DECEMBER 21, 1959

TLAS ON THE PACIFIC–
ANDENBERG VS ARGUELLO

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

AN AMERICAN AVIATION PUBLICATION

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World War II flame throwers and torpedoes...and mad
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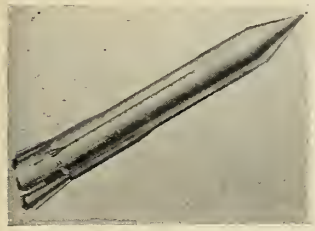
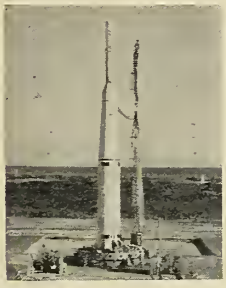
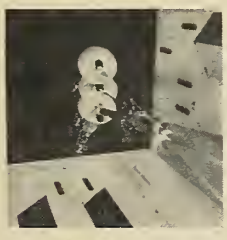
COVER: *Atlas* on a launching pad at Vandenberg AFB, Calif., symbolizes the intensified struggle between the Air Force and the Navy over who'll be top dog in West Coast missile and space launching. See p. 10.



OUT OF space picture now is the projected *Vega* vehicle. The *Centaur* will be used for most of the U.S. space jobs of the future; *Agena* will be used in the interim. See p. 15.



THREE-STAGE *Thor-Able* was to have been used in attempt to put a 95-lb. probe in orbit around the sun. For a background story on the planned shot. turn to p. 17.



SCALE MODEL of *Mercury* space capsule, with escape tower attached. is tested in the Propulsion Wind Tunnel, Air Force's Arnold Engineering Development Center. See p. 24.

missiles and rockets

MAGAZINE OF WORLD ASTRONAUTICS

31,000 copies of this issue printed

DECEMBER 21 HEADLINES

ASTRONAUTICS ENGINEERING

U.S. Reg. Pdg.

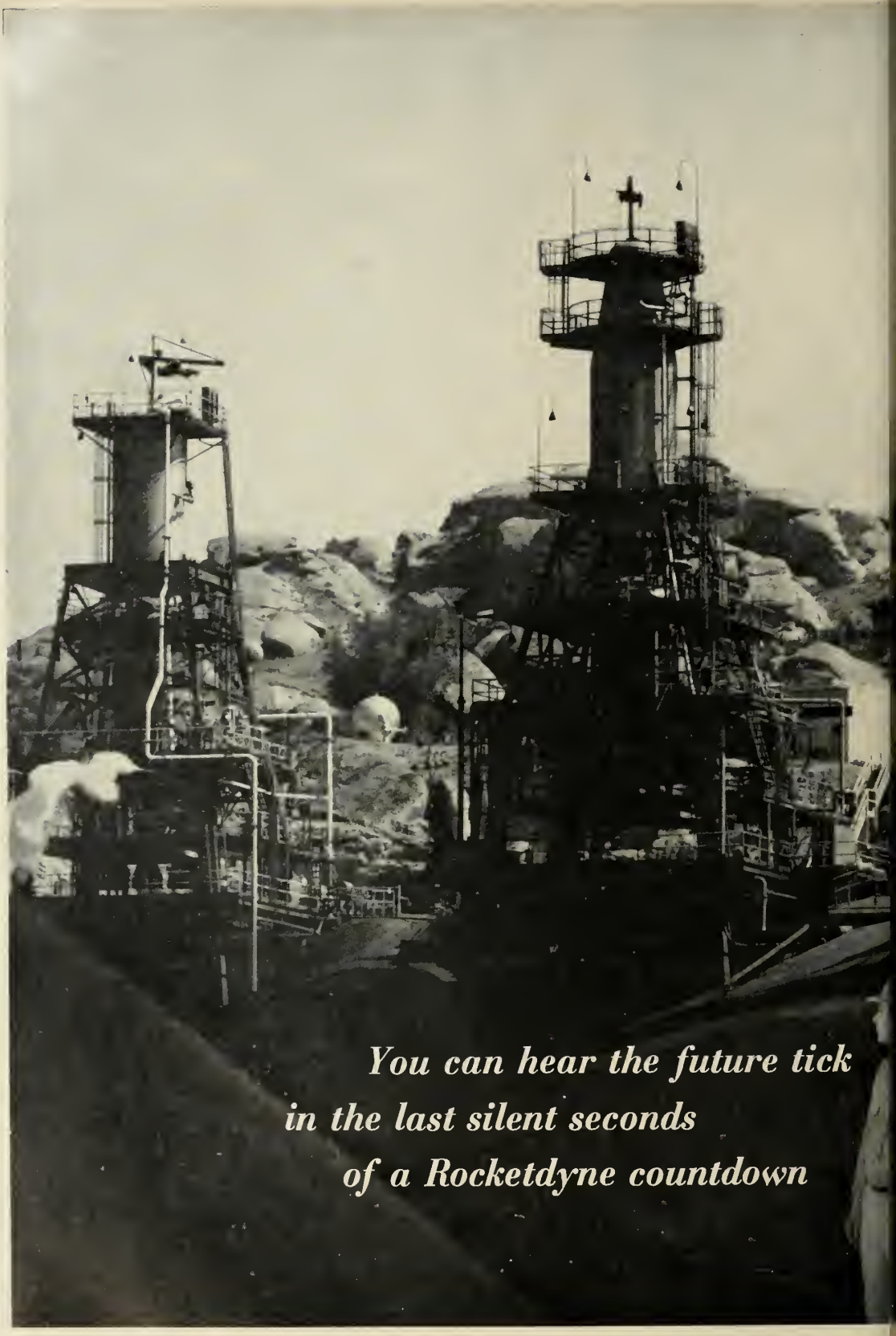
ASTRIONICS

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

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

Canoga Park, California; Neosho, Missouri; McGregor, Texas

Washington Countdown

IN THE PENTAGON

The Crow . . .
is a new Navy missile currently under development. The missile—reported to be air-to-air—has already undergone flight tests.

• • •

The *Titan* . . .
ended its latest flight test in flames and a mushroom cloud because a short-circuit accidentally tripped the big bird's destruct mechanism during the launching from Cape Canaveral. The C-model of the **Martin** ICBM included a live second stage which would have been fired for the first time.

• • •

Decision on the *Thor-Delta* . . .
controversy over where to build a pad for launching the new NASA-STL vehicles into polar trajectories is expected within the next two weeks. The question to be decided at the Pentagon: Should a new pad be constructed at the PMR's Point Arguello or should a Thor pad at neighboring Vandenberg AFB be modified? The first *Thor-Deltas* are scheduled to be available next year. (See page 17.)

• • •

More range, more accuracy . . .
is built into **Douglas'** new Super *Honest John*. The improved Army tactical missile also is shorter and more easily transported than its 16-mile range predecessor.

• • •

Less pounds, less dollars . . .
is the reason given by the Marines for choosing **Daystrom's** *Cobra* anti-tank missile for evaluation over the Army's **Nord** *SS-10* and *SS-11*. The Marines have bought 100 of the *Cobras*—a product of Daystrom's West German subsidiary, **Boelkaw**. Cost per copy: About $1000. (See page 16.)

• • •

Production stretchouts . . .
for the **Convair** *Terrier* and *Tartar* programs are expected during 1960. The two surface-to-air missiles with the **Bendix** *Talos* make up most of the main armament of the Navy's fleet of missile cruisers.

• • •

Development cycle cuts . . .
are the aim of a new Army regulation that would bring the "user" into the R&D programs from the beginning and calls for earlier production planning. The regulation—numbered 705-7—was issued earlier this month.

ON CAPITOL HILL

The main lines of attack . . .
of the sweeping hearings planned by the House Space Committee for next month are being worked out behind closed doors. The all-star cast of officials will begin appearing before the committee as soon as Congress opens up for business. The committee's goal: To pinpoint why we are lagging behind Russia in space and what can be done about it.

• • •

No firm schedule . . .
has been reached so far for equally sweeping hearings planned by the Senate. However, the Senate schedule is expected to be decided on by Christmas.

AT NASA

***Thor-Able 4* space probe . . .**
scheduled Dec. 16 was postponed by NASA apparently because of transmitter difficulty in payload. M/R on page 17 today lists the planned objectives and instrumentation of the experiment. In light of action by AFMTC Commander Maj. Gen. Donald Yates in banning the press from all military firings at Cape Canaveral (later rescinded) because a news wire service carried a story Dec. 12 of the planned firing (which, incidentally, was common knowledge in Washington for several weeks), M/R emphasizes that material for this week's article was gathered from private sources, knowledge of past programs, and in no way has this magazine violated any government news release restrictions either from the Department of Defense or the NASA.

ALONG EMBASSY ROW

France's *Matra 511* . . .
air-to-air missile is now in production for the arming of the latest French fighters. The two-stage solid missile has a range of more than four miles. *Matras* have either operated on IR or electromagnetic guidance.

• • •

West German marks . . .
are being poured out for Martin *Maces*. The German Defense Committee has approved spending $120 million for an undisclosed number of *Maces*—probably two squadrons.

Industry Countdown

MANUFACTURING

Elimination of drogue chute . . .
is being advocated by some Project *Mercury* personnel as a weight saver. They recommend using roll jets on the capsule for stabilization during re-entry and main chute deployment at 10,000 ft. However, **Radioplane** wants to retain the drogue.

• • •

New Japanese anti-tank . . .
missile TATM-2 made by **Kawasaki Aircraft** is reported to be 4.6 ft. long and weighs 300 pounds.

• • •

Over-the-counter price . . .
of air-to-air *Sidewinders* being produced by **Perkin-Elmer Bodenseewerk** near Lake Constance, Germany, is being quoted to NATO members as between $3000 and $4000 per missile, depending on the number ordered. Chief subcontractors (all under the same U.S. licensing arrangement) are **Philips-USFA N.V.,** Netherlands; **Terma, A/S Wetra, Y Hoyer Establishment,** and **Dansk Industries** of Denmark; **State Mechanical and Chemical Industries** of Turkey; **Greek Powder and Cartridge Co.,** Greece; **Kongsberg Vapenfabrikk** and **Raufoss Ammunisjonsfabrikker** of Norway.

• • •

900 lb. tungsten ingots . . .
formed from tungsten powder in high-capacity presses in sizes suitable for missile use are being produced at the **Metalwerk Plansee** in Austria. The company says they will be exported to the U.S. shortly by the **Schwarzkopf Development Corp.,** New York City.

• • •

In union contract . . .
negotiations starting in March, U.S. missile makers are expected to gear their approach pretty closely to the outcome of the steel dispute. Contracts cover 250,000 employes.

• • •

Those close to *Minuteman* . . .
program are denying reports that serious acoustic and heating problems have cropped up in silo test launchings (M/R Nov. 30, p. 11). They say all external environmental conditions have fallen within predicted range values and "no excessive deleterious effects" have been observed. The first three shots were so successful, in fact, they are making a "large reduction" in total number of previously planned silo test shots.

PROPULSION

Solid-liquid combination . . .
propels France's *Onera* four stage high altitude rocket. The 39 ft. 15-ton research vehicle has two liquid and two solid stages and has reached altitudes of 250 miles.

• • •

Leader in case competition . . .
for the first stage engine of the **Boeing** *Minuteman* appears to be **General Motors' Allison Division.** It was an Allison case that **Thiokol** tested successfully a few weeks back. **Ladish Co.** supplied the D6 steel forging and **E. W. Bliss Co.** also worked on the case.

• • •

Some private researchers . . .
are now estimating the FY 1960 demand for solid rocket fuels will be in the neighborhood of 39 million pounds. The figure is based on current budgeting for missiles. They expect the demand to rise slightly in FY '61.

ASTRIONICS

To handle the satellite . . .
command post type control center at Sunnyvale, Calif., **Radiation Inc.'s** western division is undergoing a huge expansion. Personnel is expected to reach 2500 within two years and with facilities to match. This will be larger than the parent company at Melbourne, Fla.

• • •

New space cabin simulator . . .
under development by **North American Aviation's Missile Division** in Downey, Calif., is reported capable of simulating weightlessness for days, and complete sensory deprivation for crew training. Demonstrations have been held for NASA, ARPA and ARDC.

• • •

Electronic IR scanner . . .
developed by **Philco Corp.** uses a scanning tube with a semiconductor-type window. Tests indicate the new system's sensitivity and information rate are limited only by the detector used.

WE HEAR THAT—

Nuclear division . . .
of **The Martin Co.** may expand to acquire capability in nuclear rocket engine design and manufacture. The reason: vehicle structure is inseparable from propulsion system in the management of a nuclear rocket program . . . The last class of RAF *Thor* crewmen has just wound up guidance training at the **AC Spark Plug Division of GM** . . . There's a chance the General Accounting Office may recommend a non-profit management set-up for ballistic missile programs if the Air Force shuns the job . . . NASA will replace its Cuban satellite tracking installation (closed by the political situation) with one costing $110,000 at Fort Myers, Fla.

More About the Missile Week on Page 46

Vandenberg or Arguello?

AF-Navy Space Range Fight Near

Air Force tosses Atlas pads into struggle for top space role on vast Pacific Missile Range

FIRST LAUNCHINGS—and so far the biggest—from Arguello have been *Terriers*. Soon Marines will be firing *Hawks* here.

by James Baar and William E. Howard

VANDENBERG AFB, CALIF.—Three giant Air Force *Atlas* gantries looming against the California sky are casting dark shadows across the Navy's Pacific Missile Range.

They have become the key pawns in the running Air Force-Navy struggle for the top role in the nation's R&D missile and space programs on the West Coast.

The gantries which house the nation's first operational *Atlases* stand on a plateau at Vandenberg less than 10 miles due north of PMR's key facility on Point Arguello. The two bases—Vandenberg and Arguello—lie shoulder to shoulder on the mountainous coast some 150 miles north of Los Angeles and 90 miles north of PMR headquarters at Point Mugu. Only the little Santa Ynez River separates the rival installations.

The Air Force just within the past week submitted to the Defense Department a formal proposal to convert the three operational *Atlas* pads into R&D facilities for launching military satellites into polar orbits across Point Arguello. The three pads will become available for R&D work when the Air Force completes construction of a more advanced operational *Atlas* complex here early next year.

For months there have been reports that controversy and lack of decisions on the Pacific Missile Range may have been handicapping the U.S. space effort. To get the facts of that story and others in the missile field, M/R Associate Editors Baar and Howard traveled more than 10,000 miles visiting Air Force and Navy installations to compile four special reports, of which this is the first.

Approval of the proposal could mean:

- A sharp curtailment in the build up of launching facilities at Point Arguello.
- Indefinite continuation of work-stopping missile launchings over Arguello.
- Jeopardizing future funding for large-scale expansion of the range. The Navy previously has advanced plans to spend $4 billion on PMR in the next 15 years.

The core of the interservice fight is not PMR and Vandenberg themselves, but the much bigger military issue of how to divide roles and missions in space. The Defense Department has given the Air Force the primary space mission including control of all military space boosters. However, the Defense Department has given the Navy the mission of operating PMR—potentially the world's greatest space

howdown

range—as well as assigning the Navy the *Transit* navigational satellite.

Thus the Navy considers itself still very much in the space picture. In addition to polar orbits from Arguello, PMR is designed for the launching of satellites into equatorial orbits from an as-yet-undesignated island in the far Pacific. PMR also consists of an Inland Range (extending eastward from Point Mugu to Tonopah, Nev., and Dugway, Utah) and a Sea Test Range 500 miles along the California coast and 250 miles out to sea for naval missiles. It currently is developing an anti-missile missile range for the Army's *Nike-Zeus* at Kwajalein Atoll and Johnson Island.

From its inception PMR has provided instrumentation backup and safety clearance of the Ballistic Range for Air Force *Atlas* and *Thor* shots from Vandenberg which impact from Hawaii to Wake Island. It is planning to extend this range into the Indian Ocean for *Titan* tests.

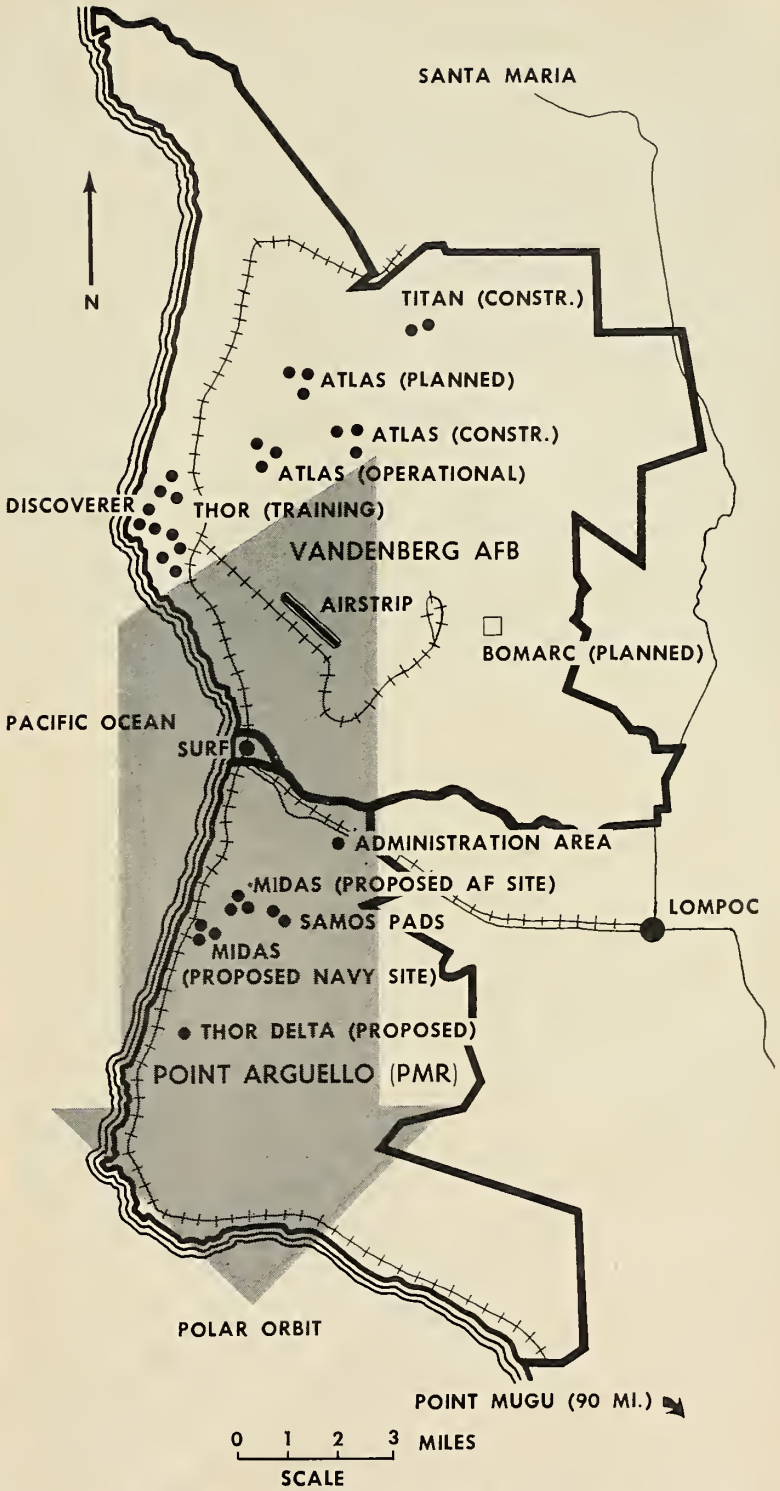
Air Force officials acknowledge the usefulness of PMR in pinpointing where warheads land through the Navy's underwater hydrophones. But they contend the Air Force needs little else provided by PMR.

Vandenberg and Arguello, at least in recent months, have lived together in relative harmony. However, behind the scenes in Washington, the fight has raged at the highest levels.

Here is the pungent way that officials on both sides are putting their cases:

Navy—"The Air Force is trying to convert an operational and training site into an R&D base overlapping PMR."

Air Force—"The Navy appears to be trying to parlay some ground sup-



SIDE BY SIDE, Vandenberg AFB and the Navy's Point Arguello jockey for R&D launching pads. All satellites fired into a polar orbit from Vandenberg pass over Arguello, resulting in evacuation and costly work stoppages. The Navy says evacuation is essential; the Air Force disagrees.

RUGGED TERRAIN of Point Arguello stretches southeastward along the Pacific from Mt. Tranquilon, site of PMR radars.

port equipment into an operational capability in space."

Navy—"We're a service organization with a mission to operate a national range for all comers. We're trying to build a capability to provide range services and facilities for everyone."

Air Force—"They are trying to set up a drive-in launching facility. They would like you to drive up with your bird to the gate at Arguello and hand it over to them. They take it, launch it, track it and then come out and give you the answer."

Navy—"We want to make PMR just like Cape Canaveral."

Air Force—"Our polar launching programs aren't like the R&D projects that we have at the Cape. We're trying to develop operational military systems, and when you develop these the user has to control everything that goes into the system."

• **Genesis**—The beginnings of the conflict can be traced back several years to decisions resulting from the nation's need for a launching facility from which satellites could be safely placed in polar orbits.

The area occupied by Cooke AFB (later renamed Vandenberg) was ideal. Cooke—an old abandoned Army training base in an advanced state of decay—had only recently been taken over by the Air Force as an operational missile base. Satellites could be launched southward into polar orbits from almost anywhere in Cooke without passing over any land areas before Antarctica.

William Holaday, the Pentagon's de-throned missile "czar," carved Point Arguello from Cooke and handed it to the Navy with an authorization to expand its west coast missile range facilities. The authorization was issued Dec. 7, 1957, and the PMR was commissioned seven months later on June 16, 1958.

The Marines celebrated the commissioning by conducting Arguello's first missile launching—a Convair *Terrier*. However, the range was then mainly inhabited by deer and mountain lions. Eighteen months later tracking and other range instrumentation is nearing completion and 50 miles of road have been built through the 20,000-acre wilderness. But almost all of the proposed launching facilities are still made more of paper than concrete and steel. Wildlife still abounds in the deep canyons.

While work proceeded at Arguello, the Air Force on its neighboring 60,000 acres was pushing ahead with construction of *Thor* and *Atlas* pads for operational use and training.

• **Who'll do what**—Even before PMR was commissioned, it became apparent that the two operations were inter-related and it was necessary to spell out who would do what. Accordingly, an agreement was worked ou and signed on March 5, 1958, by Ai Force Chief of Staff Thomas D. Whit and Navy Chief of Operations Arleig Burke for the "coordinated" operatio of PMR. The Navy was given respon sibility for:

• Establishment of a joint radi frequency coordination agency and ex ecutive responsibility for area fre quency coordination and surveillance (Frequency procurement and contro was the responsibility of individua services using the range.)

• Coordinating and scheduling o firings conducted in PMR.

• Range safety—"including actua tion of inflight destruction device when required for safety for missile launched in to the PMR except fo those launched from Cooke AFB."

• Coordination to prevent undesir able duplication of facilities and equip ment "in or for operation" on th PMR.

• Providing all the basic operatin facilities such as instrumentation, com munications, supplies and services tha could be utilized by all range users Users with specialized requirement would have to pay for them out o their own pockets.

The agreement also stated tha "control of missile flight operation will be a function of the service spon soring the flight." Control was define

as including flight preparation of missiles and launching devices, "launching and controlling the flight through impact of the missile," and operation of the range safety equipment.

The latter provision built a contradiction into the agreement, giving the user the same control over the destruct button that an earlier provision gave the Navy.

The real operational problems began to mount with the start of the ARPA-Air Force *Discoverer* program last February. ARPA directed the Air Force to launch *Discoverer* satellites into polar orbits from Vandenberg because the necessary *Thor* pads were available there. So far none have been built at Arguello.

However, by that time—at ARPA's direction—the Navy was building two pads at Arguello for the Air Force-assigned *Samos* reconnaissance satellite. These are both *Atlas*-type pads.

Each *Discoverer* trajectory has gone over Arguello. The Navy, being in charge of range safety, has insisted upon evacuating the Point—thus halting work on the *Samos* pads. The Air Force contends evacuation is unnecessary.

The Air Force says the odds against anyone being killed by a destructed vehicle are about 200,000-to-one. However, there is even a dispute over the odds. The Navy says they are 20,000-to-one or less.

According to one story making the rounds, a high Vandenberg official ribbing a Navy officer said that even in the very remote possibility that someone were killed, this would bring honor to Arguello. The man would be the first ever killed by a ballistic missile and a big monument could be erected. The official is supposed to have added if the Navy couldn't afford the headstone, he'd pay for it.

However, the Navy sees no joke, says Rear Adm. Jack P. Monroe, PMR Commander.

"This is my personal responsibility. Safety is something you can't take lightly. It's easy to say you don't have to evacuate. But it's no accident that in firing these missiles, we've never killed anyone."

Evacuation of Arguello means that all construction workmen, administrative and range personnel not connected with the shot are cleared from the Point a half hour before launch. This can mean a loss of from several hours to several days for each shot, depending on countdown delays.

During polar launches, the Navy also halts all traffic on the main line of the Union Pacific RR which passes through both Arguello and Vandenberg, and it evacuates the little railroad village of Surf and a nearby public recreation park. The population of Surf is about 50.

The evacuations have resulted in delays of all work in the area, sizeable financial losses and strained relations among area residents.

The Navy has estimated that the cost of evacuation varies from $25,000 to $50,000 a day and that the total cost to date has been about $600,000. Slippage in the construction of the *Samos* pads has had to be built into the program.

• **Minor projects**—Point Arguello —and PMR—are now at the turning point.

The more than $200 million that have been poured into PMR in the last 18 months provide only part of the base needed for the great range that was originally planned.

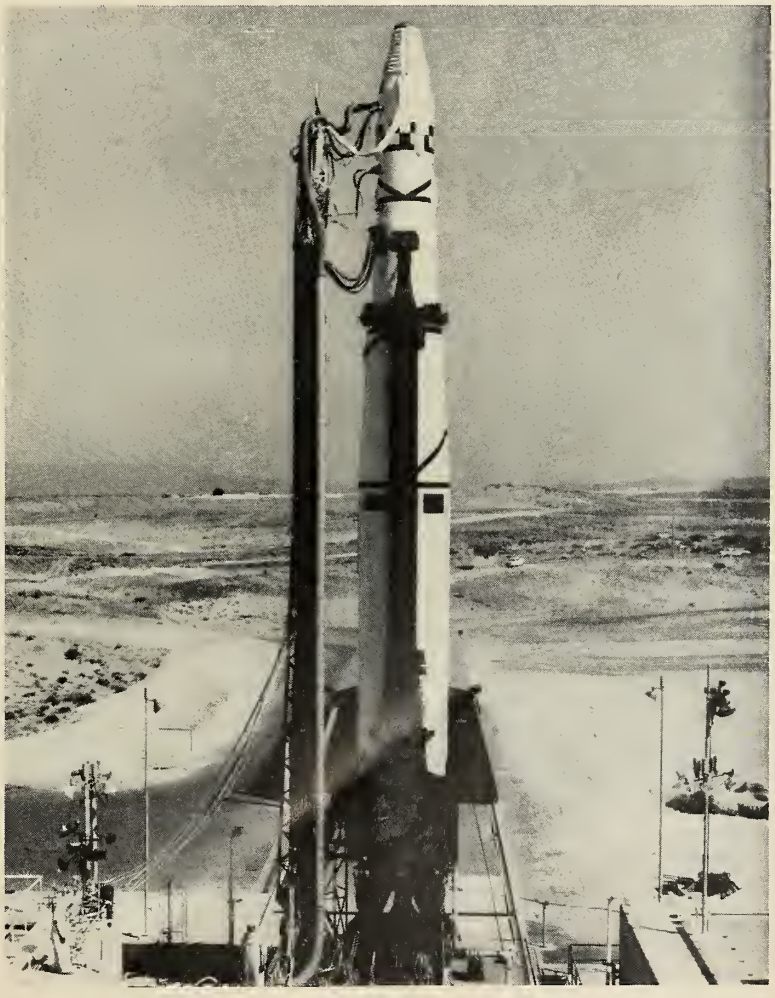
Arguello today has only one major launching complex—the still uncompleted *Atlas* pads for *Samos*. All other launching facilities are minor operations in any range officer's book.

One is for NASA's *Sunflare*. This is a *Nike-Asp* sounding rocket used to collect data on the occasional great flares of burning gas shot into space by the sun.

Another is for the Atomic Energy Commission's *Tumbleweed*. This is a *Nike-Viper* sounding rocket which will be used to collect data on radiation.

Finally the Marines have been using Arguello for training troops in the firing of *Terriers* from land-based launchers. They also plan to use Arguello for training troops to launch **Raytheon's** surface-to-air *Hawks*.

The two *Samos* pads are expected to be completed early next year. Their tall gantries already tower alone over the rugged terrain. However, work on none of the other major launching



POLAR LAUNCHING of *Discoverer* satellite over Point Arguello is readied at Vandenberg AFB. Operational *Atlas* gantries are barely visible at the right.

pads originally planned has been started.

At first, ARPA planned to order construction of six more *Atlas* pads at Arguello for development of *Midas*, the early warning satellite.

NASA also had plans to order construction of a pad for launching its new *Thor-Delta* vehicles. Studies were under way for construction of a huge pad for launching 1.5-million-pound-thrust rockets into polar orbits. And more studies were begun to determine what pads should be built to accomodate the launching of other space vehicles in the years ahead.

• **Picture changes**—None of this may ever become more than pieces of paper. Events have intervened.

First came the budget cutters of the Administration. As they have squeezed the budget noose tighter and tighter, the Navy has found it more and more difficult to sell the Administration any kind of overall range development program that would take into consideration the future needs of space exploration and advanced military space weapons.

The only kind of program that has had any chance of approval has been one backed up with pressing immediate requirements for projects already underway. And even funds requested for facilities of this kind have been hard to get.

The prime example is the *Midas* program. First the Administration cut the number of pads planned from six to three. Then, while the Air Force and Navy were still arguing over where the three pads should be placed, the Administration settled the matter by cancelling them, too. It said the two *Samos* pads would be sufficient for both *Samos* and *Midas*.

The range received its second major blow even as the *Midas* pads were being stripped away: ARPA, its principal military customer, was put out of the space business and the Air Force took over most of ARPA's space programs including *Midas*, *Samos* and *Discoverer*.

This meant that henceforth these programs would have to be financed with Air Force rather than ARPA funds. No one had to remind the Navy that history shows few examples of one service using its dollars to build up another service's facility.

The Air Force already had made very clear that it felt that Vandenberg should be maintained as an R&D base. Earlier this year, it had not only conducted the *Discoverer* program out over the PMR, it performed most range functions as well. And, as Arguello reached the point where it was ready to take over these functions, there was considerable reluctance on the Air Force's part to relinquish them.

• **New pact**—A new Air Force-Navy agreement supplementing the White-Burke agreement resulted. This one—signed this fall by Burke and Air Force Vice Chief of Staff Curtis LeMay—turned over to the Navy the key range function of safety and other duties. However, the Air Force retained tight control of the military systems that it was developing.

As for *Discoverer*, the Air Force said it had no intention of moving it to Arguello to stop the overflights. And there have been hints that the *Discoverer* program may be continued indefinitely.

The latest round has followed swiftly on the last. The Air Force opened it with a series of economy offers.

One—placed before NASA—proposes that one of Vandenberg's many *Thor* pads be converted for the launching of *Thor-Deltas*. The other—placed before the Defense Department—proposes that the three operational *Atlas* pads at Vandenberg be converted to R&D use.

The Air Force contends that it needs the extra R&D *Atlas* pads for *Midas*. And it says millions of dollars can be saved by converting the already-constructed facilities.

The Navy contends that use of the Vandenberg pads would make permanent the launchings over Arguello and the resulting costly evacuations. Therefore, it says, the proposals would cost more than they would save.

So far, no decision on either the *Thor* or *Atlas* pads has been reached. But money-strapped administrators are eyeing the proposals hungrily.

A factor that may influence the situation is the forthcoming report of missile range management by utility executive W. L. Cisler. He has been studying the nation's ranges for several months and is scheduled to submit his report to the Secretary of Defense about Jan. 1. He may make recommendations that would resolve the time-consuming conflict.

Meantime, the Navy and Air Force are continuing the behind-the-scenes struggle.

The stakes are clear.

If the Air Force's latest proposals are accepted, Vandenberg as an R&D center would dwarf Arguello. The PMR would in effect become a subsidiary of the Air Force.

REMOTE RADAR building under construction at Point Arguello. Wild deer are frequently spotted watching as workmen unload electronic equipment.

Vega Out, Hopes Pinned on *Centaur*

Delay in schedule thought to be primary reason for cancellation and reshuffling; the Air Force's Atlas-Agena will be used as interim vehicle

by C. Paul Means

WASHINGTON—The National Aeronautics and Space Administration cancelled the $65-million *Vega* space vehicle program last week and pinned its hopes for major U.S. space achievements (still two years away) on Project *Centaur*.

Apparent reasons for the shuffle were:

- The *Vega* schedule had slipped badly, and the early two-stage version of the vehicle was not expected to have been ready until the spring of 1961;
- Project *Centaur's* schedule had accelerated, and the successor to *Vega* now is expected to be ready by the summer of 1961;
- The Air Force expects to have its *Agena* adapted for use atop *Atlases* by the end of 1960; NASA can employ it for some missions while it waits for *Centaur*.
- **Money lost**—*Vega's* cancellation means that $17 million goes down the drain. This is the money spent on **General Electric's** engine, guidance systems for each stage, **Jet Propulsion Laboratory's** research, and **Convair's** preparations to adapt the *Vega* to the *Atlas*.

The rest of the $65 million, including funds for the six *Atlases* slated for *Vega*, will be spent on *Centaur* and to buy *Agena* vehicles from the Air Force.

Though the space agency buys very little time and actually loses some payload capability by switching to *Agena* as the interim vehicle, NASA administrators think that they may have bought some reliability. The *Agena* has operated very successfully on top of the *Thor* in the Air Force's *Discoverer* series, and they think it is possible this history of reliability will hold true for the souped-up version to be used with *Atlas*.

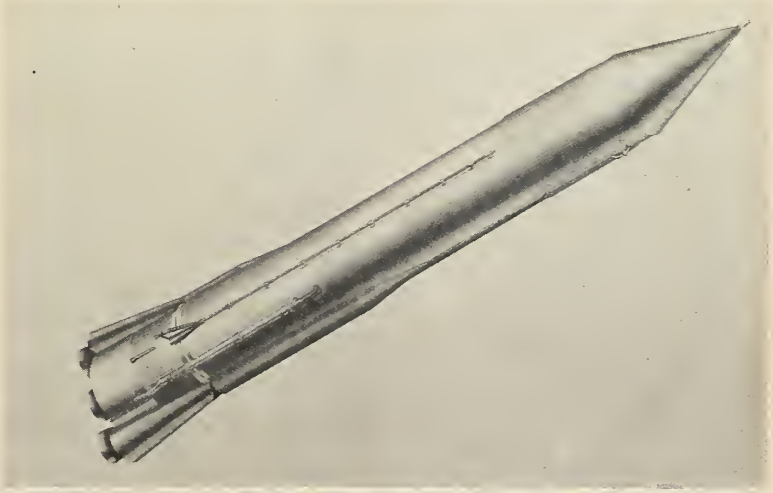
- **Time saved?**—If the *Agena* can be delivered as scheduled in late-1960, NASA may shave a few months off the two-year time period during which a lack of large vehicles—and *Atlas* boosters—threaten to bring the U.S. space effort to a standstill. (See M/R. Dec. 7. p. 30.)

The late 1960 delivery date should mean that NASA could start using the vehicle for significant missions in 1961. But it will still be late 1961 or early 1962—when *Centaur* is finally poised on its launching pad and ready to perform a full fledged space mission—that the U.S. will be able to surpass today's Soviet space accomplishments and begin to chase after the lead that the Soviets will have developed in the interim.

- *Vega's* **potential**—*Vega*, under the direction of JPL and Convair, was to have been a modified *Atlas* with a General Electric *Vanguard* engine with start and restart capability as its second stage, and a 6000-lb.-thrust, storable solid JPL 6K engine as its third stage. It was scheduled to put 5800-lb. meteorological space stations into 300-mile orbits, 740-lb. communications satellites in 22,400-mile orbits, and payloads of 1000 lbs. or more on the moon and nearby planets.

The ill-fated vehicle was to have been a forerunner and companion vehicle to *Centaur*, which has a high-energy liquid hydrogen-oxygen second stage being developed by **Pratt & Whitney**.

Centaur almost doubles *Vega's* payload capabilities and can perform more difficult missions—such as orbiting 275 pounds around the moon and then returning the payload to earth.



ARTIST'S DRAWING of ill-fated *Vega*, which had been expected to play a major role in the U.S. space effort, but has now been dropped in favor of the *Centaur*.

Centaur was catching up . . .

The main cause for *Vega's* demise is thought to be delays in its development. The two-stage version of the vehicle was expected to be ready before the end of 1960. At the time of cancellation, this schedule had slipped until sometime in the spring of 1961.

In the meantime, *Centaur* was catching up. Tests with the Pratt & Whitney two-gimballed, 15,000-lb.-thrust engines have progressed rapidly in solving the problems of high-altitude start and restart. The first *Centaur* vehicle is now expected to be ready for flight by the summer of 1961—only a few months after the target date for the two-stage *Vega*.

With space funds and *Atlas* vehicles in short supply, NASA decided to eliminate *Vega*. The nation's underfunded space effort cannot accomplish the *Lunik III* type of space mission for two years anyway, and by then *Centaur* will be able to do everything *Vega* could do—and more.

• **Alternatives**—But what of the interim period, especially 1961 when NASA had hoped it would be able to use the two-stage version of *Vega*? To keep large payloads moving into space, NASA had two alternatives:

• It could take one or more of the six *Atlases* slated for *Vega* and use them with *Able* upper stages for moon-orbit attempts;

• It could use the Air Force's larger version of the *Agena*, now under development, to conduct significant missions when it is ready.

The first of these two possibilities is remote (See M/R, Dec. 7, p. 30). Though the delivery date of the Convair *Atlases* for Project *Vega* is unknown, it is doubtful that it would have been before late 1960—when the first *Vega* engine was supposed to have been ready. And the *Atlas* delivery schedule can hardly be speeded up: lead time on an *Atlas* is 18 months—15 months under a crash program. By the time the *Vega Atlases* are available, the superior *Agena* engine should be ready to go.

The only other place that NASA could get an *Atlas* would be from the Project *Mercury* effort, or from the Air Force's missile and space programs. None of these possibilities are likely. (See M/R, Dec. 7, p. 31.)

It is therefore evident that NASA's cancellation of *Vega* left only *Agena* to do significant space work before the advent of *Centaur*.

• *Agena's* **specs**—**Lockheed's** *Agena* engine, as it is presently employed with the *Thor*, uses hydrazine and nitrogen tetroxide, and produces 15,000 lbs. of thrust. It can put a payload into a nearly circular orbit with its horizon-seeker guidance.

This capability does not compare with GE's *Vanguard* engine, which would have produced 35,000 pounds of thrust, and whose ability to start and restart in space, together with its guidance system, conceivably could have placed payloads into accurate circular orbits in the angle of inclination desired.

Though the *Agena* project is shrouded in military secrecy, informed sources state that the *Atlas*-based version of the vehicle will have increased thrust, will carry more fuel, and have a start-restart capability.

The only other available information about the *Atlas-Agena* is that it will fit into the 10-foot-diameter *Atlas* barrel the same way the *Vega* engine would have. This could mean that some of the work done to adapt *Atlas* for *Vega* will not be lost.

Present estimates are that the *Atlas-Agena* could put more than 3000 lbs. of payload into a nominal 300-mile orbit as opposed to the 5800-lb. payload capability for the same mission claimed for *Vega*. This means that NASA could use the Air Force vehicle for significant heavy-payload missions around the earth, and to the moon and beyond during 1961.

How many *Agenas* NASA intends to buy is not known. This may depend somewhat on how many of the six *Atlases* liberated by *Vega's* demise NASA will transfer to its new *Agena* account.

But if the late 1960 delivery date holds up, one specific mission NASA might use the vehicle for is a mission to Mars.

• **Mars shot**—The favorable astronomical time for such a shot is late 1960, and the *Atlas-Agena* is capable of such a mission. If it is not ready, the space agency will have to use a less adequate vehicle such as the *Thor-Delta* or *Atlas-Able* or wait many years until Mars makes its closest approach again.

Another use that the *Atlas-Agena* could be put to is an attempt to place **Space Technology Laboratories'** 375-pound payload in orbit around the moon. The earliest this shot could be scheduled would be early 1961—almost a year and a half after the *Atlas-Able*'s failure to perform this mission last month.

With the elimination of *Vega*, the NASA space vehicle lineup for the next five years is:

• *Scout*. A cheap, reliable, solid-propellant vehicle which can launch a 300-lb. payload into a 200-mile orbit. Under prime contractor **Chance Vought**, *Scout* is expected to cost $500,000 per vehicle and should be ready this summer. This vehicle will be the workhorse of low-altitude satellite orbit research.

• *Thor-Delta*. Capable of putting 65 pounds of useful payload in orbit around the moon and of rough-landing 50 pounds on the moon, *Thor-Delta* under STL management is expected to be ready next year.

• *Atlas-Agena*.

• *Centaur*.

• *Saturn*. The first space vehicle in the U.S. arsenal that will be capable of operational manned space flight. With a booster consisting of a 1½-million-pound-thrust cluster of eight **Rocketdyne** H-1 engines, *Saturn* can lift heavy manned stations into low orbits. It would allow the U.S. to put up a space communication center, a meteorological observation center, and a scientific research center. Under ABMA direction, *Saturn* can also launch large unmanned payloads into deep space and to the planets. With funding, it could be ready sometime in 1962.

• *Nova*. A cluster of 1.5-million-pound-thrust engines being developed by Rocketdyne, *Nova* could make a manned landing and return from the moon of a 2100-lb. payload, orbit Venus with a 15,000-lb. payload, or make an unmanned landing on Venus and return with a 4500-lb. payload. Estimated operational date is 1965.

Marines Taking *Cobra* For Evaluation Testing

WASHINGTON—The Marine Corps early next year will begin tactical evaluation and test firing of the *Cobra* antitank missile, which is already operational in the West German Army. **Daystrom, Inc.** has exclusive manufacturing and sales rights for the U.S. and Canada, and will produce *Cobras* at its Military Electronics Division, Archbald, Pa.

The wire-guided *Cobra* weighs only 20 pounds, warhead and all, and can be carried and set up by one man. The warhead carries 5.5 pounds of explosives—sufficient to penetrate the heaviest armored tank. Using solid fuel, it has a 1.8-mile range.

One guidance control unit can launch and control eight of the 30-inch-long *Cobras*. The four-finned, cruciform-shaped missile, four inches in diameter, has two sections—the body, which contains the receiver, and the warhead.

Probe Would Be Tracked 5 Months

NASA's planned sun orbiter, Thor-Able IV, could stay within tracking range until May, expanding communication know-how and providing new information on solar system

WASHINGTON—The *Thor-Able IV* "Paddlewheel" satellite which the National Aeronautics and Space Administration planned to place in orbit around the sun Dec. 16 would permit ground tracking stations to keep in touch with its powerful transmitter for almost five months.

The 95 lb., 26 inch diameter payload (M/R, Oct. 19, p. 33), would be tracked out to 50 million miles or better, and if the payload obtains its programmed velocity and trajectory, it would not travel that far ahead of the earth until mid-May.

As was reported first by MISSILES AND ROCKETS, the payload has been designed to study interplanetary gas and solar terrestrial relationships. (M/R, Oct. 19, p. 33.)

Studies by Van Allen in earlier earth satellites indicated that the sun emits quantities of plasma gas into the solar system, some of which is captured by the earth's magnetic field to form belts of charged particles.

• **To study gas**—These streams or fields of gas would be studied by a one-pound search coil magnetometer developed by **Space Technology Laboratories,** which possesses a sensitivity of at least 10^{-5} Gauss. (M/R, Oct. 19, p. 33.)

The satellite would also study the magnetic fields of plasma globs floating through interplanetary space from the sun and try to determine the mechanism for the propagation and transportation of the plasma streams from the sun to the earth and into the rest of the solar system.

The satellite's instrumentation would also observe meteorites and dust particles in solar space outside the earth's gravitational field. And it would collect data on the sun's ultra-violet and X-ray regions, which when correlated with the plasma and meteorite information, should give a clearer picture of terrestrial relationships.

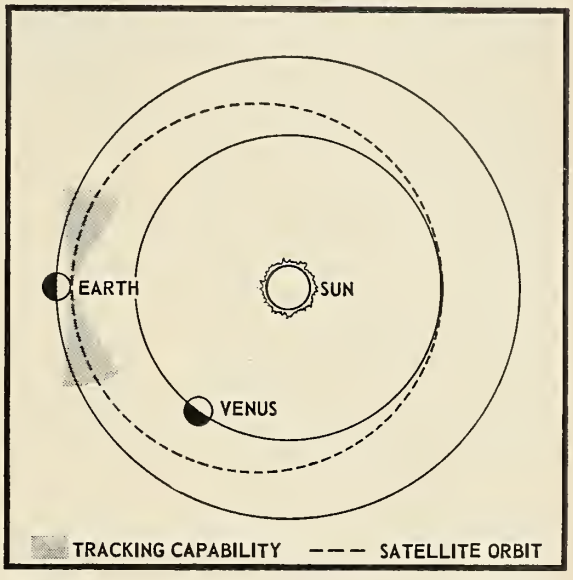
Specific instrumentation which would perform these tasks (besides the magnetometer) are a five-pound high-energy radiation counter which classifies radiation by how many tiny argon gas-filled cylinders the particle can penetrate, a micrometeorite counter, an aspect indicator which triggers electrical impulses each time it looks at the sun, a Gieger-Mueller tube which measures the total radiation flux encountered, a five watt and a 150-watt UHF transmitter, both of which operate on 378 MC.

Helping to transmit the information received by the satellite's instruments would be a compact telemetric digital unit developed by STL called "Telebit." Designed to transmit information over interplanetary distances upward of 50 million miles, this instrument collects, stores, and tallies data while the transmitter is off, and sends the totalled information by radio signal to earth when the transmitter resumes operation. (M/R, Oct. 19, p. 34.) The satellite will transmit information about five minutes every hour.

• **Astronomical unit**—A second mission would be to make a more accurate determination of the astronomical unit. Long-range communication with the satellite would allow scientists to make satisfactory triangulations with the satellite and the sun.

The solar-cell encrusted paddlewheels would be similar to *Explorer VI's* and *Atlas Able-IV's,* but apparently are smaller and carry almost half as many cells. The unit would get about the same power as *Explorer VI,* however, since it is travelling closer to the sun and it would get about one-third more solar energy.

Originally scheduled to go to Venus last June, the satellite would be the first attempt to orbit around the sun inside the earth's orbit, and may come close to Venus' orbit at perihelion. Time of orbit would be between 280 and 300 days.



TRAJECTORY OF *Thor-Able IV's* trajectory should take it to the orbit of Venus at perihelion, and back to Earth's orbit at aphelion. Orbital period should be 280-300 days and its velocity in excess of 25,000 mph.

Nest for a Bird: *Polaris* Container

BURBANK, CALIF.—Production men in Lockheed's facilities here are building the biggest and most durable bird's nests in history.

The "birds" are the Navy's *Polaris* FBM nearing operational readiness under Lockheed weapon system management. The nests: double-lined shockproof shipping containers designed for air, rail or truck transportation of the submarine-launched weapon.

Accommodating the three-story-high missile, the containers are built to precision standards yet are rugged enough to protect a shipment of eggs over a corduroy road without cracking a shell.

The pressurized containers are designed for repeated usage, protecting the entire missile from damage and temperature variation in transit or storage.

The double-sheath, double-strength containers weigh approximately 11 tons. Special product sales, which includes missile activity, will amount to about $12,000,000 in the division this year, and involves 700 employes.

Approximately $1 million in precision tooling is involved in the missile container program alone.

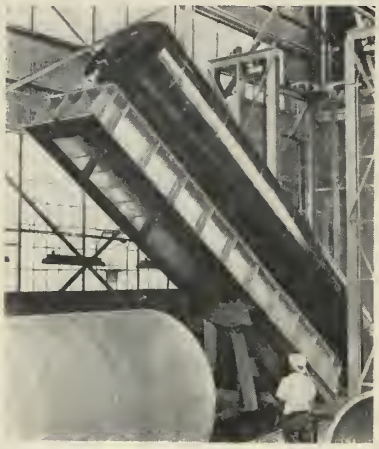
The inside portion of the missile's double container consists of a fiberglass inner liner incorporating electrical heating elements to hold uniform temperature during transit or storage, a two-inch foam plastic insulating layer, and a tough aluminum alloy skin.

Inflated air cushions between the inner and outer containers prevent jostling or vibration in transit from disturbing the missile's vital controls. The external container holds the entire missile.

The fiberglass lining, fitting over the missile body, is produced by **Zenith Plastics** on one of the largest plastic-impregnated tape wrapping machines in the United States; the pneumatic cushions are supplied by **Goodyear Tire and Rubber Co.**; and the foam plastic insulation material is produced by **American Latex Co.** under license from Lockheed.

Completely loaded, the missile is carried right to dockside or to the warehouse for "shelf storage," retaining its liner and inner container for protection until the bird is actually loaded aboard the Navy's new nuclear powered *Polaris* submarines.

The Burbank facility is constructing precision dummy missiles called "MFTV" bodies—for mechanical fit test vehicles—which are identical in size and weight to the actual *Polaris*.



DOUBLE-LINED shockproof shipping containers are designed at Lockheed for air, rail or truck transport of the FBM.

These units, built with optical tooling measured to an accuracy measured in thousandths of an inch, also are reusable. Produced for *Polaris* submarine-building shipyards to check the launching tubes of the actual submarines, the test units are speeding the *Polaris* to operational use by freeing actual missiles for test work while providing functional realism to shipbuilders.

Burbank plants also are producing *Polaris* "exit nose fairings" for the missile's escape from the earth's atmosphere in its ballistic trajectory, and launcher adapters providing a compressed air seal inside the launching tube for the missile's subsurface firing—thus doing a similar job to that of piston rings in an automobile engine for the weapon's initial launch phase.

Even With Gold, *Scout* 'Poor'

DALLAS, TEX., Dec.—Gold is helping to conquer the heat problem posed by space age rockets.

Chance Vought Aircraft, assembler of the National Aeronautics and Space Administration's *Scout* research rocket, uses more than 100 square feet of gold plating in the "poor man's" rocket skin. The rocket ultimately will cost $500,000 a copy.

The precious metal is gaining prominence in space vehicles because of its high heat reflectivity, relatively high melting point, low spectral emissivity and excellent corrosion resistance. It will resist melting up to nearly 2000°F.

The fourth stage of the *Scout* rocket has its inner skin gold coated to protect the scientific instruments from extreme heat caused by atmospheric friction. This plating is only .00001 of an inch thick and the gold costs only 60 cents a square-foot to apply.

Because the parts of the rocket requiring gold plating are so large the usual electrolytic and vapor deposition methods were not practicable and Vought went back to a process used centuries ago to apply gold coatings. A gold resinate soluable in pine oil is sprayed on the part to be coated. The part then is baked in an oven at 375°F for 15 minutes. The coating turns to pure gold in a second hour-long bake at 700 degrees.

Gold coatings also have another possible value for today's high performance aircraft, which radiate considerable infrared energy. Some antiaircraft weapons use infrared seeking devices to locate aircraft targets. For this reason, it is desirable to have the emissivity at all wave lengths as low as possible to reduce the possibilty of detection.

By preventing structural heating through use of gold coatings on the internal skin structure or shroud, the heat radiated from the engine to a plane's structure can be reduced substantially, lessening the danger of infrared detection. A sizeable reduction in costly shroud weight may also be realized by gold coating in the engine area.

In the case of the *Scout* missile, the problem was to protect the payload of instruments contained in the fourth stage from excessive skin temperatures generated by high Mach number flight into space. Vought applied a highly emissive ceramic coating externally to the rocket's skin to radiate friction heat back into the atmosphere. On the inside, the low emissive gold coating was used to reduce heat radiation to the payload.

Another use of gold in aircraft and missile manufacture is on printed electrical circuits and contacts made from copper. Gold is deposited on the copper by ionic decomposition. The .000002 inch thick gold coating on the copper is lightweight, economical and continuous. This method is used by Vought principally to extend the storage life of printed circuits and improve solderability by increasing resistance to oxidation and tarnish.

Computer Simulation of Lab Testing May Cut Costs

Expermits during component design indicate savings in time and money; CEIR's approach described

by Charles D. LaFond

WASHINGTON—Components reliability before integration into systems—the old bugaboo of the missile industry—may be solved by extensive use of high-speed electronic computers in the early R&D phase.

While it's too early to determine cost savings, experimental sampling during the design phase with computer simulation of laboratory testing offers promise of considerable economies in time and money.

A major problem in the development of a complex weapon or electronic system is the incredible amount of laboratory life-testing necessary before minimum reliability of each component is proved. While this is a problem, establishment of optimum tolerances during the much earlier design stage usually is even more troublesome.

System designers always face a basic problem in economics: What tolerances should be specified on each particular part to achieve the desired degree of system reliability?

Often, in designing a complex system, the engineer has to work backward from contractually specified total-system requirements to determine parts and subsystem performance tolerances. There's always the risk of overly tightening tolerance limits. Usually this is caused by design conservatism.

Extreme tolerances are injurious to the whole effort—components become costly and often unobtainable as standard items.

Result is over-engineering of vastly complex major weapon systems which imposes a burden on our military effort—already suffering from a tight budget.

• **Current policy**—The Air Force ballistic missile program is one good example of tackling the reliability problem. It has experienced certain success, but it has been costly. In defense of high cost is the urgency of national defense, although when started, the program lacked previous engineering experience.

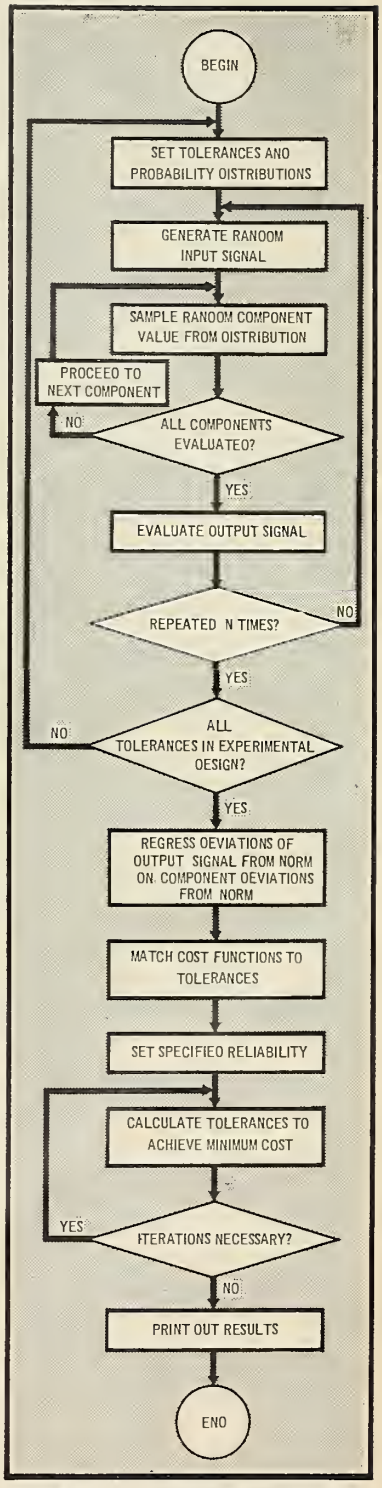
Because of program urgency, R&D time has been limited on each of the four major weapon systems: *Atlas*, *Titan*, *Minuteman*, and *Thor*. Air Force Ballistic Missile Division said lead time for R&D phases was less than half the normal time allowed for projects of similar magnitude and complexity.

In these programs, various phases of subsystem development were performed concurrently and with the spectre of previously defined reliability requirements covering each, hovering overhead. Normal developmental steps, however, were not compressed. As items met minimum acceptable reliability goals, they moved forward to the next phase of the program. Statistical data were amassed in the progression, providing meaningful information for determining initial total-system reliability.

One major premise in current military policy is that 100% reliability is not attainable and is even impractical as a design goal. For example, in a typical ICBM the design objective may be for a reliability of 0.97 for guidance, but this would be a final goal achieved long after the system had become operational. The initial operational capability would be assigned a minimum acceptable value of the order of 0.88.

But to achieve desired minimum reliabilities requires a tremendous effort in testing. Data processing machine simulation has not been employed generally as a design tool to reduce error and minimize the amount of testing required.

The technique has been used by many as an aid in modification. For



SCHEMATIC computer simulation for determination of optimum tolerances.

example, **Norair Division** of **Northrop Corp.** used an IBM 704 extensively for redesign of the *SM-62A Snark* fuel system. Result was a vastly simplified system with a correspondingly higher operational reliability.

• **Computer solution**—Each complex electronic system used in a missile or rocket is composed of many parts and subassemblies known to interact in certain ways. Engineering considerations have resolved problems dealing with the nominal response of the system components to each of the various inputs that may come into the system.

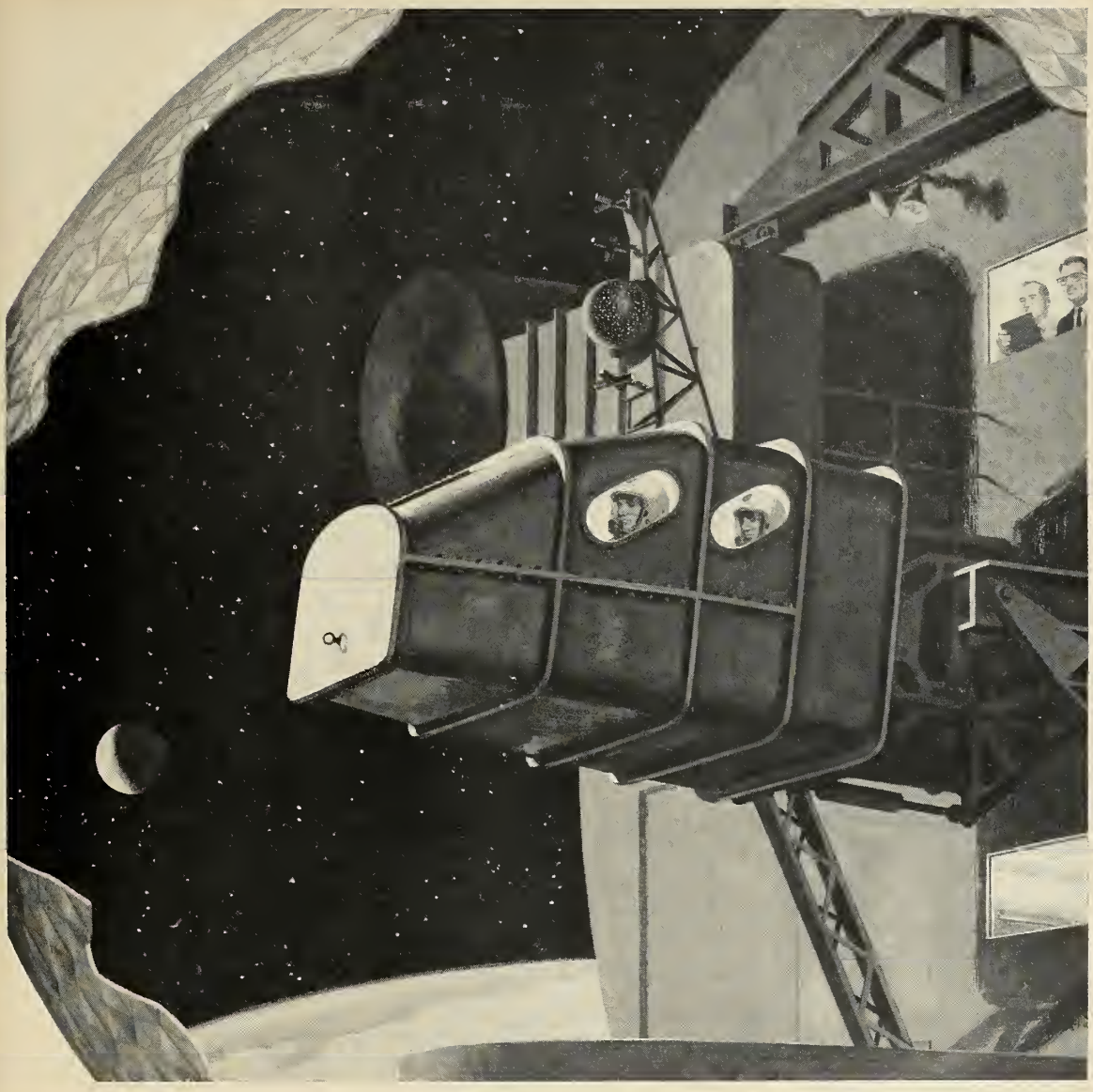
To achieve reliable operation, the input must be known and the output must be predicted within some specified degree of variation. Output may be a voltage having some nominal value, or it may be the presence or absence of an electronic pulse. If a voltage, specified bounds about the nominal value are indicative of successful operation. In the event that the output is a pulse, this pulse generally must exceed some threshold.

One organization that has used computer simulation to determine optimum tolerances is **CEIR, Inc.** (Corporation for Economic and Industrial Research of Arlington, Va. It has developed and used a technique that establishes tolerances on each of the individual components of a system to meet required total-system reliability at minimum component costs.

For efficient performance of such simulation, one condition is self-evident: The task must be a joint effort of the engineer or scientist having intimate familiarity with the system to be designed, together with a statistician, numerical analyst, and a programmer and coder. The engineer supplies system parameters; the statistician specifies what numerical results are necessary for analysis; the analyst specifies computational algorithms; the programmer and coder translate numerical procedures into machine language.

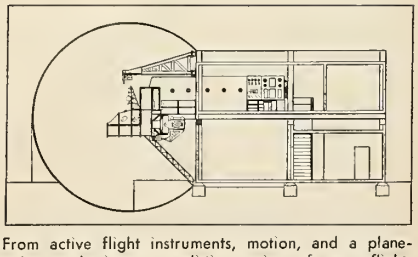
• **Data needed**—In the CEIR approach, certain basic statistical data are required, including cost-versus-tolerance curves for each of the components. These curves may be smooth continuous curves or they may be step functions, indicating that cost is constant over a range of tolerances, increasing by a discrete amount for another and smaller set of tolerances, etc.

In addition to the cost-versus-tolerance information, the theoretical structure of the system must be known precisely. That is, it must be possible to express the output as a function of an input signal and of each of the system components. This expression will take the form of some (generally) complex mathematical function. Reliability then is measured by the probability that the



A PLACE TO IRON OUT THE STRESSES OF SPACE

Seventeen different stresses will flay the minds and bodies of the first spacemen. Under the combined attack of acceleration, anxiety, heat and other stresses, how will man perform? The answer probably won't be known until the problem can be simulated, in all of its parameters. Vought Astronautics — a division of Chance Vought Aircraft, Incorporated — is preparing the way with the proposed simulator above. Inside the laboratory's mock space vehicle, a man — without leaving the ground — would know the heat, movement, noise — and many psychological effects — of an extra-terrestrial voyage. He would glimpse a pitching, yawing close-up of the solar system. He would experience, altogether, an invaluable preview of combined stresses of space flight. Vought Astronautics can produce and operate such a lab now for the development of spacecraft and the training of pilots.



From active flight instruments, motion, and a planetarium projection — a realistic preview of space flight.

AERONAUTICS | ASTRONAUTICS | ELECTRONICS | GENESYS CORP. | RANGE SYSTEMS | RESEARCH

CHANCE VOUGHT DALLAS, TEXAS

output for a given set of inputs will be within certain specified limits.

The technique advocated by CEIR simulates random values of each of the components subject to some underlying probability law which may or may not be symmetric about the nominal value. Information must have been acquired either through experience or theory or through an informed assumption about this underlying probability distribution.

It might be added that the sensitivity of the final result to assumptions about probability distributions can be tested. The corresponding random response of the system is generated on the computer.

• **Cutting cost time**—At this point the programming effort begins to simulate required random values of individual components and insert into the underlying mathematical expression to derive a distribution of output values to some nominal input. The dispersion of the probability distributions can be changed to simulate changes in tolerances.

Experimental results are analyzed by means of a regression analysis. Making use of cost-versus-tolerance information, Lagrange multipliers are employed to obtain those tolerances which yield specified reliability at minimum cost. Wherever possible, full advantage is taken of internal symmetries in the system.

In essence, the computer simulates the arrival of the input signal and derives the output signal consistent with the random variations of the components that have been derived from their assumed probability distributions. Most important is the fact that changes in tolerances, interpreted as changes in the dispersion of the probability distributions, can be examined by additional computer runs without the cost or time of laboratory models, prototypes or breadboarding.

The final results in the form of suggested parts tolerances must be examined with reference to their availability and the practicalities of the real world. A further cycle of computations with some restrictive constraints placed upon certain tolerances may be required. Further testing in order to establish the sensitivity of the results to any assumed probability distributions would also be planned at this point.

The final result is an exhaustive list of components with associated tolerances which, if achieved, would insure overall system performance reliability at minimum cost.

The approach described was limited to "performance" reliability. To obtain a truly optimum-reliability system, both operating time and environment would have to be considered. These are both primary contributors to parts failure and parts or system degradation.

If data concerning operating time and environmental effects are available, these too can be inserted into the problem.

• **CEIR's growth**—CEIR provides data processing services in addition to scientific, industrial and economic research and consulting services.

Starting in 1954 with $20,000, a handful of people (with a vaultful of brains), a contract, and an overwhelming faith in the future of electronic data processing, the organization has grown rapidly.

Now grossing above $4 million a year, CEIR is planning nationwide expansion with the establishment of new facilities in New York, Chicago, Houston, and Los Angeles, according to Dr. Herbert W. Robinson, company president. Present staff of over 200 will be increased to some 1300 in two years.

Its facilities include IBM-704 and 709 computers. Three transistorized IBM-7090 machines are on order. CEIR probably will get one of the new (due 1961) IBM Stretch computers for its Los Angeles facility.

Part of the company's success is due to the very great cost of computing machines. Unless a manufacturer or research organization can keep its equipment busy through a large part of a 24-hour day, machine costs are not justified.

To be able to buy computer service for just hours or days can be a great asset to smaller companies. Large corporations buy services to handle their overload or for special problems, thus keeping their machines free for regular workloads.

Indicative of the nature of CEIR's highly exacting business is the unusually large number of personnel holding advanced degrees. Almost all the sciences and many of the arts are represented. To keep up with its growth, the company operates continuous courses in computer programming for trainees.

Alternate Basis Sought For Electrical Standards

WASHINGTON—The National Bureau of Standards—working to improve the accuracy of electrical measurements, measuring devices, and standards—is attempting to establish an alternate, more accurate foundation for the whole structure of electrical standards.

The basis for the new approach is an accurate capacitance measuring bridge and an accompanying calculable standard of capacitance developed last year. It will provide a check on the standard ohm and volt—the basis for determination of all other electrical units.

NBS Studies Electric Arc As High-temperature Source

WASHINGTON—Electric arc techniques as sources of stable, controlled gas temperatures up to 20,000°K are under study at the National Bureau of Standards.

The recently initiated program is geared to find simple and reliable methods of producing and measuring extreme temperatures—eventually leading to establishment of high-temperature standards.

In the electric arc, gas temperatures can be calculated from spectroscopic composition measurements. A device for maintaining a controlled electric arc in an atmosphere of any composition has been constructed.

Consisting of a stack of water-cooled copper washers alternating with electrically insulated bakelite washers, the arc burns in the center cylindrical core between electrodes at each end. Windows are provided for optical viewing and spectrographic analysis of the radiation from the arc.

Current research at NBS involves comparisons between photoelectric and photographic measurement methods, between observations from the side and along the arc axis, and among the effects of optical geometry, arc length, current and similar easily varied parameters to determine their importance to the precision and accuracy of temperature measurements.

The biggest experimental difficulty is in obtaining suitable high-intensity light standards for use in measuring the absolute intensities of the arc spectroscopic lines. As the research on arcs progresses, high-temperature continuum radiation standards are being improved.

An example of this is the development of a carbon tube blackbody heated directly by a heavy current. This seems promising as a constant radiation standard up to about 3000°K. Different construction materials may permit higher temperatures.

A high-pressure, free-burning arc is currently under fabrication. It may provide a suitable standard of continuum radiation corresponding to temperatures of 10,000°K or more.

Heavy Soviet Missile Edge Reported

by G. V. E. Thompson

LONDON—Soviet missile strength heavily outweighs that of Western Europe, according to a report by the Institute for Strategic Studies.

The Russians have about 100 principal missile bases and a missile arm of about 200,000 men, the report says, while the NATO command has, in being or on the way, seven IRBM bases—four *Thor* bases in Britain, two *Jupiter* bases under construction in Italy, and one projected *Jupiter* base in Turkey—each to be equipped with 15 missiles.

The Institute for Strategic Studies is the only non-governmental center in the Western world outside the USA devoted to a continuous study of the problems of defense and disarmament in the nuclear age. It had its origin in the Brighton Conference Association, founded in 1957 'to study defense policy in the present stage of the cold war, and to relate its findings to political and moral issues which govern public opinion in the Western alliance.'

During 1958, conversations between BCA and The Ford Foundation resulted in the Foundation providing an annual grant of $50,000 for three years to enable the work of the BCA to expand and continue. As a result, BCA was replaced by the present Institute, which operates on a non-partisan basis and is intended to serve an international purpose.

The 200,000 men in the missile arm are commanded, the report says, by an Engineer-General, who controls production of rockets and guided missiles and nuclear weapons, and is in charge of testing sites and operational units. The missile bases are along the Baltic coast (mostly around Konigsberg), between Lake Ladoga and the White Sea, in the Southern Ukraine, in the Carpathians, and in the Thuringian Forest in East Germany.

The main weapons listed are the *T-3* ICBM (range over 5000 miles), the *T-2* and *T-4 IRBM's* (over 1600 and 1000 miles respectively), and the sea-to-ground missiles *Komet* and *Golem* (95 and 310 miles). *Golem* can only be fired when the submarine has surfaced; *Komet* can also be launched whilst submerged.

• *Blue Water* **missile for West Germany?**—Britain has had little success so far in exporting its missiles. Its biggest potential market is West Germany, which has shown more interest in U.S. missiles, in particular *Hawk* and *Sidewinder*. However, the Federal Government in Bonn is now reported to be considering a new British missile, *Blue Water*.

Little information has been released about *Blue Water*, but it is understood that it will have a range of up to 80 miles and a maximum speed of 2000 mph. Manufactured by **English Electric**, it will have a nuclear warhead and be highly mobile.

• **Australia orders the** *Bloodhound* —The announcement about *Blue Water* followed shortly after news of another export achievement. The Royal Australian Air Force is to be equipped with the **Bristol-Ferranti** *Bloodhound* surface-to-air missile. This has been chosen after an exhaustive appraisal of all the anti-aircraft defense systems available in the free world.

Australia becomes the third country to adopt *Bloodhound*, which has been in service with Britain's Royal Air Force and has been chosen for use in Sweden. The weapon now in production is the Mk. 1 *Bloodhound*, propelled by two **Bristol-Siddeley** Thor ramjets and four **Bristol-Aerojet** rocket boosters. An advanced Mk. 2 version is in a late stage of development.

The missile trade between Britain and Australia is not all in one direction. The United Kingdom has bought 150 *Malkara* anti-tank missiles (developed at the Australian Government Aircraft Factory near Melbourne) and 30 of these have already been sent for acceptance trials in Scotland. The 200-lb. *Malkara* was adopted by the British Army despite the availability of several other anti-tank missiles developed by U.K. firms (**Vickers, Pye**, and **Fairey**), as private ventures.

In addition, Britain for some time has been receiving deliveries of the Australian pilotless target, *Jindivik 2B*, for use in ground-to-air and air-to-air missile trials. The initial order was for 50 *Jindiviks*, but an additional order for at least another 40 is now expected.

The *Jindivik* has proved very successful: although the design life was seven missions, the mean achieved last year was 14 flights, and one *Jindivik* has already made 40 flights.

Japan Getting More *Sidewinders*

by an M/R Correspondent

TOKYO—Fourteen *Sidewinder* air-to-air missiles were delivered from the U.S. Government to the Japanese Air Self-Defense Force early last month. Shipment of 90 more is expected by early 1960.

The missiles already delivered have been assigned to the Defense Force's experimental unit in Gifu and will be attached to F-86F and F-86D jet fighters for training and test purposes. Test sites for the *Sidewinders* to be imported next year have not as yet been made public.

Assignment of *Sidewinder* to the Air Self-Defense Force appears to mean that that force has gained the upper hand in the current interservice competition between air, ground and sea forces for development of guided missiles and establishment of a missile corps.

Three weeks ago, a rocket corps was established in the Anti-Aircraft Gun School of the Japanese Ground Self-Defense Force in Shimoshizu, Chiba Prefecture, on the outskirts of Tokyo. This corps is in charge of testing the guided missiles to be test-produced by the Japanese Defense Agency's Technological Research Institute, and later will become the nucleus of the missile corps.

By the end of 1965, four *Nike* and four *Hawk* battalions are expected to be formed under the Defense Agency's second defense build-up program. The program goes into force on April 1, 1960.

The Maritime Self-Defense Force has a three-year program for building a missile destroyer of 2500 tons displacement. It will be fitted with *Tartar* launching pads.

The missile research program, currently being pushed by the Defense Agency's Technical Research Institute, has made a number of advances recently. The first air-to-air missile will be attached to jet fighters in the near future, and mass production is reportedly scheduled to begin about 1960.

Tullahoma Tunnel Testing Booms

TULLAHOMA, TENN.—As every airframe maker knows, it is cheaper in money and may save lives to test a vehicle in a wind tunnel. This is why the huge tunnels at Arnold Engineering Development Center here operate every night and are booked up for many months in advance.

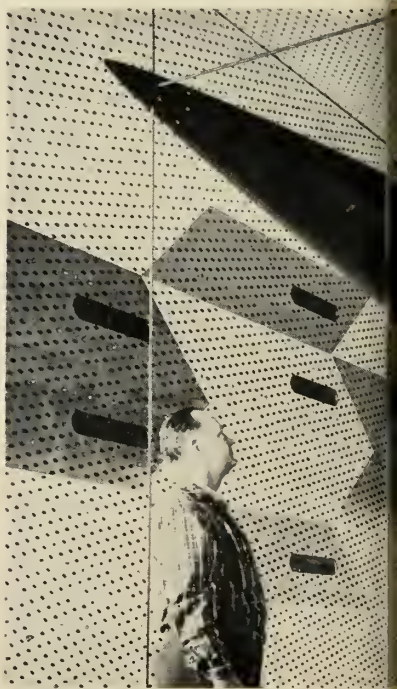
Among the programs involved in recent tests here are the Air Force *Titan* ICBM, the Army *Sergeant* battlefield missile, the Navy *Polaris* FBM, and Project *Mercury* of the National Aeronautics and Space Administration. A full-scale *Sergeant* was tested. The others were scale models.

Testing at Tullahoma is done at night because of the amount of electricity consumed—a significant part of the output of the Tennessee Valley Authority. If it were done by day the cost would be much higher.

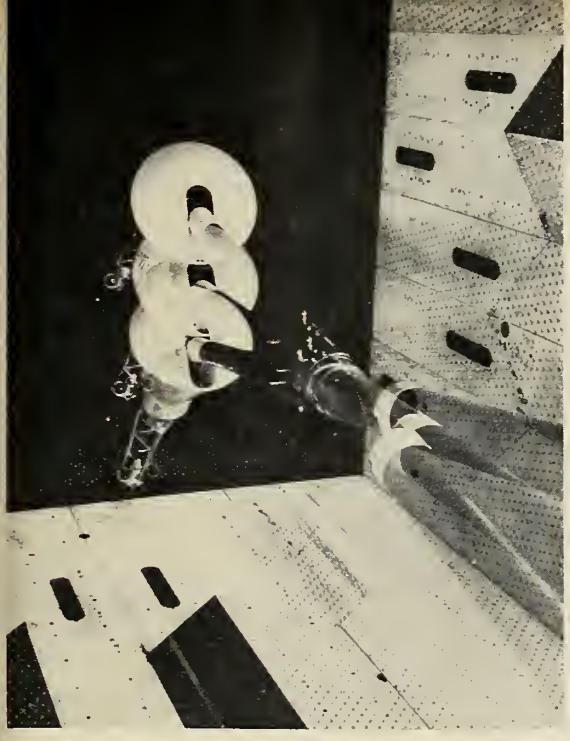
The Air Force located the center here 10 years ago on a secluded spot on an unused government reservation that had been a teeming Army infantry camp (Camp Forrest) during World War II. Isolation is necessary because the noise made by a big wind tunnel in operation is enough to shake the rafters of a house many miles away.

The problem that keeps AEDC engineers busiest nowadays is simulated altitude testing of rockets and missile components. For example, a rocket engine generating about 15,000 lbs. of thrust was tested successfully last summer at a simulated altitude exceeding 100,000 feet. This was the first time a rocket of this size had been tested under such extreme conditions. Early this month about 200 representatives of the services, industry and scientific organizations held a two-day symposium here on simulated altitude testing.

TITAN **ICBM, in 11.5%-scale model, is installed for transonic test runs in the 16-foot test section of the Propulsion Wind Tunnel at Tullahoma. Inset is a frame from a motion picture film showing the missile with its rocket operating during a test run at the 10-year-old Arnold Engineering Development Center.**



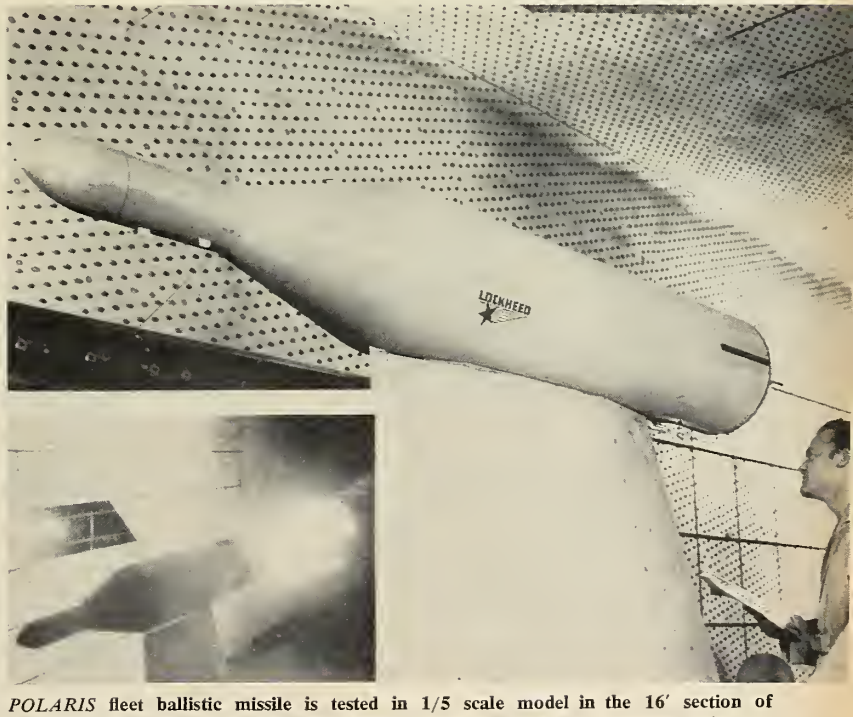
FULL-SCALE flight-type *Sergeant* missile, about 30′ long, is installed for transonic test program in the 16′ Propulsion Wind Tunnel at AEDC. Such tests illustrate



MULTIPLE-EXPOSURE photograph shows a 32% scale model of *Mercury* space capsule, with escape tower attached, on a movable support in the 16′ transonic test section of PWT. Tests were made from Mach 0.5 to 1.5.

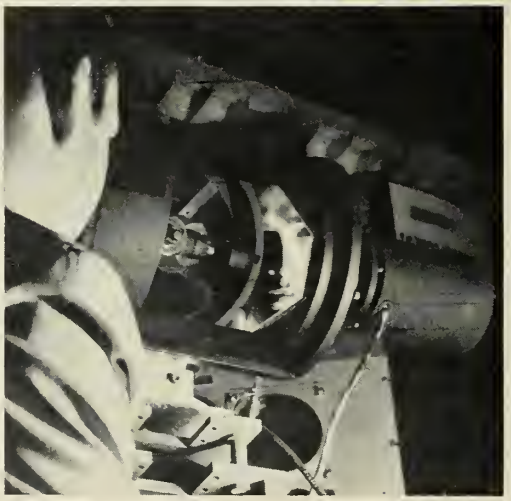
HYPERSONIC airflow is shown striking *Mercury* capsule at 50° angle of incidence. Mach 20 airflow became incandescent during test lasting 0.1 second, which determined stability and heat transfer characteristics.

value of large wind tunnel for critical aerodynamic measurements difficult to obtain by using small-scale models in smaller tunnels.



POLARIS fleet ballistic missile is tested in 1/5 scale model in the 16′ section of the PWT. Inset shows the flaming exhaust from the rockets. Although *Polaris* is solid-propelled, tests were made with both liquid and solid motors. Tests with liquid motors allowed for longer runs.

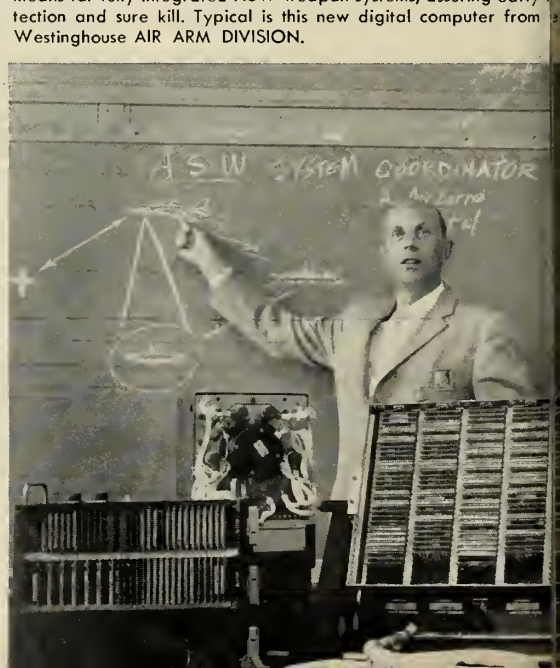
FROM THE SEA COMES A MAJOR THREAT...



A BROAD WESTINGHOUSE

IMAGINATION: Westinghouse develapments in sconning syste cells and special circuitry make possible detection of submarines i tactical environment.

Developments in computer techniques and companents pravide means far fully integrated ASW weapan systems, assuring early tection and sure kill. Typical is this new digital computer from Westinghouse AIR ARM DIVISION.

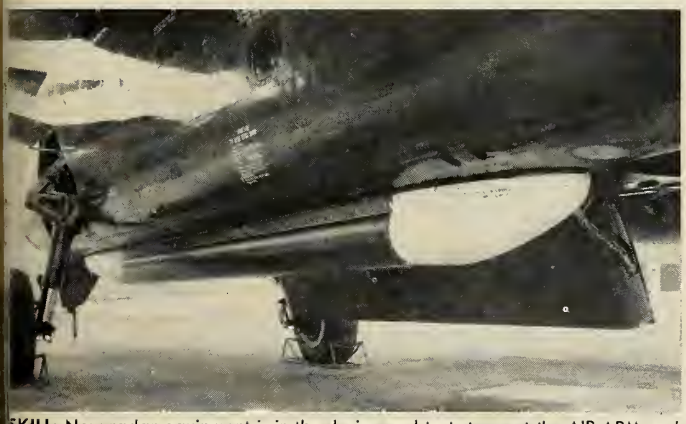


The environment of the sea favors the submarine. This makes antisubmarine warfare—from detection to kill—one of the most formidable tasks faced by the U. S. Navy. Missile-firing nuclear subs further complicate this acute defense problem. ASW calls for all the imagination, skill and resourcefulness that industry, in its assisting role, can bring to bear.

Westinghouse is engaged in a program to help our forces deal with this increasingly urgent challenge. The corporation's facilities—from research laboratories to manufacturing divisions—are working to help solve this threat.

FLEXOLON wire by Tensolite Insulated Wire Company, Inc., is used in many systems developed at the Westinghouse Air Arm Division.

ASW PROGRAM IS HELPING TO MEET THIS MENACE



SKILL: New radar equipment is in the design and test stage at the AIR ARM and ELECTRONICS DIVISIONS. These Westinghouse radar developments will add effectiveness to ASW search and detection operations in a manner and to a degree never before achieved.

The precision-guided ASTOR torpedo system, provides a powerful weapon in effectively attacking enemy submarines. The ASTOR was designed and built for the Navy by the Westinghouse ORDNANCE DEPARTMENT.

RESOURCEFULNESS: From Westinghouse RESEARCH LABORATORIES comes special knowledge needed for the ASW program. An example is fundamental work aimed at understanding underwater sound "scatterers."

Westinghouse

DEFENSE PRODUCTS

1000 CONNECTICUT AVENUE, N.W., WASHINGTON 6, D.C.

AIR ARM DIVISION
AVIATION GAS TURBINE DIVISION
ELECTRONICS DIVISION
AIRCRAFT EQUIPMENT DEPARTMENT
ORDNANCE DEPARTMENT
WASP

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

Circle No. 4 on Subscriber Service Card.

Curtiss-Wright Makes Expendable Drone

by **Frank G. McGuire**

SANTA BARBARA, CALIF.—A low-cost, expendable target drone for use with air- and ground-launched missiles has been developed by the Santa Barbara Division of **Curtiss-Wright Corp.** The Air Force has awarded the company a $470,000 production contract for the bird, designated *SkyDart* TDU-12/B.

The rocket-powered drone now is being used primarily with *Sidewinder* missiles, and employs that weapon's launch rail and umbilical connector. The *SkyDart* features simplicity, high performance and low cost—since it can be manufactured for less than $2000, it is rated by the company as expendable.

The 80-inch-long target, 6.4 inches in diameter, is built around a single-chamber, dual-thrust rocket motor originally developed for the now-defunct *Dart* antitank missile. This motor forms the main structural portion of the target, and produces 620 pounds boost thrust for two seconds, then 75 pounds sustainer thrust for 44 seconds. Grain consists of ammonium nitrate bound by a synthetic rubber compound, and is divided into a large burning surface boost phase, and radial burning surface sustainer phase. Motors have been supplied by **Grand Central Rocket Company** and **Hercules Powder Company.**

• **Specs exceeded**—The Curtiss-Wright specifications were for a target that could be launched between 40,000 and 60,000 feet at speeds between Mach 0.8 and 2.0, with a useful endurance of 90 seconds while maintaining an altitude of ±5000 feet from launch altitude, and a maximum azimuth angle deviation from launch of ±5°. Tests of the bird showed many improvements on these specifications, including an actual endurance of 110 seconds, with maximum course deviation of less than 1° during a 30-mile trip downrange.

A canard-type vehicle, the target has two small adjustable control surfaces between nose and center section, preset for desired trajectory in the pitch plane. Main lifting surfaces are mounted in cruciform arrangement around the tail cone.

The *SkyDart* is roll-stabilized, maintaining level flight through two flippers comprising the outer panels of the vertical fins. These oscillate at a given frequency and achieve roll control through dwell-time modulation.

The autopilot translates signals received from the position roll gyro into corrective control surface action through electronic differentiation.

Manufactured by the Santa Barbara division, the autopilot consists of a printed circuit design with plug-in modules. Power is supplied by a 28V battery with a useful life over three minutes. The gyro is spring-wound and actuated by a pyrotechnic cartridge. Its useful life is also over three minutes, and it has a maximum drift rate of one degree per minute.

The forward section of the target is connected to the head cap of the rocket motor, and consists of a cylindrical payload compartment 18 inches long, to accommodate radar augmentation gear, telemetry equipment or self-destruct devices. Installation of a transponder would make the *SkyDart* useful with missiles other than *Sidewinder.*

Curtiss-Wright is adapting the *SkyDart* for ground launching to act as a target for missiles like *Hawk, Nike, Talos* and *Terrier.* A super-*SkyDart* target drone also has been proposed.

DUAL-THRUST rocket motor powers C-W's expendable *SkyDart* TDU-12/B drone. Supersonic vehicle costs about $2000 per copy.

Simplified Military Rockets

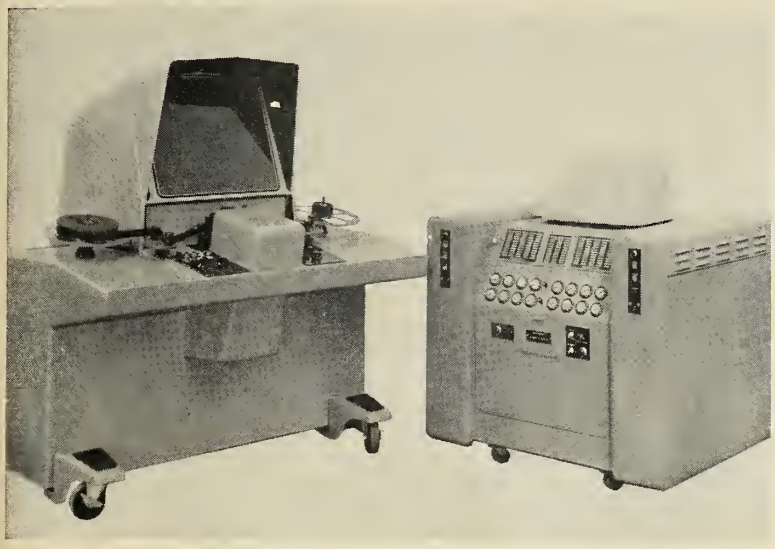
LONDON—Lieut.-Col. L. V. Stewart Blacker is advocating simplification of military rockets; he considers that for many targets artificial guidance is not needed. Absence of guidance would greatly reduce the man-hours required for design, development, production and testing of the missile, and would also lead to an improvement in reliability.

Blacker claims that the rocket he has designed will fly truly and in a manner free from errors due to irregular burning, etc. His invention is covered by British Patent Specification 773,190.

The principal feature of the invention is that the nozzle is not situated at the extreme tail, as in the conventional (and classical) rocket. Other drives have been tried, of course. Goddard experimented with nozzles near the nose without much benefit, and more recently Hickman was able to reduce dispersion considerably by building rockets with several nozzles, with thrust axes coinciding at the centre of gravity.

However, the "turning point" about which the missile tends to turn when the thrusts are out of balance does not coincide with the centre of gravity. The turning point is a function of both the centre of gravity and the centre of pressure. If all the axes of the nozzles are arranged to meet the turning point, any irregularity in burning or nozzle fabrication will be automatically compensated.

In practice, the thrust axes would be arranged to converge slightly behind the turning point, to take account of tolerances. They must not meet in front of the point. The angle of convergence need not be large, but depends on individual design requirements. The multiple nozzles are well in front of the tail stabilizer, which is not rotated.



Film Reader Automatically Digitizes

A semi-automatic film reader with an automatic, high-speed electronic digitizing unit which measures distances along two axes on 16mm to 70mm sprocketted film, has been produced by **Data Instruments,** a division of the **Telecomputing Corp.**

The Dilog 510 displays a magnified image of the film being measured. The digitizer is an indicating and recording accumulator which counts and stores measurement pulses generated by the reader. These counts are displayed visually, or may be read out on electric typewriter, punched cards, perforated tape or x-y plotter.

The reader has a counting rate of 20,000 counts per second with a maximum storage of 100,000 counts along each axis. Card punching speed is 50 cards per minute, and it will also type up to 600 characters per minute, or will provide 20 columns per second of punched tape with optional output equipment. The optical system provides the operator with a resolution of up to 60 lines per millimeter.

The film reader has a power requirement of only 8 amperes at 110 volts ac. The reading unit is 52″ high by 53.5″ wide and 36″ in depth. The separate digitizing unit is 32″ high by 38″ wide and 33″ in depth. All controls are located to insure minimum fatigue and maximum convenience for a seated operator.

Circle No. 225 on Subscriber Service Card.

Digital Unit Compares Command/Feedback Signal

United Aircraft Corp's Norden division announces an electronic device which performs continuous digital comparison of command and feedback signals and produces an accurate analog drive signal.

Two models of the Comparatron are available—one accepting up to two 24-bit parallel binary numbers, and the other up to two 24-bit parallel binary-coded decimal digits. Input data may be presented from a storage register, handset switches, or shaft encoder. By a process of digital comparison, an error-modulated ac output is produced for direct use as the positioning signal.

The company reports an inherent accuracy of within ±½ the least significant digit or bit, high-speed comparison, proportional error signal up to a predetermined saturation level, and compatibility with standard resolvers and servos.

Either model may be purchased with or without integral power supply. The output signal is a 60-1000 cycle (dependent on power supply) error modulated ac voltage with an amplitude of 23 mv peak-to-peak per unit error for the pure binary model and 15 mv peak-to-peak per unit error for the binary-coded-decimal model. Saturation level is at 100 units for the binary-coded-decimal model and 64 units for the pure binary model while saturation amplitude is 1.5v ac peak-to-peak at approximately 5K impedance. Required dc voltages are available from Norden Model 24A power supply. AC input required is 115 ± 10v 60-1000 cycles.

Construction of Comparatron is modular, each digit handled by a separate transistorized circuit board. The size of either model with or without integral power supply is 6 1/6″ high x 22 9/16″ wide x 18″ deep.

Circle No. 226 on Subscriber Service Card.

Molybdenum Stampings Used for Transistor Base Tabs

Gold-clad molybdenum stampings are now available to the semiconductor industry from **Accurate Specialties Co.,** for use as base tabs for silicon transistors and diodes.

Molybdenum has been found a suitable base tab material for silicon semiconductors since it matches the thermal expansion rate of silicon closely, exhibits good high-temperature properties, and has excellent thermal conductivity. Gold is used to permit easy soldering and because it can withstand subsequent etching operations in the semiconductor manufacturing process.

Accurate Specialties Co., Inc. has combined both of these materials in a single composite stamping consisting of a thin overlay of gold metallurgically bonded to a thicker base of molybdenum. This permits easier assembly in the device and allows a smaller

package. Since oxidizable surfaces are reduced, semiconductor manufacturers can expect greater yield using this composite stamping.

The gold-clad moly stampings are available in diameters from .030″ O.D. to .250″ O.D.; in thicknesses down to .002″, and with tolerances held as close as plus-or-minus .0001″ on thickness. Delivery runs two to four weeks from receipt of order in lots of a million or more.

Gold-clad moly stamping also have

other possible uses in the chemical and missile industries where the user would like to use molybdenum at elevated temperatures in oxidizing atmosphere. The protective coat of gold on the moly part would permit its use in this application.

Circle No. 227 on Subscriber Service Card.

Actuator Made to Prevent Premature Air Launching

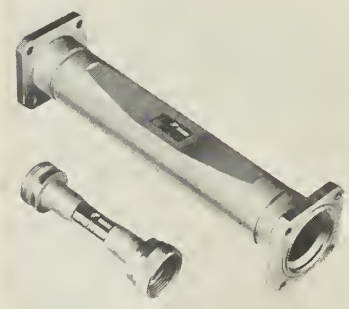
An actuator developed by Bendix-Pacific division of **Bendix Aviation Corporation** prevents the premature launching of a missile from its airplane cradle.

The mechanism, called a Geneva-Loc linear actuator, weighs 1¼ lbs. Electrically powered and mechanically positioned, the actuators are said to eliminate the need for clutches, brakes and limit switch adjustments through a pin-and-slot design, reducing maintenance and boosting efficiency.

Circle No. 228 on Subscriber Service Card.

Waveguide Unit Transforms Linear Waves to Circular

The **DeMornay-Bonardi Corp.** is producing a line of cylindrical waveguide components which transform linearly polarized waves to circularly polarized waves. Units are used with the corresponding size of rectangular waveguide. Cylindrical components cover the same frequency ranges, and exhibit the same broadband characteristics as equivalent D-B components.



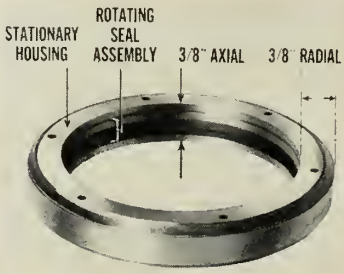
Three items are available. The first is a rectangular-to-cylindrical transition used to launch a TE_{11} mode of great purity in a cylindrical waveguide. The second is a circular polarization phase shifter used to transform a linearly polarized TE_{11} mode in a cylindrical waveguide to either left- or right-hand circular polarization. The third is a conical horn which radiates or receives either a linear or circularly polarized wave for antenna testing. By using the phase shifter in groups of four, a means is provided for continuously changing phase through as many full cycles as desired.

Sizes cover 5.85 to 90 kmc/sec. Among new applications for these cylindrical components are uses in plasma diagnostics. The different behavior of circularly polarized radiation is employed to derive information on the interaction of plasma with a magnet field.

Circle No. 229 on Subscriber Service Card.

Shaft Seal Withstands 30 psi Differential

A self-contained mechanical seal suitable for temperatures to 450°F that



resists pressure differentials in one or both directions to 30 psi at shaft speeds to 15,000 s.f.m. is announced by **The Universal Grinding Corp.**

The compact seal design requires only about ¼ the axial space usually needed for seals of this type. The units frequently will fit existing lip-seal cavities without alteration, so that they are suitable for replacement where more efficient sealing is required. Available for shaft sizes from ½" to 8" diameter, UGC Seals are said to retain water, gases, and any type of lubricant with viscosity ranging from kerosene to heavy greases.

The enclosed seal assembly revolves with the shaft with a two-point static shaft contact so that shaft scoring or wear is not possible, the manufacturer states. This arrangement is said to eliminate need for costly superfinished shafts, and at the same time compensates for normal end play and whip. The completely self-contained UGC Seal is designed for press fit in the housing cavity. Need for customer-furnished seal rings, outboard washers or special retainers is eliminated.

The unit incorporates a rigid enclosure for the revolving assembly. A spring-loaded split grip ring transfers rotation from the shaft to the seal assembly. Primary seal is accomplished in the contact between a specially ground face on the carrier and the polished side plate. To achieve high sealing efficiency, the mating surfaces are lapped flat to within two light bands.

Heat transfer is achieved with pressure relief vents in the side plate on the wet side. Action of the revolving seal assembly causes the lubricant drawn into the seal to be recirculated under centrifugal pressure back out through the pressure-relief vents.

Circle No. 230 on Subscriber Service Card.

Cathode Ray Tube Has 3000-line Definition Range

A lightweight cathode ray tube capable of high resolution under standard circuit conditions has been made available to manufacturers of military and industrial equipment by Sylvania Electronic Tubes, a division of **Sylvania Electric Products Inc.**

The five-inch tube, designed for high-resolution photographic recording, has a definition range of 3000 lines with a spot size of .0013 inches at currents of five micro-amps.

The tube's electron-optical system and fine-grain screen achieve extremely fine trace width with conventional focus and deflection units and a simple beam centering magnet.

Designated type SC-2782, the new Sylvania tube has a flat, clear non-browning optical glass faceplate for optimum photographic quality. An integral encapsulated high-voltage connector is employed to minimize corona at high altitude. The tube is aluminized and uses a non-ion trap construction with magnetic deflection and focus.

Circle No. 231 on Subscriber Service Card.

Line of Low-speed Digital Test Equipment Available

A line of coordinated low-speed Digital Test Equipment "building blocks" has been announced by **Digital Equipment Corp.**

The "3000 Series" fits many low-speed digital applications where price and utility are important and is suitable for educational use, both in classroom demonstrations and in laboratory experiments, and for process control research and development involving digital techniques.

Units in the 3000 Series operate at

speeds up to 500 kilocycles, and are compatible with the company's high-speed units, since both employ the same logical techniques. Prices on the low-speed units average about half the cost of the comparable high-speed units.

All logical interconnections are made with banana-jack patch cords on the front panels, and standard power connections are made through the plug-in back panels. Consequently the units can be readily assembled and reassembled for a variety of test and logical design applications.

Circle No. 232 on Subscriber Service Card.

Electric Hoist Scale Made for Support Vehicles

An electric hoist scale for use on lift trucks, warehouse tractors, and other materials-handling vehicles has just been announced by **Gilmore Industries, Inc.**

The M116 is composed of (1) two strain gage load cells, (2) an amplifying box which steps up the electrical impulse coming from the load cells, and (3) a digital type indicator (similar to that on a gasoline pump). Power

from the scale comes from the vehicle's regular 6 volt dc battery.

According to the manufacturer, since the M116 is both portable and mobile, the operator can move the scale to the material to be weighed, whether it is cotton, pulpwood, metal, or any other bulk or angular material. The manufacturer also says the instrumentation is sealed against dust, moisture, and temperature variations—and is rugged enough to stand movement over rough terrain. The weight indicator can be placed wherever it is most convenient for the operator.

The M116 can be supplied in capacities ranging from 1000 to 100,000 lbs. Accuracy of a 1000 lb. model is ± 1 lb.

Circle No. 233 on Subscriber Service Card.

Smallest Package Claimed For Six Lumped Delay Lines

Six lumped constant delay lines with delays of 0.1, 0.14, 0.2, 0.3, 0.5 and 0.7 microseconds are available from **Valor Instruments, Inc.** Each delay line has a 3 to 1 delay to rise time ratio and is molded in a 0.4" x 1" hermetically sealed brass tube with a fused tin

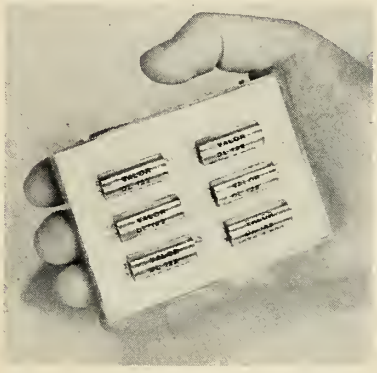


plate finish. The company claims that the package is the smallest in which lumped constant delay lines are available.

Subminiature powdered iron toroidal inductors and temperature-compensating ceramic disc capacitors are used in the construction of these phase- and frequency-compensated delay lines. The delay lines are designed for transistor and printed circuit applications.

Circle No. 234 on Subscriber Service Card.

New Acoustic-Noise Test System Developed

Associated Testing Laboratories, Inc. has developed a new acoustic-noise test facility to duplicate the high-intensity sounds found in the proximity of high-thrust jet and missile engines.

This equipment will be used to evaluate the ability of missile and aircraft components and systems to operate and function properly in simulated flight conditions. It will produce sound pressure levels up to 150 decibels' overall intensity within eight controllable octave bands covering a frequency range of 37.5 to 9600 cycles per second.

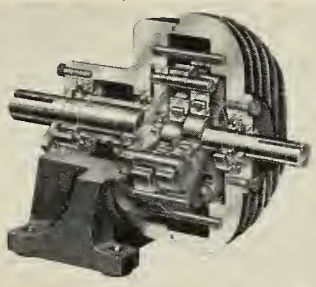
Designated Model AN-RV-15, the test facility includes a 15-cubic-foot chamber which accomodates test specimens up to 44" long. Larger chambers are now being built.

Circle No. 235 on Subscriber Service Card.

Cycloid-type Reduction Drive Is Introduced

A reduction drive based upon the cycloid principle of speed reduction is now being manufactured and distributed by **Black Tool, Inc.**

Because of the cycloid design, these



HI-RANGE drives are 40% to 60% smaller than other types of reducers with comparable ratings. They provide a wide range of torque which ranges from about 30 in.-lb. torque per pound of reducer weight to over 80 in.-lb. torque per pound.

The new drives provide a particularly wide selection of ratios. They run virtually without noise in an oil-sealed cast iron housing, with a number of teeth carrying the load at all times so that there is a minimum of wear.

Black Tool says these units lend themselves to special applications and to integral design, especially where weight or space—or both—are important and where high torque is required. Sizes vary from small units for instruments to drives for large machine tools.

Circle No. 236 on Subscriber Service Card.

Small, Seamless Bellows Operate at 5000 psi+

A new line of miniaturized, seamless, high-pressure bellows has been

introduced by the **Mechtronics Corporation.**

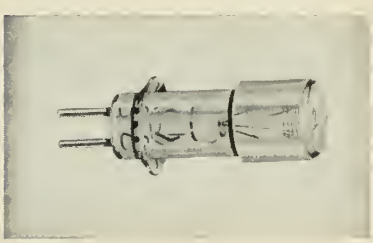
The bellows operate at pressures of 5000 psi or greater. Fifteen convolutions are precisely spaced over a one-half-inch active length and employ 100% of the functional wall area during operation. Deflection range is 45% in compression and up to 100% in extension. Effective area is 0.015 square inches on a 3/16" diameter.

Each bellows is gold-plated to provide maximum protection from extreme environmental conditions. The noble metal plating also provides an excellent surface for assembly by soldering or by epoxy-cementing techniques. Existing applications include high-pressure switches, valves and cryogenic systems for aircraft, missiles and space vehicles.

Circle No. 237 on Subscriber Service Card.

Clip-mounted Indicator Made for Instrument Use

Transistor Electronics Corp. has announced the production of a clip-mounted light indicator featuring single



unit construction and press-on clip mounting.

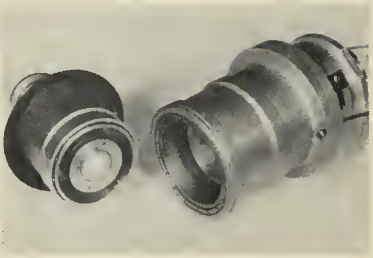
The CML mounts in a .294" hole and the circular clip permits mounting on ½" centers.

Available with a choice of neon or incandescent lamps, and with or without hot-stamped legends, the CML-series is intended for use in instruments and small equipment as well as on computers and data processors.

Circle No. 238 on Subscriber Service Card.

Quick Disconnect Couplings For Engine Start Systems

On Mark Couplings, Inc., has announced the availability of a two-inch Quick Disconnect Coupling for missile engine start systems. The coupling features pressure-balanced valving that will allow connection and disconnection under full 300° psi line pressure with zero spillage and air inclusion.



A high degree of reliability is achieved by rugged construction and simplicity in design of both the airborne and socket half. Full 360° gripping action is used for positive locking by means of a series of jaws that grip the mating half in the nature of a collet.

Circle No. 239 on Subscriber Service Card.

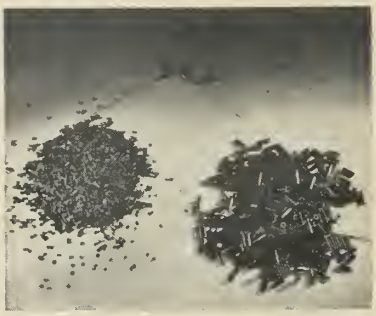
Anti-light Black Glass Has Semiconductor Uses

A black glass that is impervious to light has been developed by **Corning Glass Works** for enclosure of silicon semiconductor devices.

The glass is being offered in the form of beads and cases for sealing to standard .017 Dumet lead wires. The glass filters out virtually all wavelengths of the ultraviolet, visible and near-infrared spectrum to which silicon semiconductor crystals are sensitive.

The black glass eliminates the need to paint the devices in mass production and solves the costly problem of surface rub-off or scratching.

The company said the glass, designated Code 9361, has physical properties equivalent to the standard clear glass now used by diode manufacturers.



The new glass has resistivity similar to the bulb glass used in standard radio tubes.

Code 9361 glass has thermal coefficient of expansion of 92 x 10^{-7}/°C. Softening point is about 675°C; annealing point approximately 495°C, and strain point about 455°C.

The beads and cases are precision-made to tight tolerances. Bead O.D. is .053 (±.002) and I.D. is .023 (±.002). Case O.D. is .095 (±.002) and I.D. is .060 (±.002).

Circle No. 240 on Subscriber Service Card.

New Unit Provides Portable Refrigeration

Remote supplies can be packaged and transported at low temperatures to −120°F by a new line of refrigeration equipment produced by **Tenney Engineering, Inc.**

The Kold-Pak is a one-piece, packaged, mechanical refrigeration assembly that provides low temperature mediums to any enclosure through heat exchangers connected to the required flow lines. The exchanges are either of the direct expansion type, with freon refrigerants passing through a user's heat exchanger, or the brine chiller type with a liquid acting as a secondary cooling agent.

At −40°F brine temperature or −60°F evaporator temperature, the K standard models have a capacity from 3240 to 34,000 BTU/hr; at −100°F brine temperature or −120°F evaporator temperature, capacity ranges from 660 to 7000 BTU/hr.

Caster mounted for mobility, this source of low temperature makes it possible to refrigerate an independently built work space or to augment the capacity of other refrigeration equipment. The equipment is used as a source for rapid temperature changes in testing and in production for adaption to low-temperature baths, cold traps (vacuum equipment), quenching baths and metal treatment.

In atomic energy areas, refrigeration can be provided in a "hot" zone without endangering personnel. Expendable liquid cooling agents can be disposed of as they become contaminated.

Circle No. 241 on Subscriber Service Card.

Viscous-coupled Dampers Available in Two Models

A viscous-coupled damper designed for use in applications requiring high velocity and high torque constants has been produced by **Feedback Contracts Inc.**

The manufacturer claims that the low-cost damper replaces higher priced tachometers, networks, and other servo-stabilizers and that its performance is not affected by line frequency shift.

The compact unit consists of a flywheel, free to rotate inside a low-inertia shell rigidly fastened to the

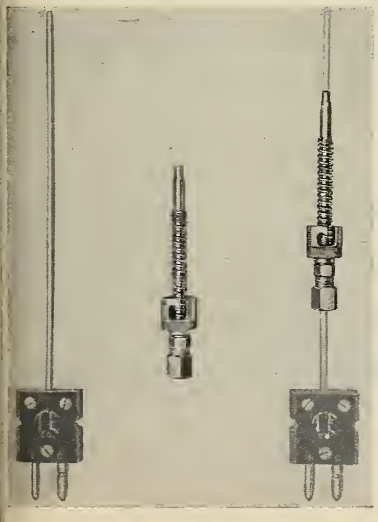
servomotor shaft. The damping action is produced by a special, viscous fluid between the flywheel and shell.

The viscous-coupled inertia damper is available in two models with a diameter of 1.52 or 1.79", and with 10 time constants ranging from 0.02 to 1.20 seconds. Damping action is factory-set for the life of the unit.

Circle No. 242 on Subscriber Service Card.

Adapter Adjusts Immersion Length of Thermocouples

Thermo Electric Co., Inc. has developed a thermocouple adapter which converts a 1/8" or 1/16" "Ceramo" (or other metal-sheathed tubular type thermocouple) to a spring-loaded thermocouple with an adjustable immersion length. This adapter solves problems caused by measuring temperatures at varying immersion depths



in a system where a fixed immersion thermocouple would be impractical.

The adapter allows the user to adjust the thermocouple to any desired immersion length from a 1" minimum. It is constructed of a stainless steel sheath and cap, Inconel X or Stainless Steel spring, a nickel-plated brass compression fitting and a brass or nylon ferrule. The brass ferrule provides a permanent immersion setting while the nylon ferrule allows for adjustment of the immersion length.

The spring-loaded thermocouple compensates for expansion, contraction, and vibration by keeping the measuring junction of the thermocouple in intimate contact with the surface being measured. It can be used for measuring temperatures in engine or pump cylinder heads, turbine housing, pipes, electric motors, generators, transformers, plastic extruders, and other situations requiring an imbedded, spring-loaded thermocouple.

Circle No. 243 on Subscriber Service Card.

Titanium-base Alloy Strengthened by Heat

An alpha-beta type titanium-base alloy that can be strengthened by heat treatment is reported by **Crucible Steel Co.** The alloy, entitled Crucible O-135-AMo contains 7% aluminum and 4% molybdenum.

After heat treatment, a 1" maximum section has ultimate strength of 170,000 psi, 0.2% offset yield strength of 160,000 psi, 8% elongation and 20% reduction of area. In section sizes btween 1" and 2", ultimate is 160,000, 0.2% yield is 150,000. From 2" to 4", ultimate is 150,000 and 0.2% yield is 140,000.

Other properties: 0.162 lb./cu. in. density; 16.2 x 10^6 psi modulus of elasticity at 80°F; 3.70 BTU/hr/ft.^{2}/ft./°F at 68°F thermal conductivity.

Circle No. 244 on Subscriber Service Card.

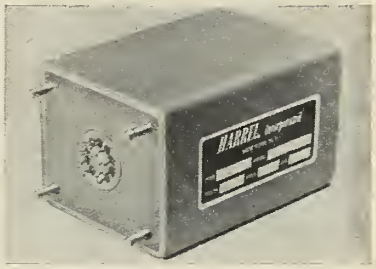
New Gyro Wheel Supply Has Improved Regulation

A gyro wheel supply of improved regulation is announced by **Harrel, Inc.** Designated the WS213, the new unit is designed to drive three phase gyros from a single phase line.

Instead of the purely passive elements of a conventional phase splitter, the new unit contains a transistorized amplifier which provides a low impedance output and maintains good line-to-line voltage regulation.

The improved regulation can mean significant improvements in the drift stability of a high-precision gyro. Gyro motors differ greatly in impedance, even among units of the same lot of the same manufacturer, depending upon lubrication, wear, bearing preload, and many other factors. A low-impedance wheel supply maintains thermal symmetry in the gyro and reduces drift and uncertainty torques to a minimum.

The WS213 is completely transistorized for maximum reliability and draws all of its power from the ac



line. One, two, or three gyros can be excited from the same wheel supply unit. The supply is furnished in a hermetically sealed enclosure and meets applicable MIL specifications for vibration and shock.

Circle No. 245 on Subscriber Service Card.

New Literature

POTENTIOMETER. A certified test report for engineers with trimming potentiometer applications is now available from the Helipot Division of **Beckman Instruments, Inc.** The report's 16 pages statistically describe the series 50 Helitrim trimming potentiometer, a ceramic/metal unit produced in quantity by Helipot. Fifty-one of these small cermet pots were subjected to various tests, and the results reported in detail. A complete summary of the pot's environmental capabilities is included, as well as a listing of test procedures and equipment used.

Circle No. 200 on Subscriber Service Card.

MAGNETIC CLUTCHES. PIC Design Corporation, a subsidiary of **Benrus Watch Co., Inc.,** is offering an 18-page, 8½" x 11" technical booklet entitled, "Magnetic Clutches and Their Applications." The booklet has complete details on design and applications, technical and testing specifications.

Circle No. 201 on Subscriber Service Card.

CONNECTORS. A 16-page condensed catalog featuring standard lines of electronic connectors manufactured by H. H. Buggie Division, **Burndy Corporation,** is now available. The catalog includes basic engineering application data on electronic connector types including printed circuit, MS, rack and panel, triaxial, glass seal, BT type (miniature) plugs and receptacles and cable assemblies. In addition, one page features special type connectors that have been engineered and manufactured for specific applications.

Circle No. 202 on Subscriber Service Card.

The U.S. Navy POLARIS, developed by Lockheed:

From ocean depths to any targe

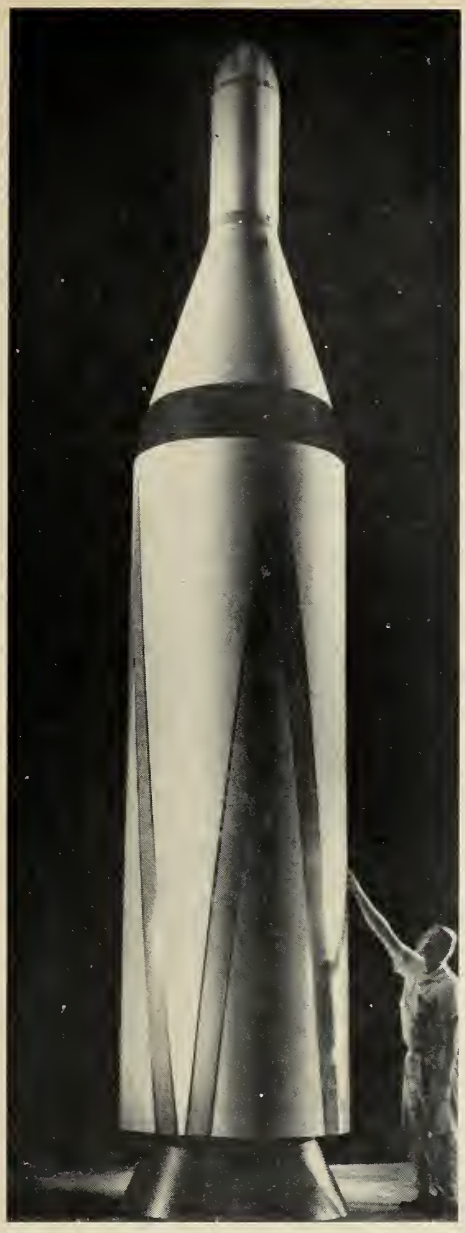
Navy's hidden nuclear submarine (1) launches a solid-propellant POLARIS missile, which erupts from the depths (2), rockets its way i space (3). Plunging earthward minutes later, the warhead of the POLARIS re-enters earth's atmosphere (4) and destroys its target (

America can breathe easier next year when the Lockheed-developed POLARIS missile goes to sea aboard the Navy's nuclear-powered submarines—far ahead of original schedule. For every significant military target will be within its ultimate range of 1500 nautical miles.

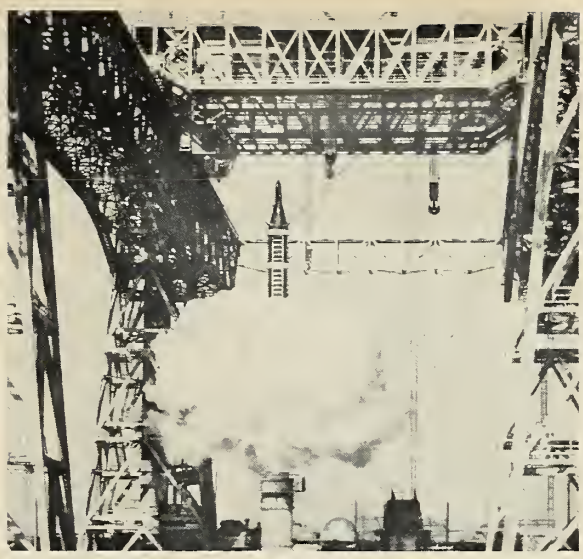
To be an effective deterrent to aggression, a weapon system must be safe from surprise, ready to strike back after any attack. The Navy's POLARIS submarines will be immune to detection as they prowl submerged for weeks at a time. And they'll move the bulls-eye of enemy attack from our soil to the trackless depths of the sea.

Lockheed's Missiles and Space Division is POLAI Missile System manager and prime contractor — leader an industrial team that includes Aerojet-General, Gene Electric, Westinghouse, and hundreds of other contract and suppliers, large and small. Close cooperation has brou the POLARIS from blueprint to hardware in record time.

This new combination of nuclear submarine and POLA missile will round out the nation's arsenal and give us t flexibility we need for adequate defense.



POLARIS is much smaller than other U.S. ballistic missiles of the same range, thanks to new miniaturization techniques developed by Lockheed scientists. This permits each nuclear submarine to carry 16 missiles.



"Operation Sky-Catch" is apt name for this huge overhead assembly. It catches POLARIS test vehicles in mid-air after test launchings. This prevents damage to components and gives more accurate instrument readings, thus saving time and speeding development. Tests are conducted jointly by U. S. Navy, Westinghouse, and Lockheed.

4,000-acre test base in the Santa Cruz Mountains of California is where Lockheed's Missiles and Space Division puts completed POLARIS missiles through simulated flights that prove the propulsion and guidance systems before actual flights of development missiles.

LOCKHEED

JET TRANSPORTS • JET FIGHTERS • JET TRAINERS • COMMERCIAL & MILITARY PROP-JET TRANSPORTS • ROCKETRY
BALLISTIC MISSILE RESEARCH & DEVELOPMENT • WEAPON SYSTEM MANAGEMENT • ANTI-SUBMARINE PATROL AIRCRAFT
NUCLEAR-POWERED FLIGHT • ADVANCED ELECTRONICS • AIRBORNE EARLY-WARNING AIRCRAFT • AIRPORT MANAGEMENT
NUCLEAR REACTOR DESIGN & DEVELOPMENT • GROUND SUPPORT EQUIPMENT • WORLD-WIDE AIRCRAFT MAINTENANCE

FIRST INTO OUTER SPACE, Theodore J. Gordon and Julian Scheer. St. Martin's Press, 197 pp. $3.95.

The book is a first person account of events leading up to the firing of missile 130, the first vehicle to penetrate outer space. Gordon, 29, is a Douglas engineer, test conductor of three Air Force probes described in the book.

RECOVERABLE BOOSTERS-THE NEXT BIG STEP IN SATELLITE AND SPACE SYSTEMS, R. P. Buschmann, Lockheed Aircraft Corp., Palo Alto, California. Order ARS-1012-59 from American Rocket Society, 500 5th Ave., New York 18, N.Y.

As a result of this study, a recommendation can be made for the practical application of recovery concepts. In the immediate future, the first stage of existing vehicles can be recovered by means of parachutes or a combination of parachute and retrorocket (pararockets).

Recovery of existing vehicles with high burn-out velocities is impractical. By 1963, the first and upper stages should be recoverable if steps are taken now to incorporate recovery features. In 1965, consideration can be given to the recovery of all stages, including stages in near-earth orbits.

A concept of a 1965 vehicle is shown. This is a three-stage booster of the *Nova* class whose first stage has wings. Turbojet engines will probably be used to return this booster. The second stage is a winged glider which is air-snatched and towed back to base. The third stage is parachute recovered by the air-snatch method.

DEVELOPMENT OF THE CAPSULE PRESSURE VESSEL FOR PROJECT MERCURY, Fred Sanders, McDonnell Aircraft Corporation, St. Louis, Missouri. Order ARS 987-59 from American Rocket Society, 500 5th Ave., New York 18, N.Y.

The need for early development and high reliability has led to use of materials previously developed for the Project *Mercury* capsule. In order to meet the severe environmental requirements and to keep the weight to a minimum, the full spectrum of these available materials is utilized and carefully integrated into the capsule pressure vessel.

The development of the capsule is traced from its overall purpose as related to the mission, through detail environmental requirements, materials and construction, to manufacturing processes and problems. A brief review of manufacturing processes and problems is then given. The environment association with each phase of the mission is outlined, which briefly illustrates the structural design criteria used.

TARGET FOR TOMORROW, Dr. I. M. Levitt: Fleet Publishing Corp., N.Y. $4.95

An easy-to-read description of some of the problems and objectives of space travel. Dr. Levitt, director of Fels Planetarium and a longtime author of books and newspaper columns on space, is that extreme rarity—a scientist who can discuss an exceedingly technical subject in accurate but simple terms.

The author briefly and explicitly describes the basic principles of our earth and planetary systems, travel to and life on other planets, and the practical problems relating to this new dimension. Although some may appear at first glance somewhat "blue-sky," Dr. Levitt's prognostications are based on solid scientific fact and scientist and layman alike will be impressed with the logic of his extensions.

ELECTROMAGNETIC RADIATION FROM CYLINDRICAL STRUCTURES, James R. Wait, Permagon Press, N.Y., Library of Congress Card 59-8284.

Presents a comprehensive review of the basic work in the field and theoretical treatment of slot antennas on cylindrical surfaces. Particularly of interest to missile structure and communications system designers due to the necessity of flush antennas in high-speed missiles.

ENCYCLOPEDIC DICTIONARY OF ELECTRONICS AND NUCLEAR ENGINEERING, Dr. Robert I. Sarbacher, Prentice-Hall, Englewood Cliffs, N.J., $35.00. Library of Congress Card 59-11990.

This massive reference work—the first complete compilation of information on these two specialties published in a single volume—is the result of 12 years' work. The 14,000 entries and 1400 illustrations cover all the modern terms and definitions relating to electronics and nuclear engineering.

MODERN ELECTRONIC COMPONENTS, G. W. A. Dummer, Philosophical Library, N.Y., $15.00.

A comprehensive survey of the characteristics of common electronic components, together with data on their operation in extreme environments. Includes component specifications, transistor-circuit components, reliability, and future developments.

THE CONTACT MODULATOR, Airpax Electronics Inc. Engineering staff. Cambridge Division, Cambridge, Md.

A six-pamphlet series on choppers has been compiled. The various parts are entitled, "Why Use Choppers?", "Definitions and Measurements," "Modulation Methods," "Applications and Performance," "Noise in Chopper Circuits" and "Chopper Amplifier Design."

Part 1 discusses why choppers are necessary and the types employed in the various applications. A glossary of chopper terms and mounting dimensions is included. In Part 2, detailed definitions and measurement of chopper parameters are provided and the test equipment used in measurement is discussed.

Part 3 is devoted to modulation methods and practical modulator circuits. Input circuits, phase relationship and the ambient changes are discussed in part 4.

The final two sections deal with noise sources, reduction of noise and comparative measurements, details of chopper amplifier design and frequency response in chopper amplifiers circuitry.

FOUNDATION OF AERODYNAMICS, A. M. Duethe and J. D. Schetzer, University of Michigan. John Wiley and Sons, Inc. 435 pp.

Presented are the foundations of aerodynamics. An effort has been made to treat the successive steps in the consideration of problems in viscous compressible fluids, to explain the concepts involved, and to show the extent to which the various approximation methods are valid.

Partial contents include; Kinematics of a Fluid Field, Introduction to Compressible Fluids, Some Applications of One-Dimensional Compressible Flow, and Turbulent Flow in Tubes and Boundary Layers.

MODERN NETWORK ANALYSIS, Fazlollah M. Reza and Samuel Seely, McGraw-Hill Electrical and Electronic Engineering Series. 368 pp. $10.

Written as an intermediate level text, the book gives its subject a modern treatment expressed in terms of the complex variable *s*.

Considerable attention is devoted to the response of networks to singularity functions, as well as to the more usual excitation functions.

The book concludes with a thorough discussion of general network properties —the positive real character of the driving-point network function, network stability, natural modes, and the specific properties of networks containing elements of only two types.

DAYTIME DETECTION OF CELESTIAL BODIES USING THE INTENSIFIER IMAGE ORTHICON. R. K. H. Gebel, WADC. Order PB 151866 from OTS, U.S. Department of Commerce Washington 25, D.C. 45 pp. $1.25.

The daytime photographic techniques described may make it possible to probe farther into the universe than was previously considered possible.

An image orthicon, with and without intensifier stages, was combined with the Air Force's "Cat Eye" light amplifier installation. Daytime photographs of astronomical objects, including a full-face photograph of the moon, were produced in better detail than possible with conventional photography.

The report discusses the fundamental limit of sensitivity set by quantum statistics, the limiting star brightness detectable by the intensifier image orthicon, and the results of using this type of camera tube for daytime astronomical photography.

NAVY RELIABILITY DESIGN HANDBOOK and supplements. Order PB 121839, handbook and PB 1211839-S1 to 121839-S6, supplements from OTS, U.S. Dept of Commerce, Washington 25, D.C. Handbook $3, supplements $2.25 a year for subscription, or $.75 per copy.

The handbook is intended as a source of information on ways of achieving greater simplicity, economy, and reliability in electronics equipment for the Navy.

It presents new information on materials, processes, and techniques as well as design aids.

MAGNETISM AND ELECTROMAGNETISM, Edited by A. Schure. John F. Rider Publisher, Inc. New York. 78 pp. $1.80.

The book, volume 20 in the Electronic Technology Series, deals with those aspects of magnetism and electromagnetism which underlie the operation of communication and industrial electronic devices.

The intent is to give attention to the major theoretical considerations of magnetism, magnetic circuits, and electromagnetism at the intermediate level. The mathematical techniques used are simple but extensive enough to develop in the interested reader the mastery of typical computations.

APPLICATION NOTES FOR MILITARY RECEIVING TUBES, ARINC Research Corp. 1700 "K" St. Nw. Washington 6, D.C. 222 pp. $2.50.

This is a supplement to Military Handbook No. 211, Techniques for Application of Electron Tubes in Military Equipment, published by the Government Printing Office.

The handbook covers all data pertaining to the receiving tube types designated for use in military electronic equipment.

The supplement goes beyond the handbook in dealing with various application problems which are commonly encountered in complex equipments.

Part I discusses the design of circuits. Part II provides application data similar to that provided in the handbook.

SUBTERRANEAN LOGISTICS FOR ROCKET AND GUIDED MISSILE BASES, translated from Fusees et Recherche Aeronautique (France). Order 59-14110 from Photoduplication Service, Publication Board Project, Library of Congress, Washington 25, D.C. Microfilm, $2.70; Photocopy, $4.80.

The use of subterranean facilities is highly economical, in contrast to brick or cement buildings which are subject to more or less expansion and wear, in above-ground installations.

When dug several hundred meters into solid rock, a subterranean installation offers complete protection from Atomic weapons and will last for centuries.

COSMIC TELEVISION, Druzhkin, Translated from Sovetskiy Flot (USSR). Order 59-16340 from Photoduplication Service, Publication Board Project, Library of Congress, Washington 25, D.C. Microfilm, $1.80; Photocopy, $1.80.

Answers are summarized which were given L. A. Druzhkin to questions put to him by a correspondent of Sovetskiy Flot. Questions include:

1. Is it possible to use the satellites for TV purposes and if yes what advantages may be expected from that method? 2. How do you intend to realize transmissions from the satellites? 3. How long would the TV equipment of the satellite be able to operate normally?

THE CHARACTERISTICS OF HYDROGEN AND WATER AS WORKING GASES FOR REACTOR-HEATED ROCKET MOTORS, Irene Sanger-Bredt. Translation of Astronautica Acta (Austria). Order 59-21108 from Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. 51 pp. $1.50.

Hydrogen and water vapor have been investigated as to their applicability as working fluids with an energy higher by several orders of magnitude than has hitherto been available with steam boilers.

Enthalpyentropy diagrams are computed for either gas, with complete regard to dissociation, as well as ionization, over the pressure range between 10+1 to 10—5 atm, and within the temperature range between 500 and 10,000°K.

Three methods of heating the working fluid are investigated: fission reactor, arc, and fusion reactors.

DICTIONARY OF ATOMIC TERMINOLOGY, Lore Lettenmeyer, Philosophical Library Inc. 15 E. 40th St. New York, N.Y. 298 pp. $6.

The dictionary provides German, French and Italian translations of scientific terms employed in connection with atomic and nuclear physics, reactor engineering, radiation physics and associated fields.

DYNAMIC ANALYSIS OF A SIMPLE REENTRY MANEUVER FOR A LIFTING SATELLITE, Frederick C. Grant. Order NASA TN D-47, from NASA, Technical Information Div. Code BID, Washington 25, D.C. 35 pp. $1.

Calculated angles, times, distances, and accelerations associated with a simple one-skip maneuver to a glide trajectory are presented.

The principal parameters considered are entry angle up to 6° and lift-drag ratio from ½ to 5. For the range of parameters considered, the limitations on the maneuver are indicated.

Newest Japanese Rocket Tested at Akita

K-420 IS LARGEST solid motor in Kappa project, studied at the University of Tokyo. Its diameter is 420 mm, length is six meters. Thrust is 10 tons, and duration is 15 sec.

THE ROCKET was tested on September 30, at Akita rocket test range. The K-420 will be used for *Kappa Type 7*, and for the booster of *Kappa Type 8*.

Paul H. Astrello, *Sidewinder* manufacturing manager for General Electric's Light Military Electronics Dept., has been named senior technical consultant to the U.S. Liaison Office, North Atlantic Treaty Organization *Sidewinder* program. Working under contract with the Navy, Astrello will advise NATO nations on techniques for manufacturing the air-to-air missile.


ASTRELLO

Astrello, who joined GE in 1942, has been in charge of manufacturing for the LMED *Sidewinder* guidance and control project since 1956. **Vincent A. Melfi,** formerly superintendent of *Sidewinder* Quality Control, will replace Astrello in this capacity, and **Robert H. Gripp** will replace Melfi.

Vincent Alessi has been appointed general manager of Dallons Semiconductors, a division of Dallons Laboratories, Inc.


ALESSI

Alessi's broad background and experience in the semiconductor field includes such key production executive positions as manufacturing manager at Texas Instruments, International Rectifier and the Hughes Semiconductor Division. In addition, he had engineering responsibility at Raytheon in the development of sub-miniature vacuum tubes and germanium point contact diodes.

Wesley L. Hjornevik has been named deputy director of business administration for the National Aeronautics and Space Administration.

Hjornevik has served as assistant to NASA Administrator T. Keith Glennan since the agency was formed. Prior to that he was assistant to the Under Secretary of the Department of Health, Education and Welfare.

Beal P. Moore has joined Stavid Engineering, Inc. as engineering consultant assigned to the Airborne Electronics Department. He was formerly senior engineer and consultant to the advanced design staff at Aerojet General Corp. Moore attended the University of Texas and completed advanced courses in engineering and nuclear physics at Rutgers University and Stevens Institute of Technology.


MOORE

Edward L. Montgomery has been appointed executive assistant to the vice president and general manager of Aeronutronic, a division of Ford Motor Co. In his new assignment, he will be responsible for investigating programs to supplement the division's current product interests and new product areas to increase diversification and capability.


MONTGOMERY

Montgomery joined Ford Motor Co. in 1950.

Arthur H. Attebery has been named chief of engineering services at Ryan Electronics, reporting to **C. H. Gottwald,** chief engineer.


ATTEBERY

Attebery comes to Ryan from Convair, where he spent six years doing "value," electronic parts and reliability engineering. Value engineering is a relatively new field, in which equipment is analyzed part-by-part for possible cost reduction on the basis of function. Earlier, Attebery spent seven years at Naval Electronics Laboratory and four years at the Air Force's Wright Field.

Sperry Semiconductor has appointed **Carl Tishler** applications engineer responsible for evaluation and application of advanced semiconductor products for this division of Sperry Rand Corp. Tishler has had several years' experience in semiconductor applications with the Remington Rand Division, where he worked on transistorizing computing equipment, including high-speed printers. He was also responsible for developments in the area of high-current transistor driving circuits for computer memories.


TISHLER

Prior to joining Remington Rand, Tishler had been a circuit design engineer with Barnes Engineering, MB Manufacturing and General Electric.

William C. Benson has been promoted to manager of ground support equipment sales at Solar Aircraft Co. He will handle sales activities directed toward three major fields—ground power for missiles and aircraft, development of transportation and handling equipment and electrical checkout support equipment programs.

Benson came to Solar as a project engineer from Beech Aircraft Corp., where he was manager of support equipment. Prior to joining Beech he was chief engineer for Spencer Safford Loadcraft, Inc., and before that, chief engineer for American Body and Trailer Co.

Victor J. Grubenhoff has been appointed assistant manager of industrial engineering for Jack & Heintz, Inc., developers and manufacturers of power systems for aircraft, missiles and support equipment. In his new post he will assist in the supervision of the company's methods engineering section.

Grubenhoff was formerly supervisor of industrial methods engineering for Westinghouse.

James B. Williams has been elected vice president-engineering of Electronic Communications, Inc.

Williams was previously director of weapons-system engineering for Philco Corp., where for a number of years he acted as executive and later chief engineer of weapons-system engineering.

Dr. Charles E. Reed has been named general manager of the Chemical and Metallurgical Div. of General Electric Co., succeeding vice president **Robert L. Gibson,** who has been appointed general manager of the company's Transformer Division.

Dr. Reed was formerly general manager of the company's Metallurgical Products Dept. in Detroit.

A. G. Puglisi has been chosen chief engineer of the Douglas Aircraft Co.'s Tulsa Division.

E. S. Rutowski, former chief of the Tulsa aerodynamics section, will succeed Puglisi as assistant chief.

Rudolph A. Rieder has been appointed operations manager for United Aircraft Corp.'s Norden Division Data Systems department. He will be responsible for all manufacturing, material control, facility maintenance and industrial engineering.

Prior to joining Norden, Rieder was with Librascope Inc. for six years, serving as chief production engineer.

Joseph E. Trankla has been named to the new post of assistant general manager at Anadite, Inc. Trankla, credited with developing many of the new skills and techniques for hard anodizing of aluminum, was for the last four years director of research and development for the Anachrome Corp., an affiliate company of Anadite, Inc.

Dr. James H. Fisher has been elected to head a newly formed advanced technical planning group at Electro-Optical

Systems, Inc. Dr. Fisher will also continue as manager of the company's energy research and advanced power systems division, a position he has held for the past two years.

Kearfott Company, Inc., has appointed **Ronald Paradise** head of its Electronics Laboratory. He joined Kearfott in 1954 as an assistant project engineer.

Hughes Aircraft Corp. has appointed three executives to managerial positions: **David A. Hill,** formerly manager of the Santa Barbara Research center, to manager of the semiconductor division; **Lloyd H. Scott,** former director of engineering change management, to manager of the Santa Barbara Research Center, and **L. James Levisse,** previously semiconductor division manager, to director of material.

Norman P. Johnson has been elected assistant chief industrial engineer for Norton Co. He joined the firm in 1951 as a time study engineer.

A. N. Ballard has been named factory manager of Summers Gyroscope company and **Fred Heine** has been appointed head of The Potter Instrument Co.'s product engineering department.

Device Permits Visual Check of Grain Surfaces

AZUSA, CALIF.—Visual inspection of the internal surfaces of solid-rocket grains is possible with the BoreSCOPE, a development of **Aerojet-General Nucleonics.**

The device allows the operator to view all points with the same power of magnification. The light source provides a constant level of illumination so that no attenuation occurs as the object distance increases.

The light is filtered and, along with the electrical components, is located at the ocular end of the instrument eliminating the introduction of dangerous elements into sensitive areas.

Magnezium-Thorium Alloys Are 30% of *Bomarc* Ramjets

MIDLAND, MICH.—Magnesium-thorium alloys developed by the **Dow Chemical Co.** constitute 30% of **Marquardt's** *Bomarc* ramjet engines.

Designated HM21A, the alloy castings are used in the control system for the fuel pump housing, air turbine inlet ducts, the Mach sensor and shock positioner housing and the fuel inlet.

Structural applications include the nose cone, longerons and diffuser inner body. The total weight of the alloy in the engine is 300 lbs.

letters

Economy First

To the Editor:

You view with alarm the present state of our missile progress and propose a crash program at costs far beyond present Administration plans even if such a program would unbalance our national budget . . .

Before we get hysterical over our lag in missiles, it would be well to consider two things: a sound American economy is more important than equality or leadership in missiles; and a much huskier missile program is possible, if we really want it, without upsetting our national budget.

One of the best things that has happened to our nation since the war has been our realization that we are behind Russia in rocketry. Otherwise we would have become insufferably cocky—like some missile industry ads (*sic*)—and completely obnoxious to the rest of the world . . .

Our missile program should be based on a realistic appraisal of our needs rather than on political popularity of a big-money crash program. Are the exceedingly expensive hardened underground bases for ICBM missiles necessary? It was an eye-opener for me to read that the *Nike-Zeus* program was planned not to protect our cities (which is hopeless), but to protect retaliatory ICBM bases. The entire system of ICBM bases with protecting *Nike-Zeus* looks too much like a modern Maginot Line.

Wouldn't unprotected, mobile ICBM bases combined with foreign IRBM bases and a *Polaris* Navy be a much better retaliatory force? Our Administration should decide these questions on their own merits without pressure from missile manufacturers or magazines . . .

If a larger military and space budget is required, it is possible to have this with a balanced budget if we want it enough to give up some other expensive frills. Mr. Kallis didn't suggest such an educational program, but let's have enough political nerve to ask for:

A rapid end to farm subsidies.

Retrenchment of stockpiling to actual security needs.

Continued high taxes until reduction is safely possible.

Revision of labor laws to give the large unions a right to bargain, but not to bludgeon.

Then let's have good, healthy progress in rockets, science, education and our national economy.

Edwin P. Plueddemann
Route 2
Midland, Mich.

Points Well Taken

To the Editor:

Both Mr. George Beardshall and myself were most gratified by the very full coverage given to our recent paper concerning Cabin Conditioning Equipment for a Satellite (M/R, Oct. 5, p. 26).

We should like to point out one minor error of printing which is certain to have caused some confusion to those readers who studied the quoted weights in detail.

In Fig. 4, a diagram showing the component parts of the system, the decimal point of a number of the weights was omitted, causing in some cases an increase of weight either by 10 or 100 times.

Another point which may have confused your readers, and which is our fault, is the statement that the oxygen supply in its container represents the heaviest item of the system; in fact, of course, we were referring to the pressure control side and it will be realized that, using absorbents of known type, the chemical absorption equipment represents a very high proportion of the total system weight.

P. W. Fitt
Project Engineer (Oxygen)
Normalair, Limited
Yeovil, England

M/R regrets the omission of decimal points. Here are the correct weights (with incorrect figures in parenthesis): discharge valve, 1.0 lb. (10 lb.); isolating control, .25 lb. (25 lb.); inwards relief valve, .75 lb. (75 lb.); manual shut-off and n. r. v., .5 lb. (5 lb.); manual humidity control, .5 lb. (5 lb.); 2-way valve for circulation induced by breathing, .25 lb. (25 lb.); manual control for recompression, .25 lb. (25 lb.); liquid oxygen storage, total: 4.5 lb./man/day (45 lb.), and pressure controller, .75 lb. (75 lb.)—Ed.

Temperature Transducers

To the Editor:

In your Oct. 12 issue under the Astronautics section, you published a rather descriptive article on the various types of transducers being manufactured for the missile industry today. In addition to the three companies mentioned in your article, **ASTRA TECH** and other companies make temperature-measuring instruments.

Of interest was your discussion on page 36 of the temperature transducers. The reasons for using thermocouples or variable-resistance transducers seem to have been transposed in your description. Actually, for rapid response and accuracy (30 to 100 milleseconds and .1°F), the variable resistance-type transducer is most used by missile manufacturers.

Also, for a higher signal output and durability under high vibration and shock, tungsten elements are specified. By comparison, where requirements call for time constants ranging from 100 milliseconds to seconds, with accuracies of ± 2°F, thermocouples are most generally used. From this comparison, it can be seen that more resistance-type temperature transducers will be used in the future as requirements become more and more demanding for both the cryogenic and high-temperature fields.

Jack Probst
Sales Manager
ASTRA TECH
South Pasadena, Calif.

Small Firms' Headaches

To the Editor:

Thanks for your editorial of Oct. 26 ("A Captive Small Business?"). As a small business which has been a leader in handling the very difficult process of heat treating rocket and missile bodies, we agree in general with your conclusions. We shall be glad to write our Congressman if you will indicate the most appropriate time, presumably not now.

However, we suggest you pursue this subject further for the purpose of aiding the small business in some of its other problems, for example:

Secrecy. Under the guise of military secrecy of classified information from subcontractors. Our particular field is metallurgy. We know our business, having been engaged for more than 30 years in aircraft, rockets, and other essential Government work.

Rocket engineers, though brilliant and well versed in their field, are apparently behind the times in the application of basic metallurgical principles. Accordingly, they embody specifications in their designs which tend to retard rather than assist in the solution of difficult metallurgical problems, especially the reduction of weight and the achievement of close dimensional tolerances for best ballistic performance—but they are reluctant to discuss this.

Wasted time and effort. There has, during the past 2 years, been a flood of "inquiries" covering, for example, the heat treatment of rocket bodies of an endless number of designs. The contractor or subcontractor sends out inquiries and wants a reply "by telephone or return mail." This is quite burdensome as it takes several days to figure out the best and most economical proposal. Accordingly, a "horseback" figure must sometimes be given, to the mutual detriment of bidder and purchaser. In any event, a lot of effort is spent on figuring. After this frantic demand for immediate reply, months go by without any action whatever. In fact, one seldom hears further about the matter.

Subcontracts. As to placing subcontracts, it has been obvious that the "learning curve" is neglected. Contracts are placed with suppliers who have little or no experience in the field, who fail to understand the technical problems involved and who consequently put in a low bid—too low to permit satisfactory attention and performance without loss. Meanwhile, a competent bidder who has put in a fair price, based upon experience, loses the job. Then the buyer gets an unsatisfactory job from the inexperienced supplier or must waive technical requirements which should have been met.

Padding of payrolls? It is almost impossible for the small technical organization to hire a competent engineer today. Enormous ads appear in daily papers offering most tempting inducements to engineers. When one walks into the plants of one of these companies one sees "acres" of engineers apparently doodling. At any rate, the output is not commensurate with the size of the staff. Is this cornering of the market of engineers necessary? Is there a financial benefit to the contractor in having a large number of engineers, (relatively non-productive) on his payrolls?

There is plenty of opportunity for your excellent magazine to render a real service to the industry, including both large and small business, by a courageous campaign of investigation and truthful reporting.

A Reader

Obfuscous Syllabub?

To the Editor:

I was fascinated by your Nov. 23 issue. The information is timely and certainly summarizes the challenge facing the nation's materials engineers. I feel it unfortunate, however, that you let one article creep in written in something other than English. This particular article is so timely that I need to check a few translations with you for fear of drawing false conclusions—and maybe even killing myself.

1. Does "most refractory coatings to date exhibit lack of reliability when subjected to impingement of entrained particulate matter in the propellant stream under extended firing durations" mean

"The exhaust gas eventually chews hell out of existing ceramics"?

2. Does "Abortive missions induce greater hazard to terrestrial ecology and can completely inactivate firing stands and launch areas in case of catastrophic failure" mean

"Shooting off nuclear rockets is dangerous and, if they go boom on the ground, a lot of people are killed"?

Yours for better editorial controls,
Gordon S. Mustin
4710 W. Langley Lane
McLean, Va.

We are in substantial agreement with Mr. Mustin. It developed that the increment of editorial volume for the issue in question was of an order of magnitude such that even optimum utilization of the in-house capability of our desk failed to achieve total obviation of redundancy. Besides, it was a good article anyhow. Ed.

missile business . . .

By WILLIAM E. HOWARD

In its struggle to make the huge military supply system more manageable, the Defense Department now is ready to turn to industry for aid in setting up more realistic standards and eliminating duplication. This word comes from Perkins McGuire, assistant defense secretary for supply and logistics.

Wherever possible in the future, says McGuire . . .
"we intend to adopt industry specifications, standards and practices whenever they will meet our needs. We will not establish duplicating or overlapping military efforts. Furthermore, we will be seeking more industry participation in our future standards operations. In addition, under our weapons systems contracting program, we will be giving prime contractors more responsibility for insuring the use of standard parts and for developing proposed military specifications and standards required in the production and operation of the weapons."

One reason for this departure, McGuire says, is that a study by the American Standards Association revealed "a real question" whether there could be across-the-board standardization as originally envisioned by the program. "We now realize we must concentrate our efforts in vital high-payoff areas and must turn our back on many (low-payoff) desirable standardization projects which are not absolutely essential."

While not mentioning any specific areas of attack . . .
the assistant secretary made it clear that the main effort to obtain savings through uniformity of procurement will be directed at the big missile programs. The multimillion-dollar weapons systems, he said, "urgently" need standards and specifications.

The study also disclosed that not only were many military projects duplicating industrial projects, but DOD "had not been taking advantage of the wealth of technical competency in manufacturing industries and technical, trade and professional associations." McGuire said there is also a need for a more aggressive engineering standardization program at the drawing board, to avoid the need for standardization after the items are produced and in the supply system.

He said these various improvements are now being programmed into the DOD standardization effort and will be in effect before next July.

Big savings in dollars and engineering time . . .
are anticipated by McGuire in the DOD's new military standard and specification for engineering drawings—which replaces 158 different Army, Navy, Air Force and Marine Corps specs. The uniform drawing spec for all military services was developed by the Navy; it eliminates the need for a manufacturer under contract to more than one service to redraw his engineering documentation.

Cost of engineering documentation to DOD, incidentally, is estimated by McGuire at upwards of $2 billion a year.

All items in the military supply system now are catalogued uniformly. And this recently completed monumental task has revealed there are 3.5-million different items stocked by military. These items are manufactured and supplied by more than 34,000 companies. Some 500,000 new items come into the supply system every year and an equal number of obsolete or surplus items are eliminated.

McGuire said the single manager system for procuring commodities for all services appears to be working out well, opening up the possibility that it may be tried in some phases of missile procurement —perhaps for support items or missiles purchased by more than one service i.e. *Hawk* for the Army and Marine Corps.

Looking at DOD reorganization from the logistic . . .
point of view, McGuire says he can't see it as a panacea. "We're afraid we would only be reorganizing our problems—not solving them."

Lunik II Impact May Have Contaminated the Moon

BLOOMINGTON, IND.—The Russians may have contaminated the moon.

The final-stage carrier of *Lunik II* apparently was not decontaminated, although the instrument package was reportedly sterilized, according to Carl Sagan, of the Yerkes Observatory, University of Chicago.

Speaking to a meeting of the National Academy of Sciences at Indiana University here, Sagan said that if *Lunik II* was carrying terrestrial microorganisms when it hit the moon on Sept. 13, the resultant biological contamination could be an unparalleled scientific disaster in three ways:

• The moon may contain no indigenous living organisms, and may be incapable of supporting terrestrial microorganisms. But on or beneath the lunar surface there may be relics of organic matter or primitive organisms which arose during the moon's early history. There are other theories on lunar organic matter, and on the possible existence there of organisms of interplanetary origin.

The area contaminated by the impact of earth-launched vehicles would be rendered useless for establishing whether any of these notions is right or wrong.

• The moon may contain no indigenous living organisms but may be capable of supporting some earth-born organisms. Subsurface heat sources, water and organic matter would be required. Then there is the possibility that terrestrial organisms might form a biological explosion which would destroy prebiological organic matter surviving from ancient times.

• The moon may contain indigenous living organisms, and deposition of earth forms would upset balance and abundance of such organisms.

The survival of terrestrial microorganisms in space, and on the moon, depends on shielding from the sun's radiation. Sagan said lack of oxygen and extreme temperature is known to have little or no effect on some of the hardier organisms, but ultraviolet radiation will eventually destroy them.

He explained that the surface of the moon is a semiporous matrix of congealed dust particles. Terrestrial microorganisms lodged in the pores would be shielded from the solar radiation and would survive for long periods.

Speculation that there may be organic remains on the moon is based on the idea that the moon may once have had an atmosphere of methane, ammonia and water. Solar radiation is known to form organic molecules in such an environment.

by M/R Staff
from Translations

Red Scientists Criticized By Russian Academicians

Editor's note: N. A. Kozyrev has recently made news in both the East and West for his time-space hypothesis and his theories regarding lunar eruptions. These theories have come in for criticism by U.S. scientists and are now being attacked in the Soviet press by Russian scientists. This is indicative of a recent trend in the Soviet Union for scientists to wage war in the press against another's theories; it also reflects recent charges that claims by some Soviet scientists and journalists have been irresponsible and damaging to Russian prestige. The following are excerpts from an attack by Academicians L. Artsimovich, P. Kapitsa and I. Tamm on Kozyrev's theories in the Nov. 22 issue of Pravda:

". . . Cases are encountered when the popularization of many scientific and technical achievements is replaced by rushing after cheap sensations and the printed page is turned over to completely incompetent people . . . As an illustration let us consider the . . . 'revolution' in science presumably caused by N. A. Kozyrev, consisting particularly in discovering the possibility of 'using the course of time to obtain energy' . . . Kozyrev's book, "Causative Mechanics," (published) in 1958 . . . begins with the problem of sources of energy radiated by the stars.

"At present, science considers that the basic source of energy lies in the thermonuclear reactions occurring inside the stars. Not only without analyzing the facts but without a single word about nuclear energy, the author on the basis of unconvincing discussions taking up a number of pages asserts that 'inside the stars there are no special sources of energy.' This is what leads him later to the conclusion that the first and second laws of thermodynamics are incorrect, and in particular the physical law of the conservation of energy.

"Of course, the fact that the law of conservation of energy is strictly fulfilled in all processes occurring within the limits of our planet does not provide a basis for denying categorically the possibility that phenomena on a cosmic scale are subject to some different laws. In modern cosmology daring hypotheses of such types are much discussed. We are not against daring hypotheses, but favor them only when they are convincingly based. This is not the case in Kozyrev's book . . . The real meaning of his assertions that the course of time can create energy remains incomprehensible to us . . .

"The form of all the planets including the earth must, according to Kozyrev, be somewhat asymmetrical, pear-like, and their northern hemispheres must be more massive than (their) southern (hemispheres). Recent measurements of the earth's magnetic field have actually revealed a very slight asymmetry in the shape of the earth. However, the character of that asymmetry is directly opposite to the predictions of Kozyrev: the southern hemisphere is more massive than the northern . . . One needs not only a high degree of accuracy when setting up experiments but also thorough analysis proving that observable effects are not the result of secondary causes. Such an analysis is not given by Kozyrev . . .

"From the fact that Kozyrev's experiments are absolutely unconvincing and unsatisfactory from a methodical point of view we do not at all want to draw the conclusion that they should not be checked and analyzed. We consider it absolutely correct that thorough checking of this type has been taken up by the Pulkovo Observatory . . .

"Meanwhile, the well known writer Marietta Shaginyan in an article devoted to Kozyrev ("Time with a Capital." *Literaturnaya gazeta*, Nov. 3) says that she absolutely believes that theory . . . The only positive opinion of a physicist about Kozyrev's 'discovery' which Shaginyan was able to give contains the following reservation: 'I have not read Kozyrev's book and do not know his theory.' However, it is hardly necessary to analyze in detail her article. Its style and character would suit the assertion of a new faith better than the explanation of a scientific problem . . ."

Lunar Surface Analyzed

Scientists of the Main Astronomical Observatory in Leningrad and the Kharkov Astronomical Observatory recently rejected the theory held by many U.S. astronomers that the lunar surface is covered with dust particles, according to an article written by astronomers N. P. Barabashov and A. T. Chekirda in *Astronomicheskiy zhurnal* (Vol. 36, No. 2, 1959, pp. 315-321, and No. 5, pp. 851-855.)

The Soviet astronomers contend that the lunar surface is most probably covered with disrupted tuff-like rocks with scattered large-grain volcanic ash, and state that this conclusion was arrived at by parallel application of several different physical methods.

The various studies used, according to Barabashov and Chekirda, were: brightness for integral light; the reflection coefficients for different regions of the spectrum; the law of reflection of light; the smoothness factor; the energy distribution in the spectrum; curves giving the variation of the degree of polarization in dependence on the angles of incidence and reflection of light; and the phase angles, thermal conductivity, and density of the moon.

The characteristics of lunar objects also were compared to earth rocks whose surface had been irradiated by ultraviolet rays, X-rays, and protons in vacuum. The rocks had been fused at atmospheric pressure and in vacuum, and then broken up into grains of various size and striated before and after fusion. The combined results of photometric, calorimetric, and polarimetric investigation were utilized to compare results with tests of terrestrial rocks thought to be most similar to those on the moon.

The studies present the final concept of a lunar surface covered with a porous, sponge-like material, sharply striated and fragmented, and very probably with sharp spikes and deep furrows. This material may have originated from the solidification of lava foam (sytinskaya), and its composition may possibly be similar to that of the basic magnesium-bearing rocks, like gabbro and basalts. The paper states that Lambert's law and the deviation from it gave the criteria for distinguishing between the dusty martian and the clastic lunar surface.

The Soviet astronomers believe that the lunar surface was caused by explosions accompanying the impact of meteorites on its surface. This "meteor slag" theory, according to the article, is confirmed by the determination of such low values of the possible lunar atmospheric density that even micrometeorites can reach the lunar surface with cosmic velocities.

Telemetry Improvements

N. V. Pozin has written in *Avtomatica i telemekhanika* (No. 10, 1959, pp. 1403-1408) that a method of designing coders has been proposed that would take into account spectrum characteristics of the signals to be transmitted, and would use automatic control of transmission speed.

after rash of troubles . . .

Titan Is Re-evaluated by AF/STL

Program judged technically sound, but management is questioned; industry feels DOD must provide truth on all ICBM claims—or Congress may do the job

by William J. Coughlin

LOS ANGELES—The Air Force has just completed a full-scale re-evaluation of its controversial *Titan* missile program.

The technical portion of the study was made by **Space Technology Laboratories** on behalf of USAF's Ballistic Missile Division, MISSILES AND ROCKETS has learned.

Re-evaluation covered all aspects of e program, including a new study of the military requirement for *Titan*, design evaluation of the missile itself and a close scrutiny of **Martin Company** management of the program.

BMD is said to have concluded that there still is a military requirement for the *Titan* and that the missile is technically sound. Company management of the program has been questioned, however.

• **Series of troubles**—The resurvey was spurred by troubles which have plagued the Martin ICBM since last May. These reached a fiery climax Dec. 12, when the first of the *Titan C* series exploded on the Cape Canaveral launch pad. The accident is said to have been caused by a malfunction of the safety destruct system simultaneously with launching. All other systems were reportedly operating properly and the destruction system should not have been activated prior to lift-off.

It is understood that an electrical relay in the destruct system accidentally closed mechanically due either to vibration or a structural weakness.

The destruct system was recovered Dec. 14, and cause was pinned down to a relay in its lower part.

A previous *Titan B* launch attempt Aug. 14 also resulted in a burnout on the pad. That accident was blamed on the master operating control (MOC) system cutting off the rocket engine during lift-off after an umbilical line failed to release promptly. The missile fell back on the pad and burned.

• **Questions on the Hill**—The recent explosion of the 90-ft., two-stage missile could be politically damaging to the program in the light of congressional hearings on the defense budget slated for next month. A full-scale congressional probe of the *Titan* program early in the year is possible.

Present programming calls for 13 **Convair** *Atlas* squadrons, 14 *Titan* squadrons. *Atlas* backers assert something like $400 million could be saved by cancellation of the *Titan*.

One question which could be raised by Congress is whether need for *Titan* still exists.

The degree of *Atlas'* operational capability and the status of the **Boeing**

———What Congress May Ask about ICBM's———

WASHINGTON—When and if Congress, with its budget-pruning knife poised for slashing, attempts to clarify the muddled Air Force ICBM program, look for action in these principal areas:

TITAN

• A blow-by-blow account of test firings. Whether they met schedule, and if so—whose schedule? Exact cause of failures, whether technical or procedural errors. How much slippage in program, and why? Is fault technical or management? What effect will slippage have on operational dates? Back of it all will be the underlying questions: Why three Air Force ICBM systems? What are the merits of hardened sites vs. unhardened—and hardened vs. mobility? And—in light of touted capability of the other two systems—is the *Titan* road necessarily the correct road?

ATLAS

• What is its true operational capability now? Up for close scrutiny will be some claims that improvements —either made or contemplated—will give it range equal to *Titan's* and the same or improved guidance accuracy. Deciding factor—if it can match or achieve *Titan's* distance and accuracy—could be amount of payload it can carry. Latter, in turn, could affect *Minuteman* program with its smaller nuclear warhead. Look for Congress to attempt to place blame in individual areas for lack of true public information on claims and counterclaims which have been promulgated by all factions in the ICBM program.

MINUTEMAN

• How much bang will we get for the buck? How is the program proceeding technically? Look for another round of claims and counterclaims on merits of liquid systems vs. solids. Barbs which may be aimed at *Minuteman:* Difficulty in transporting big solid motors, high cost of mobility, whether "instantaneous readiness" is really necessary and worth the cost of hundreds of hardened silos.

POSSIBLE CONGRESSIONAL OUTCOME: Either more mud in the ICBM water or decided recommendations on what program or programs should be pushed—with funding determining the degree.

tightening called for . . .

Minuteman program undoubtedly will have a direct bearing.

But the Air Force study indicates that in the critical time period ahead—the so-called "Missile Gap" in 1960-65 when the United States will lag behind the Russians—both *Titan* and *Atlas* will be necessary to provide the maximum number of operational missiles.

BMD's study finds that stepping up *Atlas* production at Convair's San Diego facility—or phasing in of a second *Atlas* production line—would not provide as many missiles in the critical period ahead as continuing with both programs.

This statement has been challenged by those who believe that *Atlas* production, with adequate funding, could be increased to meet the gap.

• **How much slippage?**—Past, and any future, trouble with *Titan* could make the program one of the most controversial in the defense budget. Defenders of *Titan* point out that the *Atlas* also was plagued with a long series of disasters in the early stages of its program, including five straight launch failures.

Titan originated as a backup missile to the *Atlas*. Its two-stage conventional-airframe approach was considered insurance against difficulties which might arise with the pressurized thin hull and so-called "stage-and-a-half" design of *Atlas*.

Contract for the *Atlas* was let in March, 1954. The *Titan* contract came in October, 1955.

The Air Force acknowledged in December, 1958, before the first *Titan* launch, that the program had slipped slightly while that of the *Atlas* was being accelerated. This spread the operational dates for the two missiles to approximately 18 months apart.

Titan proponents, however, insist that a more realistic figure would be 12 months.

At the moment, with a very few *Atlas* missiles now operational at Strategic Air Command's Vandenberg, Calif., base, some sources say *Titan* has fallen roughly another six months behind and that there have been something like seven launch schedule revisions since the first of the year. *Titan* proponents, however, question the use of "operational," and insist that it should be clarified to "technically operational."

They add that the operational *Atlas E* has yet to be fired, and *Titan* will reach *Atlas*' present capability in October, 1960. The additional program slippage of six months also is questioned, but no revised estimate of slippage is given.

The Air Force believes, however, that *Titan* can become operational on its present schedule, sometime in 1961. This will require a tightly-run program to make up the present lag. Close USAF supervision will be maintained over Martin Company management of the project to assure that this comes about.

• **Basically sound**—Even strongest opponents of *Titan* will admit that the missile appears technically sound, despite its chain of mishaps.

Firing of the series of four *Titan-A* missiles, designed to check out engine-frame compatibility and first-stage control, went off well. *Titan's* last successful launch was on May 4.

Since then, one disaster after another has wiped out or damaged practically the entire series of *Titan-B* missiles. A tank was badly damaged while being cleaned at Martin's Denver plant. First stage of another was damaged during air shipment to Cape Canaveral, as a result of uncorrected pressure differential. First stage of one was extensively damaged on the pad at Canaveral when a helium line tore loose. Two engines exploded in "battleship" firings at Denver.

Not all of the B missiles—about nine—can be accounted for because some apparently have been cannibalized. Last of the B series was on the Canaveral stand in November, and is next in line to be fired.

Firing of this "bird" could come at any time. However, it would take at least six weeks for a firing from a C stand.

There are three stands at the Cape and one under construction. The first of the existing stands was used for A and is now modified for G and C. The second is for B, and the third is for C. The latter was damaged on Dec. 12.

Series B was to be used to test altitude start of the 80,000-lb.-thrust second-stage engine as well as roll control of the guidance system. **Bell Labs** and **Remington Rand** are the guidance contractors.

Propulsion and guidance systems, as well as frame, received technical approval in the STL evaluation. **Aerojet-General** manufactures both the second-stage and the first-stage 300,000-lb.-thrust liquid rocket engines.

• **Test picture unclear**—One source said all of the *Titan B* series, half of the C series and one G were to have been tested by now.

Another said, however, that only two of the C series were scheduled and that the G bird at the Cape now is a non-flight being used exclusively for compatibility checkout.

Series C tests are designed to check out guidance systems and nose cone separation. Series G are probably for re-entry.

Feeling at BMD Headquarters here is that *Titan's* troubles are administrative, not technical. STL's role, however, was to evaluate the program, not solve its problems.

Comparative military capability of *Titan* and *Atlas* undoubtedly will come up in closed session at the forthcoming congressional hearings. Some sources say USAF is ready to concede that there may be little difference between the two missiles in accomplishment of their ICBM missions, although *Titan* was intended to have 3000 miles more range, greater guidance accuracy, and larger payload delivery.

• **Closing the gap**—*Atlas* proponents, however, say that improvements in their bird have eliminated the gap. They cite that the "operational" missiles at Vandenberg are capable of reaching any point in the Soviet Union or Red China; that *Atlas* has demonstrated a "phenomenal" accuracy at 6300-mile range (statute); and is capable of 8000-to-9000-mile range. On the *Titan* side, however, it is stated that the 6300-mile shot was a "hot-rod" version with strip-down of bird to get the range, and that guidance accuracy was not proved. As to an 8-9000 mile *Atlas* range, one person said, ". . . but with what kind of a bang in the nose?"

Proponents of *Titan* believe its advantages, in addition to providing additional operational missiles, lie in other fields. For one thing, it is said to have a space capability which *Atlas* lacks. USAF, still strongly interested in military space missions despite an Administration downhold on the subject, is counting heavily on the *Titan* in this field. The missile is at present programmed as a second stage in the *Saturn* project of National Aeronautics and Space Administration, although there have been rumors that the German team at Huntsville is pressing for a new second and third stage program.

Despite its troubles, *Titan* is backed enthusiastically by BMD and the Air Research and Development Command. Belief is that the *Titan* is technically sound and that elimination of management "bugs" in the program can restore it to schedule.

But industry's big question is when will the Air Force officially answer the claims and counterclaims about all programs? Failure to do so, industry sources point out, means inevitably that Congress will do the job for the Department of Defense.

propulsion engineering . . .

By JAY HOLMES

Hydrogen would do double duty . . .

in a nuclear-chemical hybrid propulsion system proposed by **Convair's** Krafft Ehricke. The engine would have three thrust chambers, like the *Atlas*. Hydrogen would burn chemically in the two smaller outside chambers until the small LOX tank runs out.

Then the nuclear rocket would take over. The liquid hydrogen would be directed through the hot reactor and out the big central chamber. The smaller chemical rockets and their empty LOX tank then would fall away, again just as in the *Atlas*. Ehricke said this might take place between 120,000 and 140,000′ altitude.

The promise of nuclear flight . . .

in space might be realized sooner under the Ehricke plan. For the atom doesn't begin to win the battle with chemical propulsion until we build a big booster—something on the order of the *Nova* cluster —with upwards of six million lbs. thrust.

Current estimates are that it will take more than a decade to develop a purely nuclear booster. The reason: a high-thrust nuclear rocket requires a reactor operating at temperatures far above those possible today. In short, a materials problem.

Now there is talk about a low-thrust, upper-stage nuclear rocket, which might be ready for use in 8-10 years. Under the Ehricke plan, this smaller rocket could become a booster. He figures that each of the chemical engines could have 200,000 to 250,000 lbs. thrust, and that of the nuclear engine might range from 60,000 to 200,000 lbs., depending on the space mission desired.

A $3.75-billion chemical market . . .

in missile and space vehicle development is indicated by the 1959 sales report of the Manufacturing Chemists' Association. The nation's chemical industry posted record sales of $25 billion in all categories in 1959, a rise of at least $1.6 billion over the previous record year of 1957 and $1.8 billion more than in 1958.

No one has ever been able to make a complete survey of the missile/space chemical market. Government security regulations and industry's jealous protection of proprietary secrets make it impossible. However, the MCA estimates that 15% of total chemical sales go for missiles and space. Hence the $3.75 billion sales total for 1959.

$360,000 contract for 19 rockets . . .

points up the success of the **Hercules Powder Co.** X248 plastic rocket. NASA, which calls the X248 *Altair*, is buying a new supply of the rockets from the Bureau of Naval Weapons for use in upper stages of a modified *Scout*, which the Air Force will use in high altitude and re-entry tests.

Hercules makes the double-base propellant grain at the Navy's **Allegany Ballistics Laboratory.** The filament-wound fiber glass case is manufactured at Hercules' **Young Development Division.**

Plastic rockets like the reliable *Altair* are under consideration as second stage of the **Lockheed** *Polaris* and as third stage of the **Boeing** *Minuteman*. NASA uses *Altair* as both the third and fourth stages of *Scout* and as third stage of *Atlas-Able* and *Thor-Able* (which launched the *Explorer VI* paddlewheel satellite last Aug. 7). *Vanguard III*, the successful shot that closed that series on Sept. 18, also used X248 as third stage.

more about the missile week

• **White Sands, N. M.**—The Army on December 16 successfully launched a **Western Electric** *Nike-Zeus* test vehicle. The launching was the third in the early test series of the anti-missile missile development program.

• **Cape Canaveral, Fla.**—A **Lockheed** *Polaris* launched the night of Dec. 15 scored only a partial success because of a malfunction in the missile's second stage. The launching was the latest for the new 900-mile series of test vehicles.

• **Washington**—The Army awarded nearly $9 million in contracts to **RCA** for Project *Damp*—The Army's downrange anti-missile measurement program. One contract—$6,452,495—is for a one-year continuation of the program on the Atlantic Missile Range. A second contract—$2,459,409—is for program improvements.

• **London**—The authoritative Jane's All the World's Aircraft in its 1960 edition reiterated recent official and unofficial reports that Soviet missile-launching submarines already are on active service.

• **Washington**—Rep. Victor L. Anfuso (D-N.Y.), chairman of the House Space Subcommittee on International Cooperation, called for a joint U.S.-Soviet program to send a man into space. Anfuso made his proposal in identical letters to President Eisenhower and Soviet Premier Nikita Khrushchev.

• **Birmingham, Ala.**—**The Martin Co.** has received a $10.5-million contract from the Birmingham Army Ordnance District for continued R&D of the *Pershing*, 200-to-700-mile range solid-fueled successor to the *Redstone*.

• **Inglewood, Calif.**—Maj. Gen. Ben. I. Funk, commander of AMC's Ballistic Missile Center, has been picked to succeed Maj. Gen. John S. Mills as commander of the San Bernardino Air Materiel Area, Norton AFB, Calif. Mills is retiring Jan. 31. Brig. Gen. Don Coupland, deputy commander at San Bernardino, will move over to Inglewood to replace Funk. All changes are to be in effect by Feb. 15.

• **Washington**—Industry moves & expansions: **Greer Hydraulics Inc.** is relocating all its R&D and production facilities to a new plant in Los Angeles early next year . . . An East Coast plant is being opened at Hempstead, L.I., by **Furane Plastics** of Los Angeles . . . Construction has started on a 29,000-sq.-ft. addition to the main plant of **Aircraft Armaments Inc.,** manufacturer of a training system for *Sergeant*, at Cockeysville, Md. . . . **International Telephone and Telegraph Corp.** has established a new facility for R&D of special microwave electron tubes at its Advanced Development Laboratory in San Fernando, Calif. . . . and **The Gabriel Co.** is opening its new $2-million electronics plant at Millis, Mass., on Jan. 14.

• **London**—The British officially declared that their four **Douglas** *Thor* squadrons are operational. The four squadrons of 15 missiles each are deployed along the British east coast.

• **Washington**—The Defense Department has started polling 20 top contractors on their patent practices with subcontractors. The survey is being conducted at the request of the Senate Small Business Subcommittee on Monopoly, which wants to know whether it is the exception rather than the rule for prime contractors to release patent titles on R&D awards to subs.

contracts

NASA

Simmonds Aerocessories, Inc., Tarrytown, N.Y., has received a contract for designing, developing and producing prototype quantities of a recovery beacon to be used on Project *Mercury*. Subcontract from **Collins Radio Co.**

$69,163—**Kellogg Switchboard and Supply Co.,** a division of **IT&T Corp.,** for constructing an intercommunication system for the rocket launching site at Wallops Island, Va.

NAVY

$100,000—**Yardney Electric Corp.,** New York City, for manufacture of silvercel silver-zinc batteries for research and testing applications.

MISCELLANEOUS

$825,000—**Jet Propulsion Laboratory,** for research and development for wind tunnel testing.

$650,000—**General Bronze Corp., Electronics Div.,** for the antenna system for Project *STEER*. Subcontract from **Bendix Radio Division.**

$276,633—**Callahan Brothers,** San Diego, for construction of an engineering space research laboratory. Contract from **Convair (Astronautics) Div. of General Dynamics Corp.**

$132,000—**Gabriel Electronics Div., The Gabriel Co.,** for antennas to be used with the AN/FPS-35 radar system. Subcontract from **Sperry Gyroscope Co.**

$100,000—**American Electronics, Inc., Electro-Mechanical Div.,** Los Angeles, for electromechanical components. Contract from **Bendix Aviation Corp.**

AIR FORCE

Hamilton Standard Div. of United Aircraft Corp. has received a contract for 100 VA static inverters.

$5,323,140—**Radio Corp. of America,** for data link equipment for use with the SAGE and *Bomarc* systems.

$4,815,000—**Avco-Everett Research Laboratory Div. of Avco Corp.,** for continuation of basic studies applicable to ICBM reentry vehicles and other classified work.

$315,000—**American Electronics, Inc., Electro-Mechanical Div.,** Los Angeles for 20,000 variable frequency axial fans.

$174,600—**Motorola, Inc., Military Electronics Div.,** Chicago, for component parts used in DEW Line radar.

ARMY

$15,000,000—**Bendix Aviation Corp.,** Baltimore, for work of a classified nature.

$14,900,000—**Western Electric Co.,** New York City, for improvements on the *Nike-Hercules* system and repair parts. (Two contracts.)

$10,500,000—**The Martin Co.,** for continued work on the *Pershing* missile.

$8,617,624—**Ford Motor Co.,** Newport Beach, Calif., for design and development of combat vehicle weapon system

$4,500,000—**Douglas Aircraft Co.,** for kits to convert *Nike-Hercules* missiles for use at semi-mobile installations.

$3,940,000—**Radio Corp. of America,** for modification work on BMEWS radar units for use in Project *Defender*.

$3,500,000—**North American Aviation,** Canoga Park, Calif., for continuation of the *Saturn* program.

$3,437,200—**Radioplane Div. of Northrop Corp.,** Van Nuys, Calif., for target missile production.

$2,492,383—**Minneapolis Honeywell Regulator Co.,** for work of a classified nature.

$2,300,000—**California Institute of Technology,** Pasadena, for continued research and development on the *Sergeant* missile program.

$1,705,379—**Western Electric Co., Inc.,** for engineering and technical services to cover the fiscal year 1960 *Nike* field support program.

$800,000—**Chrysler Corp.,** for gyros to be used in the *Redstone* missile.

$320,850—**Radio Corp. of America,** Camden, N.J., for non-personal services in connection with the instructional courses and programs and providing instruction at Ordnance Guided Missile School.

$315,000—**Sperry Rand Corp., Utah Engineering Laboratory Div.,** Salt Lake City, for repair parts for guided missiles.

$225,625—**Douglas Aircraft Corp.,** for *Nike* repair parts.

$129,000—**AiResearch Mfg. Co.,** for *Nike-Hercules* repair parts.

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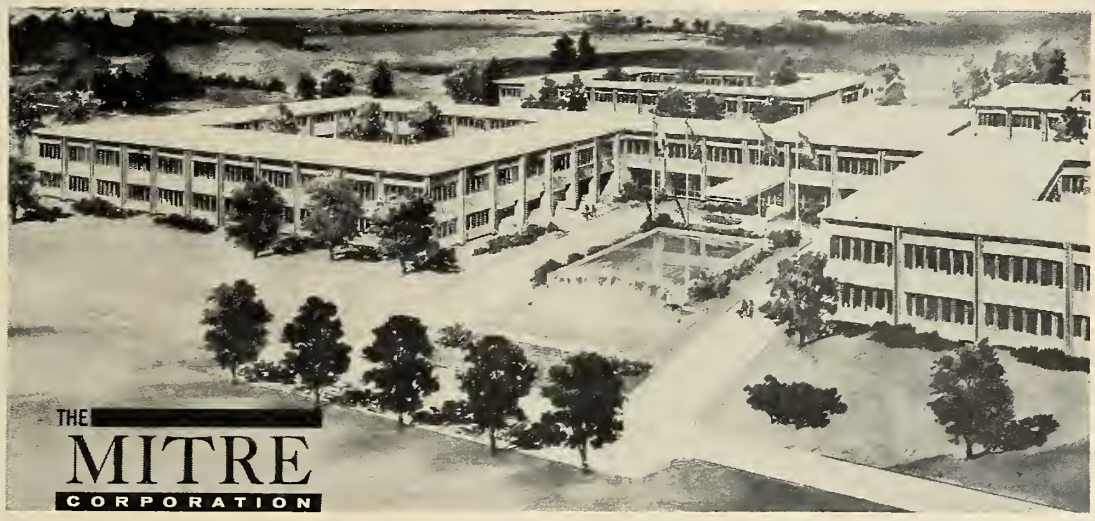

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American Chemical Society, Industrial and Engineering Chemistry Division, 1959 Christmas Symposium "Mechanisms of Interfacial Reaction," Shriver Hall, Johns Hopkins University, Baltimore, Dec. 28-29.

JANUARY

Gas Dynamics Colloquium on Electrostatic Propulsion, University of Michigan, Ann Arbor, Jan. 7.

Sixth National Symposium on Reliability and Quality Control in Electronics, IRE, EIA, AIEE, ASQC, Statler-Hilton Hotel, Washington, D.C., Jan. 11-13.

First International Space Science Symposium and COSPAR Plenary Session, sponsored by COSPAR, Nice, France, Jan. 11-16.

Society of Plastics Engineers, 16th Annual Technical Conference, Conrad-Hilton Hotel, Chicago, Jan. 12-16.

Gas Dynamics Colloquium, Shock Tube Research, University of Michigan, Jan. 14.

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

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

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

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

Colloquium: Research in Rarified Gasdynamics, Northwestern University, Jan. 28.

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

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

FEBRUARY

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

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

Sixth 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.

Institute of Radio Engineers, Professional Group on Military Electronics, 1960 Winter Convention on Military Electronics, Biltmore Hotel, Los Angeles, Feb. 3-5.

AIEE Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia, Feb. 18-19.

National Society of Professional Engineers Winter Meeting, Broadview Hotel, Wichita, Kan., Feb. 18-20.

Engineering Materials & Design Exhibition, Industrial & Trade Fairs, Ltd., Earls Court, London, Feb. 22-26.

National Association of Corrosion Engineers, Tulsa Section, 11th Annual Corrosion Short Course, Mayo Hotel, Tulsa, Feb. 24-26.

Univac Users Association, Semi-annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Va., Feb. 25-26.

MARCH

Mechanical Properties of Engineering Ceramics, North Carolina State College School of Engineering, and Office of Ordnance Research, U.S. Army, N.C. State College Campus, Raleigh, March, 9-11.

APRIL

Sixth Annual Advanced Statistical Quality Control Institute, University of Connecticut, Storrs, April 3-15.

1960 Nuclear Congress: "What Will the Future Development of Nuclear Energy Demand from Engineers?" sponsored by 28 engineering, scientific, management and technical organizations. Includes: Sixth Nuclear Engineering & Science Conference; Eighth NICB Atomic Energy in Industry Conference; Sixth International Atomic Exposition, New York Coliseum, New York City, April 4-7.

American Chemical Society, 137th National Meeting, Cleveland, April 5-14.

American Rocket Society, Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif., April 6-8.

American Welding Society, 41st Annual Meeting & Welding Exposition, Los Angeles, April 25-29.

Second Southwestern Metal Exposition & Congress, State Fair Park, Automobile Bldg., Dallas, April 25-29.

MAY

National Association of Relay Manufacturers, Eighth Annual Conference on Electromagnetic Relays, Oklahoma State University, Stillwater, May 3-5.

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Don't Mourn the B-70—Not Yet

When the Administration pulled the budget strings tighter and tighter, and something obviously had to give, the Air Force chose to put the B-70 program on the back burner. There it would simmer quietly, not discarded but certainly not cooking hotly, either.

Two matters of national principle were involved in the decision to cut back the Mach 3 Chemical Bomber, a 2000-mph missile platform.

One was strictly military. The present trend to use big bombers as missile launching platforms gave rise to the question of real need for such a plane. The B-52 carries the *Hound Dog*, a 400-mile, nuclear-armed, air-breathing missile. Under development is the 1500-mile air-launched ballistic missile, also nuclear-armed. With these missile adjuncts to the aircraft, is speed so important? And what of the nuclear-powered plane itself? Would it be better to leap-frog the B-70 and concentrate on atomic power?

The second question is the parallel gains or fallout which would accrue from the development of a Mach 3 bomber in the way of a supersonic transport. Obviously, whether or not America builds a high-speed passenger and cargo aircraft, someone else—probably the Russians—will. The U.S. now has a commanding position in the world aerotime market. This could be lost.

There is a third point which does not involve national principle, a more practical, a more realistic point.

Concerned in the B-70 program besides North American were six large corporations. Funding for the B-70 in 1959 was $412 million, with another $138 million for Fiscal '60. Payment to North American, which received the great bulk of this money, naturally, has not been released; but money actually spent by the associated companies went like this: Lockheed, $7.5 million; Westinghouse, $2.5 million; Chance Vought, $4 million; IBM, $58 million; Boeing, $17.9 million and Motorola, $300 thousand.

We are not ready to begin shedding tears for the B-70. We have a feeling that between the military need, the commercial need and the pressure which can be exerted by seven big corporations when millions of dollars are involved—the program is not lost.

The Air Force is far from convinced that the day of the manned aerial weapon system is past—and so are we. We are inclined to think the USAF was canny enough to reduce a program which won't stay reduced.

Military in Space

Naming Maj. Gen. Don Ostrander to head NASA's space booster program is a first big step toward getting the military back into the space program, even if it is by the back door.

Peace is wonderful—as long as you are strong enough to maintain it, and this goes for hot wars, cold wars, earth or solar systems. Space boosters may in time become as commonplace as six-by-six trucks, but right now they are the key to everything we do above the earth's atmosphere. To ignore military requirements in the booster program—as we have been doing—is preposterously foolhardy.

We don't advocate that the military take over the space program, but they certainly should be equal partners in it. When, incidentally, will we have a military man on the President's all-powerful National Space Council?

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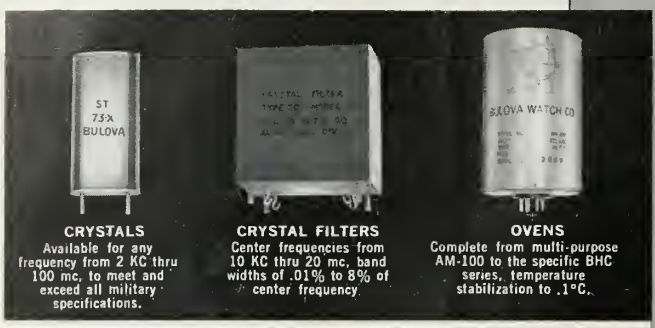

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