

Meantime, Col. William S. Rader —commander of the 13th Air Division —is bringing together the newly trained combat missilemen who will man the base's *Atlases* around the clock. The tough, intelligent new breed of airmen are already arriving at the *Atlas* sites, checking equipment, ready to go.

One by one over the next two years 24 *Atlases* will be raised over the flat prairie in a great 60-mile wide oval around Cheyenne and adjacent Warren AFB. When completed, they will form the three squadrons of SAC's 706th Strategic Missile Wing—the first half of Rader's division.

The cost: Some $250 million.

The return: The ability to obliterate or badly damage thousands of square miles of Russia any day, any time.

• **The new front**—The atmosphere of the entire area is alive with the unreality of change and contrast.

Many missilemen and area ranchers are only beginning to realize that this soon will be the front—far more than any battle post on the Iron Curtain.

ICBM LEADER at Warren is Col. William Rader, 13th Air Div. commander.

If total war should come, this entire area and everyone in it will be Target No. 1. Russian ICBM's will pour into the area in an all-out attempt to catch the *Atlases* on the ground.

There would be a concerted effort by espionage agents to assassinate key personnel. In the hours before Russia launched an attack, agents would hope to prevent Rader and his officers from ever reaching their posts.

This, too, is the end of a mighty coast-to-coast production line.

The *Atlases* that arrive from **Convair's** San Diego plant; the carriers that arrive from **Goodyear's** plant at Tucson; the automatic program checkout equipment from **RCA;** the computers from **Burroughs** are put together at the site to form the finished product—a combat *Atlas,* on site, "in the green."

This is the culmination of one of the greatest crash programs in American history—a program based on the Air Force proposition of "concurrency" which means that you must learn how to do a thing while you are doing it.

Each week the Air Force learns how to do it better. The information is passed along for future sites and bases. The book again is rewritten.

• **Coffins in the snow**—Meantime, Warren is being converted from an old Army and onetime frontier post to a modern station capable of housing and supplying the men and equipment

evolution in combat Atlas launching pads . . .

FIRST *ATLAS* launcher to be operational this spring has roof which slides off lengthwise. Unit of six is "soft."

SECOND WARREN squadrons show "soft" but improved configuration of launcher.

that make up the three squadrons of a strategic missile wing.

Old barracks are being gutted and remodeled. Old training areas are being converted into supply depots for the most modern equipment.

The slogan of the 706th SMW is: "From the Arrow to the *Atlas*."

Still much remains unchanged.

Snow, as it has for centuries, caps the mountain peaks that tower 60 miles away over the plain. Snow blankets the prairie and the missile sites—some not too many miles from The Old Oregon Trail.

The air is crisp and clean as you walk across the old parade ground at Warren. Nearby are the old brick quarters once occupied by General of the Armies John "Blackjack" Pershing in that time before the great world wars when soldiers still rode horses and flying was a fad.

The combat missileman might well shake his head and find it hard sometimes to keep in mind his post out on the icy prairie.

But at Auxiliary Site "A" the six reinforced concrete launch buildings of the 564th Strategic Missile Squadron squat grey and forbidding among the snow drifts—a row of coffins pointing at Soviet Russia.

This is the first and the largest of four missile complexes being constructed at 20 to 25 mile distances from the four corners of Cheyenne. The other three —each containing three missiles to be manned by the 565th SMS—are designated Auxiliary Sites "B", "C", and "D". They are situated, respectively, to the northeast, southeast and southwest.

Warren's nine final missiles—all to be manned by the 549th SMS—will not be in a complex at all, but will be widely dispersed at single sites scattered from 37 miles due north to Chugwater, Wyo., east 60 miles to Kimball, Neb., and 50 miles south near Greeley, Colo. A construction contract was let recently by the Army Corps of Engineers for these "Hollywood hard" type emplacements which will be built flush with the ground. The nine structures alone will cost about $22 million.

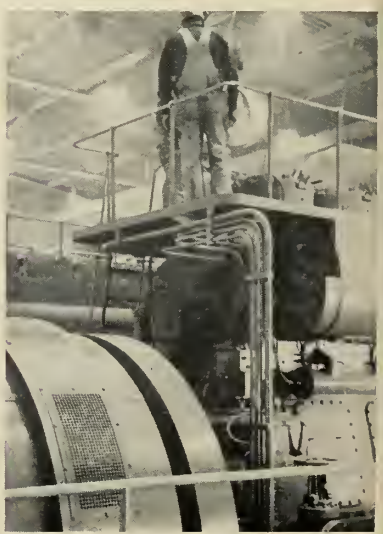
• **Double guidance**—Each ICBM squadron reflects rapid changes and improvements in the design of the *Atlas*, its support and handling equipment as well as efforts to make this vast new installation less vulnerable to enemy missiles.

At Site "A" is situated the base's only guidance building and boresight towers which are required for the early **General Electric/Burroughs** radio inertial guidance system. These facilities have been eliminated in the 565th and 549th SMS by the introduction of **American Bosch Arma's** all-inertial guidance.

The guidance building—above ground like the rest of the facilities in the 564th (with the exception of the two earth-covered blockhouses) —stands in a depression about 4000 ft. from the group of launchers. Near it is a three-diesel generator powerplant with a capacity of 22,500 kw—enough for a city of 10,000 persons. It was designed to hold a fourth 7500 kw generator. But experts found power requirements would not be that high. Actually, the entire site can be operated with two generators—the third being held in reserve in case of a breakdown.

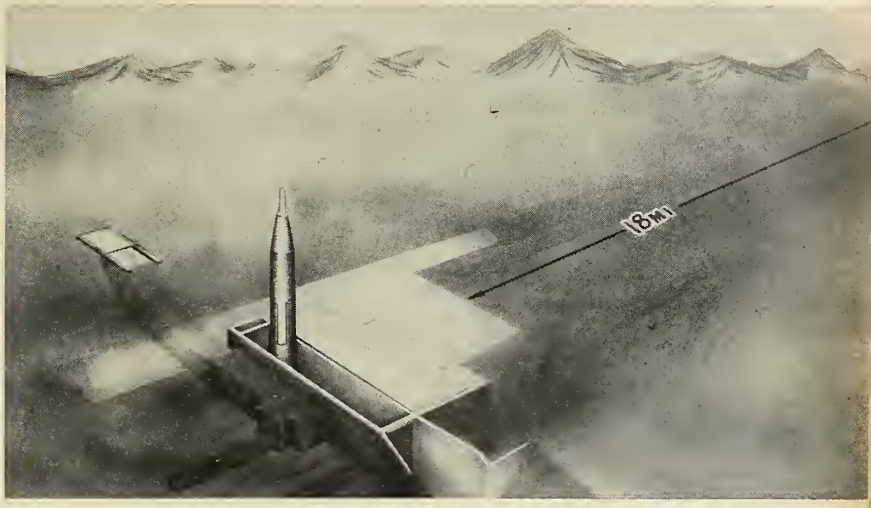
The guidance facility, a long one-story building with a full basement providing 30,000 sq. ft. of floor space, lies east and west. Each half of the building is a complete guidance unit capable of directing all six ICBM's to their targets. This duplication was built in to insure operation in the event half of the building is damaged during an enemy attack.

Asphalt paved roads connect all units in Site "A" which sprawls over 750 acres of prairie and is completely enclosed by a maximum security fence.



SITE "A" POWER is generated by three 7500 kw diesel generators.

Split-roof will shave crucial seconds from time required to fire ICBM.



"HOLLYWOOD HARD" type of launcher built flush with ground will be employed by dispersed squadron. Contract has been let.

There is also a patrol road which runs around the perimeter, inside the fence.

• **Fast fueling**—Today, at launcher No. 1 a wooden "whalebone" tailored to the exact outside dimensions of an *Atlas* lies in its low-slung carrier outside the door. It is being used to test the Convair erector mechanism which already is installed.

LOX tanks are filled and operational as are the RP-1 fuel tanks—all located outside the launch building. On the south side of the building along with the LOX pressure vessels are eight tanks of pressurized gaseous oxygen which is used to force the LOX into the missile's tanks. Gaseous nitrogen is used in the same manner to force in the RP-1.

Operating simultaneously, they can fuel the 260,000-lb. bird in two to three minutes.

All six launchers have wet pads and burnout pits which will permit static firing. Whether the missiles will be run up in static tests here is still a matter of debate—involving the morale of the launch crews on one hand and possible objections from neighboring ranchers over the noise and hazard.

Burnout pits also are being built into the "three by three" complexes of the 565th SMS, but will be eliminated entirely in the 549th.

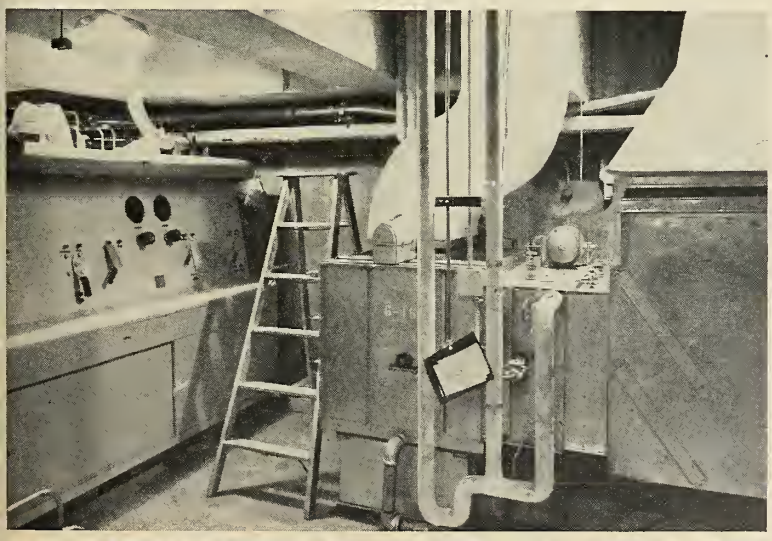
Over the "coffin" storage area at Site "A" launchers is a mobile roof which slides away from the entire length of the missile on railed supports. This design has been improved in the launch buildings of the second squaddon. Here the roof is halved lengthwise and simply slides apart to open—shaving several seconds off erection of the missile into firing position.

The entire roof of the 549th SMS missile storage area will slide off to the side for the Goodyear Aircraft-designed erection mechanism to operate.

To bring Site "A" alone to its present stage of near-combat readiness has been a massive engineering job—far more complicated than anyone realized. Says one top official: "There've been thousands of change orders. So many we've lost count."

• **Ready-made facilities**— One major reason Warren was chosen to be the first ICBM site was its availability of facilities to accommodate both Air Force personnel and a civilian contractor force numbering 2200. Contractors have taken over several hundred thousand square feet of floor space in a complex of one story interconnected buildings which had housed Air Force Technical Schools. These buildings were in top condition when turned over to the missilemen.

Here—in what is known as the "missile land" section of Warren AFB—are offices and shops for **Convair Astronautics,** the prime for *Atlas;* **General Electric,** which has the re-entry vehicle as well as radio inertial guid-



LAUNCH & SERVICE buildings at Site A are identical. Here is equipment for heating the large concrete building.

ance; **Burroughs; Rocketdyne; Radio Corp. of America; Acoustica Associates; Arthur D. Little,** which is handling the cryogenic system; and **Kellogg Switchboard & Supply Co.,** a subcontractor for installing communications equipment.

Other subcontractors on the base include the **Catalytic Construction Co.,** Philadelphia, which is responsible for mechanical construction, and a sub for RCA, **Chalco Engineering,** which is working on missile and surface radars.

The responsibility for integrating construction of the various installations —the missile and its support equipment and its airborne guidance—all devolves upon Convair. GE is integrating the ground guidance system.

• **Headaches dept.**—Side by side with the contractors are field offices of the Ballistic Missile Division, headed by Col. Edwin A. Swanke; the Army Corps of Engineers, which is in charge of contracting for construction of the launch complexes, and a liaison office of the Air Material Command.

BMD is the executive agency and technical director of the program for the Air Force, which is another way of saying it handles all the headaches. For it falls largely on Swanke to "coordinate decisions" on the hundreds of engineering problems which crop up from day to day.

Installation of equipment must be planned far in advance so that one contractor won't be getting in the way of another who might be ready to run a subsystem test at the same location.

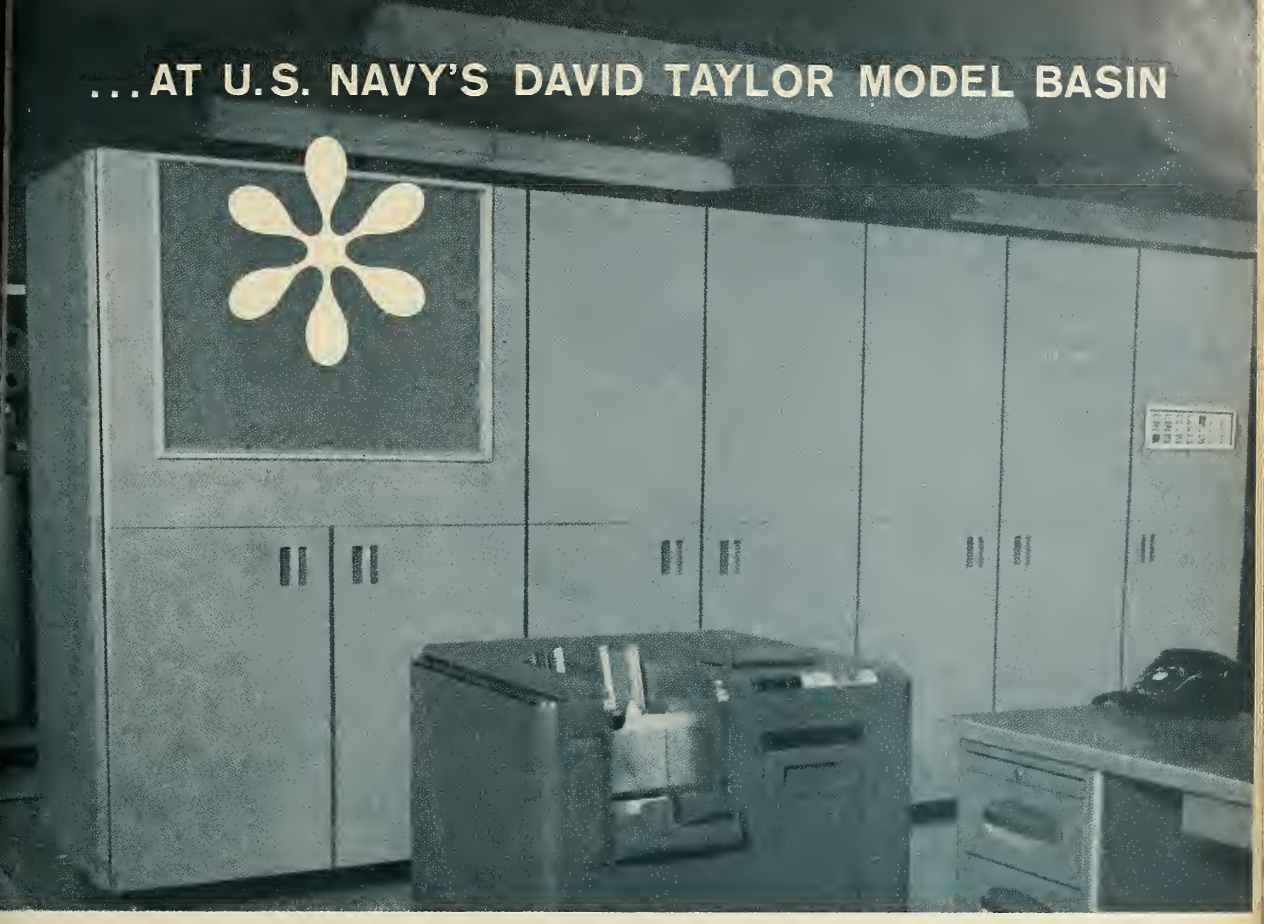
Construction of the Site "A" facility was done by the **George A. Fuller Co.,** New York. **Blount Brothers,** Montgomery, Ala., is building the three complexes of the 565th SMS, and the **Martin K. Eby Co.,** Wichita, Kan., has the contract for the nine dispersed sites of the 549th SMS. There are numerous subcontractors for installation of heavy power equipment, fuel pressure vessels, etc.

• **$250 million each**—Cost of constructing these facilities is running from $30 million to $35 million per squadron, according to the Corps of Engineers. This would bring the investment in launch facilities for three squadrons at Warren to about $100 million. Construction is estimated at about 40% of the total cost of an operational ICBM base. Thus—fully equipped and with the birds in place—the squadrons at Warren are costing about $250 million.

Rader's 13th Air Division is split into two wings—the 706th *Atlas* Wing at Warren and the 703rd *Titan* Wing at Lowry AFB, some 90 miles to the south, near Denver.

The *Atlas* Wing is backed by a maintenance squadron, a medical group and a support group. The *Titan* Wing —only now in the early stages of site

DISPERSED ICBM SITES roughly surround Warren AFB in a series of circles 15 miles apart. Numbers inside the dots marking each site signify the number of *Atlas* launchers each will have. Wide dispersion over three states makes base much harder to knock out in a surprise attack, but greatly increases problems of logistics.



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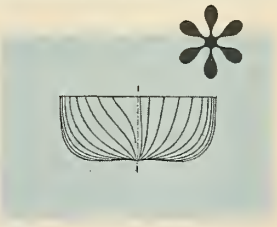

Selected data, either tabular or graphic, may be projected on the accessory viewing screen only 8 seconds after film exposure. The projection unit is useful for computer monitoring.

STROMBERG-CARLSON - SAN DIEGO

A DIVISION OF **GENERAL DYNAMICS CORPORATION**

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construction—has two missile squadrons plus support and maintenance squadrons.

Each wing is centered on an Air Force base for logistical support. However, the two missile bases themselves with their widely scattered launching sites are spread over thousands of square miles.

Warren itself is a prime example of an air base in the age of the ICBM. It is becoming a vast supply, maintenance and general housekeeping center. It has no air strip at all, but uses the one at nearby Cheyenne.

Millions of dollars have been spent on "rehabbing" existing buildings at Warren AFB and in constructing new facilities. These include a huge Missile Assembly Building where six *Atlases* can be handled at one time, a technical supply building, a tightly guarded warhead building and a liquid oxygen plant. All LOX is trucked to the individual sites.

Logistic support is provided by air from a new AMC supply center set up at San Bernadino, Calif.

• **Nerve center**—The heart of this huge, complex operation will be in a command post now under construction in the MAB building at Warren. Here will be displayed the same war plans as at SAC headquarters at Omaha, and here the orders to go to war will flow.

Out on the prairie the combat missilemen will be waiting, ready to send their birds into the air within 15 minutes of the time the order is flashed.

• **The big button**—Some idea of the life and job of these combat missilemen is summed up in a remark made by a veteran combat pilot deeply involved in the program. Standing under clocks that showed the time in Moscow and Cheyenne, he said:

"What we're asking of these men is to be proficient, to maintain their equipment, to be ready to push the button day or night. And all the time they know better than anyone else that the day they push the button is the day civilization—as we know it—ends."

The men called upon to fill this role—the cream of the Air Force—are now arriving at Warren in increasing numbers to take part in installing equipment at their battle posts. This is none too soon.

No matter how hard anyone tries, complete standardization of the *Atlas* sites is impossible. Adjustments, additions, corrections are pumped into the *Atlas* program week after week. This means that the crews must continually revise what they have learned during their extensive training.

• **Getting there early**—Rader has overcome some of these problems by bringing in an installations officer to oversee what is being done. He also is trying to get his squadron commanders on the scene 18 months before a site becomes operational.

"The specs call for one thing but a contractor decides to put a cable somewhere else," he said. "Then when the time comes and I have to buy the site for the SAC, how do I know that I won't have to rip down a wall to get at the cable in an emergency? My installation officer and squadron commanders can see to it that I won't."

Personnel and supply problems caused by ever wider dispersion of ICBM sites also are posing an enormous difficulty.

It will take days for squadron commanders to visit all of their units by car. It will take hours for a missileman or replacement equipment to travel to some of the outlying sites.

The problem becomes even tougher in the winter when the blizzards that sweep the northern American plains block the roads and cut off entire areas. Because of the blizzards some excellent missile sites in the mountains west of Cheyenne had to be passed over.

ABOVE: sign indicates turnoff to first operational site 22 miles north of Cheyenne. BELOW: contractors and military work in former technical school buildings.

• **Help from whirlybird**—The solution to the command problem and much of the supply problem appears to be the helicopter. A commander in a helicopter could visit all of his units in a matter of hours. A helicopter could bring vitally-needed equipment and other supplies to a site in minutes, or be a lifesaver to a missileman suddenly stricken ill in a snowbound blockhouse.

The Air Force recently bought two **Kaman** H-43B helicopters for trial operations at Warren. The Kaman has a range of 183 nautical miles and it can cruise at 98 knots with a load of about 1500 pounds.

The Air Force sees the solution to the missileman commutation problem in staggering shifts over several days. Missilemen may be on duty at their sites for two days straight and then have three days off.

Whatever the final answer, key men will have to be kept on or close to Warren.

"For one thing we can't run the risk of having them assassinated," one officer said. "For another, we can't have people all over the lot and have to call to them and say—'why don't you drop around your missile site, we're going to war.'"

• **Too busy for boredom**—One problem the Air Force thinks it has licked is the possibility of missilemen becoming bored as they sit by their grim birds. "It just won't be a problem," one missileman said. "There's too much to do."

Another combat officer put it more bluntly: "We used to talk about putting in ping-pong tables and games. Now we wonder where to attach the broom."

Despite all difficulties, morale among missilemen from the commanders down to the missile maintenance technicians is high and growing higher by the week. All appear to feel and welcome the tension and excitement of a front line post. All have the inner confidence and nervous edge of picked troops ready to move into action.

"By giving us these missiles we are aiding the United States in gaining the time and technical know-how it needs to build space power," Rader said. "This is our guarantee of survival."

Outside the building snow had started to fall on the parade ground and the old cavalry barracks. Twenty-two miles away at Site A electricians were installing a console in the blockhouse and an airman was waxing the floor with an electric buffer. Across Crow Creek in Missileland three *Atlases* lay shrouded in the MAB, waiting to be taken to the front.

(Continued on page 38)

Paraballoon Antennas—New Space Tool

Research indicates it may be practical to use the antennas in inflatable earth satellites to do many varied jobs

by Charles D. LaFond

BALTIMORE—Balloons are back in the news with new applications and methods of ascent that would make their ancestors inflate with pride.

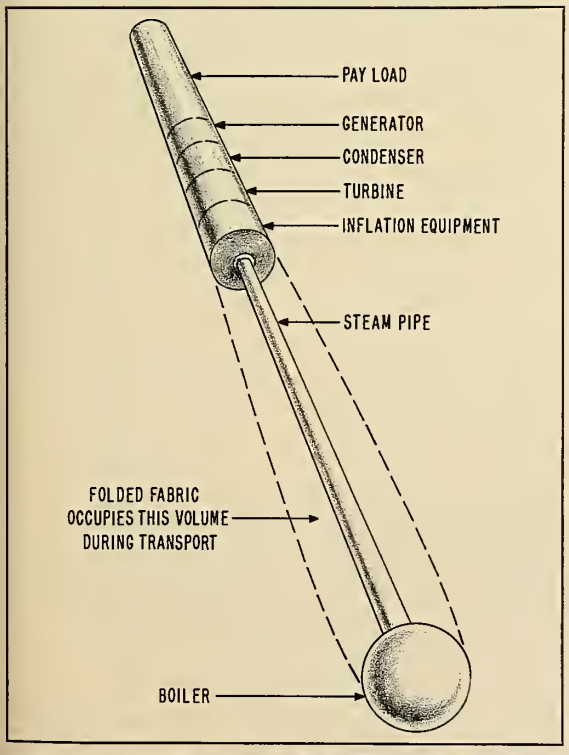
Certainly Montgolfiers, credited with construction of the first hot-air balloon in 1783, would view with awe the concept of missile-borne, pressure-erected structures for use in the earth's airless outer shell. But recent research indicates that it would be far from a "blue-sky" venture to set about using such devices for satellite auxiliary power, reconnaissance, global communications and other applications.

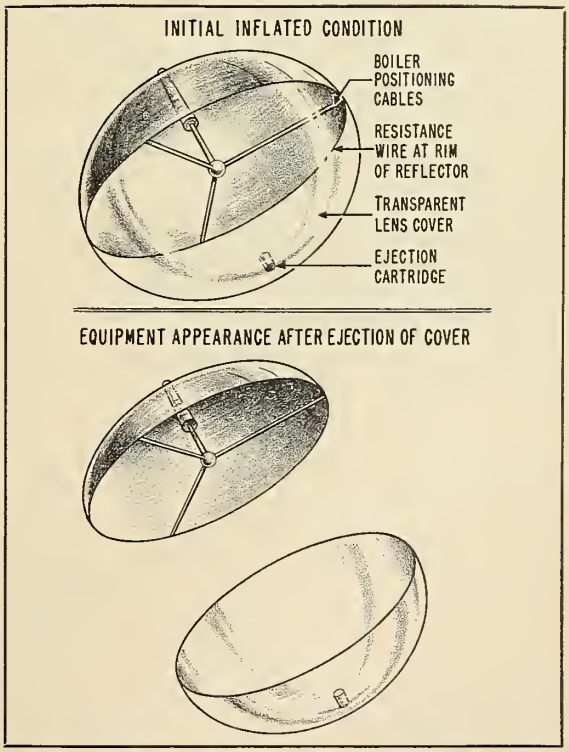
The feasibility of pressure-erected orbiting satellites already has been shown by the National Aeronautics and Space Administration's November shot over Wallops Island, Va. To test satellite drag at high orbital altitudes, a folded 100-foot diameter aluminum foil sphere was inflated automatically at a height of 250 miles.

Growing out of its work with communications and radar Paraballoon Antennas developed for the Air Force, the Electronics Division of **Westinghouse Electric Corp.** has maintained a company-sponsored program to develop these devices for space applications. (Already, over 70,000 engineering man-hours have been spent on development.)

The Paraballoon Antenna is a very lightweight, collapsible, radio-energy reflector. Basically an air-inflated balloon made of a flexible fabric, it is very precisely shaped and coated to provide a high-gain paraboloidal reflector in one inner portion of the skin —the remainder essentially being a window, transparent to r-f energy.

Essential characteristic of the antenna, according to Section Manager J. W. Currie, are a continued high degree of r-f reflectivity after creasing and folding, plus dimensional stability. The latter is now a negligible 0.05%





ELECTRIC POWER for an earth satellite could be obtained with this typical configuration of a pressure-erected solar energy collector. At left it is in transport condition, at right, in deployed state. (Figs. 1 & 2).

even under severe temperature-change and load combinations. The reflecting surface is stable within ± 1/16 inch over 75% of its area and ± 1/8 inch over 95% of its area. Deviation from the theoretical paraboloid anywhere on the surface is never more than ± ¼ inch, said Currie, who believes this accuracy has not been equalled by any other method of antenna construction.

To adapt the devices for use with orbiting satellites, the company is exploiting one of the limitations of plastics (in more conventional uses)—that is, the loss of plasticizer with age.

The goal is to obtain a material that loses its plasticizing ingredients rapidly by "boil-off" when exposed to a vacuum environment. The result of this evaporation will be the stiffening or rigidizing of the vehicle material. The pressure-formed structure would then retain its shape indefinitely even after pressure dissipation.

It has been demonstrated that such structures will retain their geometric shapes under distorting forces of up to one g. In an essentially gravity-free environment where maneuvers are not violent, this performance appears to be adequate for most satellite applications.

• **Applications**—These rigid geometric configurations could be used readily for:

1) Solar energy collectors for auxiliary power sources (APS's);

2) Infrared reflectors for strategic reconnaissance, mapping and APS's;

3) Radar reflectors for long-range target acquisition or observation, and for lunar or space station jamming.

4) Worldwide communications networks.

For example, suppose it were desirable to produce a power-generating plant for the electrical equipment of a satellite with a capability of delivering 3 kw, using solar energy. This power could be generated using a flash boiler, turbine, condenser, and rotating generator—the whole system having practical efficiencies. A 30-foot paraboloidal reflector (six-foot focal length) and a transparent-film closing "window" could concentrate the required solar energy on a two-foot spherical boiler. The boiler should be coated with a material having a high solar energy absorbtivity and low infrared emissivity.

Figs. 1 and 2 show such a system in the transport and deployed conditions. The solar energy collector would be transported to its orbit in a sealed cannister containing the balloon and its deployment inflation equipment, assembled to and folded around the other units, as shown in Fig. 1. The hermetically sealed cannister would be opened and jettisoned at the time of deployment and the antenna inflated by controlled release of bottled gas. Pressure would have to be maintained long enough to allow for completion of rigidization through temperature stabilization and plasticizer evaporation.

Following inflation, the unit would be oriented toward the sun by photocells and gas jets.

After the natural rigidizing process, the supply of gas would be shut off automatically and the internal pressurizing gas allowed to diffuse through the porosity of the fabric. Next, the transparent window could be eliminated to provide a permanently unobstructed path of radiation from sun to collector (window may become cloudy after long exposure to ultraviolet radiation).

It is significant that the weight of such a 30-foot paraboloidal collector, including the transparent window, will not exceed 100 pounds, and that transport volume should be no more than one or two cubic feet.

If it is desired to concentrate solar energy near the paraboloid's vertex rather than at the focal point, a Cassegrainian reflector, as shown in Fig. 3, could be used. A somewhat longer focal length is required, but there are advantages in locating the hot body nearer the units with which it is associated in the power generation system.

• **Environment**—What would be some of the environmental factors in such a venture? During the 5 to 10-minute transit time, temperatures might range from —10° to 170°F. Actual operating temperatures of the unit would vary regularly from —100 to 250°F.

Meteorite collisions could occur once every 120 days for a mass as

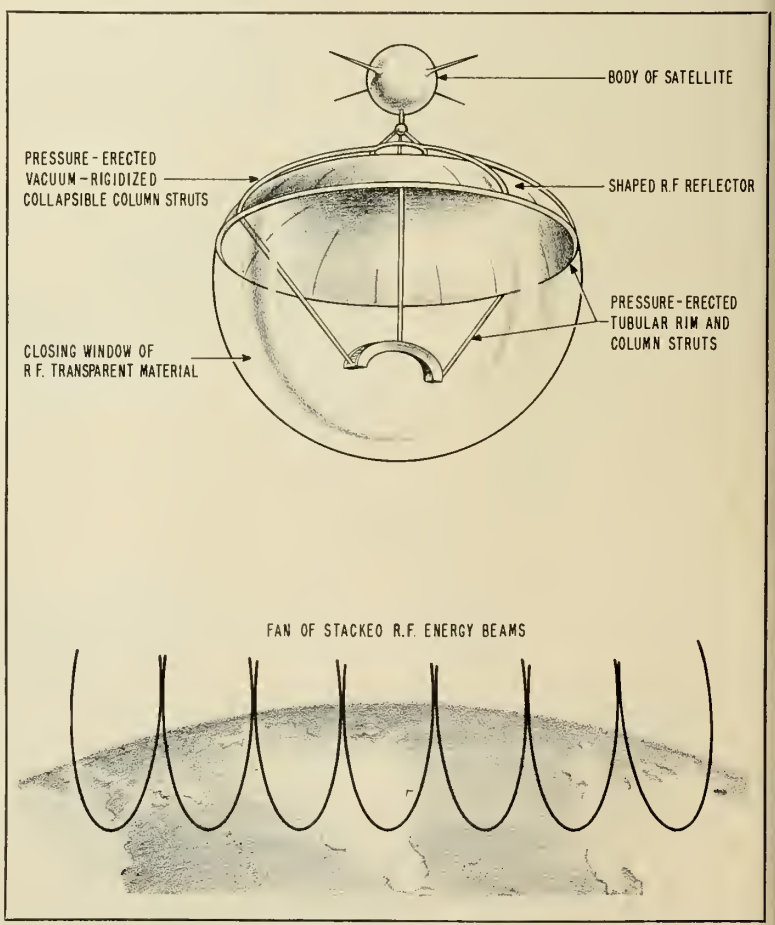
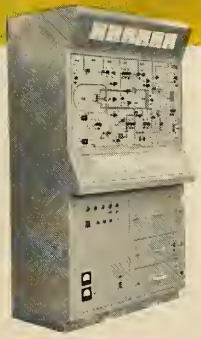


FIG. 4—Among the numerous possible applications for pressure-erected structures is this satellite configuration for a surveillance vehicle. Lightweight, collapsible radio-frequency transmission line and microwave components are also being developed.

test control and complete data

Now both test control and data processing systems are available from one firm – one central source possessing an outstanding record in each area. This is the complete test package needed by today's advanced facilities for rocket and missile power plants – engineered as a single concept by an experienced CSC team. For full information, write for Bulletin 3022-X4.



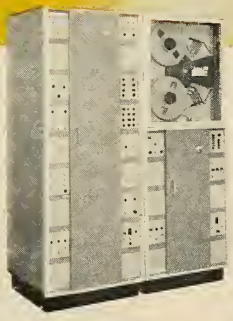


Photo courtesy Rocketdyne, a division of North American Aviation, Inc.

The Consolidated unit shown at far left provides complete programming and control versatility over wide ranges of test conditions.

Right: CSC's new MicroSADIC high speed analog-to-digital data processor which is the heart of an instrumentation system capable of delivering data from transducers to computer.

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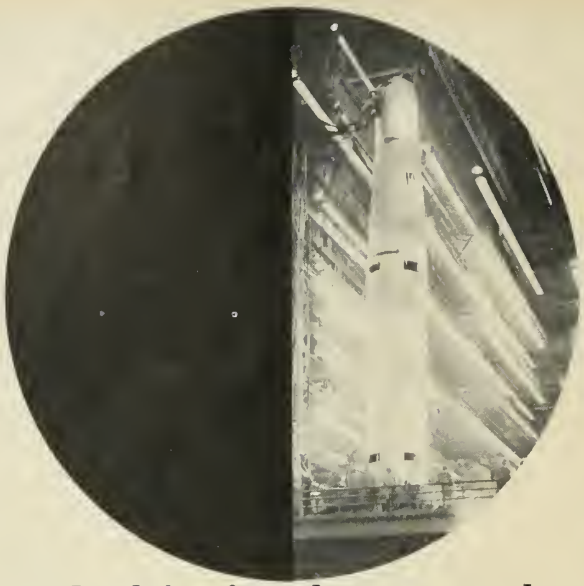
CONSOLIDATED ELECTRODYNAMICS



and this is the way the range is run:

PLANNING

On the Atlantic Missile Range, time waits for no missile. Countdowns must be completed, missile test schedules must be met, orbital interceptions must occur.

Such critical time relationships are achieved only through exact planning, *missile range planning* – a vital part of our responsibility as prime contractor to the Air Force for operation and maintenance of the range.

Here is a pioneer art, encompassing every phase of missile ground support – from operations, engineering, test scheduling and quality control to facilities design, pad safety, propellant handling and nose cone recovery.

Here too, is a pioneer area for professional achievement for the qualified engineer, mathematician or physicist. If you are one such man, we suggest you investigate a future in missile range planning with Pan Am. Please address MR. J. B. APPLEDORN, *Director of Technical Employment*, Pan American World Airways, Inc., Patrick Air Force Base, Florida, Dept. B-15.

PAN AM

Guided Missiles Range Division

Patrick Air Force Base, Florida

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large as 4.0 grams, or as often as 260 times a day for 0.0006-gram masses.

Corpuscular radiation, micro-meteorites, and sublimation will cause surface erosion in time. For optical erosion to become degrading, the surface must be roughened at least to an average depth of 7/11 wavelength.

Work already performed by Westinghouse has demonstrated one advantage of the pressure-erected structure as opposed to devises which depend on rigid mechanical members. This is resistance to damage by meteorite impact.

Since the existing Paraballoon Antennas were developed to resist damage from gunfire, materials were selected which passes the most sensitive contact-fused projectile known without explosion. The only damage is the small hole made by the projectile itself.

Because the most pessimistic probability of meteorite impact must be assumed for the structure, the safest and most reliable surface is one through which the particle passes with the least disturbance. The small hole would have no measurable effect on the performance of the reflector. The efficiency of infrared and light reflectors will be decreased somewhat, but this is predictable and can be compensated in the initial design.

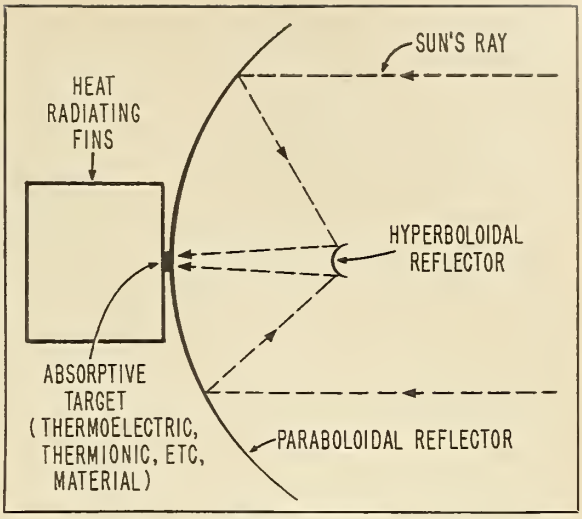

FIG. 3—A CASSEGRAINIAN REFLECTOR could be used in solar generator to locate hot body nearer to associated units in system (energy concentrated near vertex rather than at focal point.)

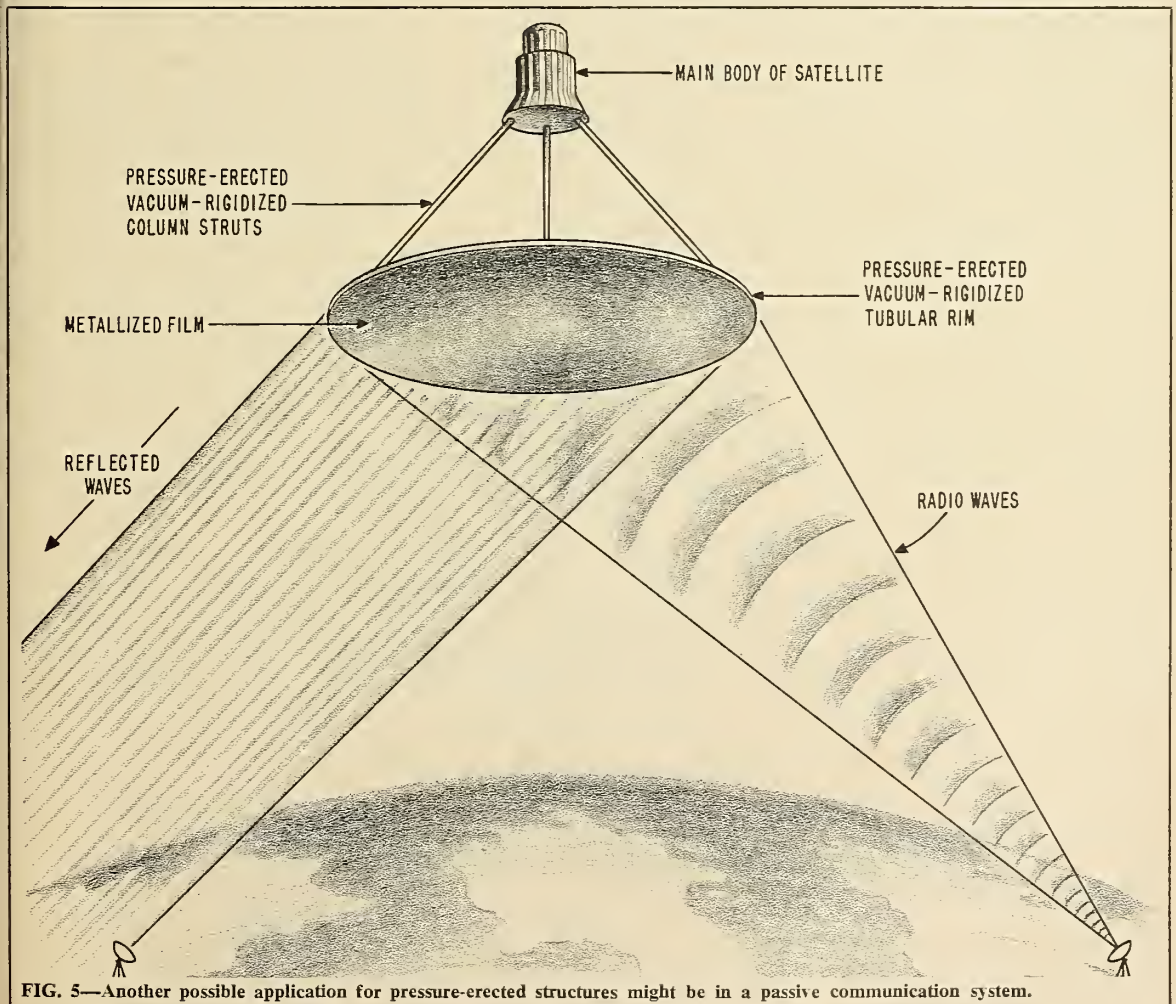

FIG. 5—Another possible application for pressure-erected structures might be in a passive communication system.

HOW FMC SERVES NATIONAL DEFENSE

FMC is one of the few companies in this country that is capable of applying coordinated mechanical and chemical research, engineering and production experience to National Defense requirements. The broad range of our company's activity in producing defense materiel is described on the opposite page.

Since 1941, FMC has designed and built more types of military-standardized tracked vehicles than any other company in America. This extensive background in the field of mobility has enabled FMC to make vital contributions to "Space Age" programs producing missile launching equipment. FMC also is a leading supplier of liquid and solid propellants, and solid propellant rocket motors for a number of advanced missile systems; also supplies pumps for atomic-powered submarines and surface vessels.

While each FMC operation can and does utilize its own creative talent and productive resources to fulfill specific needs, it may also call upon other FMC operations, as well as our central research and development laboratories. This results in specialized service backed by the total creative resources and production facilities of our company.

This progressive operating practice is the result of a long-standing policy of product diversification and decentralization of production which has made FMC a leader in three major areas: **Basic Chemicals, Industrial and Agricultural Machinery, and Military Defense Materiel.**

For complete listing of our products and services contact FMC, Dept. PRA, Box 760, San Jose, California

fmc	**Ordnance Division:** Missile ground support equipment (transporters, launchers); armored and unarmored tracked military vehicles
Westvaco Chemicals	**Westvaco Chlor-Alkali Division:** Dimazine® (Unsymmetrical dimethylhydrazine) rocket propellant
BECCO	**Becco Chemical Division:** High strength hydrogen peroxide rocket propellant
	Grand Central Rocket Co. (affiliate of FMC and Tennessee Gas Transmission Co.): Solid propellants and solid propellant rocket motors
CHIKSAN	**Chiksan Company:** Swivel joints for missile fueling and for hydraulic and pneumatic lines on ground support equipment
fmc	**Florida Division:** Missile shipping and storage containers and fuel tanks
fmc	**Chemicals and Plastics Division:** Dapon® (allylic) resin used in the manufacture of electronic components and of laminated radomes and aircraft parts
John BEAN	**John Bean Division:** Coolant charging pumps for nuclear power reactors; decontaminators; high-pressure fog and volume fire fighting equipment; aircraft ground service equipment; high-pressure pumps for defense installations
PEERLESS PUMPS	**Peerless Pump Division:** Pumps for nuclear power plants and nuclear powered vessels
"Chicago"	**Chicago Pump Company:** Sewage and industrial waste treatment equipment for defense installations; pumps
COFFIN	**Coffin Turbo Pumps:** Boiler feed pumps for all types of ships

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RCA Facility Fights Radio Interference

CAPE CANAVERAL—Operations have been stepped up in the continuing war against radio interference at the Atlantic Missile Range by the addition of the recently opened **RCA** frequency control and analysis center (FCA) here.

The FCA facility—which includes four mobile receiving and d/f vehicles and six C-131 aircraft—constantly monitors the radio spectrum from 540 kc to 10 kmc to protect missile-test radio links from interference and spurious signals. In addition, FCA also has the responsibility of monitoring and qualitatively analyzing all r-f transmissions from the Cape.

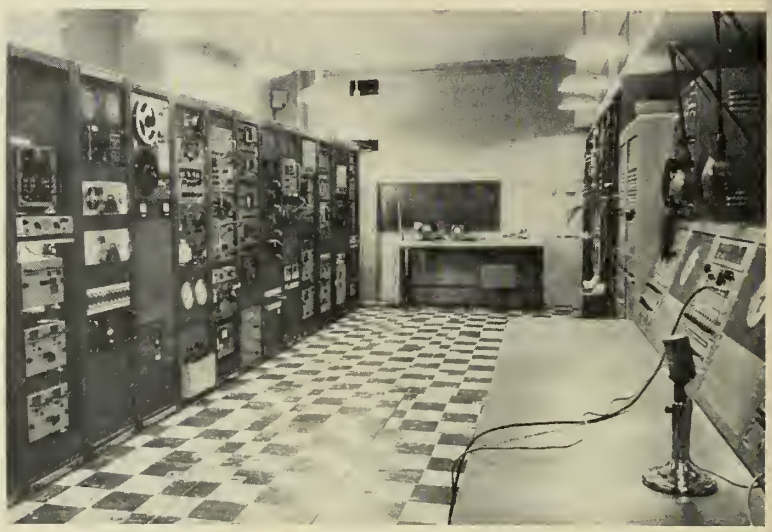
Although there are no known instances of a missile being destroyed by accidental or deliberate spurious radio signals, such emissions have caused considerable trouble in several missile tests. Many instances involve classified areas. Some which do not, and serve to illustrate the problem faced by FCA:

1) Aircraft transmissions on the 230-250 mc band, in one case, blanketed many of the Cape's telemetering receivers.

2) A *Bull Goose* test was scrubbed after a hold of almost five hours caused by radio interference which could not be located.

3) In several cases, missile beacons have been triggered by C- and X-band radar and GCA equipment.

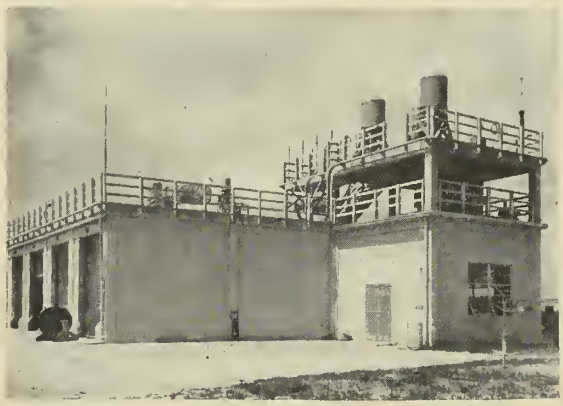
4) Radar and telemetry antennas have lost track of missiles due to interfering signals.



NEW FCA building at Cape Canaveral is filled with elaborate radio receiving, analysis, and direction-finding equipment to monitor entire AFMTC operating spectrum.

Whenever interference or unauthorized transmissions appear on monitored wavelengths, the FCA group immediately locates the offending sender or equipment and silences it during the missile test. This can sometimes be accomplished from the Cape center—or it may be necessary to call in the mobile units or scramble some of the group's aircraft to pinpoint the offender.

About the only way a missile could be destroyed by radio interference would be for a false signal to be pumped into the control or command-destruct circuits. Such is not likely, due to the elaborate coding used in command transmissions to preclude the possibility. It is the vital task of FCA to see that the possibility is made even more remote, however, and that missile tests are not held up nor interfered with by random radio signals.



HEADQUARTERS building of FCA center. Facilities include four mobile ground units as well as six C-131 aircraft.

WIDE VARIETY of receiving antennas atop the FCA center monitors, locates any troublesome radio or radar signals.

'Filterscan' Data

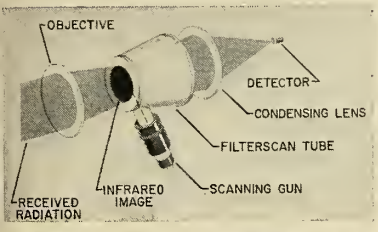
Philco's IR Scanning For Faster Monitoring

PHILADELPHIA—Although it is still under security wraps, some details of **Philco Corp.'s** newly developed "Filterscan" infrared scanning system have been released.

First reported in M/R, Oct. 26, the all-electronic IR scanner can reproduce images of fairly good quality (150-lines/inch pattern). The company has stated that if higher definition were desired for particular applications, standard TV scanning rate (525 lines/inch) could be provided.

Believed to be roughly 30 times faster than mechanical systems using oscillating-mirror scanners, electronic scanning offers capability of more rapid monitoring of changes in target direction or heat intensity.

In operation, the IR image is focussed on a tapered scanning tube which dissects the image. Window of



TYPICAL OPTICAL configuration of Filterscan as employed by the Philco Research group. The small end of the scanner is the semiconductor window.

the tube is a semiconductor; the other end is any IR transparent material.

An electron gun is connected to the scanner tube at an angle such that it allows the electron beam to strike the semiconductor window, yet keeps the beam out of the optical path between the two windows.

The image is formed on the solid-state material. When not operating the gun, IR radiation continues through the second window and is reimaged on the surface of the IR-sensitive detector.

The prototype tube developed lacks the storage capacities of a vidicon, but its construction is simple and its operation is practical when it is used with a good detector.

It has been found that photoemissive image tubes are limited by wavelength response. Vidicon or photoconductive tubes provide long-wavelength sensitivity but require extensive cooling to achieve the high resistivity required by the screen material.

costs higher than expected . . .

Mercury Must Get More Money—Or Slip

Program originally expected to need $200 million is now likely to require about $350 million and it will drop behind schedule unless Congress comes through

ARTIST'S CONCEPTION of Project *Mercury* capsule in orbit shows view the first astronaut would get 120 miles above Cuba.

by C. Paul Means

WASHINGTON—Project *Mercury*—the space program with the highest national priority—is in financial trouble, and a strong dose of Congressional gold will be needed to keep the schedule for man's first space orbit from slipping into late 1962 or 1963.

NASA will ask for the first transfusion this month when Congress will be called upon supply close to $30 million to tide the space program through the rest of fiscal '60. Most of this money would go for *Mercury*.

The space agency presently is applying first-aid by shuffling its tight budget to come up with millions more for the project. (See M/R, Dec. 28, p. 44.) Some projects have been temporarily stopped or severely curtailed in order to supply the man-in-space effort with more money.

If Congress approves NASA's fiscal '60 supplemental budget request, it will mean that over $175 million will have been spent on the program by the end of fiscal '60, and that another $175 million will have to be spent to see the program through.

Original NASA estimates were that the program would cost only a little over $200 million.

The fact that Project *Mercury's* costs have been running well ahead of estimates has been known for some time. (See M/R, Oct. 5, p. 11.) Principal reasons for the added expense are: (1) unrealistic initial estimates; (2) rising prices, especially for construction and equipment; and (3) changes and additions to the world-wide tracking range, the capsule, and to other phases of the program.

• **$100 million more**—In rough figures, the *Mercury* program is now expected to cost about $100 million more than was originally estimated, with about half the increase due to changes and additions, and about half due to higher-than-estimated costs.

NASA Administrator T. Keith Glennan told Congress last year that the program's cost would be something over $200 million. Present estimates, according to a recent statement by NASA General Counsel John A. Johnson, are that the program will cost about $350 million.

These two figures are not comparable because certain construction and equipment costs—especially those related to the tracking range—were not originally included in the *Mercury* budget. The estimated $100 million increase—admittedly a rough figure—is arrived at by taking into account the change in NASA bookkeeping procedures and comparing the result with known increases in the program.

During fiscal '59, NASA funded Project *Mercury* for $59,463,333. Dr. Glennan told Congress last February that *Mercury's* budget for fiscal '60 would be $70 million. This total has been increased to $98,762,000 because of the inclusion of tracking funds in the *Mercury* budget, and because of

additional money transferred from other NASA projects.

Total funding for *Mercury* to date, according to a recent report by the Senate Committee on Aeronautical and Space Sciences (See M/R, Dec. 28, p. 44), is $152,198,333. If Congress approves NASA's supplemental fiscal '60 budget referred to above, total funding of Project *Mercury* by the end of this fiscal year will be about $175 million.

• **Half way**—Since present estimates indicate that $350 million in all must be spent to see the program through, Congress will have to fund the program for another $175 million in fiscal '61, fiscal '62 and possibly fiscal '63.

And if the space agency is going to come even close to the originally estimated date for launching the first U.S. astronaut into space (early 1961), most of this money will have to be appropriated for the next fiscal year. However, early reports indicate that NASA and the Bureau of the Budget are not asking Congress for anywhere near this amount.

First concrete details of the Project *Mercury* fund lag were detailed in the Senate Space Committee's report. (Available from The Superintendent of Documents, Washington 25, D.C.)

• **Greater cost**—"It is now apparent," according to the report, "that the costs of Project *Mercury* will be greater than originally estimated, particularly if NASA construction and equipment funds are taken into account."

The report points out that the investment in Project *Mercury* presently is "approximately $24 million more than the amounts previously identified to the Congress by NASA as programmed . . ." Of this, "16.4 million represents inclusion in the total of construction and equipment funds devoted specifically to the Mercury tracking network, while the remaining $7.4 million represents funds shifted from other NASA research and development programs to Project *Mercury*."

M/R has learned that among the NASA R&D projects which suffered by having money budgeted to them shifted to *Mercury* were the advanced projects studying rendezvous capability ($3 million) and orbiting laboratories ($2 million). Other construction and equipment projects have been slowed down in order to divert money to *Mercury*.

NASA, according to the report, also shuffled money from other parts of the *Mercury* project to the tracking range. Specifically, the space agency "adjusted its funding for Project *Mercury* by transferring $15 million from the 'research and development' appropriation in order to expand the *Mercury* tracking network."

• **Tracking expense**—The tracking range is one of the major portions of the *Mercury* project that is adding to its cost. Originally estimated at about $27 million, the tracking range is now expected to cost well over $40 million. This includes funds to be given to the Department of Defense for use of ships and military facilities. The program has already been funded for $31.42 million.

NASA admits that early cost estimates for the tracking range were too conservative and based on too little information. Besides higher-than-estimate costs, price has gone up because the range has been modified considerably to give it greater capabilities.

Specific changes in the range's plans have been:

• The elimination of the proposed station in the Solomon Islands;

• The addition of a station near Guaymes, Mexico to give the range the capability of bringing the capsule down after only one orbit;

• Additional telemetry to maintain a more continuous check on the astronaut's physical condition;

• Greater abort capability.

• **Capsule modifications**—Changes in the capsule and the ordering of additional capsules has also increased the cost of the program. The original contract with **McDonnell Aircraft** was for 12 identical capsules and was funded at $18.7 million. NASA has now ordered 20 capsules and has re-funded the program to $37 million.

The reason for the increased number of capsules is that NASA has given up its original idea of re-using them. Project Mercury officials think that they can learn more by tearing each capsule apart after use, and the cost of putting them back together again is almost as high as a new capsule's price.

The McDonnell capsules will be used, according to present plans atop one *Little Joe*, eight *Redstones*, and eleven *Atlases* as the project graduates from instrumented to animal loads and from animal to man.

Because of increased costs, the Mercury program is not as ambitious as it used to be. The original plan envisioned longer flights of 18 to 20 orbits and an evolution towards more advanced vehicles. The tracking range as presently constituted will not have the capability to telemeter long flights adequately, and money has been transferred from the advanced manned spacecraft programs into *Mercury*.

When will the manned capsule go aloft? This depends on how much money NASA asks for and Congress allocates, and how many technical difficulties are encountered as the program progresses.

Titan Complexes Pushed by Martin

Activation Division presses facilities work at Vandenberg and Lowry. Unusual construction techniques employed at bases

by **William J. Coughlin**

DENVER—**Martin Company's** new Activation Division is pushing rapidly ahead with construction of training and operational facilities for the *Titan* missile at Vandenberg Air Force Base, Calif., and Lowry Air Force Base, Colo.

With *Titan* due to become technically operational in October, equipment now is being installed in the Operational Suitability Test Facility at Vandenberg, where excavation is finished and pouring of concrete almost concluded. Martin is one of the associate contractors on the test facility, with **Space Technology Laboratories** as the integrating contractor.

In addition to the OSTF complex, Martin also is building TF-1, the *Titan* training facility at Vandenberg. On this, the company is integrating contractor and an associate contractor.

In addition to these two complexes, Martin also is believed to be involved in the construction of the Silo Launch Test Facility at Vandenberg, but the company will not confirm this. If true, it would indicate plans for early testing of subterranean launch of the Martin missile.

In addition to these projects, Activation Division is working with Air Force's Ballistic Missile Division on site surveys at Beale Air Force Base, Calif.; Larson Air Force Base, Wash.; Mountain Home Air Force Base, Idaho; and Ellsworth Air Force Base, S.D.

Martin's activation activities were established in a separate division last June, under general manager Vernon Rawlings. Permanent headquarters are in Denver, already the home of Martin's Denver division.

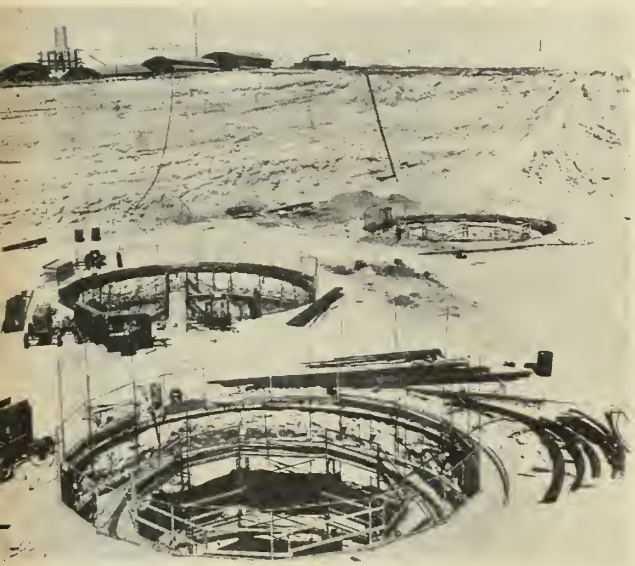
Under the Martin corporate structure, Activation is on the same administrative level as the Martin-Denver facility, where the *Titan* is built.

The company felt that the task of activating the missile bases was one of such magnitude, both from an engineering and a procurement standpoint, that it needed additional management recognition to do the job properly.

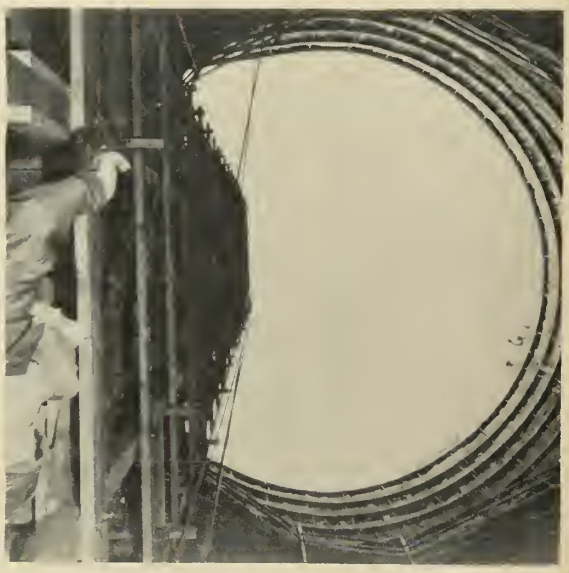
The fulltime task of the Activation Division, according to Rawlings, is "to insure the operational readiness of *Titan* launching bases to meet with Air Force schedules."

The division has some 900 fulltime employees at the moment, 580 at headquarters in Denver, the remainder in field staffs at Vandenberg and Lowry.

As additional contracts are received, the division will grow. At present, its offices are scattered on five floors of the Keith building, two floors of the Central Bank & Trust building, and one floor of the Tower building. Eventually, it is expected to have its own building.



FUEL STORAGE, missile and equipment silos at Lowry. One principal support equipment contractor is Worthington Corp.



LAUNCHING SILOS ARE 165-feet deep and have walk-through tunnels to control and maintenance facilities.

Under the Air Force's "concurrency concept," construction of bases is being pushed while the missile itself still is in the development stage. Martin's *Titan* contract, although still a research and development contract, calls for demonstration of operational capability. This includes the first base and the missiles to equip it.

Typical operational site for the *Titan* will be a hard base with all support equipment and missile silos underground. Like the **Boeing** *Minuteman*, *Titan* can be based on mobile platforms such as railway cars.

In carrying out site surveys with BMD, the Activation Division studies such problems as community attitudes, housing, labor market, transportation, medical facilities, schools, climatic conditions, city services and tax structure.

A major educational task, the division has found, is that of convincing community leaders of the need for making their town a prime target for enemy attack. A telling argument, particularly in communities accustomed to aircraft noise and associated dangers: there will be no take-offs from the missile base except in anger.

Some idea of the massive task of construction of one of these underground bases can be gained at Lowry, where initial excavation is well advanced. In actual surface launching of a *Titan*, concrete doors would slide open on the surface and the missile would be elevated from its 165-ft. deep silo to a firing position.

From each of the three silos in a squadron complex, tunnels run to adjacent propellant and equipment storage areas and to a command control center, power house, two antenna silos and an elevator shaft to the surface.

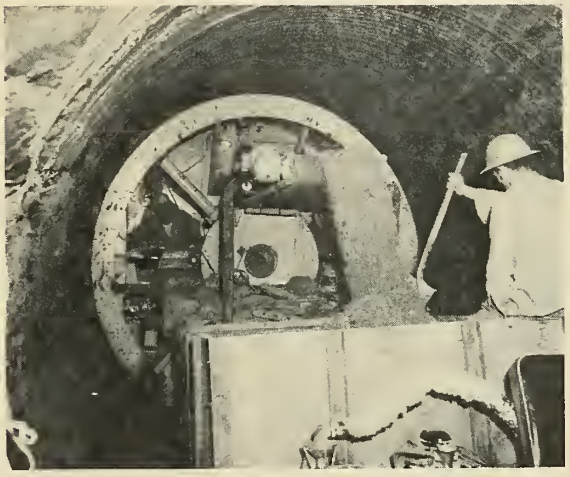
At Lowry, thousands of tons of earth are being scooped from enormous holes for each complex. After the dirt is removed—to the depth of a five-story building—deeper holes are drilled for the silo bases. The walk-through tunnels and administrative centers are constructed and the entire complex covered again with earth.

This technique differs from that used at Vandenberg, where the silo holes were drilled and then connected by tunneling.

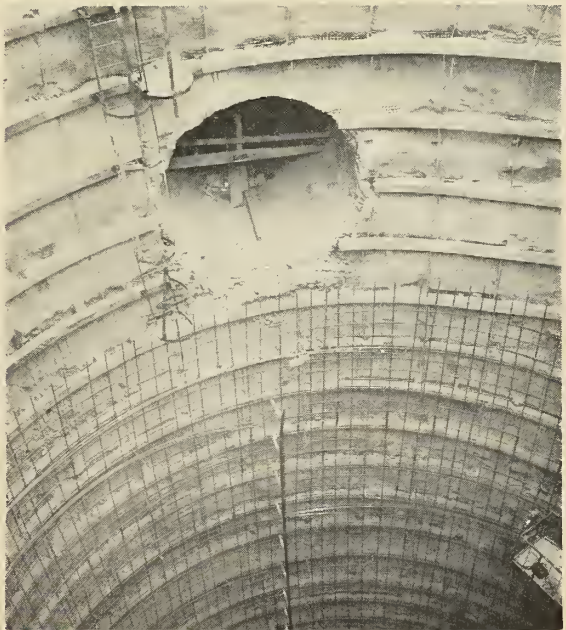
Martin's job as integrating contractor on the Lowry site is to provide the management control necessary to assure the coordination of all contractors working under separate Air Force contracts. As one of the associate contractors, it also is responsible for engineering, installation and testing of much of the ground support equipment.

Construction at Lowry began last May; work on the site for a second SAC squadron got under way in June.

FORMS are assembled for igloo-like powerhouse and control center at Lowry.



'BADGER' machine cuts out tunnels by digging with carboloy-tipped knives mounted on an X-shaped motor attachment.



THIS 10-foot diameter tunnel was cut by specially-designed **'Badger.'** Dirt is removed and carried out by a conveyor belt.

propulsion engineering . . .

By JAY HOLMES

A throttleable liquid engine

capable of operating on any thrust level between 50,000 and 150,000 lbs. has been developed for the Air Force by **Aerojet-General.** UDMH and nitrogen tetroxide make up a storable, hypergolic propellant combination. Theoretical specific impulse is 285 sec. for frozen equilibrium, 1000 psia chamber pressure, 14.7 psia nozzle exit pressure.

The engine, designated *XLR-113-AJ-1,* has a modified *Titan* first-stage injector and a film-cooled thrust chamber. It is described by Aerojet as the largest known variable thrust rocket engine on this side of the Iron Curtain.

Bursts of up to 14 seconds have been fired. Although it would have been possible to build bigger tanks and provide for longer burning, there was no such requirement under the six-month Air Force contract. The engine is designed to power rocket sleds, to be used for testing of missile components under simulated flight conditions.

In the accompanying photo, fuel feeds at the upper left and oxidizer at upper right. The diagonal tube removes drain from an actuator in the oxidizer feed. Film coolant is fed from a circumferential ring just above the drain tube.

Plastic case for a 10,000,000 lb. rocket . . .

is proposed by **Zenith Plastics Co.,** a subsidiary of **Minnesota Mining and Manufacturing Co.** Zenith says it has conceived a method of construction that removes size barriers and solves the problem of joining end closures.

A fiber glass filament-wound case for a 10,000,000 lb. thrust solid rocket could be completed on-site in two years, Zenith declared. The reference obviously is to the proposal by **Thiokol's** Dr. Harold Ritchey for a 60-second, 10,000,000 lb. booster. Zenith says its calculations were based on a requirement to handle nearly 3,000,000 lbs. of propellant. Ritchey has estimated a three-year development program.

Zenith said it has achieved a strength-to-weight ratio of 1,100,000 in. in a privately financed study of what it called "a typical motor case configuration including the closure as an integral part." In laboratory tests, Zenith researchers have achieved strength-to-weight ratios of 1,350,000 in. for semi-bidirectional and 2,210,000 in. for unidirectional wound samples.

Utah location . . .

is planned for Thiokol's new Rocket Operations. Headquarters probably will be in Salt Lake City or Ogden. Utah was obviously chosen for nearness to Thiokol's *Minuteman* R&D center at Brigham City.

Chemical market is $1.14 billion . . .

not $3.75 billion as estimated Dec. 21. Manufacturing Chemists Assn. states that the chemical industry receives 15% of the total missile/-space government spending—currently $7.6 billion.

Engines Improved by Quick Brazing

Aerojet uses GE hydrogen bell brazing furnace to turn out lighter, stronger and more reliable Titan engines—with dramatic cut in production time

by Frank G. McGuire

SACRAMENTO, CALIF.—A lighter, stronger and more reliable *Titan* engine has resulted from a new brazing method introduced into the manufacturing process by **Aerojet-General Corporation,** prime contractor for the propulsion system of the **Martin** ICBM.

Despite the advantages gained, however, there has been no increase in the time required for fabrication; on the contrary, the previous 135-hour operation now takes eight hours.

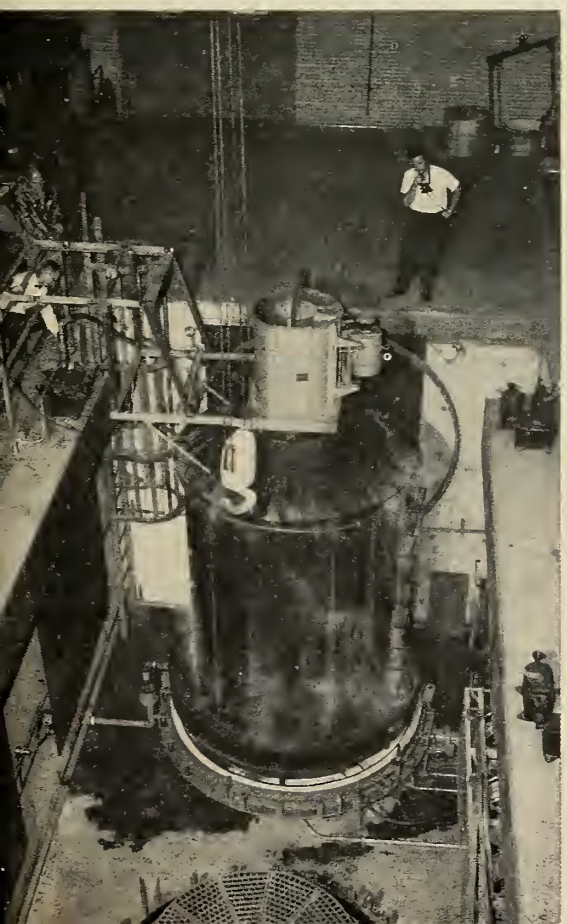
Reason for the bonanza in benefits is the new **General Electric** hydrogen bell brazing furnace installed at Aerojet's Sacramento plants. Applicable to other rocket engine fabrication processes, the method involves brazing in a sealed retort, over which a "bell" containing heating elements is lowered.

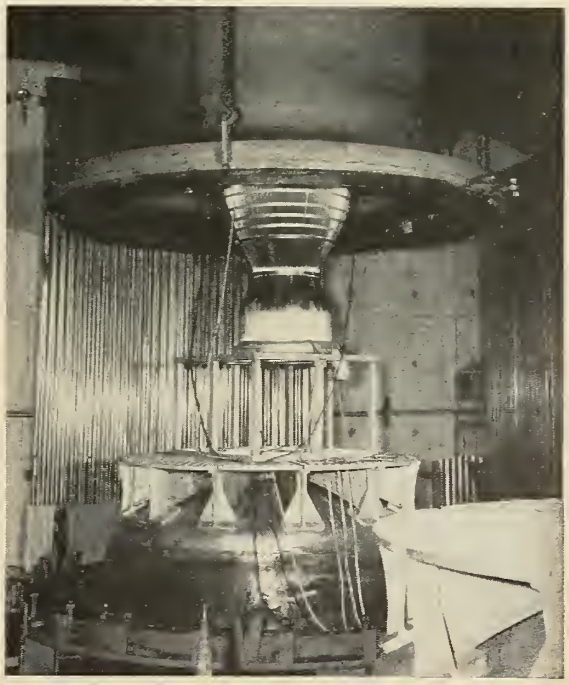
During the brazing cycle, the work within the retort is surrounded by a pure, dry hydrogen atmosphere, while the area between the retort and the furnace bell is filled with exothermic or hydrogen gas. The gas in the furnace bell protects the heating elements, which will corrode if exposed to air when heated.

• **Two gas sources**—Atmosphere for the two sections of the complex is provided by a pair of integral exothermic gas producers. One, a rich producer, provides combustible gas for heating element protection; the other, a lean producer, provides inert purging gas.

A "Deoxo unit" combines any free oxygen which might be in the hydrogen gas with hydrogen to produce a "wet" hydrogen gas, subsequently processed through a dryer to remove moisture.

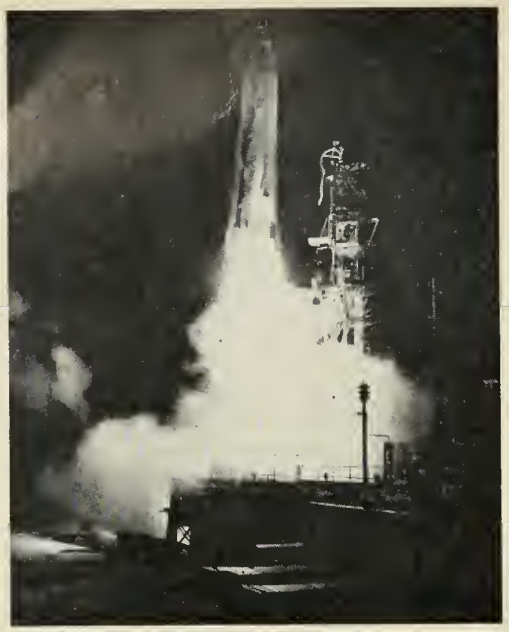
The retort used in the furnace is a dome-topped cylinder with an open flared conical base. Retorts were originally of mild steel, which subsequently



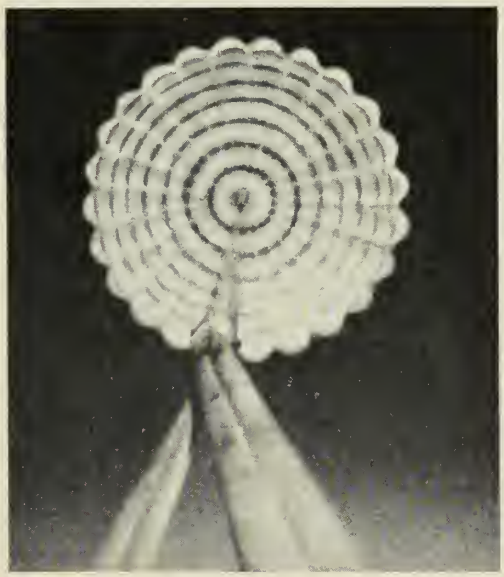


COOLING HOOD in position over a hot thrust chamber. Its fan system circulates room-temperature air over the retort while a water spray in turn cools the hood itself.

RETORT BELL being removed from the work base after completion of the brazing cycle. Present retorts are made of thinly corrugated Inconel, which averts distortion.



THE ATLAS MISSILE LAUNCHED NASA'S one-ton instrumented capsule similar to the one that will carry a man into space orbit. Initial landing phase began at 45,000 feet when a barometric switch fired a charge which deployed a Radioplane stabilization parachute directly aft into the airstream. At the same time, radar chaff was ejected to scatter into a 600-square-foot pattern to provide for radar locating and tracking.



AT 10,000 FEET another barometric switch initiated release of the stabilization 'chute and deployment of the 63-foot Radioplane Ringsail landing 'chute to safely lower "Big Joe" in its 30-feet-per-second descent. Upon water contact, a pyrotechnic charge released the Ringsail. Recovery was completed when a U.S. Navy destroyer, guided to the capsule by radar, lifted the undamaged "Big Joe" space capsule from the Atlantic.

NEWS IS HAPPENING AT NORTHROP

AFTER SPACE FLIGHT RADIOPLANE'S RINGSAIL BRINGS "BIG JOE"–NASA'S ONE-TON CAPSULE–TO SAFE LANDING

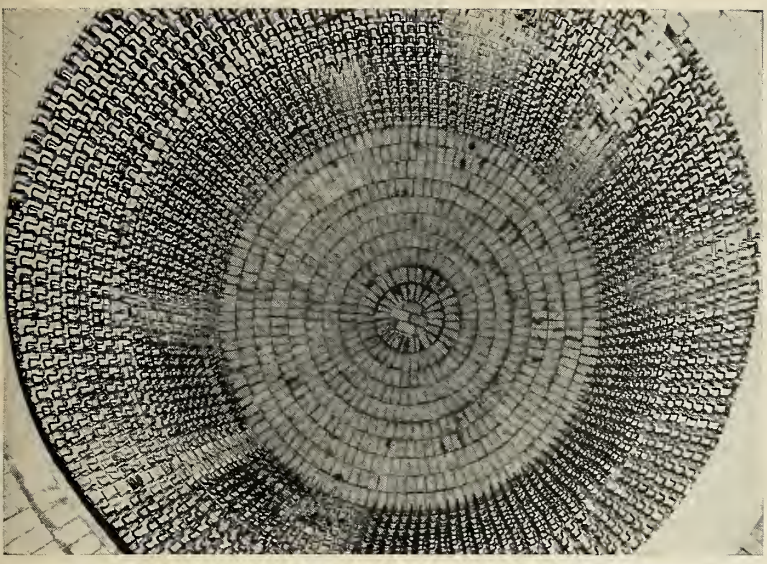
Recently the Space Task Group of the National Aeronautics and Space Administration sent its "Big Joe" capsule into space and successfully recovered it hundreds of miles down-range from Cape Canaveral. The landing system included a 6-foot conical ribbon stabilization parachute and a 63-foot landing parachute, the Ringsail. Both 'chutes, supplied by Radioplane, are proof of new advances in paradynamics.

Radioplane, also chosen by McDonnell Aircraft Corporation to develop and supply the landing system for NASA's Project Mercury, salutes its associates on this achievement. The success of this demonstration shows the ability to bring a man home safely after orbital flight.

RADIOPLANE

A Division of **NORTHROP CORPORATION**

Van Nuys, California, and El Paso, Texas



INSIDE OF the 1950°F, 12-ton heating bell of Aerojet's hydrogen brazing furnace, showing its 22 rows of heating elements. The process greatly speeds production.

proved vulnerable to distortion and scale after exposure to high temperature and air. Present models use thin corrugated inconel retorts, which do not distort appreciably or scale under similar conditions. Inconel also yields weight and heat-transfer advantages.

Furnace heating elements consist of ¼-in. keep in rod-type units capable of maintaining high temperatures. Molybdenum's characteristic offering of greater electrical resistance when heated requires that a variable power input control be provided. This is supplied to the furnace by a saturable reactor and proportional control, which offsets the resistance variant and provides for smooth, accurate control through both heating and operating phases.

• **Stress on safety**—Elaborate safety and warning equipment has been installed to protect operating personnel and prevent furnace damage. Gas flow or electrical power interruptions, for example, are signalled by both auditory and visual mechanisms which also indicate the trouble source. A flashing light remains operative until repairs are made or the power supply resumed.

To decrease explosion possibilities, numerous interlocks are built into the furnace complex. Another safety feature is an intercom system connecting all operators on the furnace equipment.

The *Titan* engine is a regeneratively-cooled type, the thrust chamber being composed of hundreds of thin-walled stainless steel tubes grouped and brazed to form a cone-shaped wall. Manifolds are then welded to each end of the cone to complete the chamber assembly.

In operation, rocket fuel enters the head manifold, is directed downward through alternate tubes, enters the other manifold, and is routed back through the remaining half of the tubing up to the head manifold, where it is ejected into the combustion chamber and ignited. The system serves the dual purpose of preheating the rocket fuel before ignition, and of cooling the thrust chamber tube walls.

Since heat transfer in such a system is extremely critical, Aerojet found it imperative that the brazing alloy used with the chambers during fabrication be applied evenly to avoid buildups which might cause hot spots and result in tube failure and eventual explosion.

• **How time is saved**—Previous to the use of the hydrogen bell furnace, fabrication was a combination of hand-welding and brazing involving over 100 hours of brazing and 35 hours of welding. Combining these operations in the new bell furnace, the company estimates production time at eight hours. (This is not man hours, since a three-man team will be required for furnace operation and subsequent minor hand-weld operations.)

Cycling of the engine with the new process will consist of a six-hour furnace cycle, followed by some hand-welding which cannot be accomplished in the furnace. Prior to the actual brazing operation, the thrust chamber components (tubing, manifolds, etc.) are assembled and held together by several tack welds and simple clamps. "Nicro-Braz" brazing alloy is then positioned on the assembled unit, and the chamber is ready for the furnace.

Brazing begins when the prepared assembly is positioned on one of two bases. These contain water-cooled, rubber-base seals and are designed to withstand high temperatures. Thermocouples are located throughout the assembly connected to multipoint strip chart recorders which record time and temperature conditions during the operation.

• **Special crane**—With the assembly in position, the retort is lifted and lowered over the assembly by a specially-built gantry crane. After being locked into position, a vacuum is drawn within the retort. When evacuation is complete, pure dry pressurized hydrogen is admitted to the retort.

The heating bell is then lowered over the retort and connected. The bell is already heated and contains an atmosphere of rich exothermic or hydrogen gas which is maintained well above the auto-ignition temperature of the gas. Final step is bringing the furnace to the melting temperature of the "nicro-braz" alloy. Hydrogen is fed into the retort during this period.

Following brazing, the hot furnace bell is lifted from the retort and replaced with a cooling hood. This hood is designed to prevent excessive heat radiation into the heat-treat room, and also to accelerate cooling of the part. A fan system circulates room air over the glowing retort while a water spray is directed over the hood.

When the retort has cooled sufficiently, the cooling hood is removed and the retort purged with inert gas. A vacuum is then drawn and held until the retort clamps are loosened. Removal of the retort and assembly completes the cycle.

Swedes To Buy *Seacats*

STOCKHOLM—The Royal Swedish Navy will use Britain's *Seacat* surface-to-air missile on its new "Östergötland" class destroyers.

The contract with the British firm of **Short Brothers and Harland Ltd.** calls for delivery in 1961 and includes spare parts, electronic equipment and a number of training and trial missiles.

The solid-propelled *Seacat*, slated for operational use with the British Navy, is radio-guided and fired from a radar-guided quadruple arrangement which includes parts of the current AA installations on board the destroyers.

This aspect reduces the cost of installation and, in addition, permits the use of the present fire control systems in *Seacat* launchings.

—moscow briefs—

Sputnik III Results

A recent paper by V. G. Istomin gives details of information about the ionic composition of the upper atmosphere obtained from *Sputnik III's* instruments. (*Doklady Akademii nauk USSR*, Vol. 129, No. 1, 1959, pp. 81-84).

During the period May 15-25, 1958, 15,000 spectra of positive ion masses in the ionosphere were obtained by *Sputnik III* at altitudes of 225 km and 980 km by means of radio-frequency mass-spectrometer. Measurements were made between 27° and 65° N. latitude. The spectrometer had a negative charge gained from the gasmass through which the satellite moved, increasing the sensitivity of the instrument.

The spectra were found to contain harmonic peaks among the primary ones, the intervals for which had been predetermined in the laboratory. The most pronounced peak relates to mass number 16, attributed to atomic oxygen O+; the second: 14, attributed to atomic nitrogen N+.

Istomin reports that spectra obtained at the perigee showed a group of peaks with mass numbers 32, 30, and 28. The most pronounced peak relates to mass number 30, such as in ions of nitric oxide NO+. Mass numbers 32 and 28 can be attributed to ions of molecular oxygen O_2+ and molecular nitrogen N_2+, respectively.

The ratio of atomic nitrogen to atomic oxygen varies depending on the geographic latitude and the distance from earth. The distance from earth's surface was divided into intervals, the first interval being from 225 km to 250 km, and the second from 251 km to 350 km. In both intervals, the concentration of atomic nitrogen increases upon transition from the zone 30°N-50°N to the zone 55°N-65°N. The influence of latitude vanishes at distances from earth greater than 450 km.

In general, *Sputnik III* indicated that the concentration of ions of nitric oxide, molecular oxygen, and molecular nitrogen increases at higher latitudes as compared to the concentration of ions of atomic oxygen. Ions of nitric oxide were found up to a height of 400 km; molecular ions were not found beyond 500 km.

Neutron Radiation Detector

A simple neutron radiation detector capable of operating in the presence of a strong X-ray field has been invented by two Russian scientists, according to a recent report.

The detector consists of two chro-

el-copel thermocouples of opposite olarities connected in a series circuit. he thermocouple joints are made of eel tubes, one filled with U_3O_8 enched with 75% U^{235}, and the other ith Pb_3O_4 (approximately 50 mg in ich tube).

The differential thermoelectromove force in the series circuit is proortional to the heating of the thermouple as a result of U^{235} fision. This etection system was tested in neutron uxes from 5 x 10^3 to 1.5 x 10^{13} /cm²sec with satisfactory results, ccording to the paper (*Pribory i tekhika eksperimenta,* No. 5, 1959, pp. 21-122).

oviet-French Exchange

The journal *Komsomol 'skaya prava* reports that the USSR has concluded pact for exchange of information on ultural, scientific and technological atters with France. No specific deails have been released. (Dec. 13, 959, p. 4, col. 3.)

—when and where—

JANUARY

merican Astronautical Society, Sixth Annual Meeting, Statler-Hilton Hotel, New York City, Jan. 18-21.

merican Management Association, Special Research and Development Conference, Roosevelt Hotel, New York, Jan. 20-22.

tructure of Strong Normal Shockwaves, Northwestern University, Evanston, Ill., Jan. 21.

nstitute of the Aeronautical Sciences, 28th Annual Meeting, Hotel Astor, New York City, Jan. 25-28.

econd Annual Symposium on High Speed Testing, sponsored by Plas-Tech Equipment Corp., Somerset Hotel, Boston, Jan. 27.

esearch in Rarified Gas Dynamics, Northwestern University, Jan. 28.

eventh Annual Western Spectroscopy Conference, Asilomar, Pacific Grove, Calif., Jan. 28-29.

merican Rocket Society, Solid Propellants Conference, Princeton University, Princeton, N.J., Jan. 28-29.

FEBRUARY

hemical Institute of Canada, Toronto Section, Symposium on Gas Chromatography, Seaway Hotel, Toronto, Feb. 1.

nstrument Society of America, Houston Section, Instrument-Automation Conference & Exhibit, Rice Hotel & Sam Houston Coliseum, Houston, Feb. 1-4.

ixth Annual Midwest Welding Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology; Chicago Section, American Welding Society, Illinois Tech. Chemistry Bldg., Chicago, Feb. 3-4.

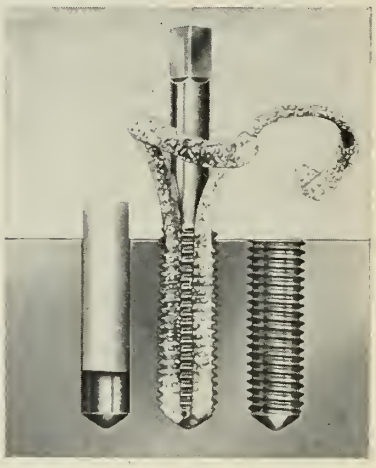
Tap Cartridge Eliminates Chipping

The Tap Cartridge Co. announces development of a new-formula wax pellet tap cartridge that completely eliminates the many chip problems encountered in blind hole tapping operations.

In the tapping operation, the tap cartridge is dropped into the already drilled, or drilled and reamed hole. As the tap works its way into the hole, a solid flow of wax carries the chips along and out the flutes as fast as the chips are made.

The last chips left at the bottom of the hole are embedded in that portion of the tap cartridge still in the flutes of the tap. Immobilized in this manner, they are withdrawn with the tap. The tap actually touches the bottom of the hole with no chip interference and there is no necessity to clean the tap between holes.

The new tap cartridge eliminates costly extra chip removal operations, reduces rejects due to torn threads, and over-comes tapered or oversized threaded hole. Tap breakage is also minimized because there are no chips to become wedged in the relief of the tap as it is being withdrawn.



Tap cartridges also allow tapping in the bottom of the hole in one pass, produce a smoother, more uniform thread, and greatly extend tap life. Tap cartridges are available in sizes 0-80 through 1¼". They can be used equally well in steel. iron, aluminum, plastics, and the newer exotic metals.

Circle No. 225 on Subscriber Service Card.

Gas Generator Used For *Mercury's* Parachute

McCormick Selph Associates' SK-6119-26 and SK-6119-36 gas generators play an important role in NASA's plan for the landing phase of the Project Mercury capsule.

The generators provide the energy to eject the main and reserve parachute packs from their compartments. To assist in the ejection of the main parachute, an SK-6119-26 gas generator delivers hot gas pressure at 25 to 30 psi to the ejector bag.

As the bag inflates (in 1½ to 2½ seconds), it helps force the pack from the compartment. In the event that the reserve parachute is required, an SK-6119-36 gas generator is actuated to help eject the reserve pack. This generator also provides pressure to expel the reserve pack after landing should the reserve pack not be employed. This latter operation is necessary to clear an opening for the astronaut's exit.

Each gas generator consists of an igniter; a one-piece screw-in type nozzle; a vibration-dampened solid propellant grain and a stainless steel gas delivery and heat exchanger tube.

After ignition, the gas pressure generated is routed through a stainless steel tube which drops the heated gas from 3000°F. to 740°F. as it enters the inflation bag. This nylon bag, 11 inches in diameter and 31 inches long, is covered with latex .007 inches in thickness. The SK-6119-26 gas generator is a zero time delay unit and the SK-6119-36 is a 1.25 second time delay unit. The gas generators provide pressure to inflate each bag completely in less than three seconds and force the ejection of the chutes with maximum clearance and safety.

Circle No. 226 on Subscriber Service Card.

Pressurized Machine Spins Solids at Huge G-force

A pressurized machine that twirls solid particles during chemical processing at a g-force 40 times greater than that experienced by an astronaut in space flight has been developed by the Chemical Machinery Division of **Baker Perkins Inc.**

It is built to remove from a liquid carrier solids like those of polyolefins, vinyl resins, penicillin, corn starch titanium, aspirin and acrylic resin fo carpets by centrifugal action at a forc of 1000 g.

Before being placed in operation materials in the machine's 40-in "basket" are pressurized under 150 psi and while under that pressure, sub jected to a centrifugal force of 1000 —as they are rotated at 154 miles pe hour. Production capacity of the ma chine is reported to be 30 tons pe hour.

Circle No. 227 on Subscriber Service Card.

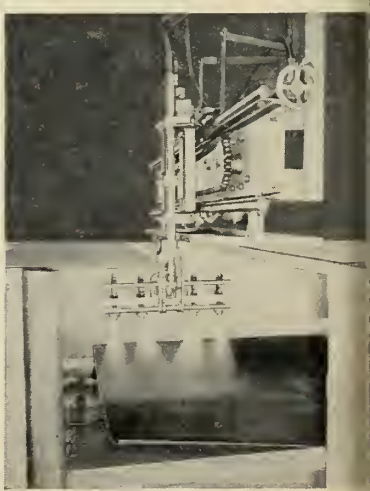
Adhesive Developed for Automatic Spray Applicatior

A 3M high-strength-oil-resistant elas tomeric base adhesive developed fo automatic spray applications in volum production operations and for bondin a wide variety of porous and non-por ous materials is now available from th Adhesives, Coatings and Sealers Divis ion of the **Minnesota Mining and Mfg Co.**

Bonds produced by this general pur pose industrial adhesive, designated a EC-1390, have high softening point and good resistance to plastic flow These properties, combined with th adhesive's rapid rate of strength build up and good sprayability, makes it wel suited for volume production applica tions. This adhesive may also be hanc sprayed or brushed.

The adhesive produces high strengt laminates with such materials as plastic thin gauge aluminum and steel, porce lain enameled steel, linoleum, leather rubber, wood, composition board anc other materials.

Typical uses are: Bonding alumi



um facings to paper honeycomb cores sandwich panel contruction. Wood-steel bonds have shear strengths in ie range of 400 psi.

High pressure plastic laminate-to-eel bonds have tensile-shear strengths f 400 psi and peel strengths averaging 0 pounds per inch width.

Circle No. 228 on Subscriber Service Card.

-Digit Resolution Voltmeter roduced at Lower Cost

A low-cost digital voltmeter with ull four-digit resolution has been an-ounced by **Non-Linear Systems, Inc.**

The V64, which costs only $785, designed for a wide range of DC easuring jobs and, with accessories, AC and low-level DC measurements. he V64 features full four-digit 0.01%) resolution, high input im-

edance and an average measuring ime of 0.27 seconds per reading.

A one-package instrument, the V64 s 5¼ inches high by 15¼ inches deep or mounting in a standard 19-inch rack.

Circle No. 229 on Subscriber Service Card.

High Power Gridded TW Tube Developed

A one-kilowatt traveling wave tube combining a periodic focused permanent magnet (PPM) with a gridded gun s being produced by **Hughes Aircraft Company.**

The tube, which operates in the S-band from 2.0 to 4.0 kmc, is said to be particularly useful to radar systems builders and users.

Combination of permanent magnet focusing with a gridded gun produces a traveling wave amplifier which Hughes Aircraft claims exhibits full one-kilowatt power output characteristics with low power consumption.

Previous to the development of the new Hughes tube, traveling wave tubes with magnetic focusing used a pulsed cathode to supply the beam and involved pulse levels of 5,000-10,000 volts resulting in a difficult modulation problem, according to Richardson.

Use of a control grid, however, enables the Hughes tube to operate with a very fast response time with much lower power consumption and simpler modulation problems.

Traveling wave tubes with gridded

guns at this power level have been available but only with solenoid focusing. Permanent magnet focusing offers the advantage of light weight, no solenoid power supply needed, low heat generation and better reliability.

Known as the Hughes MAS-1E traveling wave amplifier, the new tube is the result of solution of certain technical problems by the company's research and development laboratories.

One of its primary uses is as a final output tube. If still more power is required it can be used to drive other high powered traveling wave tubes or klystrons. Its peak output is in excess of 1 KW at only 0.5 W input. By cascading two tubes an output of 1 KW can be obtained with less than 0.5 W of drive.

Circle No. 230 on Subscriber Service Card.

Dielectric Coolant Pump Aids Cavitation Problem

A new high efficiency, lightweight pump designed for liquid cooling of electronic instrumentation and able to pump any dielectric fluid has been marketed by the **Task Corp.**

According to the manufacturer, the new dielectric coolant pump is designed to minimize cavitation problems encountered with low inlet suction pressures of high-altitude operation. Unique wet motor construction obviates use of rotating seals and attendant leakage problems.

Other applications include use as fuel transfer or booster fuel pump; the unit can be manufactured to meet applicable military specifications.

Specifications include: continuous duty 4 pole, 3 phase, 200 volt motor; weight, 21 ounces; amps, 0.75; pump pressure rise, 20 psi at 2.8 GPM. The pump is 4.38 inches long and has a diameter of 2 inches. Bearings are carbon and the pump can run dry.

Circle No. 231 on Subscriber Service Card.

Lightweight Adjustable Regulating Valve Available

A new pressure regulating valve introduced by Vap-Air, the aeronautical division of **Vapor Heating Corp.,** features light weight, small size, low leakage and stability of control.

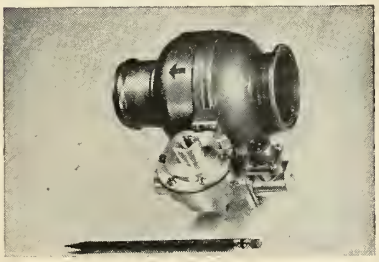
The valve, suitable for dozens of missile applications, weighs 2.6 pounds, handles upstream pressures to 200 psi with variable downstream regulation from 5 to 25 psi. (specifications cited refer to the 2 inch diameter valve handling air at 80°F.)

Leakage is low since it has a positive metal to metal seat rather than a butterfly with "0" ring seals. Leakage is from 0.005 lbs./min. at 25 psi inlet pressure to 0.014 lbs./min. at 200 psi inlet pressure.

The outlet pressure reaches its regulated level within ½ second. A typical example: With inlet air pressure going from 0 to 80 psi in two seconds, downstream regulated air pressure goes to 10 psi (regulated point) in ½ second.

Pressure drop through the regulating valve at 10 lbs./min. air flow is 1.4" Hg; at 25 lbs./min. air flow, drop is 6.2" Hg.

Typical stability of control at an arbitrary 12 psi setting shows a maximum pressure variation on the outlet side of the valve from low of 11 psi to high of 12.5 psi, with inlet pressure varying from 0 to 200 psi.



The Vap-Air pressure regulating valve is made of stainless steel or monel, or other metals to suit the customer's needs, handles air at up to 625°F.

A remote controller weighing 0.4 lbs. permits variations in pressure regulation from 5 to 25 psi. In a typical installation, this controller is mounted on the pilot's console.

The valve body overall diameter is 3.62", length 4.19".

Circle No. 232 on Subscriber Service Card.

New Fluid Curbs Heat-Treat Carbonization

A new carbon potential liquid, developed after two years of laboratory work by **A. F. Holden Co.,** now enables heat-treat engineers to take preventive measures against decarburization and scale formation on carbon steels to meet rigidly prescribed physical standards.

Designed primarily for use with the luminous wall, gas-fired furnace, it is

automatically injected under pressure during the high heat phase. The fluid supplies a supporting atmosphere which burns up excess oxygen and brings the products of combustion to a balanced state.

Coordinated with the furnace operation, decarburization and scale are controlled, reduced to a minimum. Amount of liquid injected is governed by the size and BTU rating of the furnace in use. Because the luminous wall is an open combustion system, it is possible to introduce the liquid to provide a non-explosive atmosphere.

Several grades have already been made available; others are in various stages of development. The fluid is used in the processing of steels ranging in carbon content from 0.20 to 1.00. Each can be applied to a specific type of steel of given carbon content for any heating cycle.

To accurately pinpoint the required treatment, Holden engineers report a laboratory test of customer steel samples is sometimes necessary to determine the proper carbon potential grade for the job.

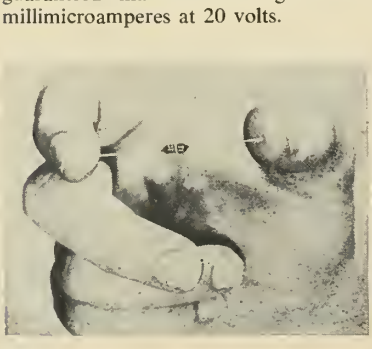
Circle No. 233 on Subscriber Service Card.

Silicon Computer Diodes Claimed to be Fastest Yet

High-voltage silicon mesa diodes—claimed to be the industry's fastest—are available from **Texas Instruments, Inc.**

The diffused devices switch from 10 ma forward current to six volts reverse in four millimicroseconds maximum.

The fast switching capability of the TI 1N914 and TI 1N916 diodes is coupled with an extremely low capacitance of only two micromicrofarads (max), making them especially desirable for high-frequency applications. For frequencies up to 100 megacycles, both diodes provide a minimum rectification efficiency of 45% and have a guaranteed maximum leakage of 25 millimicroamperes at 20 volts.



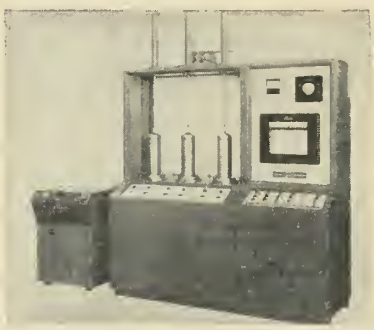
Packaged in a subminiature, hard glass package, the diodes feature a high peak inverse voltage of 75 volts. Both devices will dissipate 250 mw of power at 25°C and highlight a guaranteed minimum forward voltage of 1 volt at 10 milliamps. Through the use of silicon mesa construction, both diodes have an operating range of −65 to 150°C and a maximum storage temperature of 200°C.

The units will withstand 20,000 g during acceleration and 1000 g during shock. The black epon paint used on the TI glass packages withstands moisture, salt spray and 200°C storage temperatures.

Circle No. 234 on Subscriber Service Card.

Leak Detection System Minimizes Operator Error

General Vacuum Corp. has announced a "Series 800" line of high-production Leak Detection Systems designed specifically for in-line operation and high production rates. The systems are either fully or semi-automatic elim-



inating or minimizing operator error.

Results are quantitative so that changes in quality may be detected, recorded, and action taken prior to rejection on a "go-no-go" basis. The results are also reproduceable since the process takes place in a controlled vacuum and is not affected by stray gases or other variables in the atmosphere.

The Series 800 Leak Detection Systems are suited for production testing of all types of vacuum, pressurized, and hermetically sealed products such as aerosols, gas cylinders, refrigeration and air conditioning systems, radiators, missile and aircraft components, electronic assemblies, and fire extinguishers.

The Series 800 incorporates a standard mass spectrometer type leak detector sensitive to helium gas which can also probe rejected items to determine the exact location of the leak.

Circle No. 235 on Subscriber Service Card.

NEW LITERATURE

CHEMICAL MILLING. A 12-pag illustrated booklet describing the proc ess of chemical milling and the func tion of the **Chemical Contour Corp.**, i available free of charge. Chemical Con tour Corp., 16627 South Avalon Boule vard, Gardena, California.

Circle No. 200 on Subscriber Service Card.

SPACE CHAMBERS. A brochure de scribing features and capabilities o walk-in space chambers and picturin many applications is available fron **Tenny Engineering, Inc.**, a produce of environmental test units. Th huge chambers include a variety o specifications for the simulation of ex treme conditions, such as altitudes t 1.5 million feet, temperature fron −150° to +2000°F., humidity to 95% rain fall to 24 inches per hour, ram air flow, varied altitude climb and dive rates, solar radiation to 140 watts pe square foot, radiant heat assemblies dissipation of live or static loads and vibration accommodation.

Circle No. 201 on Subscriber Service Card.

DIMENSIONING. An illustrated 28-page booklet presenting a step-by-step explanation of the theories and practical application of the system of True Position Dimensioning. It reflects **Scintilla Div. of Bendix Aviation's** experience gained in over four years of actual application of this dimensioning practice in manufacturing for the military.

Circle No. 202 on Subscriber Service Card.

METAL CRYSTALS. An eleven-page Bulletin No. 102 entitled "Large Single Metal Crystals," which describes standard specimens as well as unusual shapes and special crystal orientations, is available from **Flow Corporation.** A large number of randomly oriented single metal crystal specimens in aluminum, cadmium, copper, lead, nickel, silver, tin and zinc are now available for immediate delivery in many standard sizes and shapes.

Circle No. 203 on Subscriber Service Card.

CORROSION. A new bulletin describing and illustrating results of a U.S. Signal Corp's Mirror Test for corrosiveness of printed circuit resin fluxes is now available from the **London Chemical Co.** The test was run in accordance with MIL F-14256 by the Inland Testing Division of **Cook Research.** Seven fluxes were tested, some at 50% solids, others "as is." Four of the fluxes, including a W. W.-cg-rosin used as a control, passed the test by showing little or no corrosive action on copper and proving superior solderability.

Circle No. 204 on Subscriber Service Card.

contracts

NAVY

,337,225—Motorola, Inc., Military Electronics Center, for sonobuoys.

0,500—Reading Prodncts Co., Inc., Boyertown, Pa., for inert parts for 0.7ES target drone boosters.

2,296—Giller Tool Corp., Dallas, for guided missile tool kit, mechanical assembler.

MISCELLANEOUS

'estern Scientific Instrument Co., Inc., has received a contract from Hughes Products Group, subsidiary of Hughes Aircraft Co., for continued maintenance of vital laboratory production test equipment.

1,000,000—Iron Fireman Manufacturing Co., Electronics Div., for delivery of gyroscopes for the Radioplane Div. of Northrop Corp.

215,000—Oliver-Shepherd Industries, Nutley, N.J., for design and manufacture of digital and analog airborne magnetic tape recorders. Awarded by Airborne Instruments Laboratory, a division of Cutler-Hammer, Inc.

AIR FORCE

5,244,096—Raytheon Co., Microwave-Power Tube Div., Waltham, Mass., for magnetron electron tubes. (Two contracts.)

2,000,000—Perkin-Elmer Corp., Electro-Optical Div., Norwalk, Conn., for production of alignment theodolites for the *TM-76B* missile. Sub-contract from AC Spark Plug Div. of General Motors.

164,999—Divco-Wayne Electronics, Cincinnati, for spare parts for radar test set.

98,957—Cornell Aeronautical Laboratory, Inc., Buffalo, for research on "Molecular Interactions at High Temperature."

53,766—Syracuse University, for research in "Quantum Field Theory and Elementary Particles Studies."

52,120—Cornell Aeronautical Laboratory, for research on "Nonequilibrium Flows."

49,958—Massachusetts Institute of Technology, Cambridge, for research on "Mechanical Behavior of Metal Composites."

48,576—Cornell Aeronautical Laboratory, Inc., for research on "Boundary Layers in High Temperature Gas Flows."

33,980—University of Pennsylvania, Philadelphia, for research on "Scattering and Polarization of Electrons" and "Factors of the Free Electrons."

ARMY

'ook Electric Co. has received a contract for theoretical design of the data system for the White Sands ARTRAC plan. Amount not disclosed.

6,708,846—Land Air, Inc., Chicago, for research and development data collection and research and development services of range instrumentation equipment at White Sands.

3,065,000—CompuDyne Corp., Hatboro, Pa., for ground support equipment for use in six *Titan* ICBM operational bases.

2,084,220—Telecompnting Service, Inc., for research and development data evaluation at White Sands Missile Range.

1,136,771—Brown Engineering Co., Huntsville, Ala., for engineering and machine shop services on missiles.

900,000—International Telephone & Telegraph Corp., Federal Division, Clifton, N.J., for repair parts for radar target simulator.

231,281—Brown Engineering Co., Huntsville, Ala., for engineering and design for Ordnance Missile Laboratories Div., ARGMA.

$179,043—Fairchild Camera and Instrument Corp., Syosset, N.Y., for 216 fuze rocket, mechanical time, T2075, loaded.

$175,265—Allied Chemical Corp., General Chemical Div., N.Y., for guided missile nitric acid propellant. (Two contracts.)

$174,500—Western Electric Co., Inc., New York City, for *Nike* spare parts and components.

$173,000—A. P. Whitaker & Sons, Randolph, Mass., for construction of FD radar facilities.

$158,000—Brown Engineering Co., Inc., Huntsville, Ala., for engineering and machine shop services.

$135,000—California Institute of Technology, Pasadena, for research and development of guided missiles.

$125,336—Hayes Aircraft Corp., Birmingham, Ala., for engineering services.

$120,168—Norris-Thermador Corp., Vernon, Calif., for motors for 115mm boosted rocket.

$98,750—Lavoie Laboratories, Inc., Morganville, N.J., for oscilloscope.

$75,000—Sperry Rand Corp., Sperry Utah Engineering Laboratory, for repair parts for *Sergeant* guided missile systems.

$59,467—General Development Corp., Elkton, Md., for development of ballistic measurement equipment.

$27,991—Southern Research Institute, Birmingham, Ala., for engineering and technical services on new heat polymers.

$17,850—Rentel & Frost, Inc., Boston, for construction of aircraft weapons calibration facility.

Physicist Doubts Red Data On Moon Magnetism

PASADENA, CALIF.—A paper by a physicist at the **Jet Propulsion Laboratory** states that *Lunik II* data used by Soviet scientists to prove the moon has no magnetic field is not conclusive.

Mrs. Marcia Neugebauer of JPL points out that the Soviet satellite took its measurements on the sun side of the moon, where incoming corpuscular radiation would interact with the weak magnetic field and tend to cancel it out.

Mrs. Neugebauer points out that the Soviet magnetometer was capable of detecting fields down to .0006 gauss and that the final reading before impact presumably was obtained at a lunar altitude of one kilometer.

"It is suggested that, if a general lunar magentic field existed, it would be confined by solar corpuscular radiation, or solar wind, to a thin layer above the sunlit surface, but it could extend a considerable distance beyond the surface on the side away from the sun," Mrs. Neugebauer declares.

Machining Process Acquired

WINDSOR LOCKS, CONN.—Hamilton Standard Division, **United Aircraft Corp.**, has acquired North American rights to an electron beam process developed by the **Carl Zeiss Foundation** of West Germany for machining or welding the hardest materials.

The process operates in a high vacuum (4×10^{-6} mm Hg), developing a precisely controlled beam of high energy density that can be directed to do work on a target.

Charles M. Kearns, general manager of Hamilton Standard, said the process is valuable in manufacturing parts for electronics, missiles and aircraft, nuclear power equipment and many other industrial areas, as well as research laboratories.

Although other electron beam equipment is being manufactured in this country, Kearns said, none has reached the stage of development attained by the Zeiss process in controlled energy densities.

The Zeiss electron beam can raise a target point to 11,000°F, while the temperature registered a micron (.000039") away is only 550°F. It can weld, melt or cut holes as small as .0008" through almost every known material—including tungsten and the refractory metals.

Energy density during drilling may be as high as 600 million watts per square inch. Hamilton Standard said even higher energy density and much smaller holes and slots are contemplated in the near future.

In laboratory tests by the Zeiss Foundation in Oberkochen, West Germany, the equpiment has welded through stainless steel 1" thick in a few seconds. In production applications, it has welded through stainless steel ½" thick.

Hamilton Standard said the process has demonstrated major improvements in the welding of reactor cores for nuclear energy installations and the milling of sub-miniaturized electronic components.

The process may be controlled by electrical relays or by complete electrical and mechanical automation.

Headquarters NASA Groups Are Renamed

WASHINGTON—NASA last week renamed two of its three original headquarters organizations to conform with their new duties.

Renamed were the Office of Advanced Research Programs (formerly the Office of Aeronautical and Space Research) under the direction of Ira H. Abbott, and the Office of Space Flight Programs (formerly the Office of Space Flight Development), under the direction of Dr. Abe Silverstein.

The action was taken because of the recent creation of a NASA Office of Launch Vehicle Programs under the direction of AF Gen. Don R. Ostrander. (See M/R, Dec. 14, p. 40). The new office was carved out of the two existing offices, and their names were changed accordingly.

The fourth NASA headquarters unit is the Office of Business Administration.

NASA Asks World's Help For Explorer IV

WASHINGTON—The National Aeronautics and Space Administration Dec. 30 released the radio codes for the seven different scientific experiments in *Explorer VII* and invited Soviet scientists and scientists from other countries to listen in and participate in analyzing the information.

Dr. Homer E. Newell Jr., NASA Assistant Director, said he hoped scientists from the Soviet Union, Japan, Red China, India, and Indonesia, and others in Asia, Africa, and the South Pacific would take part in the program.

One reason for releasing the codes, Dr. Newell reported, was that American scientists were hampered by "gaps" in the reporting of signals, and cooperation with foreign scientists could provide a world-wide reception system for the satellite's information.

M/R Contributor, Adviser Honored

TULSA, OKLA.—An adviser and a contributor to MISSILES AND ROCKETS MAGAZINE are among the "Ten Outstanding Young Men of 1959" chosen by the U.S. Chamber of Commerce.

They are Dr. S. Fred Singer, professor of physics at the University of Maryland, and Dr. Peter A. Castruccio, technical director, Aerospace Division, **Aeronca Manufacturing Corp.**

Dr. Singer, 35, was cited for his 1951 design of a small scientific earth satellite and for his leadership of the first group to measure the earth's magnetic field at 100 miles altitude. He is a frequent contributor to M/R and in 1958 wrote a series of four articles entitled "Nuclear Explosions in Outer Space," which drew wide acclaim.

Dr. Castruccio, 34, holds several radar patents and has numerous patents pending. He worked with **Bendix Radio** and the **Martin Co.** before joining Aeronca last summer. He is a member of the M/R Advisory Board.

Sperry Test Basin Devised for ASW

GREAT NECK, N.Y.—Effective evaluation of underwater detection devices without extended sea trials will soon be possible at **Sperry Gyroscope.**

A test basin, 400 ft. long, 200 ft. wide and 25 ft. deep, is being constructed by Sperry's Surface Armament Division. A 17 by 29 foot floating barge will be used to sink the sensing equipment under evaluation into the water.

Measuring facilities and equipment to simulate the desired sounds of subs, fish and other marine disturbances will be placed at the other end of the basin.

Not only sound devices such as SONAR but non-acoustic instruments for the location of anti-ship mines, torpedoes and submarines can be tested at the new basin.

The data supplied from the controlled experiments planned may lead to the development of equipment that will considerably extend the range and selectivity of present detection techniques and instruments, Sperry says.

Ryan Acquires Aerolab Development Co.

SAN DIEGO — **Ryan Aeronautical Company** has expanded its space capability by acquiring **Aerolab Development Company** of Pasadena.

Aerolab, now a wholly-owned Ryan subsidiary, has been active in the field of multistage high-altitude sounding rockets and rocket-fired free flight testing of dynamically similar models.

Ryan acquired both the majority Aerolab stock interest held by **U.S. Hoffman Machinery Corp.** of New York since 1955, and minority stock of Aerolab founder E. G. Crofut.

Aerolab will continue operations at Pasadena under direction of Ryan vice president E. G. Uhl, former **Martin Company** vice president who joined Ryan six months ago. Uhl was general manager of the Martin Division at Orlando, Fla.

Aerolab has specialized in arranging standard military rockets such as *Honest John, Nike, Sergeant, Recruit* and others into multistage combinations. Among Aerolab sounding rockets have been systems known as *Argo, Jason, Javelin, Journeyman* and *Percheron.*

Solar Radiation May Be Top Hazard

SANTA MONICA—The main radiation danger in space travel is expected to come not from the Van Allen belts but from the sun itself in the form of solar flares and corpuscular streams, according to a study by three **Douglas Aircraft Company** researchers.

They describe these solar emanations as the least understood and perhaps the most dangerous of space radiations.

"Solar flares are probably the most dangerous to man," the paper said. The emission of energetic protons during a flare could result in dose rates as high as 1000 Roentgen per hour in outer space, it declared. The particles are believed to be in the hundreds of Mev range, "occurring without warning and no particular pattern that can be determined at this stage of our knowledge."

The study, prepared for publication by the Institute of Aeronautical Sciences, was made by M. W. Hunter, assistant chief engineer, space systems; E. Konecci, chief of life sciences, and F. F. Trapp, nuclear engineer.

In the corpuscular streams the dose rate may be higher than in solar flares, but the energies are lower, the Douglas scientists said. Shielding of space travelers against the streams therefore is expected to be simpler.

The paper also noted that streams are preceded by the more dangerous flare so that detection and protection against the flare will give warning against possible arrival of a stream.

"Usually, the flare activity follows very closely the sunspot activity," the paper said. "However, there have been many solar bursts of intense radiation which have occurred during minimum sunspot activity. Although some correlation exists between sunspot activity and solar flare frequency, no definite theory can be postulated until satellites have explored the flare phenomena during minimum sunspot numbers, i.e., approximately five years away."

Radiation environment in the Van Allen belts comes from high-energy protons, the study said, predicting that transit through the inner belt might yield a dose of 2-10 rem. High-energy particles could be stopped by material used for space vehicle structure or for sustenance, it was stated.

"In determining the radiation environment in detail," the Douglas scientists said," shield estimates will have to be examined in light of secondary radiations. Since unshielded radiation intensities in the inner belt may be as high as 100 rem/hr., man will most certainly require shielding while performing extravehicular functions."

The study said the outer Van Allen belt exhibits an equally dangerous unshielded environment from electron fluxes, but it noted that these radiations can be removed by modest shields.

The radiation study was made in connection with the hypothetical journey of a three-man expedition to Mars in a two-stage, 734,000-lb., nuclear-powered vehicle. The three scientists said the U.S. can undertake such an expedition within the next 10 years.

Radiation exposure on such a 421-day round trip, including that from the propulsion system, would be within permissible limits, the researchers said.

9.5 Billion Market een for Electronics in '59

LOS ANGELES—Profits for electronics manufacturers will become narrower despite an increased share of the defense dollar, according to a prediction by Kenneth F. Julin, president of **Leach Corporation.**

In a year-end survey, Julin estimated the electronics industry will hit a peak of $9.5 billion in military and commercial production in 1960.

But he said mounting competition will prevent price increases in spite of rising production costs. Higher cost of research and development is expected to be another factor holding down profits.

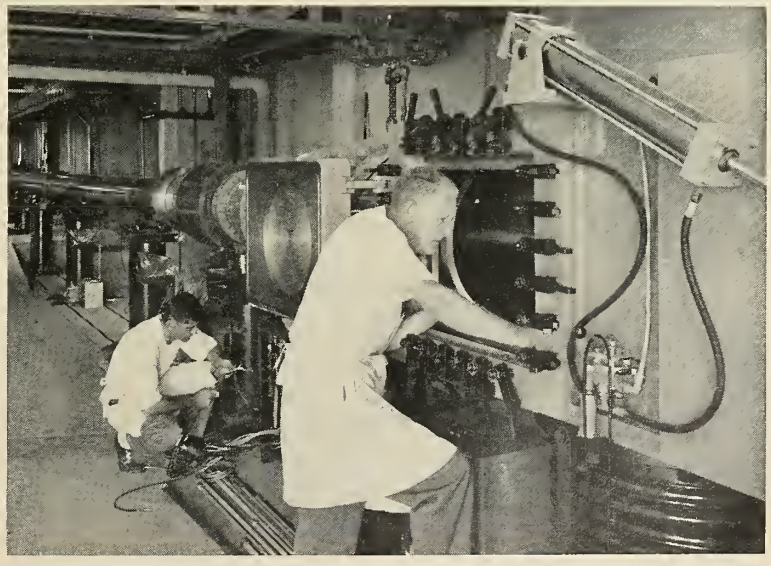
Julin said the struggle for survival in the industry may last another five to eight years.

eramics Division lant Being Expanded

LOS ANGELES—**Gladding, McBean nd Company,** producing ceramic nose cones for the *Sparrow III* guided missile, is expanding its newly formed chnical ceramics division.

The company has leased a 15,000-.-ft. plant in Monrovia which is expected to be in operation by Feb. 1. he plant is described as a highly automated production facility.

CAL Operating New Shock Tunnel



BUFFALO—**Cornell Aeronautical Laboratory, Inc.** has put on the line a new hypersonic shock tunnel for testing missile designs at speeds up to 14,000 mph.

Small-scale prototype work has been performed for **North American Aviation, Boeing, McDonnell, Chance Vought** and the Air Force's Wright Air Development Center. A CAL innovation, "tailored interface," enables the tunnel to produce steady airflows for 15 milliseconds, about eight times longer than possible with previous shock tunnels.

Shock tube is 90 feet long and one foot in diameter. Nozzle and test section extend 20 feet beyond the tube.

west coast industry . . .

By FRANK G. McGUIRE

A ten-year "program of action" has been instituted by the Los Angeles Chamber of Commerce to combat various industry problems during the '60's. Chamber President J. E. Fishburn, Jr., commented that "serious economic problems are coming into focus just now for every business, and the opening of a new decade has a turning-point characteristic." The new program will deal with inflation, excess production costs (in which featherbedding is a prime target), surplus capacity, and other industry complaints.

The chamber foresees population increasing from the present 6.6 million in the metropolitan area to 9.3 million by 1970. The labor force is expected to increase from 2.7 million to 3.9 million in the same period. Further inflation is predicted, with the value of the 1947-49 dollar expected to drop from the present $.78 to $.62 by the end of the decade.

Networks Electronic Corp. . . .
has set up a fourth division, **Infrared Laboratories,** to develop such components as IR detectors, detector dewars, detector coolers, and low-noise preamplifiers. Subsequent plans call for the company to enter the prime contracting field in IR guidance systems. In the past two years, the firm has expanded from a one-product operation to one having a line of 55 miniaturized, proprietary products.

Electronic Engineering Co. of California . . .
has recently come up with two needed systems. One, a tape search and control system, will automatically play back a selected portion of tape on the **Ampex** FR-100, at a search speed of 120 ips. The other, a computer language translator, will greatly speed handling of *Hound Dog* test data.

North American Aviation, Inc. . . .
has paid its largest employe-suggestion award, $7275, to three technicians at Rocketdyne's propulsion field laboratory. The three photo lab employes developed a splicer for oscillograph record paper. Previously, much of the expensive paper was wasted on short runs. The new machine will eliminate much of this loss.

Aerojet was outbid in a land auction . . .
of surplus government property in Yuba County, Calif. AGC, which wanted to use the 40,585 acres for rocket engine testing, went as high as $45 an acre (a total of $1,826,325) but lost anyway. The land will probably be used for cattle raising.

Douglas' F. W. Conant . . .
feels the transition from aircraft to missiles is primarily an engineering transition, and will be performed most rapidly under pressure from a generation of engineers and scientists. The senior vice president of **Douglas Aircraft** suggests that the manufacturing transition is not as drastic as the engineering transition. Likening the situation to the change from sail to steam, he said he feels no fear for the future of Douglas in the Missile/Space Age.

United Research Corp. . . .
is rapidly "organizing and getting under way" in the industry, and expects to play a major role in the space effort. Two multimillion-dollar facilities are under initial construction, one in Sunnyvale and the other 13 miles southeast of San Jose. Reports indicate the firm will make a dramatic bid to demonstrate its capability in solid-propellant rocketry by developing, entirely with its own funds, a million-pound-thrust booster in a relatively short time.

Hewlett-Packard's new test instrumentation . . .
which is quite flexible because it's assembled from standard compatible components, has the name "MARTINI" hung on it. Seems the name stands for "Massive Analog Recording Technical Instrument for Nebulous Indications." A footnote at the bottom of the tech sheet says "Machine and operator require same before and after operation."

Alfred H. Faulkner: appointed technical director of Automation Industries, Inc.'s Datran division, responsible for all engineering and manufacturing activities.

FAULKNER

Faulkner was formerly senior staff engineer for Telemeter Magnetics, Inc. In previous positions he developed a line of commercial electronic instruments and was supervisor of electronic switching systems for Automatic Electric Co. He holds patents on twenty inventions and has thirty pending.

Robert F. Goodwin: vice president, elected president of Airtek Dynamics, Inc., manufacturer of missile assemblies, ground support equipment and commercial marine hardware accessories, succeeding **Gustave G. Michel,** named chairman of the board.

GOODWIN

Goodwin joined Airtek in 1956 as works manager after previous experiences in executive and engineering positions with General Metals Corp., George H. Elliott & Co., Martin Co. and Pratt & Whitney division, United Aircraft Corp.

Philip S. Hessinger: named research manager for National Beryllia Corp. In the newly created position he will be associated with **Dr. Eugene Ryshkewich,** director of research, in the development of beryllium oxide and other pure metal oxide ceramics.

HESSINGER

Previous post: acting director, research and development for Mycalex Corp. of America; also engaged in and directed ceramics research at Ohio State University Research Foundation and Wright Air Development Center.

T. W. Shinafelt: appointed to the newly-created position of director for quality control and service departments of the Aeronautics division of Chance Vought Aircraft, Inc.

SHINAFELT

Prior to joining Vought (1947), as assistant supervisor of engineering liaison, Shinafelt served with the Navy's Bureau of Aeronautics as project officer on several aircraft programs.

M. M. Siar, Jr., assistant service manager, will succeed Shinafelt as manager of the service department.

Frederick C. Durant, III: named director of public and government relations and **E. Douglas Kenna, Jr.,** director of marketing at Avco Corp.'s Research and Advanced Development Division.

Durant, who joined Avco in 1957 as executive assistant to the director of Avco-Everett Research Laboratory, was previously a staff member of Arthur D. Little, Inc. Kenna returns to Avco from Westinghouse Electric Corp., where he was product division manager.

Richard M. Clarke: elected sales manager of Joclin Manufacturing Co., designers and custom molders of high and low temperature reinforced plastics. Was previously in charge of product design and development.

Other appointments: **Kerin G. Boardman,** West Coast regional manager; **Arthur J. Goodwin,** representative for the New England States; **Stephen C. Markham** for Upper New York State and the Great Lakes Region; **Bedford Byron** for the Middle Atlantic States and Metropolitan New York.

Robert B. Corby: appointed staff engineer in the program planning department of Motorola, Inc.'s Western Military Electronics Center. Corby joined the company in 1953 as assistant manager in microwave products, was formerly marketing coordinator for the firm's military plants.

Efcon, Inc. names **Joseph Sipovic** project engineer of the film capacitor division and **Adolph Herbst** project engineer of the tantalum capacitor division.

Sipovic was formerly chief engineer with the condenser products division of New Haven Clock & Watch Co. Herbst was previously associated with Pyramid Electric Co. as chief field engineer and was responsible for the development of tantalum capacitors.

Dr. M. John Rice, Jr.: appointed manager of semiconductor material engineering at CBS Electronics, manufacturing division of Columbia Broadcasting System, Inc. Was formerly director of research for Trancoa Chemical Corp. and prior to that senior chemist with Transitron Electronics Corp.

James P. Murray: Boeing Airplane Co.'s Washington representative for thirty-one years, has retired but will continue as an advisor to the company. He has been a vice president for many years and one of the nation's first airmail pilots, having flown in World War I.

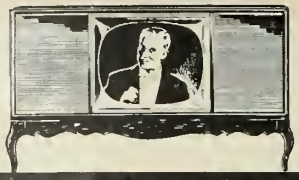
Clifford E. Roberts, with Boeing since 1946, now manages the Washington office.

Lawrence S. Churchill, Jr.: joins Stavid Engineering, Inc. as engineering consultant in underwater electromagnetic propagation and ASW projects. He was formerly a member of the technical staff of Bell Telephone Laboratories, Inc., engaged in research and development and systems engineering in connection with underwater sound and sonar systems.

The Pall Corp. appoints the following to four newly-created engineering posts: **Charles H. Hacker,** chief engineer industrial filters; **Martin Kurz,** manager of porous metals; **Stanley Sakol,** assistant sales manager and **Morris Sankey,** director of quality control.

Dr. S. Dean Wanlass: former marketing manager, elected to the newly-created position of manager of product planning for Aeronutronic, division of Ford Motor Co.

Prior to joining the division he was manager of the inertial navigation department of Lockheed Aircraft's Missile Systems Division, Ramo-Wooldridge Corp. and Hughes Aircraft Co., where he made important contributions to the ICBM and *Falcon* weapon systems.



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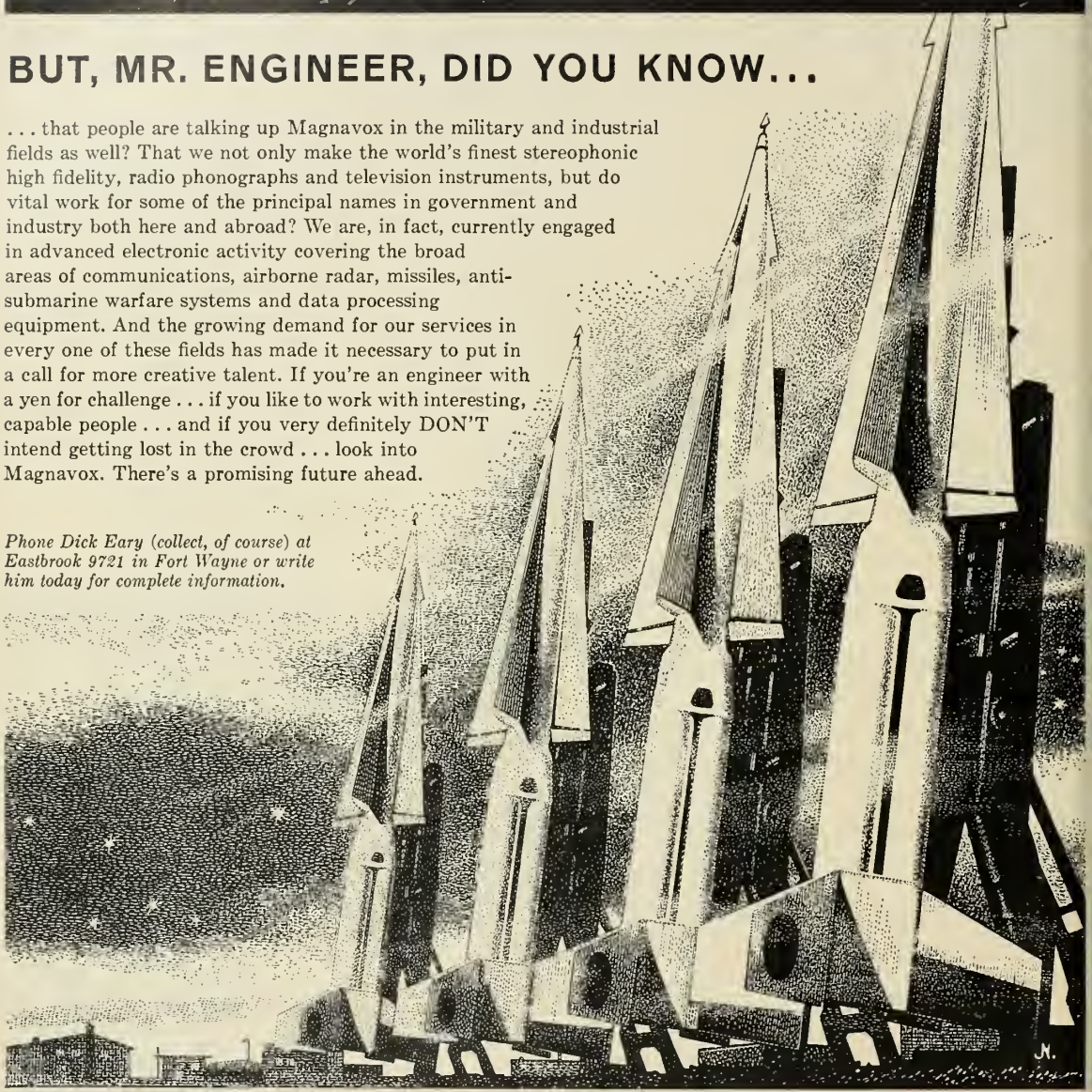

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Space Program—Direction by Default

One of the main problems with the nation's space program is that no one is really running it. Partly through lack of time and partly through lack of appreciation, the President has declined the assignment. By default most of the decisions these days are being made by Dr. T. Keith Glennan, Administrator of the National Aeronautics and Space Administration.

Under the provisions of the National Space Act—and at the insistence of the Administration—Congress made the President Project Officer for the American space program.

The act specifies that he shall "survey all significant space activities, including policies, plans, programs and accomplishments; develop a comprehensive program; designate and fix responsibility for direction; provide for effective cooperation; resolve differences arising among departments and agencies . . . including whether a particular project is an aeronautical and space activity."

The attention of a very busy President is directed to the space program on those infrequent occasions when he meets with the National Aeronautics and Space Council, of which Dr. Glennan is a member. On these occasions, we are informed, the NASA chief briefs the President for 30 minutes, before the program, and items on the agenda are disposed of at the meeting without debate. Dr. Glennan suggests the action or lack thereof and the President nods concurrence. Thus the program is set.

This is hardly what Congress had in mind and we doubt it is what the country—as it watches us fall further and further behind the Russians—wants. For one thing, it indirectly and inadvertently gives NASA a powerful and perhaps decisive voice in determining the military role in space. This the National Space Act rather specifically prohibits.

For another, it places in the hands of one man a great deal more authority than was contemplated when his job was created. The written law says that the NASA Administrator shall "plan, direct and conduct aeronautical and space activities" (except military) as programmed by the President. The law presumably did not intend that the chief of NASA should be dictating the national space program.

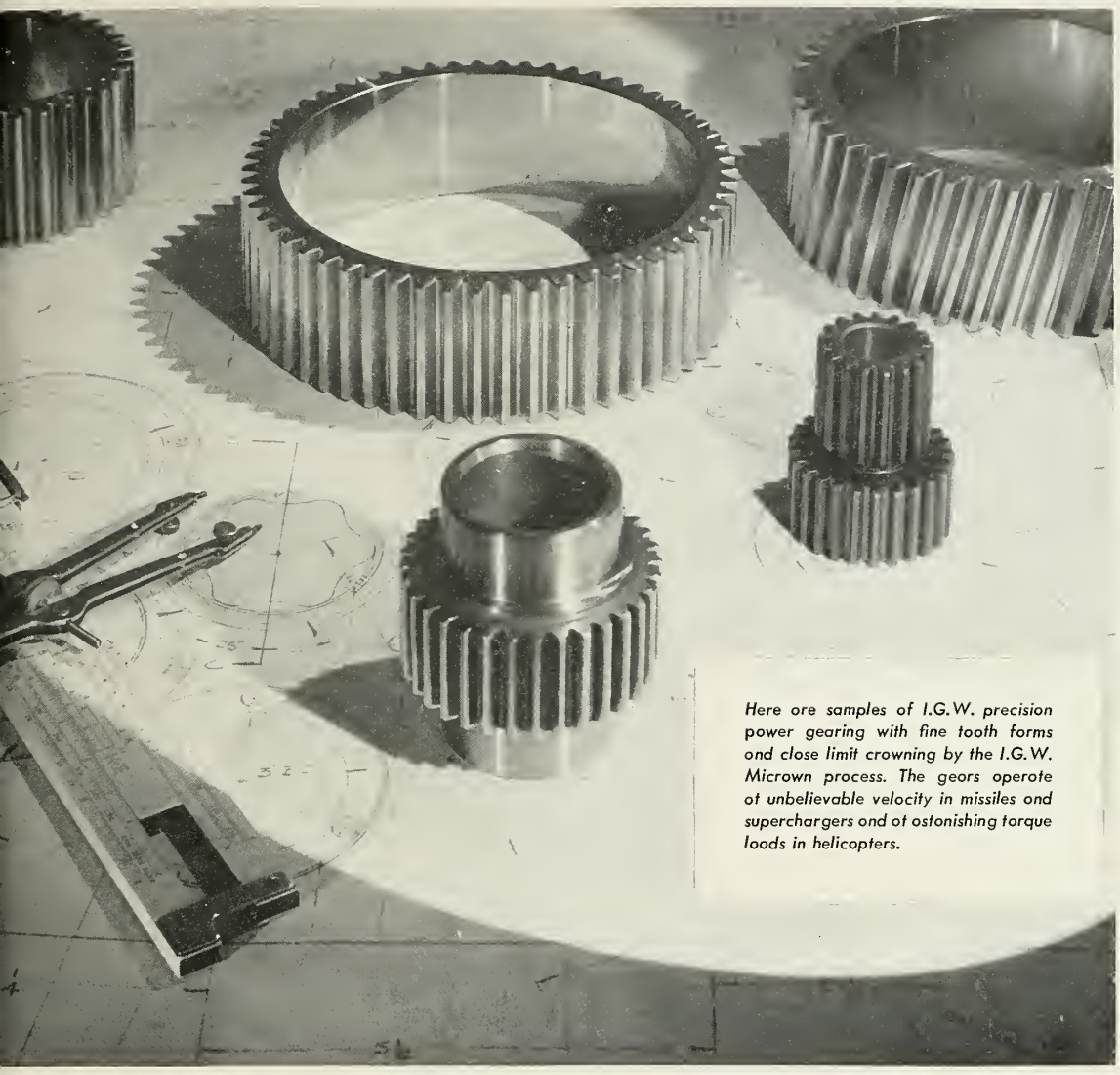
With the reconvening of Congress, several committees have announced firm or tentative plans for conducting thorough investigations of the U.S. space program.

We would like to suggest that the House and Senate Space Committees, as the groups most concerned, point their investigations toward a consideration of reworking the law to:

- Relieve the President of his assignment as Project Officer for the space program, a task he can't possibly have time to carry out.
- Change the charter of NASA from programmatical to functional. Give NASA the job of *exploring* space.
- Reaffirm the military role in space to clarify the grey areas now existing between the Department of Defense and NASA.

There's no real need for all this confusion about space and its use—peacefully, commercially, militarily or what have you. Space is a place—not a program. Let NASA explore it. Let the Services be prepared to defend our right to use it. And let the other government agencies (such as the Department of Commerce for weather forecasting) and private industry make hay with what the explorations produce.

CLARKE NEWLON



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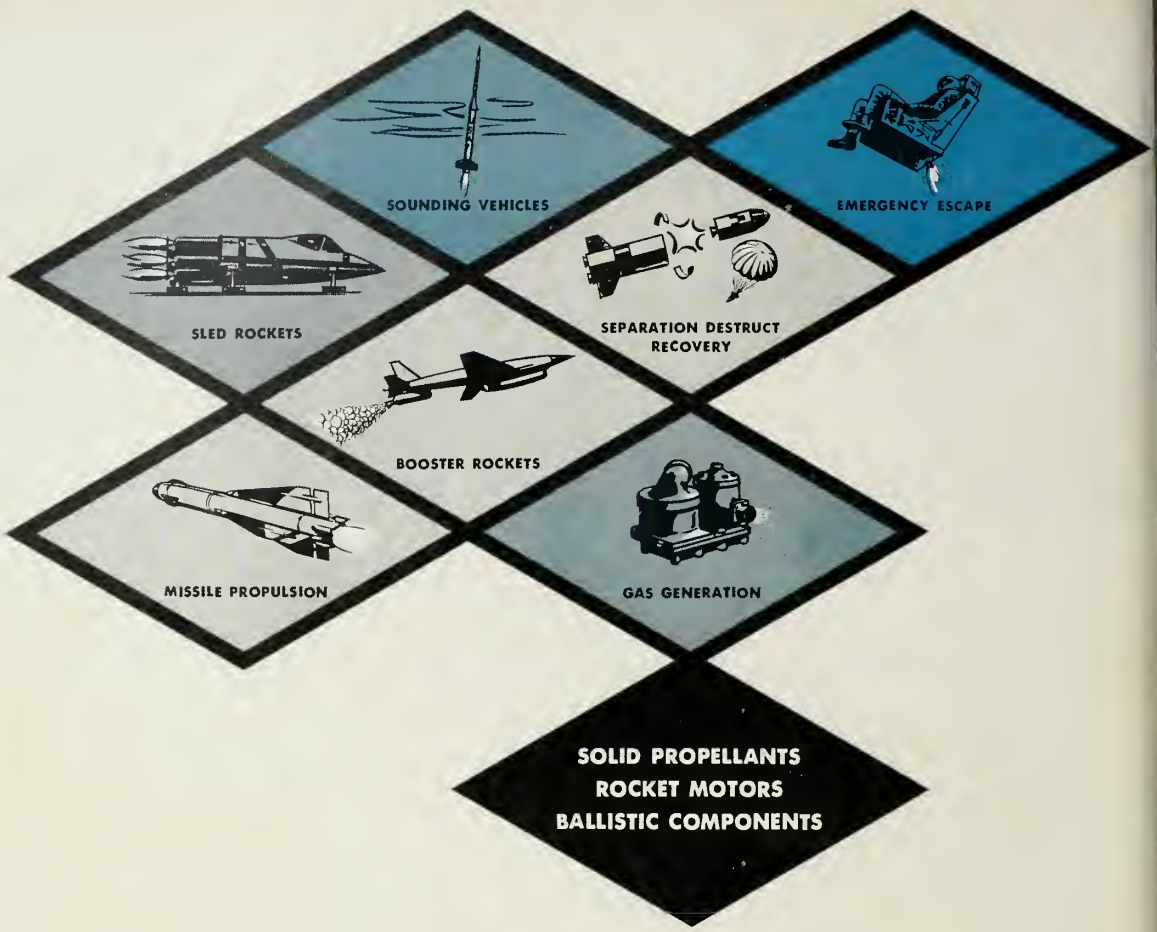

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