JUNE 27, 1960

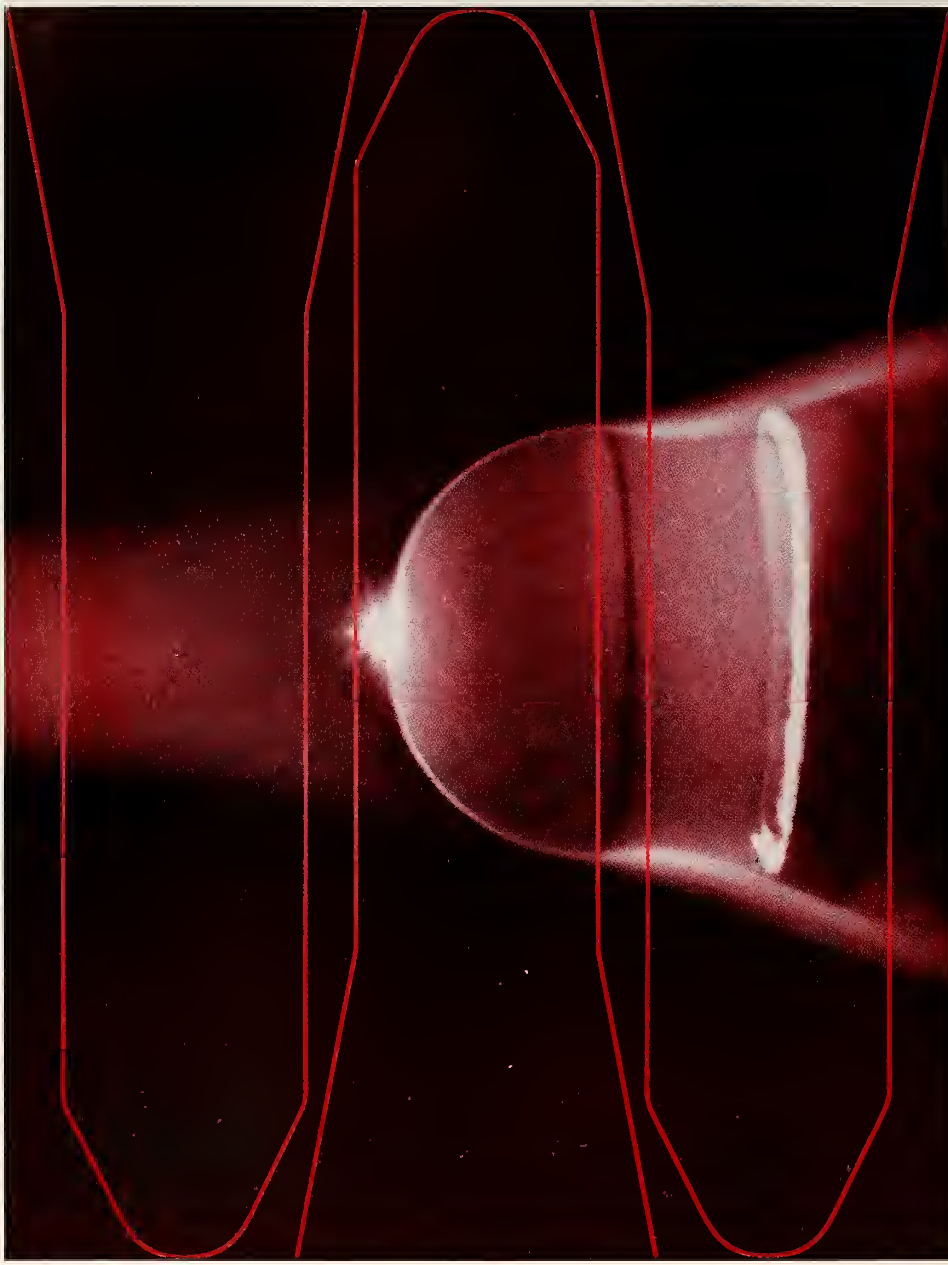
missiles and rockets

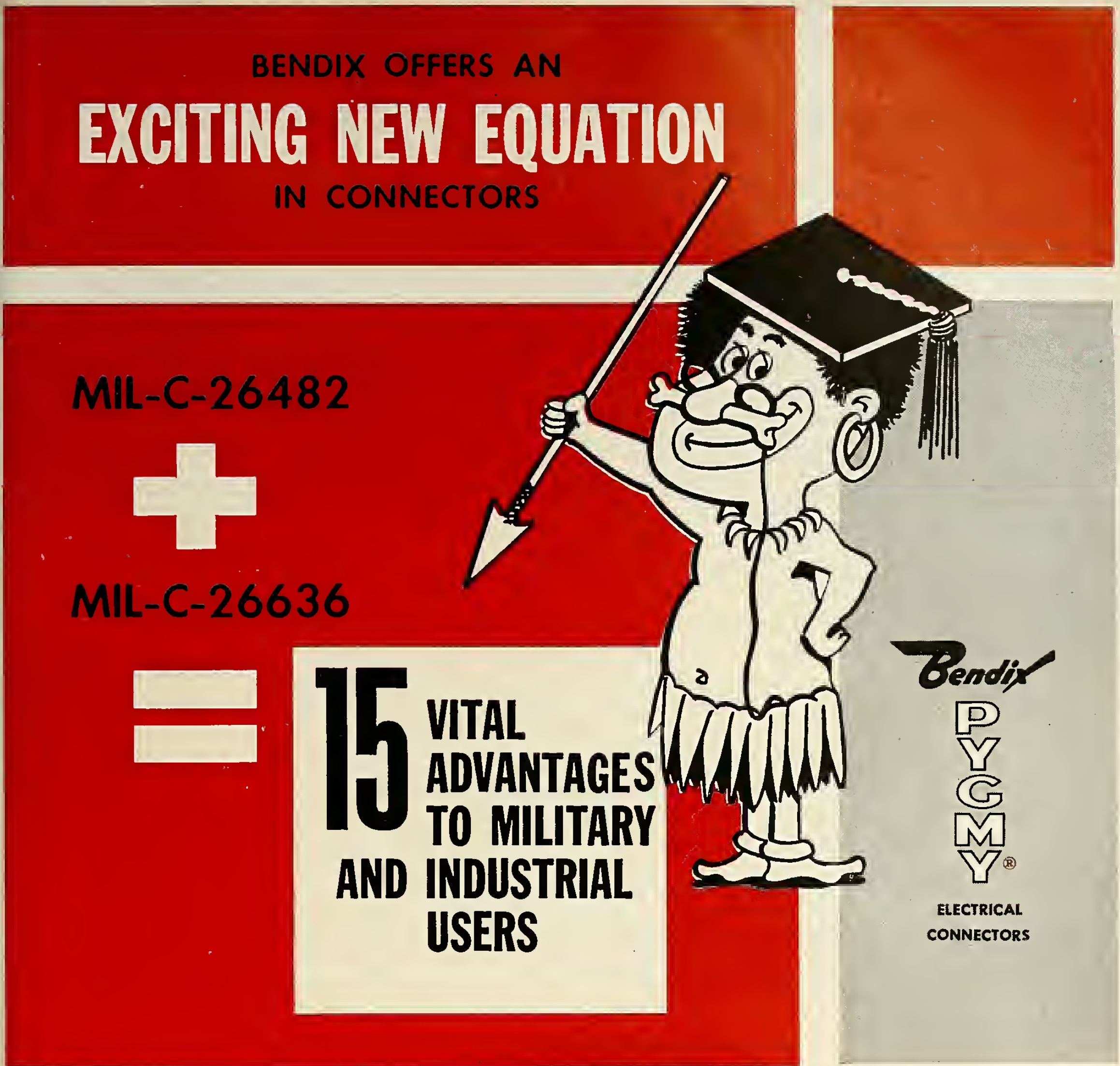
THE MISSILE/SPACE WEEKLY

ASROC—Navy's Newest ASW Weapon

SPECIAL REPORT: Revolution in Drones . . . 19

AN AMERICAN AVIATION PUBLICATION





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Ground support equipment development at Lockheed Missiles and Space Division has encompassed an unusually broad area, ranging from the problems involved in the unique water environment of the Navy POLARIS FBM to the more conventional land-launched missiles and satellites.

Thus, the Division is involved in the design, development and operation of shipping, handling, assembly, checkout, erection and launch control units and systems in all their mechanical, electrical and electronic aspects.

Electrical and electronic equipment designed by the Division includes items tailor-made to checkout missile subsystems before flight; the major portion of electrical equipment used at the launch pad; the complex equipment needed to receive and record telemetry flight data; and such mechanical ground handling equipment as fuel handling and transfer units, transporter erectors, handling dollys and trailers, mobile servicing and handling units, and rolling stations. One such special digital comparator system checkout known as ACRE/Flight Test, developed by Lockheed, saves from 10 to 15 thousand man hours in final checkout of each missile, allowing complete checkout in approximately one-fourth the time needed by other methods.

Excellent opportunities are available at Lockheed in this rapidly growing field for personnel experienced in mechanical, electrical and electronic design; packaging; instrumentation; digital computer programming and analysis; modification and checkout; ground handling equipment; controls and communication; circuitry; prototype fabrication; test; and air conditioning.

If you are experienced in one of the above areas, or in related work, we invite your inquiry. Write: Research and Development Staff, Dept. F-29B, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

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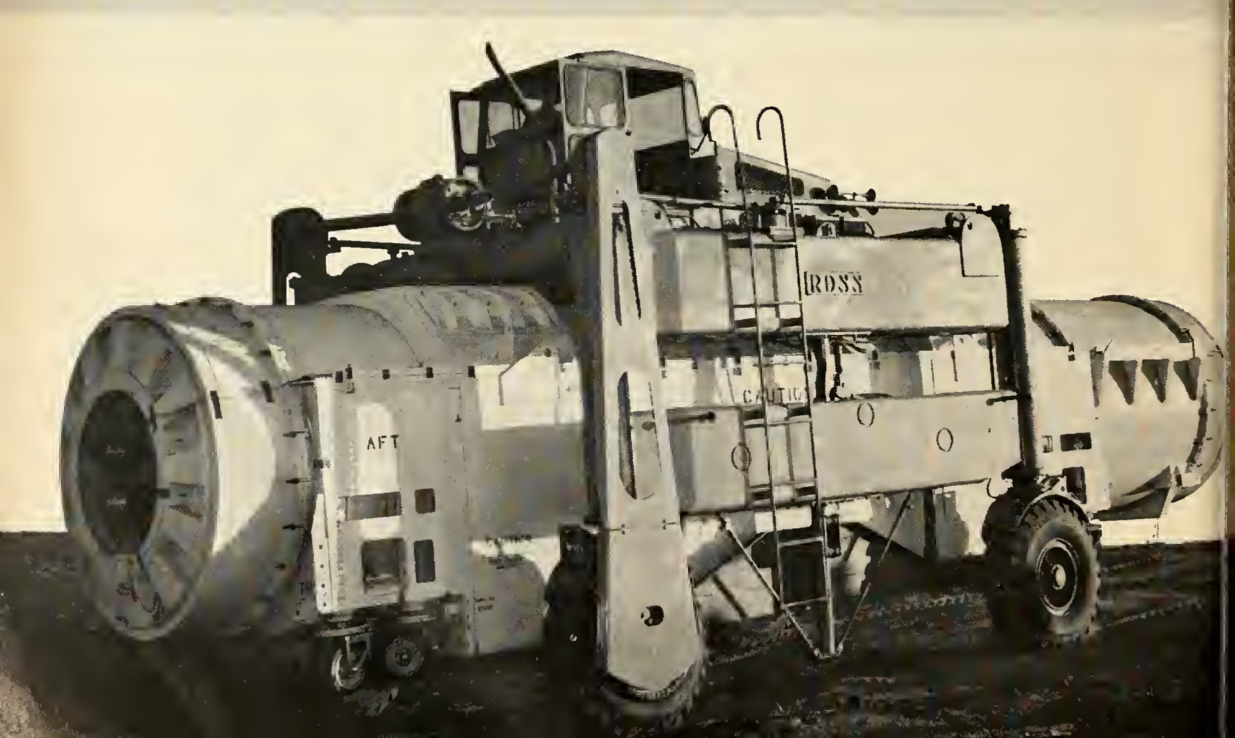

THE MISSILE / SPACE WEEKLY

missiles and rockets

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Wayne W. Parrish
President

Leonard A. Eiserer
Exec. Vice President and General Manager

Fred S. Hunter
Vice Pres. and Editorial Director

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THE COVER

ASROC poised ready for loading into a launcher aboard USS Norfolk. The Minneapolis-Honeywell missile is now officially operational. *See report on p. 9.*

JUNE 27 HEADLINES

A SPECIAL M/R REPORT

ADVANCED MATERIALS

ELECTRONICS

PROPULSION ENGINEERING

DEPARTMENTS

30,393 copies this issue

VERSATILE SD-2 SURVEILLANCE DRONE SYSTEM BY AEROJET

Designed for night and day battlefield surveillance, the Army's improved SD-2 Surveillance Drone System is an all-weather eye in the sky. In situations of general or limited warfare, the SD-2 provides the field commander with up-to-the-minute information on enemy activities. A product of Aerojet's Aeronautical Division at Downey, California, this versatile drone system features greatly improved performance and mission capability. Advanced flight testing is taking place at the Army's test station near Yuma, Arizona.

The current model carries the Army's latest sensory devices, including radar, infrared, photo transmission equipment, and high speed cameras. Stability in flight is excellent, making camera stabilization unnecessary and reducing system complexity and cost. Flight of the vehicle and subsequent recovery by parachute are remotely controlled, or supplemented by an on-board programer.

Aeronautical Division

Aerojet-General
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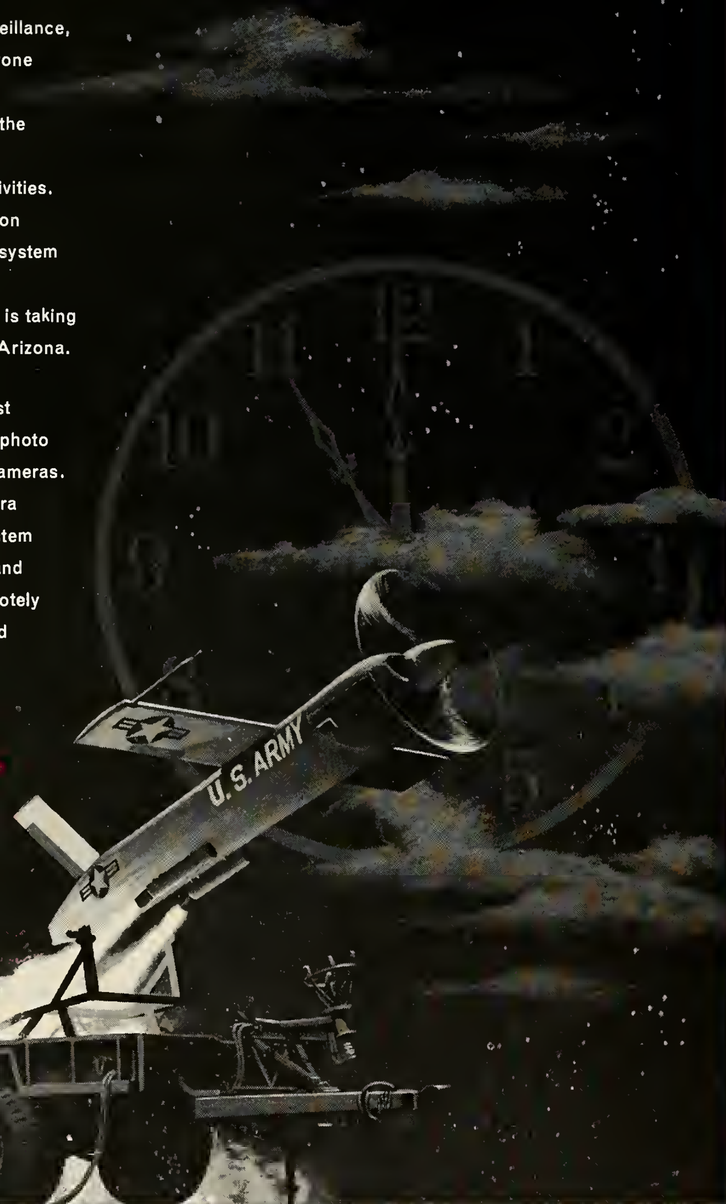


ROUND THE CLOCK SURVEILLANCE

Engineers, scientists—investigate outstanding opportunities at Aerojet

The Countdown

WASHINGTON

Samos—How Soon?

Target date for an operational Air Force *Samos* reconnaissance satellite at present is understood to be late 1963. However, COUNTDOWN is told by highly-reliable congressional sources that additional funds could shorten the development time by as much as a full year. This is still a long wait for a replacement of the sidelined U-2.

Operational Subroc Near

The Navy now expects to deploy *Subrocs* aboard the new nuclear-powered attack submarine Thresher by early next year. The Goodyear antisub missile will be launched from submerged killer submarines, fly from the water and plunge back again on enemy subs at ranges of 30 miles or more.

Fencing the Question

Management of the U.S. satellite detection "fence" will be assigned to the North American Air Defense Command, according to Washington rumors. Such a decision would resolve the Air Force-Navy battle for control. But it still would leave up in the air responsibility for research and extension of the system.

V-Bombers over Florida

RAF V bombers will join SAC bombers and tankers in R&D test launchings of the Douglas *Skybolt* down the Atlantic Missile Range. The British and U.S. planes involved in the tests will be based at Eglin AFB, Fla. The British are buying 100 *Skybolts* at $560,000 per copy.

Bigger Bang for Polaris

The Navy is considering the possibility of boosting the punch of the *Polaris* warhead. Presumably the bigger-megaton wallop would be designed for the advanced 2500-mile *Polaris* now under development.

Eavesdropping the Candidates

Sen. Stuart Symington is assuring friends that he will get the Democratic presidential nomination—IF Sen. Kennedy doesn't.

INDUSTRY

Off to the Field

Under ARDC's reorganization much of the technical staff at headquarters in Andrews AFB, Md., is being shifted to field commands where its skills will be put to more direct use. One office already has been pared from eight to one technical man.

Storable Survey

Coming soon—a contract award from Edwards AFB, Calif., for a complete survey of storable liquid propellants. Every major propulsion company is said to be hot on the trail of this one. The winner presumably will have an in on all future AF switches to storables.

Rectifier Prices Halved

General Electric's slash in rectifier prices is expected to chain-react in the semiconductor industry. Cuts are in three lines: 10 and 16-amp silicon-controlled rectifiers—47% off; 10% amp inverter series—51% off. All are used extensively in power supplies for electronics and control distribution systems, plus a variety of commercial uses.

New Interest

The new Celanese Corp. rocket venture—Amcel Propulsion Inc.—is expanding its interests to include storable liquid fuels and composite solids, in addition to its work in double-based solids. Heading up the research staff is Dr. Clayton Huggett, former research director for Rohm & Haas at Redstone Arsenal and later at Philadelphia.

No Target for Zeus

Army officials are still looking for targets with which to test the *Nike-Zeus* AICBM. They say the *Zeus* is ready but no full-scale missile or reasonable facsimile is available to try it on.

INTERNATIONAL

GE-Nord Sign SS-11 Pact

General Electric and Nord Aviation have signed a 10-year agreement giving GE a license to produce *SS-10* and *SS-11* wire-guided antitank missiles in the U.S. The agreement (M/R, May 2, p. 44) is expected to prelude a substantial buy of the missiles by the American Army.

Swedish Falcons

Sweden is getting ready to produce air-to-air *Falcon* missiles under a licensing agreement with Hughes Aircraft.

Franco-Italian IRBM

SISPRE of Italy is being approached by SEREB of France on the design of an IRBM. The two organizations also are discussing the possibility of joint production of an American missile under license.

ASROC Becomes Navy ASW Haymaker

Some 150 ships to get missile during next few years; first public evaluation exercise shows high capability

by James Baar

ABOARD THE DESTROYER LEADER NORFOLK—The trim *ASROC* antisubmarine missile is to become the new big punch of the Navy's ASW forces.

A total of 150 destroyers and cruisers are scheduled to be armed with *ASROC*'s within the next few years.

Navy missile experts disclosed the plan this last week as they officially declared the *ASROC* operational. They called the 15-foot Minneapolis-Honeywell missile the greatest ASW weapon to be developed in the last decade.

They conceded that a few adjustments were still needed. But they said the problems were nothing that would prevent proceeding into full production.

ASROC's already are prepared to go to war aboard the Norfolk and the destroyer Peary. Soon they are scheduled to be installed aboard the new destroyer leaders Preble and Dewey.

The missiles will be deployed aboard more than a dozen additional destroyer leaders, at least several cruisers, and a large number of newly rehabilitated destroyers by 1962. An informed source says that with sufficient financial backing the deployment of *ASROC*'s can be pushed at the rate of three a month.

Total installation costs are expected to be about $270 million—$1.8 million per ship. The missiles themselves cost about $22,000 each.

• **Potent and available**—*ASROC*'s deployment places on U.S. surface warships for the first time a weapon considered capable of effectively meeting the coming threat of the fast deep-diving nuclear submarines that Russia is reported to be building.

The Navy has other potent ASW weapons such as *SUBROC* under development. But these are not considered anything that would rapidly outmode *ASROC*—and they suffer from the failing of not being immediately available to fill the Navy's gaping ASW defenses.

ASROC's most important feature—its effective range—is secret. However, the missile is estimated to be capable of destroying a nuclear submarine at ranges up to about eight miles, compared to the 900-yard range of *Weapon Alfa,* the ASW rocket-boosted depth charge.

• The range of the *ASROC* missile can be increased considerably to match expected increases in the effective range of the *ASROC* system's submarine detection sonar—Sangamo Electric's SQS23.

• The effectiveness of *ASROC* can be increased by making its payload more potent—an improved homing torpedo or a nuclear depth charge.

"Just as is it's amazing," one former destroyer commander said. "You ought to see the faces of submarine skippers when we smack them at these ranges. They never heard of anything like it."

No major world power other than the United States has developed an ASW weapon considered to approach *ASROC*. The closest Russia is reported to have come is a rocket roughly comparable to *Alfa*.

All NATO countries have received information on *ASROC* and some—particularly Britain—are expected to be interested in buying it.

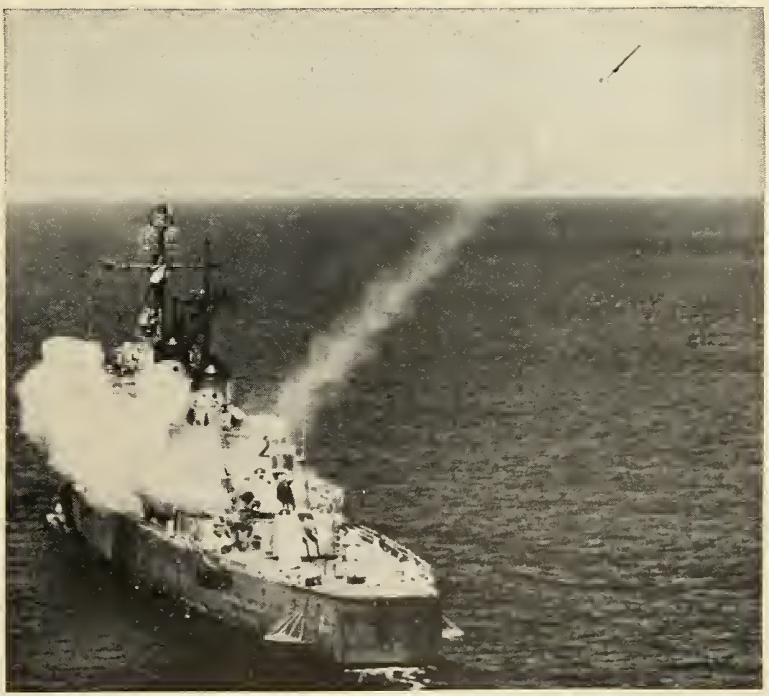
• **Premiere**—The Navy publicly revealed the capabilities of *ASROC* for the first time in a day-long evaluation exercise in the Atlantic some 50 miles southeast of Key West, Fla.

Navy crewmen of the USS Norfolk launched a total of four *ASROC*'s against the submerged nuclear-powered submarine Skate.

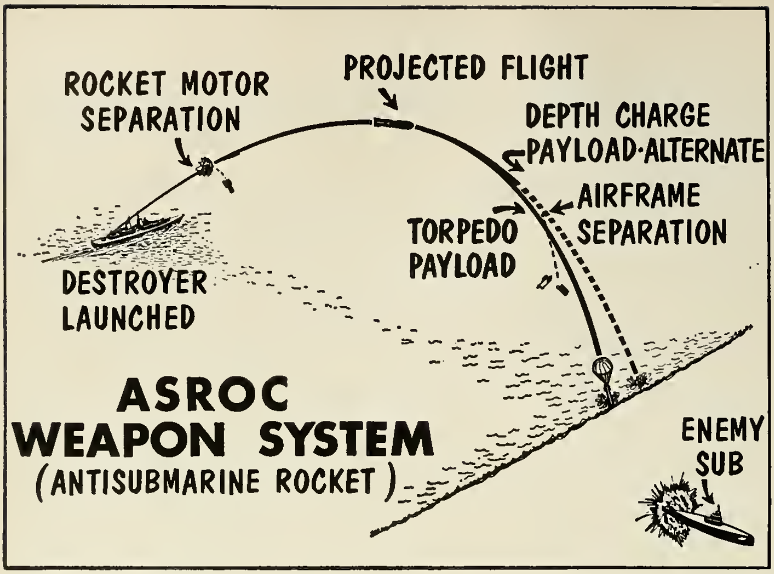
The Skate made three runs on the 7200-ton Norfolk as she cut through the warm southern sea with the destroyer, The Sullivans, trailing at her stern. Navy helicopters taking part in the evaluation tests hovered in the area.

On the first and second runs—both described as short-range tests—the *ASROC* sonar obtained fixes on the Skate at ranges of about 2500 yards.

Each time an orange *ASROC* roared into the hot June sky in seconds. The solid-propelled booster separated with a flash of flame about five second later and the warhead—a General Electric Mark 44 torpedo—arched toward the sea. About two seconds before it hit, an airframe fell away like



USS NORFOLK FIRES deadly *ASROC* during evaluation tests off Key West. The now-operational missile is unofficially estimated to be effective up to eight miles.



a banana skin and a small parachute shot out, slowing the torpedo's fall.

The Mark 44, the Navy's most advanced operational homing torpedo, shed the parachute and a protective nose covering as it entered the sea and began searching for the Skate.

• **Two for four**—Navy evaluators said preliminary reports showed the torpedo would have hit the Skate the first time if the torpedo had not automatically ceased operating as planned. They said it appeared to miss the second time.

The Norfolk fired two *ASROC*'s at the Skate when the submarine made its third run. This time the range was more than 4000 yards.

The two inert Mark 44's were not preset to cut off this time. Navy evaluators said early information indicated that one hit the submarine and the other may have.

Development of *ASROC*—A direct descendant of the defunct Navy missile program called *Rat*—began in 1956 under the direction of the Navy Ordnance Test Station and an industry team headed by Minneapolis-Honeywell.

The missile itself is powered by a single-based solid propellant developed by the Navy during World War II. The same booster can easily be coupled with the Mark 44 torpedo or a depth charge casing made by Minneapolis-Honeywell.

• **Backstopping control**—The fir control system—a development of th Librascope Division of General Pre cision—is one of the first to use digital computer on shipboard. Th system is housed in a control roon below the launching deck.

The control room is manned b two fire control men, two sonar me and an officer. They launch th *ASROC*'s from there once the ship' captain has thrown a fire switch on th bridge.

The only other crewmen needed t operate the *ASROC* system are tw gunnery mates who visually monito launchings from a control room di rectly behind the launcher. A gunner mate can launch a missile from his pos should a breakdown occur elsewhere

• **Fast reloading**—The launcher— developed by Universal Match—i unique. It resembles a modified pepper box gun.

Eight square shafts in rows of fou hold the *ASROC*'s ready at all time for launching. Each pair of two shaft can be elevated separately and the en tire box-shaped launcher can be swun in an arc of about 300 degrees.

Small doors cover the front en of each shaft. A plastic-coated dis protects the rear of each shaft from rain and the sea.

The doors are opened several sec onds before a launching. The plastic coated discs are blown out by th launching blast.

The launcher can be reloade swiftly and extra *ASROC*'s will b stored on larger ships in light alumi num shipping containers. Reloads ca be easily provided for smaller vessel from supply ships.

• **"Very satisfied"**—More than 20 test launchings were conducted durin the development of *ASROC* before i was turned over to the Navy for evalu ation this spring.

ASROC's were successfully launche from a platform moving at 30 knot at the NOTS test area at China Lake Calif. Dummy payloads were launche into water at Morris Dam, near Azusa Calif. Other dummy payloads wer dropped from airplanes into a hydro phone range off San Clemente Islan in the Pacific.

The Navy's evaluation tests throug June included only *ASROC*'s carryin the Mark 44 torpedo. A series of test with depth charge-carrying *ASROC*' is planned next.

"We're very satisfied," one Nav test officer said. "What we're doin now is looking for trouble spots and working the thing so that we can say to a skipper—'Buster, here's you system. Here's what it will do.'"

The consensus among the tes officers was that *ASROC* can do plenty

ASROC Fact Sheet

Name:	**ASROC (contraction of antisubmarine rocket)**
Dimensions:	**Length, 15 ft.; missile diameter, 1 ft.; overall diameter, 2½ ft.**
Weapon Weight:	**Approximately 1000 lbs.**
Speed:	**Nearly Mach 1**
Developed by:	**Naval Ordnance Test Station, China Lake and Pasadena, Calif., technical direction of development program.** **Minneapolis-Honeywell Regulator Co., Ordnance Div., Duarte, Calif., and Hopkins, Minn., prime contractor**
Principal Subcontractors:	**Librascope Div., General Precision, Inc., Glendale, Calif., fire-control and attack console.** **Universal Match Corp., Armament Div., St. Louis, launcher.**
Sonar Detection:	**Sangamo Electric.**
Payload:	**GE, torpedo; Minneapolis-Honeywell, depth charge.**
Development Cost:	**About $65,000,000.**

Two Satellites Orbited in One Shot

A navigational satellite system to give pin-point accuracy to *Polaris*-firing submarines last week took a major step toward its 1962 operational date with the first simultaneous orbiting of two satellites—one of them *Transit IIA*.

A third R&D navigational satellite —the *Transit IIB*—is expected to be launched in three to four months. It will carry the same basic instrumentation, but will be placed in a different orbit (20-25° angle of inclination to the equator).

Transit IIA, launched June 22, involved an almost perfect orbital injection and equipment response.

Transit IIA Statistics

LAUNCH VEHICLE 2-stage Thor-Able Star: 79.3 ft., 52.5 tons at lift-off. **1st stage:** 160 sec. burning time. **2nd stage:** 300 sec. total burning time (285 sec. initially, 18 min. coast, then restart for final injection into orbit). **Total weight in orbit:** 1500 lbs.

TRANSIT IIA Size: 36-in. dia., 223 lbs. **Orbit:** apogee, 563 statute mi.; perigee, 400 statute mi.; inclination, 65 degrees (2½ degrees low); period, 101.5 min.; approx. life, 50 yrs.; operating life, 5 yrs. (designed).

INSTRUMENTATION: 2 ultra-stable oscillators (54 or 325 and 162 or 216 mc); infrared scanner (measures spin-rate); digital clock (for precise timing); galactic-noise receiver (Canadian-3.8 mc); antenna, spiral silver paint. **Power:** silicon solar cells—2 circumferential banks; Nickel-cadmium storage batteries.

RADIATION SATELLITE Size: 20-in. dia., 42 lbs. **Orbit:** slightly higher and slower than Transit IIA; operational life, 1 year. **Instrumentation:** transmitter AM/FM-108 mc carrier, 10 channels; command receiver (to kill xmtr.); antennas—4 rigid tubes, spring-erected; two ion chambers for radiation measurement (Lyman-alpha and X-rays below 8 Angstroms). **Power:** silicon solar cells—6 patches, total 936 cells; 12-volt storage battery (9-cell).

Transit IA, a partial success, failed to orbit Sept. 17, 1959, when the third stage did not ignite. It did, however, reach planned altitude.

Transit IB, launched last April 13, was a complete success and is still transmitting data. Besides proving feasibility of the Doppler navigation-aid concept, it successfully demonstrated (1) injection and separation of the piggyback dual-satellite using a dummy second payload, (2) the despin action of its flying weights, and (3) the restart capability of Aerojet-General's *Able-Star* second-stage rocket engine.

• **Siamese satellites**—Housed within the second stage, the 3-ft. dia. *Transit IIA* was connected to a 20-in. sphere by a cable, clamp, and set of explosive bolts. The smaller satellite, developed by Naval Research Laboratory, Washington, to measure solar radiation, was separated from the second stage with the *Transit* vehicle after orbital injection. Shortly afterward, the exploding bolts effected separation and a spring propelled it upward and away from its bigger cousin.

Being in a higher orbit, its angular velocity is slower—separation rate is about 1 ft./sec.

• **Three-pronged experiment**—Although this is primarily a continuance of the navigational-aid satellite research program directed by Johns Hopkins Univ.-Applied Physics Lab. for the Navy, two other experiments are being conducted.

To perfect Doppler navigation, which is the basis of the *Transit* concept, NRL devised the smaller payload. Accuracy of Doppler measurements is affected by ionospheric perturbations and radiation intensity.

Instrumentation in the piggyback capsule will measure the Lyman-alpha hydrogen resonance line and the X-ray spectrum below 8 Angstroms. These are the only ionizing radiations penetrating the earth's atmosphere believed degrading to radio propagation.

Included within *Transit IIA* instrumentation is a receiver for measuring galactic-noise. This package was developed by the Defense Research Telecommunications Establishment (DRTE) of Canada.

The Canadian equipment will be shut down in one week when satellite spin is stopped by releasing despin weights.

• **Operational system-1962**—If all goes well, the operational *Transit* system will use four satellites, two at 22° and two at 67° inclination with each pair located on either side of the orbital path.

It is hoped that a 0.1 mile accuracy can be obtained with the operational satellites.

Shipboard equipment for use with the navigation system is now in parallel development. In mass production, eventual cost estimates vary from $2-4 thousand per ship, said the Navy.

Titan II to be static-fired in Silo

An entirely new testing procedure will be attempted with the storable liquid-fueled *Titan II*. The larger follow-on version of the *Titan* will be static-fired in its silo.

First in-silo static tests are scheduled later this year at Vandenberg AFB. Disclosure of this first attempt to run an ICBM's engines underground came after the Air Force awarded an initial $8-million contract last week to The Martin Co. for *Titan II*.

No design details of the *Titan II* silo have been disclosed. However, the one at Vandenberg—now virtually complete—has a double-ring configuration. The exhaust of the missile, which stands inside the inner ring, is deflected to the outer ring and vents above ground. This is a considerably simpler approach than earlier-suggested U-shaped silos which involved the digging of a separate vent tunnel.

If the in-silo static firing proves successful, it will mean that the Air Force would be able in wartime to reload the *Titan II* silos and fire more than one shot, although as yet no provision has been disclosed for reloading any ICBM launching pads. Combat missilemen could also use them for on-base training.

Principal features of the *Titan II* missile—expected to be operational in 1963—will be:

• A propulsion system being developed by Aerojet-General using storable hypergolic propellants (nitrogen tetroxide and a 50-50 mixture of UDMH and simple hydrazine).

• An all-inertial guidance system being developed by the AC Spark Plug Div. of General Motors.

• A greater payload capacity allowing for flights of 9000 miles or more, or heavier payloads.

The switchover to storable propellants eliminates fueling and "topping-off" operations during launch, and allows the missile to be fired from its underground silo. The *Titan* must be elevated to the surface for launching.

Possibility of enemy jamming is diminished by use of the all-inertial guidance system, though such systems thus for have not attained the accuracy of the radio-inertial system in present use.

The contract gives a permanent place to *Titan* in the nation's missile deterrent force. Mishaps in testing the first *Titan* series earlier this year had brought demands for the program's cancellation in favor of the *Atlas*.

The advanced *Titan II* will be deployed in the seventh *Titan* squadron and thereafter. So far, sites for two squadrons of *Titan II* have been announced at Davis-Monthan AFB, Tucson, Ariz., and two squadrons at McConnell AFB, Wichita, Kan.

Air Force Claims It Will Double Research Spending

Smarting from charges that it is allowing basic research to wither on the vine, the Air Force has produced figures to show that it will double spending in this area to $70 million by FY 1965.

Despite the figures, however, some question persists over whether the money would go into increased basic research or, through some semantic twist, actually be channeled more into applied research.

At the core of the controversy is the Air Force's Office of Scientific Research. Long the center of pure research sponsored by the Air Force, OSR has been made one of the operating elements of the Air Research and Development Command's newly organized Research Division. This, in the eyes of some OSR scientists, amounts to downgrading their function.

OSR Commander Col. A. P. Gagge recently protested in a memorandum the withdrawal of 10 technical vacancies, which reduced his staff to 89. He called this an indication that "a decision has been made to curtail AFOSR's responsibilities and that a new future for it is in the planning."

Adding to the dispute is a somewhat blurred line between "basic" and "applied" research, and apparently different interpretations by some Air Force officials of what direction each should take.

• **Tied to management**—In FY 1960 the initial basic research request was $34 million. This was increased to $43 million, largely through additional support for a hi-gauss magnet research facility. The 1961 budget calls for $42.1 million—a $7-million increase over the original request for this current year.

Maj. Gen. William Canterbury, commander of the Air Force Research Division (AFRD), said the Air Force plans to fund the division at a $70 million level by 1965 regardless of whether the overall AF budget is increased. As to the function of AFRD, Canterbury said it is regarded as a "management tool for all basic research in USAF, no matter where it is done, and for applied research that is not specifically tied to a weapon system."

He added that "if a piece of basic research is tied to a development, then the development command may do it —or the work can be sent to AFRD," in effect giving AFRD cognizance over all AF basic research.

"We're doing research of potential application to USAF, regardless of what it is," said Brig. Gen. Benjamin Holzman, Canterbury's deputy. He said AFRD was not trying to stop any basic research, but was working to avoid duplication.

The division, established Jan. 15, is the direct result of recommendations by a group of scientists which studied ARDC for two years. The study, headed by MIT Prof. Guyford Stever, advocated not only the reorganization of ARDC—much of which has been effected—but the raising of research to a division level to make it as important as weapon system development.

AFRD has five operating elements: OSR at Washington, D.C.; electronic and Geophysics Research Directorates, both at ARDC's Cambridge, Mass., center; the Aeronautical Research Laboratory at Wright Air Development Division, Dayton, Ohio, and the European Office in Brussels, Belgium.

• **AFRD to coordinate research**—The largest element in terms of funding is OSR, which will be getting $22.5 million for FY 1961. This office awards contracts entirely on the basis of evaluating unsolicited proposals coming largely from scientists in universities or non-profit organization[s]. Guide lines for such contracts are se[t] up for AFOSR by research plannin[g] objectives.

The other operating elements, ex[cepting] the European Office, do mostl[y] in-house research. The contracts the[y] give are solicited, are relatively smal[l] in number, and are for support re[search].

The coordinating work of Head[quarters] AFRD will be one of its mos[t] important functions, Canterbury saic[d]. For example, his division has bee[n] given management responsibility fo[r] USAF sounding rocket programs. "Now, before any rocket is sent up we shall make sure that we hav[e] spoken to all our scientists about it. Then if any of them have a worth[while] experiment to put in the rocket it will be included."

Asked if he contemplated any im[portant] changes in the operating ele[ments] of AFRD, Canterbury said, "w[e] couldn't make any major progran[m] changes now even if we want to. We'v[e] not been in business long enough."

AFRD Research Funding by Operating Elements
(IN MILLIONS OF DOLLARS)

Operating Element	FY '59	FY '60*	FY '61 (est.)
Electronic Research Directorate	5.126	9.003	3.5
Geophysics Research Directorate		2.909	3.2
Office of Scientific Research	20.683	22.322	22.6
Aeronautical Research Laboratories	7.478	6.840	7.5
All others	1.298	2.448	5.3
	34.585	43.522	42.1

* Includes FY '59 augmentation of $8.2 million for High Gauss Facility.

Unions Settle With Some Firms But New Strikes Loon

The battle by missile industr machinists for more money, extende unemployment benefits, and cost o living increases ended for certain com panies last week and threatened t close down others.

A look at the labor map at week' end showed:

• A tentative agreement has bee negotiated for Convair's 26,000 Inter national Association of Machinists em ployees at San Diego, Palmdale an Pomona, but agreement is still to b reached with Convair's off-site IAM employees at Vandenberg and the op erational *Atlas* missile sites;

• Tentative agreements are als subject to IAM and United Aut Worker member votes at Douglas;

• The strike deadlock at Lockheed' Missile and Space Division reached a impasse last week when the company' latest offer was booed down by it 10,000 IAM employees.

• 38,000 United Aircraft IAM an UAW employees are still out at th company's plants in Connecticut.

• Boeing IAM employees in fou states have voted to strike and hav turned down the company's lates offer.

• UAW employees at Chanc Vought and Bell Aircraft held one-da strikes last week and threatened to g out again "unless management offer improve."

Minuteman 3rd-Stage Fight Centers on Casing Materials

The *Minuteman* third stage competition last week shaped up as a battle between two advanced rocket case materials—titanium and fiber glass reinforced plastic.

Aerojet-General announced it has successfully fired a development model of the *Minuteman* third stage with a titanium chamber—the first time, Aerojet said, that a titanium case has been successfully demonstrated in a full-scale solid propellant motor.

Aerojet and Hercules Powder Co. are competing for the third stage—the last major contract in the *Minuteman* system. Hercules is developing a unit packed in a plastic case, similar to the Hercules-Allegany Ballistics Lab third and fourth stages in the *Scout* which uses double-base propellant.

It was learned that Aerojet is using an alpha-beta titanium alloy containing 6% aluminum and 4% vanadium. Welding details were not disclosed but it is believed the case has only circumferential welds—none longitudinally.

The Air Force financed the Aerojet titanium chamber program, which was done in-house in conjunction with Space Technology Laboratories.

Aerojet used a polyurethane composite propellant—describing it only as a "high-energy solid propellant meeting *Minuteman* specifications." The unit is light enough to be handled by two men. The additional cost of titanium is more than offset by increased range and payload possibilities, Aerojet said.

Plastic cases save even more weight than titanium and have apparently had the edge in the competition in recent weeks. However, titanium supporters have been pointing out that plastics tend to distort under moist conditions—a possibly important factor if the missile is to be stored underground for long periods.

Aerojet Protests Award of NASA Rocketdyne Contract

The National Aeronautics and Space Administration is studying a protest by Aerojet-General Corp. over the recent award of a $44-million liquid hydrogen engine contract to Rocketdyne Division, North American Aviation.

Meanwhile, it was learned that copies of the protest—in a letter from Aerojet President Dan A. Kimball to NASA Administrator T. Keith Glennan—have been given to members of the House and Senate committees on space.

A NASA spokesman said the agency will reply to Aerojet in due course.

Aerojet noted that NASA has contracts with Rocketdyne for development of the 1½-million-lb.-thrust F-1 engine, supply of the H-1 *Saturn* booster engines and Project *Rover* nuclear rocket component hardware, in addition to the 200,000-lb.-thrust liquid hydrogen-LOX engine contract awarded June 1. An Aerojet source said NASA officials have already indicated that Rocketdyne eventually will be awarded a contract for development of a nuclear engine.

Rocketdyne declined comment on the protests.

Goddard Staff Begins Move to New Headquarters

The vanguard—a particularly apt simile—of the staff of Goddard Space Flight Center has moved into its big new headquarters in the Washington suburb of Greenbelt, Md.

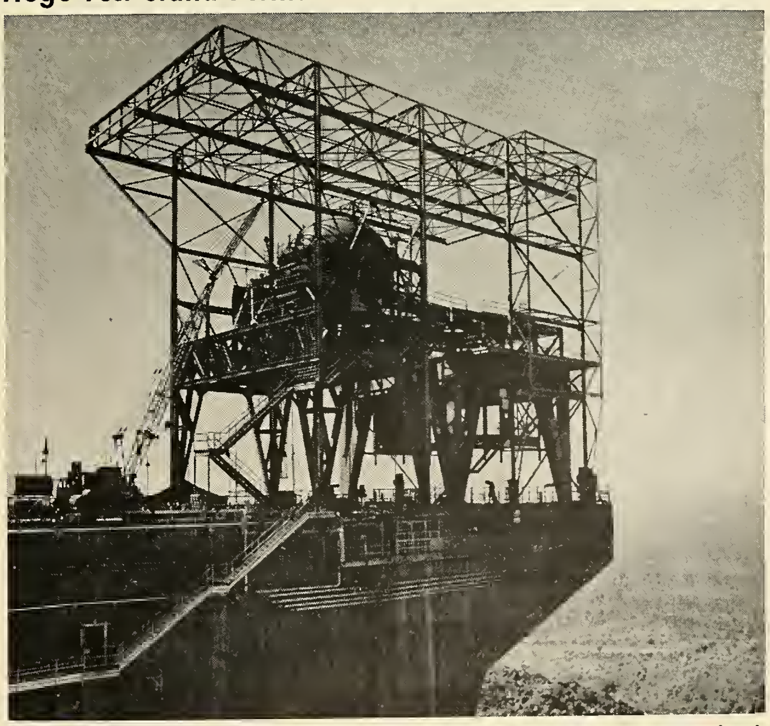
About 30 technicians have begun operating two computers in one building of the Goddard Center, a major division of the National Aeronautics and Space Administration. The bulk of the agency's staff, now scattered in several locations in Washington, will begin moving into the center in late summer, when the first two of six buildings are fully ready for use.

The Goddard center, which was formed by NASA around a nucleus of the Navy's old *Vanguard* group, is responsible for developing payloads for NASA's sounding rocket and satellite programs. It will be the data center for all space programs. Goddard also supervises the manned space flight program.

Goddard has a staff of 1200 at present. The NASA FY 1961 budget calls for an increase up to 2000. Activities now are at the Naval Research Laboratory and the Naval Receiving Station in Washington and a rented building in Silver Spring, Md.

The first two buildings at Greenbelt will be completed and the staff will move in the latter part of August. Two IBM 709 computers are already in operation in one of these buildings. Two more computers—the complex IBM 7090s—are to be installed shortly.

Huge Test Stand Forms



STATIC TEST STAND for Rocketdyne's 1.5-million-lb.-thrust F-1 rocket engine is nearing completion at Edwards Air Force Base, Calif. Approximately 500 tons of structural steel were used in the massive framework built by Kaiser Steel. First test firings are scheduled for early next year. Aerojet-General, A-E prime for the project, says the stand will ultimately accommodate 6-million-lb. engines.

Douglas Cites Drop in Plant Area

Plant area required in the aerospace industry to fill defense orders has dropped 50% since 1957—from 60 million to 30 million square feet—and is expected to be cut in half again over the next three years.

This dramatic reduction has been caused by the shift in emphasis from aircraft to missiles and satellites, sharply increased combat capability of aircraft still being produced, and the advent of nuclear weapons, according to Deputy Defense Secretary James H. Douglas.

In a recent speech before the Board of Governors of the Aerospace Industries Association at Williamsburg, Va., Douglas said that efforts to move toward controlled arms reduction are also bringing "new elements of uncertainty into defense and industry planning."

"There are no ready answers to the problems that industry faces," he said. Industry and the Pentagon "are caught up . . . in a series of moving equations, for which the solutions will depend on circumstances and factors that are still unresolved."

But Douglas said he was confident that industry would be able to make the necessary adjustments. He said DOD would help to "minimize" the effects.

To illustrate the problems, the defense official cited these additional statistics:

- In 1953, the Air Force alone accepted nearly 6000 aircraft; the total for all services was nearly 11,000. In 1959, production declined to less than 3000 for all services, while production is estimated at 2200 this year.
- Total DOD spending increased from about $35.5 billion in FY '55 to $41 billion in FY '59; aircraft and missile expenditures increased by nearly $2.2 billion. But aircraft expenditures, which in 1955 totalled $8 billion compared with less than $1 billion for missiles, in FY '61 will amount to only $6 billion as against $3.5 billion for missiles.
- With aircraft becoming more costly and missile expenditures increasing, producers of electronic and other advanced equipment have received a bigger share of aircraft and missile procurement dollars.
- Aeronautical products exports have declined from about $1 billion in 1956 and 1957 to $750 million in 1959. Britain's efforts to encourage consolidation of its aircraft industry will in some degree increase U.S. industry's problems with competition both home and abroad.
- If consolidations or mergers should be necessary to retain essential U.S. aerospace skills and capacities, DOD will have a "real interest in exploring the probable effects of any such proposals."

mergers and expansions

REMINGTON RAND UNIVAC has formed a Reliability Engineering Dept. to centralize its reliability efforts. Some 50 component, circuit and failure analysis engineers and statisticians will work in the department under the direction of G. A. Raymond, former assistant project manager for one of Univac's navy computers.

ALLIS CHALMERS MFG. CO. has purchased 50% of the common stock of Consolidated Systems Corp., Monrovia, Calif., from Bell & Howell's Consolidated Electrodynamics Corp. The firm will be operated jointly by Allis Chalmers and CEC.

DACO INSTRUMENT CO. has acquired the Motoroid Division of Leetronics, Inc. . . . Wilcox Electric Co. of Kansas City has formed a Magnetics Division . . . Kelvin Electric Co. has sold its Magnetics Division to Datafilter, Inc., both of Van Nuys, Calif.

TENS CORP., (The Electro Nuclear Systems Corp.) of Minneapolis has completed initial financing with public sale of 650,000 shares of stock. TENS will engage in R&D and manufacture of systems and equipment for government and industry, particularly in automation, data processing, weapons and missile systems, medical and nuclear electronics.

TELEX, INC. has purchased Aemco, Inc., Mankata, Minn. manufacturer of components for the electrical and electronic industries. Telex earlier this year acquired Ballastran Corp., Ft. Wayne, Ind., and a one-fourth interest in Electro-Logic Corp., Venice, Calif.

OHIO SEAMLESS TUBE has contracted for a factory structure to house its new welded tube mill at Shelby, Ohio. The 460-ft. long building is scheduled for completion Oct. 31.

MINIATURE PRECISION BEARINGS has opened a sales office in Redwood City . . . The DeVilbiss Co. has integrated its subsidiary, De Vilbiss Metal Fabricators Co., making it a division of the company.

GENERAL ELECTRIC will add another 260,000 sq. ft. of office, engineering and manufacturing space to its transistor and tunnel diode facilities in Electronics Park within the next few months. This will bring GE's Syracuse facilities for manufacture and sale of transistors and related electronic components to 450,000 sq. ft.

POLARAD ELECTRONICS CORP. has added a 100,000 sq. ft. building to its Long Island City production facilities, bringing its total plant area to almost 250,000 sq. ft.

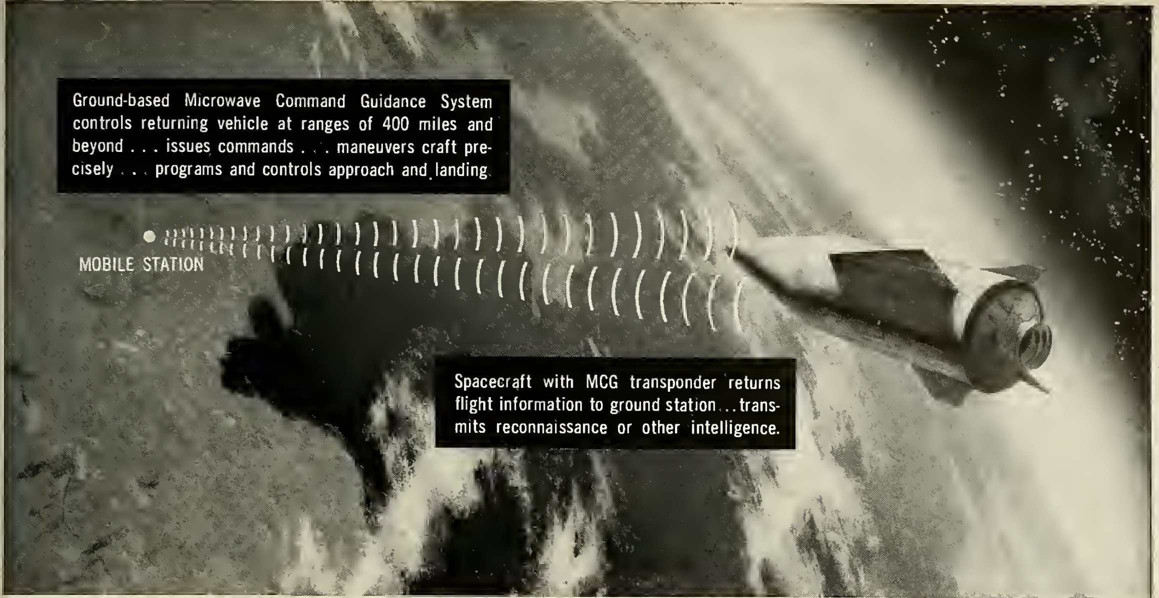
APPLIED PHYSICS LABORATORY of Johns Hopkins University, has contracted to construct a two-story, $310,000 building to house experimental radar equipment and scientific research staff. The building will be used for experimental evaluation of APL-developed search and guidance radar and weapons direction finding equipment for BuWeap, Navy Dept. Completion of the building is scheduled for late October, 1960. It will be located in Howard County, between Washington, D.C., and Baltimore, Md.

financial

IMC Magnetics Corp.—Net sales for the fiscal year ending Feb. 29 rose 43½% to a record high of $4.4 million. Profits dropped to $25,841 from $105,589. Company spokesmen attribute this to large-scale investment in R&D and a 100% expansion of IMC's Westbury plant. Current backlog nears $2 million.

Northrop Corp.—Sales and profits slipped somewhat for the nine months ending April 30. Net income was $5.31 million compared to $5.35 million for the same period in the previous year. Sales amounted to $170. million, compared to $195.8 million for the corresponding 1959 period. Northrop President Thomas V. Jones reports an upward trend this fiscal year.

Dynatronics, Inc.—The three-year old firm predicts gross revenues for the current fiscal year of $2.7 million, nearly $1 million more than in 1959.



How Sperry Puts Spacecraft "On Instruments"

SPERRY 50 YEARS 1910 1960

One of the big questions in returning spacecraft to earth—how to "steer" with precision—is being answered by Sperry. Sperry's Microwave Command Guidance System, developed with the Air Force, will fly any kind of vehicle remotely 400 miles and beyond, exercising levels of precise control far beyond the ability of a skilled pilot.

Sperry Microwave Command Guidance can establish the optimum approach path and provide accurate landing control. It issues high-speed commands, monitors performance, plots course, transmits intelligence in both directions. It can control any reconnaissance vehicle, as well as returning spacecraft, and is ideal for test-range instrumentation applications.

Already proven in remote control of supersonic vehicles, MCG is a compact, mobile package in an air-transportable van . . . can also "go airborne" to avoid terrain problems and extend range. Write for system information pertinent to your project.

SPERRY PHOENIX COMPANY, *DIVISION OF SPERRY RAND CORPORATION, PHOENIX, ARIZONA*


...NEWS IS HAPPENING AT NORTHROP
This thirty-first parachute decal denotes the successful completion of as many surveillance missions. Informally dubbed "Repeater" by its crew, this is not an unusual SD-1. Many Radioplane SD-1 drones have exceeded "Repeater's" record, because Radioplane designs these systems to be rugged, simple, and *reliable.*
"REPEATER"

Technical Countdown

ELECTRONICS

Explorer VII Channel Fails

Failure of a multiplexer has made signals on one of four channels from *Explorer VII* unreadable since June 13. The malfunction cut off data on solar far UV and soft X-rays, heavy cosmic radiation and operation of a solar cell. Three channels still in operation are carrying information on other cosmic radiation, radiation balance and temperature. Meanwhile, NASA has issued its promised *Explorer VII* telemetry code in a publication (TN D-484) available to scientists around the world.

24-hr. Satellite Study Nears Completion

General Electric has substantially completed research into the feasibility of communications satellites. Aimed ultimately at the 24-hour satellite, the study conducted for the Army covered five major areas: satellite electronics, reliability, environment, noise sources, and anti-jamming.

New Radar Scans Electronically

A computer-controlled radar being built by Bendix will be able to track simultaneously space vehicles and low-altitude aircraft. Multiple electronic search and track beams eliminate conventional mechanical scanning. The ESAR (Electronically Steerable Array Radar) is being built for ARPA and the Air Force under a $4-million contract.

Two for the Price of One

Successful orbiting of the 223-lb. *Transit IIA* included first practical use of a piggy-back secondary satellite. The smaller 42-lb. sphere contains solar radiation measurement devices. The feasibility of orbiting dual payloads was proved out with *Transit IB* in April, when the vehicle was separated from a simulated second satellite.

Performance Up, Cost Down

New high-speed, solid-state digital computers not only outperform previous systems—they save money. When the second of a pair of IBM 7090's is installed at Marshall Space Flight Center, Huntsville, they will replace three machines, require only one shift, and cost $50,000 a month less. (See story p. 34.)

PROPULSION

Plastic Key to Success

A plastic insert in its steel nozzle has contributed greatly to success of the Army's *Pershing* test program. *Pershing*'s single nozzle is believed to be the largest under current development.

9-Foot Apache Flies High

The new Thiokol/New Mexico State Univ. *Apache* sounding rocket carried a 35-lb. payload to almost 40 miles altitude in a test earlier this month. Gross weight of the 104-in.-long, 6¾-in.-dia. motor is 223 lbs.

MATERIALS

Super Strength Steel Due Soon

Designed specifically for missile cases, super alloy MX-2 will be made available soon by its developers, Scaife Co. Pressure vessels fabricated from the new steel have been hydrostatically tested up to 280,000 psi burst pressure without failure. The cobalt-modified alloy has two to three times the strength of normal construction steels but is easily rolled, deep drawn, welded and machined. (See story p. 31.)

Lunartics on Water Wagon

Solar energy may provide water for future moon explorers, according to Dr. Jack Green of North American Aviation. Water can be extracted from volcanic rock through heat supplied by focusing the sun's rays through a Fresnel lens. The process presumes existence of volcanic lunar rock.

"T-1" Castings License Issued

Alloy Steel & Metals Co., has obtained a license from U.S. Steel to produce "T-1" steel castings. Possible applications include GSE and missile launch systems where strength and light weight are necessary for airlift operations.

Helium Plant Fabricator Error

The Navy's mobile liquid helium plant was built by Air Products Inc.—not Air Reduction Inc., as reported in TECHNICAL COUNTDOWN, June 6.

ASW ENGINEERING

New Technique Saves Sonobuoys

Sonobuoy manufacturers are wondering what the "Circling-Line" sonar-search concept will mean to their market. The Navy, trying to limit use of expendable gear, has Douglas Aircraft's Johnsville Lab developing the technique, in which a patrol aircraft lowers the sonobuoy on cable, makes a complete listening circle, retracts gear and moves to another area. With correct turn radius and speed, the sonobuoy remains virtually motionless.

Ike Supports New Ocean Study

The White House has announced support of an intensive IGY-type oceanographic study of the Indian Ocean. The National Academy of Sciences will direct the four-year program. Up to 20 vessels (Navy-supplied) and 350 scientists will participate. A basic research program, it should give the Navy welcome information (ocean-floor charting, shoal locations, current variations, and meteorological data).

Need for New ASW Aircraft

Data retrieval still is a serious problem for ASW aircraft forces. Fleet personnel have healthy respect for the existing S2F and P2V and their successors S2F-3 and P3V, but still higher performance craft are needed. They're looking toward a turbo capable of 4-hour patrol duty and speed bursts up to 400 knots.

A Special M/R Report

Drone Market Undergoes Drastic Transition for Future

- ***Future missile and satellite weapon systems probably will include target drones as part of the complete package—a drastic change from today's separate procurement.***
- ***Research is now under way by the services on whole new families of target drones.***
- ***Pressure is on to reduce the unit costs of both surveillance and combat drones.***

IMPROVED SD-2 successfully flown on first attempt.

Directory of U.S. Drones Starts on p. 22

A LITTLE-RECOGNIZED revolution is taking place today in the American market for airborne and space-travelling drones.

With the increasing dominance of missiles and the relative decline of military aircraft, the drone market is going through a radical transition that should be completed by the mid-60's.

By then the Armed Services expect to have four great new families of drones:

- The missile target drone for testing both tactical and strategic antimissile missile systems and for training AICBM crews. These drones will be needed not only to provide targets for such land-based systems as *Nike-Zeus* and *Mauler* and sea-based systems such as *Typhon,* but for space-based systems now on drawing boards.
- The spacecraft target drone for testing antisatellite and antispacecraft systems that will be needed to combat such enemy systems as reconnaissance satellites and other military space vehicles.
- The surveillance drone for a wide variety of reconnaissance missions.
- The combat drone for the dissemination of chemical and biological agents.

Although considerable work has already been done in all of these areas, major development of the systems needed is still ahead. Such systems call for new materials, smaller and more effective electronic systems and propulsion systems that must be improved in a number of ways.

Above all, the military services are pressing for a reduction of cost.

In recent years, the rising cost of drones has made their use in many cases almost prohibitive. Many drone experts doubt that this trend can be reversed in the field of missile and space drones, but they are optimistic about reducing the cost of surveillance and combat drones.

The FY 1961 military budgets for

SPERRY MICROWAVE command system: missile target (1) is controlled by airborne director (3), which relays the microwave signals from ground director station (2).

drones clearly reflects the changes that are taking place.

The three military services plan to obligate about $100 million, a $30 million drop from last year. This is mainly attributable to a hiatus caused by a decline in production of drones for aircraft and the beginning of the full development of the drone systems of the future.

• **Costly sophistication**—The Navy money for powered aerial targets including expensive support equipment jumps up $4.4 million in the next fiscal year to a total of $25.3 million. Oddly enough, this money will buy only half the number of targets bought with lesser amounts of money in either FY '58 or FY '59. Reason is that the Navy is asking for more sophisticated and thus higher-priced vehicles.

Emphasizing this point, a Navy spokesman pointed out that his service's training targets have risen from a cost of a few thousand dollars each to between $70,000 and $100,000. Price tags on targets to test out weapon systems now read as high as $500,000 per vehicle. In some instances, there is as yet no adequate target and the Navy must use analytical means to find out the performance of a weapon system.

"This trend will continue," added the Navy spokesman. "Within the next five to ten years the number of targets we buy will keep lessening, but the total cost for the vehicles and supporting equipment will go up because of our need to simulate realistically a manned aircraft threat."

There has been talk in the Navy that money might be saved if the aerial targets used for training its personnel were replaced by analog computers. Most line officers believe, though, that no analog computer can adequately simulate the field environment. These men say that the psychological conditions that exist in the field and the seemingly trivial incidents that arise, like a man tripping over a wire, are all essential experience that a computer can never give a man.

• **AF sees new target needs**—The Air Force will be spending about half as much in FY '61 as they did in FY '60. This is a drop of nearly $28 million. Reasons given are: (1) The programs for air-breathing targets have advanced to a point where development money can be cut. (2) Because of AF emphasis on ballistic missiles, the air-breathing weapons and their targets will get less consideration.

This cut in money has been called a "leveling-off" process. As one AF colonel put it, "We're going to have to simulate aircraft for a long time to come and to do this we're going to continue needing appropriate targets." Hence it is expected that the $26-million FY '61 figure will remain more or less steady for the next few years.

Plans of the AF indicate a future requirement for ballistic targets, and could involve substantial amounts of money. These will be targets for missile defense systems and for aerospace defense systems. Money has already been spent on studies, which may develop into R&D ones in the near future.

• **Part of weapon system**—A new trend for funding targets for weapon system evaluation is becoming apparent. For example, funding of an AF advanced target for R&D work will probably fall under the budget for the weapon system that the target is evaluating. This is a change from the way such targets are financed now, independent of the weapon system. However, the new method is in line with a June 1958 OSD memorandum to the three service Secretaries.

The directive calls for each service to examine its targets used for R&D work to see whether they are good enough to do the job at hand. If not, then a target should be developed to suit the needs, even if this means making a new target for each weapon system. The memorandum directs that money for the targets be included in the missile system budget.

This means that for highly sophisticated weapon systems, a parallel development might be that of its target. Important is that the OSD memorandum calls for no change in handling training target requirements which "will continue to be justified under the present procedures and budgeting methods."

• **Army target & drone money to rise**—The Army will be spending almost $40 million in FY '61 for powered aerial targets and combat surveillance drones. This is considerably more money than either of the other two services are spending. It is also a figure that will probably go much higher during the coming years. Three factors indicate more money will be spent:

(1) Since 1957, $88 million has been spent for the RDT&E work on combat surveillance drones *SD-2*, *SD-4* and *SD-5*. An advanced version of the *SD-2* was successfully test-flown last April, and the first flight of the *SD-2* took place in May. The *SD-4* is scheduled for flight testing early this fall. Production contracts are anticipated for each of these birds, which after the initial R&D vehicles are delivered, should significantly raise the FY '62 funding over the FY '61.

(2) With the Army's responsibility for point defense against missiles goes the responsibility to get aerial targets to simulate missiles. For example, the *Jupiter* was recently modified for a mission as a target for evaluating the *Nike-Zeus* weapon system. Although the project is now under review, this does not change the eventual need for tar-

gets for antimissile missiles. Using the missiles themselves is felt to be much too expensive.

(3) The Army is only now beginning to tap the enormous potential of the combat surveillance drone. Although the fact is not being given much publicity, the Army Chemical Corps Research and Development Command is very much interested in using such drones as carriers in chemical and biological warfare. For the past year, the Command has been consulting with industry about the possibilities for such use and has been encouraging studies of the problem.

Four functions are required of a surveillance drone. (1) To give timely and accurately the coordinates of potential targets. (2) To detect enemy intrusions of the battlefield. (3) To detect all nuclear detonations in the battlefield, hostile or friendly. (4) To transmit intelligence to the field commanders fast enough to do some good, in most instances, immediately.

Beyond these standard missions, the surveillance drone system may be used to gather weather and terrain data and then enlarged to include missions such as: weapons carrier, decoy, enemy harassment, countermeasures, short-range observation, air-sampling, supply and communication.

Other possible applications are mapping, training, system exercise, weapon evaluation and research.

• **Targets by appointment**—A trend that is gaining high favor in the Army is for manufacturers of targets to contract to put their vehicles in the sky where and when the Army wants them. In this way, the service gives the entire problem of target presentation to the manufacturers.

Lockheed, operating under one such contract, is making presentations with its *Q-5* for weapon system evaluations; Radioplane is making presentations with its *RP-76;* and Beech, with its *KDB-1.*

The advantage of this service is that the military does not have to train personnel in the special skills needed for target operation and maintenance. Thus the Army can assign personnel to the primary duty of testing systems and shooting down targets instead of to the supporting activity of target presentation.

There are significant economies for the Army, according to Radioplane project engineer Jack Pfarr. One instance given is that the engineers responsible for target presentations are permanent and experienced employes, residing in the area in which they are working. Thus they do not have to be trained every few years, as would be the case with military personnel in view of their turnover, they are not paid per diem, and they have usually grown up with the systems.

The Army likes the idea so much that the Redhead and Roadrunner competition for target drones, which is being processed now, will probably include in the resulting contract some provisions for contractor operations.

On the other hand, neither the Navy nor the AF are encouraging these services. The Navy feels that there is no room on its ships nor money for a near-permanent staff of civilians. The AF takes a similar stand in saying it does not want to pay for civilian technicians to reside at overseas bases. Yet the Navy and AF leave the door open for contractors to arrange to present their targets over domestic bases.

• **Which propulsion system best**—There are four basic propulsion types being used in targets and drones. These are the piston engine, the turbojet, the ramjet and the rocket. Each has its domain, depending on the use to which the craft will be put, and each domain is fairly well defined.

The main technical argument involves—as it has for a number of years in other circumstances—the question of whether in the rocket field the solid or the liquid propulsion system is best.

Where relatively long-duration, low-speed and low-altitude performance is required, the piston engine is apt to be chosen. Examples are Radioplane's 160-knot *SD-1*, which uses a McCulloch engine; and Aerojet-General's *SD-2*, which uses a Lycoming engine.

For relatively long-duration missions but ones with moderate speeds and altitudes, the turbojet with or without afterburning is a likely candidate. Examples here are Republic's *SD-4* and Fairchild's *SD-5*, each powered by Pratt & Whitney's J60 engine. This is a small, high-performance powerplant

(Continued on p. 30)

Annual Funding for Aerial Targets And Combat Surveillance Drones

ARMY

(in millions of dollars)

Aerial targets, powered (Does not include support equip.)	FY '58	FY '59	FY '60	FY '61 (est.)
Procurement	10.0	9.0	31.1	28.5
RDT&E	. . .	3.0	4.7	0

Combat surveillance drones (Does not include support equip.)	FY '57	FY '58	FY '59	FY '60	FY '61 (est.)
Procurement	——— 15.6 ——→			5.5	↑ 11.0 ↓
RDT&E					
SD-1	? ——→				
SD-2	10.0 ——→				
SD-3	? ——→				
SD-4	30.0 ——→				
SD-5	48.0 ——→				

NAVY

(in millions of dollars)

Procurement and RDT&E (Including all support equip.)	FY '58	FY '59	FY '60	FY '61 (est.)
Aerial targets, powered	20.6	20.2	20.9	25.3
Tow targets	7.5	3.0	5.4	7.8

AIR FORCE

(in millions of dollars)

Procurement and RDT&E (Does not include support equip.)	FY '58	FY '59	FY '60	FY '61 (est.)
Aerial targets, powered	40.2	46.7	53.9	26.0
Tow targets	. . .	. . .	7.0	. . .

Aerial Targets and Combo

DIRECTORY

Q-5 (Kingfisher)

ARMY

Q-5 (Kingfisher)

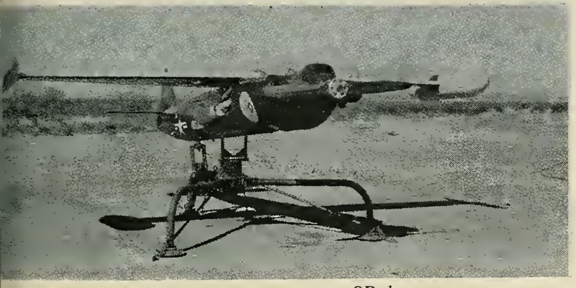
Manufacturer Lockheed Aircraft Corp.
Mission Target for surface-to-air weapon system evaluation
Status In inventory
Speed Mach 3 at 80,000 ft.
Altitude 80,000 ft. operational
Endurance 9 to 11 min. after climb to 60,000 ft.
Launch Air-launched from B-50
Propulsion Underwing boosters until Marquardt ramjet takes over
Recovery Parachute and landing spike
Flight Control Programed and command control override
Span/Length/Height (ft.) 10/39/1.7
Gross Weight, without payload 7600 lbs. plus
Augmentation Luneberg lens passive radar
Notes Derived from Air Force X-7A system

RP-76

RP-76

Manufacturer Radioplane
Mission Target for surface-to-air weapon system training
Status In production
Speed Mach 0.9 at 40,000 ft.
Altitude 40,000 ft. operational
Endurance 8 to 9 min. at 40,000 ft.
Launch Air-launched from fighter-type aircraft bearing external store pylon
Propulsion Aerojet-General 53ONS-35 end-burning solid-propellant rocket engine
Recovery 2-stage parachute
Flight Control Programed and command control override
Span/Length/Height (ft.) 5/9.7/1.5
Gross Weight, without payload 300 lbs.
Augmentation Luneberg lens passive radar
Notes Production contract for 400 craft

urveillance Drones



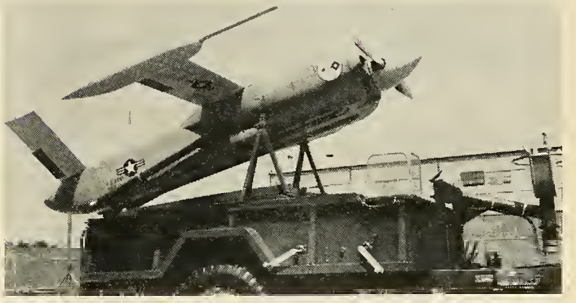
SD-1

SD-1

Manufacturer Radioplane
Mission Combat surveillance
Status In production
Speed 160 knots at sea-level
Altitude 15,000 ft. service
Endurance 40 min. at sea-level
Launch Zero-length
Propulsion McCulloch 4-cylinder, 2-cycle air-cooled engine driving a 44" dia. propeller
Recovery Single-stage parachute
Flight Control Proportional command control system
Span/Length/Height (ft.) 11.5/13.4/2.6
Gross Weight, without payload 430 lbs.

SD-2

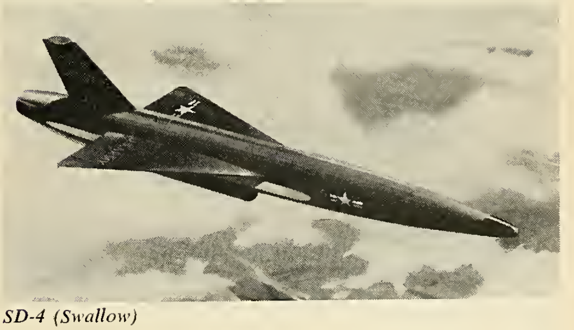
Manufacturer Aerojet-General Corp.
Mission Combat surveillance
Status Advanced flight testing
Speed, est. 300 knots at sea-level
Altitude, est. 5000 ft. operational
Launch Zero-length with two rocket assist boosters
Propulsion Lycoming IMO-360-B1B air-cooled 4-cylinder, 225 hp. engine
Recovery Parachute
Flight Control Programed and command control override
Span/Length/Height (ft.) 13.3/16.1/3.6
Gross Weight, without payload 992 lbs.
Notes Improved version of SD-2 was successfully flight tested in April, 1960



SD-2

SD-4 (Swallow)

Manufacturer Republic Aviation Corp.
Mission Combat surveillance
Status Under development
Launch Zero-length with Thiokol rocket booster
Propulsion Pratt & Whitney J-60 turbojet rated at 3000 lb. sea-level static thrust
Recovery Parachute plus landing bags
Flight Control Programed or controlled by mobile ground or airborne command
Notes Craft scheduled for early fall, 1960 flight testing



SD-4 (Swallow)

SD-5

Manufacturer Fairchild Engine and Airplane Corp.
Mission Combat surveillance
Status Under development
Speed High subsonic
Launch Zero-length
Propulsion Pratt & Whitney J-60 turbojet rated at 3000 lb. sea-level static thrust
Recovery Parachute plus landing bags
Flight Control Programed and command control override
Span/Length/Height (ft.) 24/36/8
Notes Craft was successfully test-flown in May, 1960

SD-5

Additional ARMY targets:

- KDB-1, under Navy listing
- OQ-19B, under Air Force listing
- "Notes," in Air Force listing of Q-2C

NAVY

KDB-1

KDB-1

Manufacturer Beech Aircraft Corp.
Mission Target for air-to-air and surface-to-air weapon system training and evaluation
Status In production
Speed 275 knots at 25,000 ft.
Altitude 40,000 ft. service
Endurance 60 min. at 25,000 ft.
Launch Zero-length with JATO, or compressed-air catapult
Propulsion McCulloch 6-cylinder, 2-cycle supercharged air-cooled engine driving a 52" dia. propeller
Recovery Single-stage parachute
Flight Control Command with automatic stabilization
Span/Length/Height (ft.) 12.5/13.5/3.5
Gross Weight, without payload 600 lbs.
Augmentation Reflectors in wing pods and tail cone for radar tracking
Notes Craft also being used by Army

XKD2B-1; WS462L

XKD2B-1; WS462L

Manufacturer Beech Aircraft Corp.
Mission Target for air-to-air weapon system training and evaluation
Status Under development
Cognizant Services XKD2B-1, Navy; WS462L, Air Force
Speed Mach 1.5 and Mach 2.0 at 70,000 ft.
Altitude 70,000 ft.
Endurance 5 min. at 70,000 ft.
Launch Air launched from fighter-type craft
Propulsion Liquid rocket made by Rocketdyne
Recovery Self-destruct
Flight Control Programed system with automatic stabilization
Span/Length/Height (ft.) 3.25/12.8/1.4
Gross Weight, without payload 560 lbs.
Augmentation Installations for radar and infrared reflectivity
Notes Arranged as a Navy-Air Force joint venture. Operational in 1962.

KD2U-1

KD2U-1

Manufacturer Chance Vought Aircraft, Inc.
Mission Target for air-to-air and surface-to-air weapon system evaluation
Status In production
Speed Mach 2 class at 60,000 ft.
Altitude Over 60,000 ft. operational
Launch Rail using rocket booster
Propulsion G. E. J79-3A turbojet with afterburner
Recovery Airplane-type landing with parabrake
Flight Control Programed and command control override
Span/Length/Height (ft.) 20.5/57.5/12.5
Gross Weight, without payload 21,000 lbs.
Augmentation Compatible with standard systems
Notes Converted from Regulus II design; in operational use by Navy and Air Force

Additional NAVY targets:

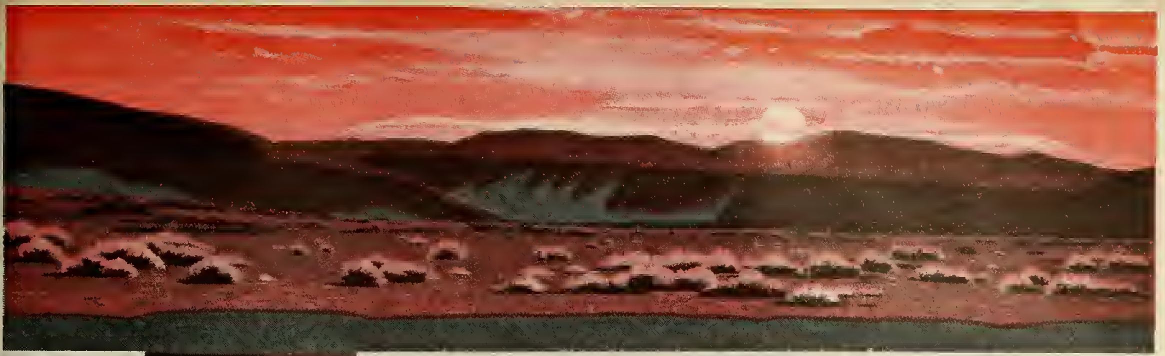
- KD2R-5, under Air Force listing
- "Notes," in Air Force listing of Q-2C

AIR FORCE

KD2R-5

OQ-19D; OQ-19B; KD2R-5

Manufacturer Radioplane
Mission Target for surface-to-air missile and gunnery training
Status In production
Cognizant Services OQ-19D and OQ-19B, Air Force and Army; KD2R-5, Navy
Speed 193 knots at sea-level
Altitude 23,000 ft. service
Endurance 60 to 90 min. at sea-level
Launch Ground launched and can be fitted for air launch; except KD2R-5, which can be ground-launched only
Propulsion McCulloch 4-cylinder, 2-cycle air-cooled engine driving a 44" dia. propeller
Recovery Single-stage parachute
Flight Control OQ-19B, command control with automatic stabilization; OQ-19D, command control; KD2R-5, proportional command control with automatic stabilization
Span/Length/Height (ft.) 11.5/12.2/2.6
Gross Weight, without payload 327 lbs.
Augmentation Two wing-tip radar reflector pods are optional on OQ-19B; are standard on KD2R-5; are not provided for on OQ-19D
Notes Thousands of these craft have seen service in U.S. and abroad



SEALED IN A SECRET SILO

Somewhere in a wasteland, the Air Force Minuteman will keep its lonely vigil all through a thousand nights. Buried and untended, it must be ready to spring to life if the button is ever pushed.

Minuteman poses a real challenge to the New Reliability —reliability which must guarantee successful firing at any moment in the far future. Each of the missile's systems, each of its thousands of electronic components, must function perfectly at that given moment. For once the missile is lowered into its silo, no human hands again need touch it.

The Minuteman's critical guidance and control system has been entrusted to Autonetics. We are proud to be a member of this United States Air Force missile team.

Once again America's defense force reaps the harvest of Autonetics' pioneering. A decade of experience with major projects has given Autonetics a unique capability in systems management—and in meshing its work with that of other companies in building modern weapon systems.

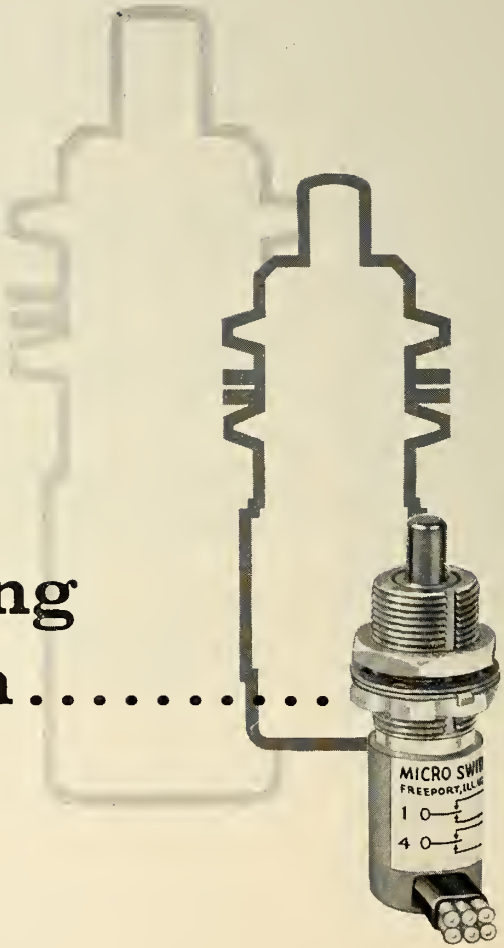
Guidance Systems by Autonetics

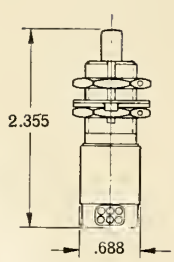
DOWNEY, CALIFORNIA

A DIVISION OF NORTH AMERICAN AVIATION, INC. REGIONAL OFFICES: WASHINGTON, D.C. AND DAYTON, OHIO

INERTIAL NAVIGATION / ARMAMENT AND FLIGHT CONTROL / COMPUTERS AND DATA SYSTEMS

We've been reducing again..........





402EN SEALED SWITCH

Operating Force	6-12 Lbs.
Pretravel	.040 In. Max.
Differential Travel	.020 In. Max.
Overtravel	.250 In. Min.

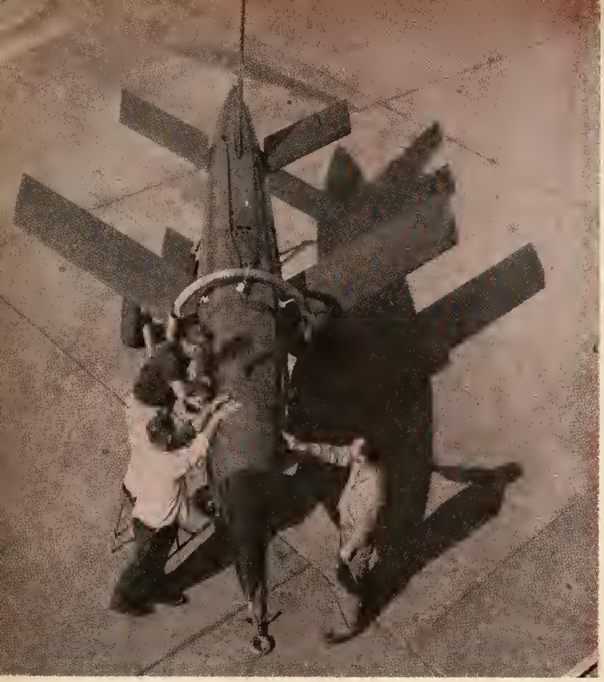
Electrical rating at 28 vdc: resistive, 7 amperes; inductive, 4 amperes.

New 402EN—smallest two-circuit sealed environment-free switch available—The new reduced diameter of the MICRO SWITCH 402EN makes it possible to "tighten up a notch" on component designs, save both space and weight. This plunger-actuated sealed environment-free switch contains two sub-subminiature basic switches, for two single-pole double-throw circuits—yet measures only .688″ in diameter.

It is fully enclosed and sealed against changes in atmospheric conditions. An "O" ring seal on the actuator shaft, plus glass-to-metal terminal seals and potted leadwire termination seals keep dust, water and air from entering switching chamber. An ice scraper ring on the actuator shaft removes ice or mud that might cause jamming or binding. The new 402EN meets immersion test requirements of MIL E-5272A Procedure 1.

For more information on this new unit, check the Yellow Pages for the nearest MICRO SWITCH branch office or write for Data Sheet No. 171.

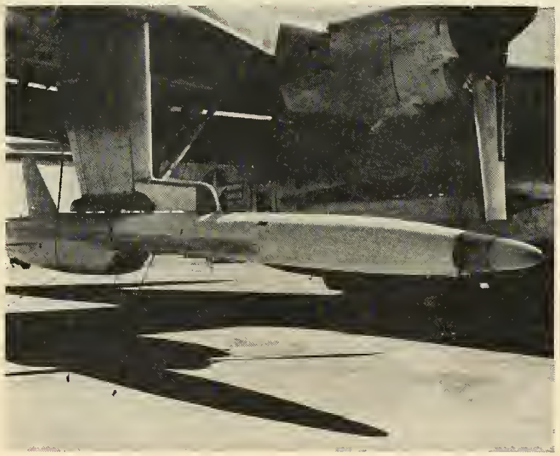
AIR FORCE continued



Q-2C (Firebee)

Q-2C (Firebee)

Manufacturer Ryan Aeronautical Corp.
Mission Target for air-to-air and surface-to-air weapon system training and evaluation
Status In production
Speed 545 knots at 60,000 ft.
Altitude 50,000 ft. operational
Endurance 76 min. after climb from 15,000 ft. to 50,000 ft.
Launch Zero-length ground launch capability with RATO, or air-launched from GC-130 or P2V-5D type aircraft
Propulsion Continental J-69-T-29 turbojet rated at 1700 lb. sea-level static thrust
Recovery Parachute
Flight Control Command control and automatic stabilization system
Span/Length/Height (ft.) 12.9/22.9/6.7
Gross Weight, without payload 2060 lbs.
Augmentation Radar return by broadband traveling wave tube amplifiers
Notes Q-2C is advanced version of Q-2A and KDA Firebee series, which has wide use in all services



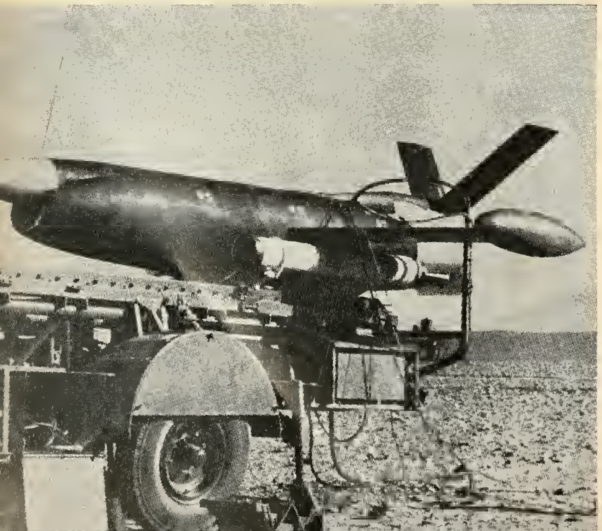
XQ-4B

XQ-4B

Manufacturer Radioplane
Mission Target for air-to-air and surface-to-air weapon system evaluation
Status Under development
Speed Mach 2 at 70,000 ft.
Altitude Over 70,000 ft. ceiling
Endurance 17 min. after climb from 36,000 to 70,000 ft.
Launch Air launched from GC-130 or similar aircraft
Propulsion G. E. J85-5 turbojet with afterburner
Recovery 3-stage parachute plus flotation equipment
Flight Control Sperry microwave command
Span/Length/Height (ft.) 13/35/6
Gross Weight, without payload 3300 lbs.
Augmentation Radar return by broadband traveling wave tube amplifiers
Notes Drone is follow-on of Q-4 series

Additional AIR FORCE targets:
- KD2U-1 and WS462L, under Navy listings

CT-20



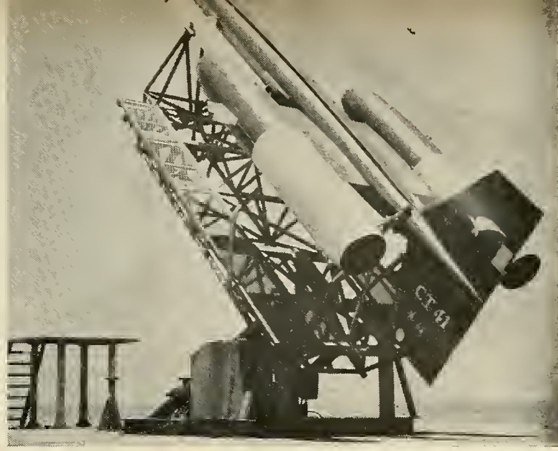
COMPANY-SPONSORED AND FOREIGN

CT-20

Manufacturer Nord-Aviation; U.S. sales through Bell Aircraft Corp.
Mission Target for air-to-air and surface-to-air weapon system training and evaluation
Status In production
Speed Mach 0.85 at 33,000 ft.
Altitude 46,000 ft. maximum
Endurance 60 min. at 33,000 ft.
Launch Rail with two rocket-assist boosters
Propulsion Marbore (Turbomeca) turbojet engine rated at 880 lb. sea-level static thrust
Recovery Parachute
Flight Control Command with automatic stabilization
Span/Length/Height (ft.) 11/18/2.2
Gross Weight, without payload but with boosters 1470 lbs.
Augmentation Radar reflectors
Notes 350 targets delivered to France, England, Italy and Sweden, and Nord is filling order for 100 more

CT-41

Manufacturer Bell Aircraft Corp. under license from Nord-Aviation
Mission Target for air-to-air and surface-to-air weapon system training and evaluation
Status Under flight test in France
Speed Mach 2.7 at 80,000 ft.
Altitude 80,000 ft. operational
Endurance 14 min. at 70,000 ft.
Launch Zero-length with two solid rocket boosters
Propulsion Two wing-tip ramjets, Sirius II
Recovery Parachute
Flight Control Command with automatic stabilization
Span/Length/Height (ft.) 11.9/32.2/7.6
Gross Weight, without payload 2865 lbs.
Augmentation Luneberg lens passive radar
Notes Quantity production scheduled for 1961. Target compatible with U.S. range requirements



CT-41

OQ-19E

Prime Contractor Radioplane
Mission Low-altitude target for surface-to-air weapon system training and evaluation
Status Under flight evaluation
Speed 222 knots at sea-level
Altitude 25,000 ft. ceiling
Endurance 60 min. at sea-level
Launch Ground launched and can be fitted for air launch
Propulsion McCulloch 6-cylinder, 2-cycle air-cooled engine driving a 47" dia. propeller
Recovery Single-stage parachute
Flight Control Command or proportional command system with automatic stabilization
Span/Length/Height (ft.) 11.5/12.5/2.6
Gross Weight, without payload 405 lbs.
Augmentation Two wing-tip radar reflector pods are optional

OQ-19E

RP-77D

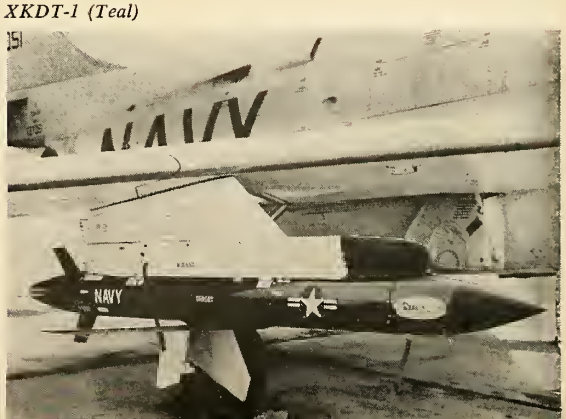
Manufacturer Radioplane
Mission Target for surface-to-air missile and gunnery training
Status Under flight evaluation
Speed 350 knots at 40,000 ft.
Altitude 40,000 ft. operational
Endurance 60 min. after climb to 40,000 ft.
Launch Zero-length using Loki or Falcon rocket boosters
Propulsion Boeing 502-10F free-turbine turboprop; 52" dia. propeller
Recovery 3-stage parachute
Flight Control Proportional command control and automatic stabilization system
Span/Length/Height (ft.) 17.5/14.9/5.2
Gross Weight, without payload 1000 lbs.
Augmentation Two wing tip radar reflector pods
Notes Craft can be used for combat surveillance missions

RP-77D

XKDT-1 (Teal)

Manufacturer Temco Aircraft
Mission Target for air-to-air weapon system training
Speed Mach 0.95 at 50,000 ft.
Altitude 55,000 ft.
Endurance 8.5 min. at 45,000 ft.
Launch Air launch from carrier-based swept-wing fighter aircraft
Propulsion Dual thrust solid propellant rocket motor (Rocketdyne)
Recovery Expendable
Flight Control Programed and automatic stabilization
Span/Length/Height (ft.) 4.9/11.8/1.9
Gross Weight 350 lbs.
Augmentation Radar reflectors
Notes Craft is first successful solid-propellant rocket-powered target

XKDT-1 (Teal)



(Continued from p. 21)

weighing only 436 lbs. and developing 3000 lbs. of thrust, a thrust-to-weight ratio of 7.

Another example of turbojet use is G.E.'s J79 with afterburner, which drives to Mach 2 the *KD2U-1*, a Navy target made by Chance Vought. Weighing 3200 pounds, the J79 provides 15,000 lbs. of thrust.

Where high-speed flight of at least seven to eight minutes at high altitude is wanted, the ramjet must be considered. There has been some criticism of this powerplant, laying to its door problems of flameout and inflexible operation.

Proponents of the ramjet, such as Lockheed who makes the *Q-5*, say that the "relative" inflexibility of the ramjet results in high reliability and low cost. "Besides," a company spokesman counters, "a target drone designed to perform all possible combinations of missions will degrade the performance . . . where it will not really be satisfactory for any mission."

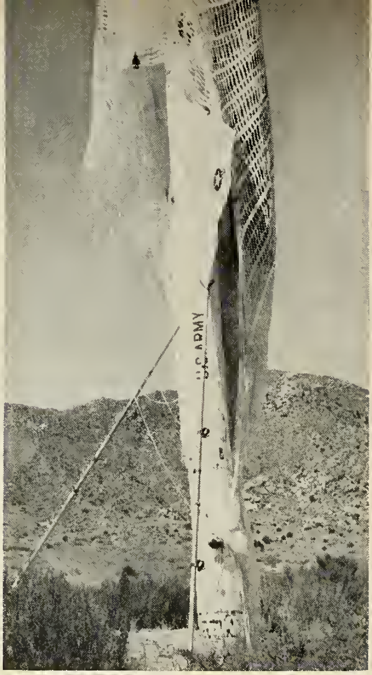
• Programing a solid rocket—The advantages of the rocket engine are well-known, high speed at any altitude but performing best with increasing altitude.

An advanced solid-rocket propulsion system, proposed by Rocketdyne's Solid Propulsion Operations at McGregor, Tex., uses a variable area rocket nozzle to give versatility to programing high-altitude, supersonic aerial targets.

For low cost and high performance, the propulsion system uses an ammonium nitrate propellant similar to that used in Temco's *"Teal"* target. For the *Teal*, a unique solid propulsion system was used in which a "boost" disc of fast-burning propellant was bonded to the slower burning "sustain" phase. The extra burst of power needed to get the drone away from the launching aircraft and up to cruise speed was thus designed into the propellant charge.

Addition of the variable area nozzle lets technicians program a variety of target missions together with launches at varying speeds and altitudes. Activation of the nozzle during flight can also be done by command control.

The scheme for liquid rockets powering targets, according to Thiokol's Reaction Motors, is to use "simple, inexpensive modular powerplants." A major feature of such a system is said to be its adaptability to meet most target mission requirements. By using one of three basic off-the-shelf thrust chambers or by merely "plugging in" extra chambers and components, the company says that any thrust level or flight profile can be had.



DRAPED in its parachute, the *Kingfisher* digs its landing spike into the ground.

In a performance envelope for its liquid-rocket powerplants, the company shows available thrust ratings with single-chamber configurations ranging from 15 to 320 lbs. at 100 psia chamber pressure; and from 50 to 530 lbs. at 300 psia chamber pressure. Two-chamber or three-chamber configurations extend the thrust to 960 pounds at 100 psia and 1590 pounds at 300 psia.

• Firebee looks like B-52—Augmentation, the technique of making aerial targets look in some aspect like the weapon being simulated, will always fall short of its intended purpose. Perhaps this comes from an engineering theorem which states that the only model that acts like a full-scale system is one that is identical to the full-scale system.

The familiar augmentation techniques to simulate a radar echo, of corner reflectors and Luneberg lenses, are systems usually compatible with most aerial targets. However, the disadvantage of the reflectors and lenses are that they give only a mono-static response to the inquiring radar.

Although these passive devices are relatively inexpensive, and show high degrees of reliability, their inability to provide the bi-static response needed for semi-active homing systems gives merit to the traveling-wave tube. According to Ryan Aeronautical Corp., which built a system around such a tube, the device can give a 22-foot long *Firebee* the average radar "echo" size equal to the AF's B-52 or the Russian's "Bison" bomber. One disadvantage of the tube is that it is not a cheap item, compared with other radar simulation means.

Another augmentation system using the traveling wave tube, a system that can also be used for target identification and tracking, is the Sperry Echo Enhancer, the "SEE" system. This is a wide-band microwave amplifier which re-radiates an illuminating radar signal with high fidelity. The amplifier gain can be adjusted with external attenuators to simulate the radar echo area desired. Radar illumination can be cw, pulse or doppler. All these can be applied simultaneously, says Sperry, with no appreciable interaction. The system has proved effective at speeds exceeding Mach 2 and at altitudes above 50,000 feet.

• City mapped at Mach 1—The effectiveness of a surveillance drone can be no better than the sensitivity, accuracy and versatility of its complement of sensors. For this reason, the number of sensors being used and considered for combat surveillance is long and includes optical aids, photography, television, passive and active infrared, radar, flash- and sound-ranging sets, and acoustic devices.

Here is an example of modern work in the sensor field being applied to drones.

The Motorola Military Electronics Division presently has a contract for developing side-looking radar for the *SD-2*. This extremely fast information-gathering radar system, when mounted in a drone, is able to map terrain and moving targets at drone speeds approaching the speed of sound. The system can map terrain at ranges approximating the diameter of a city from the flight path on either one or both sides of the drone.

As the drone flies along, the radar return signals from the narrow antenna beam are displayed on an intensity-modulated cathode ray tube. The single-line trace on the cathode ray tube is optically imaged on photographic film. The film is moved at a speed proportional to the speed of the drone. The motion of the drone thereby develops a radar map of all the terrain along the flight path.

In order to map on both sides of the drone simultaneously, it is necessary to switch the transmitted power from one antenna to the other very rapidly. The Motorola Solid State Electronics department developed a high-powered microwave rf switch for this application. Development of this switch, according to the company, represents an advance in the state of the art as well as providing a valuable radar capability.

Earlier it was said that what the

Army field commanders want from their drones is battlefield information in time to do something about it. One sensor system that appears will give this is Fairchild Camera and Instrument Corp.'s "Photo Transmission System."

This system permits aerial photography from any type vehicle including satellites, rapid in-flight processing of the aerial negatives, opto-mechanical scanning of the negatives to convert light energy into electrical signals for driving a microwave FM data link, and transmission of the aerial negatives to a ground station.

The ground station demodulates the FM signal and displays it on a pair of direct-view monitors (storage tubes) and generates a positive transparency which is rapidly processed for immediate viewing.

The time delay between the actuation of the aerial camera taking the picture and the viewing of a positive transparency on the ground is less than two minutes. The aerial negative after processing has a photographic resolution of 40 lines/mm on 70 mm film.

• **Controlling beyond-horizon drones**—What gave us the aerial target and drone field was the automatic guidance and control capabilities developed for the craft. An important system now in production, and used in Radioplane's *XQ-4B*, is the Sperry Microwave Command Guidance System (MCGS), developed by the Sperry Phoenix Company.

The system consists of three major sub-systems: a Flight Control Central, a Transponder Set and an Air Director. The Flight Control Central and Transponder Set are used for vehicle control, track and telemetry out to 200 miles, limited only by radar line of sight.

The Air Director is used as a relay to extend the operational range out to 400 miles, thereby getting below the horizon control with respect to the Flight Control Central. The Air Director is also able to control the vehicle independently of the Flight Control Central. Chain station operation of Flight Control Centrals can be used to give unlimited range.

Motorola is currently developing a navigation, guidance and control system for advanced, high-speed combat surveillance drones, under contract with the Army Signal Corps. The system uses a combination of a low-frequency hyperbolic navigation system and a doppler navigator, and the computer necessary for combining information from these two systems to control the flight of a drone.

The proof of a weapon system is how close its missile comes to the target. To get this information, several companies have devised and marketed highly accurate systems, ones that measure relative trajectory between a missile and its target, relative velocity and miss distance, among other parameters.

One objection to the systems available, according to a Navy engineering director, is that all of them require a signal source in the missile. He says, "When we fire a missile we don't want to first have to take it apart and plant some piece of apparatus inside of it, no matter how small the piece is." He added that opening up the missile might also influence its performance, perhaps in some subtle way.

Among the prominent companies making the systems are: Aerojet-General's Ordnance Engineering Division, which developed the FIRETRAC, Firing Error Trajectory Recorder and Computer; the Ralph M. Parsons Company, which developed PARAMI, Parsons Active Ring-Around Miss Indicator; and Aircraft Armaments, developer of the MDMS System, Miss Distance Measuring System.

• **Mach 1.5 tow target devised**—An idea of the workings of a typical system can be gained form Aircraft Armaments engineer Philip Yaffee's description of the MDMS. It comprises three basic components: A simple transmitter in the missile, a receiver-recorder on the ground monitor station, and a transponder in the target aircraft.

The aircraft transponder is actually an airborne relay station, which receives a radio signal from the missile transmitter on one frequency and retransmits it to the ground receiver on a different frequency. The doppler effect is the basic operating principle. A recording of the doppler frequency shift of the missile signal as it approaches and then passes the target is made at the receiving station. This record provides precise data on the miss distance, the relative intercept velocity, and the time of closest proximity of missile and target.

One airborne device that solves a number of problems such as cost and guidance, is the tow target. A leading company in the field is Del Mar Engineering Laboratories, maker of the newly announced Mach 1.5 high-altitude RADOP (radar/optical) tow target system. Tow lengths up to six miles are said to be feasible at supersonic speeds through the use of this system.

The target is lightweight, containing a passive radar reflector assembly designed to give 360° coverage with a uniform radar return. It is equipped with flares to provide an infrared source, powder cartridges for visual augmentation, a command receiver to actuate these aids and provision for miss-distance indication equipment.

Missile Steel

Motor Case Alloy Announced by Scaife

A cobalt-modified low-alloy steel has been developed specifically for missile motor cases by Scaife Co., Pittsburgh, Pa., subsidiary of Wilson Brothers.

The alloy, MX-2, is reported to be two to three times stronger than normal constructional steels. MX-2 can be readily fabricated by rolling, deep drawing, welding and machining.

The new alloy also appears to have increased resistance to weaknesses originating from notch sensitivity and heat treating. Design requirements can be met with only one half to one third as much MX-2 as compared to other constructional steels.

Motor cases of the material reached a 0.2% offset yield strength of 225,000 to 235,000 psi in uniaxial tensile tests. Ultimate tensile strengths of 275,000 to 290,000 psi have been reached and in hydrostatic tests, the alloy withstood 280,000 psi burst pressure.

The new steel was discovered by two Mellon Institute scientists assigned to a Scaife research team. One nominal composition released by the company is in the lower cobalt range and includes carbon, 0.39%; manganese, 0.70%; silicon, 1.00%; chromium, 1.10%; molybdenum, 0.25%; vanadium, 0.15% and cobalt, 1.00%.

Scaife has filed patent applications in the U.S. and abroad.

• **Broad market**—MX-2 is expected to find applications in areas other than missiles. The company estimates that potential use in the steel industry alone will be in excess of $100 million annually.

More than $750,000 worth of the new alloy has been produced for prototype investigations.

Scaife Co. is a metal fabricator; its deep drawing presses have been producing missile cases for over seventeen years. Since the firm does not have the facilities to melt MX-2 on the anticipated production scale, a licensing program is being formulated. Royalty figures have not been settled for this program, but the range might run from 3% to 10%.

Solid motor cases for the *Falcon*, *Matador*, *Hawk*, *Nike-Hercules* and other missiles have been produced by Scaife with its reverse deep draw technique. The MX-2 alloy is the result of a concerted effort at Scaife and the Mellon Institute to develop a steel ideally suited to exploitation of this forming method.

'Microcrazing' Enhances Castings

by John F. Judge

Details of a unique metal casting method, involving the phenomenon of "microcrazing," were revealed recently by the U.S. licensor, Shaw Process Development Corp., Port Washington, L.I., N.Y., division of British Industries Corp.

Smooth surfaces, close-dimensional tolerances and complex shapes—qualities that usually result from costly machining operations—are possible in the as-cast product.

The heart of the process lies in the structure of the Shaw ceramic mold—a microscopic network of cracks aptly termed "microcrazing."

The entire mold is composed of jagged ceramic particles separated by minute fissures, or air gaps. Fissure size is critical since it must be small enough to prevent entry of molten metal, large enough to permit thermal expansion of the particles and yet adequate for the proper venting of gases trapped during the casting process.

This structure is directly responsible for such improvements as;

- Thermal Shock Resistance—individual particles have room to expand without affecting neighboring particles.
- Dimensional Stability—The mold does not change size during casting due to a coefficient of expansion of practically zero.
- Resistance to Hot Tears—According to the firm, this problem does not exist.

In addition, there are no inclusions, the mold is free of gas, and heavy and light adjacent sections can be designed into it without fear of voids.

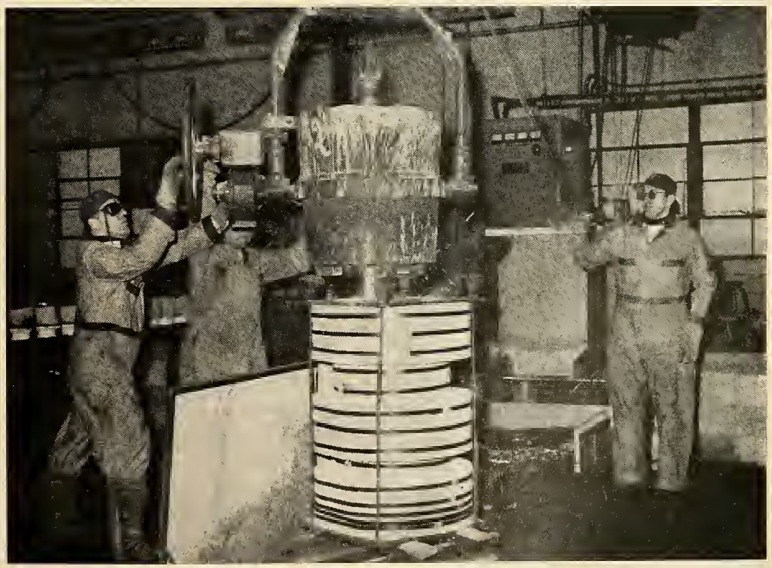
- **Mold formation**—Initially a variety of blended refractory powders are mixed with an ethyl silicate-based binder and a small amount of gelling agent. The slurry is poured over a wood, or plastic, pattern and allowed to harden to a strong, rubbery gel. After being stripped from the pattern, the mold is ignited—burning off all the volatiles and setting up the microcrazed structure. Immune to thermal shock, the mold is then baked at elevated temperatures, removing the last vestige of moisture, and sent to the casting area.

More than 100 foundries, precision casters and tool shops throughout the world are using the Shaw Process under license. Auto Specialties Mfg. Co. turns out first stage deflector nozzles for the *Nike-Hercules* through the Shaw Process. The firm also produces the second-stage nozzles in the same manner.

Gas inlet manifolds in Hastelloy B for the *Jupiter, Thor* and *Atlas* missiles are Shaw-cast by Lebanon Steel. The Watertown Arsenal is another licensee.

The process is a result of studies by two British scientist-brothers, Clifford and Noel Shaw. The Shaws were responsible for establishing the use of ethyl silicate as a binder for refractory molds—the foundation for the modern "Lost Wax" investment molding process. Their microcraze method is an improvement over the wax technique in that larger castings, closer tolerances and tooling cost savings are possible.

SECOND-STAGE NOZZLE for Army's *Nike-Hercules* ground-to-air missile is a Shaw-cast product.



POURED DIRECTLY DOWN the risers, molten 4340 alloy drops over four feet without causing wash in the thin sections of this nozzle casting at Auto Specialties Mfg. Co. The mold is composed of Shaw zircon faced cheek cores with a CO_2 grog backup.

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IBM 7090 Saves Money, Too

by Charles D. LaFond

HUNTSVILLE, ALA.—An often overlooked virtue in the newest of today's super-capacity computers is the fact that they not only enlarge operational capability—they actually save dollars.

It was with an eye on both of these attributes that scientists at the Army Ballistic Missile Agency here pushed so hard to obtain a pair of International Business Machine Corp.'s new solid-state Model 7090 computers.

Their efforts proved more than successful: the first two of 82 such systems obtainable during the next 11 months will be installed in the Computation Laboratory of the George C. Marshall Space Flight Center, located within Redstone Arsenal. (The Center, manned by Dr. Wernher von Braun's ABMA team, officially joins the National Aeronautics and Space Administration on July 1.)

First assignment for 7090's will be processing of test data and trajectory simulations for the *Saturn* space-vehicle booster.

Capable of making nearly 14 million logical decisions a minute, the IBM 7090 fully transistorized digital computer is considered the most advanced computational system which IBM has developed for general-purpose use. The first machine, dedicated at the Center on June 15 (M/R, June 20, page 17), is getting its final acceptance tests; the second will be installed in August.

The pair will replace two IBM 704's and one 709, both vacuum-tube computers until now regarded as highly advanced systems. Six times faster than its 709 predecessor, the 7090 is 7.5 times faster than the 704.

The desk-size machine employs over 50,000 transistors in its circuitry and a high-speed magnetic core memory. Data can be extracted from the 32,768-word memory in 2.18 millionths of a second.

• **Doubled output, same price**—Cost of each 7090 is roughly 25% more per month than for a 709, but a closer look at price vs. performance shows an entirely different picture. Rental for the three incumbent systems totals $180,000/month for a 24-hour operational day. The two 7090's will cost $130,000 for an 8-hour working day, and will accomplish the same amount of work as the replaced machines.

In time, if another 8-hr. shift is required, the additional cost will be 40% of the basic rental, or $52,000. The overall total then would be $182,000/mo., which is roughly the three-machine former cost. But total capacity would be doubled and there is still room to grow toward a third shift.

Finally, the Comp. Lab. personnel told M/R that a 70% savings also will be achieved with reduced power and air conditioning requirements.

• **Will level mountain of data**—The amount of data obtained at each static firing of the *Saturn* booster is overwhelming. Six to eight times greater than from any previous space program, information pours in from as many as 970 data channels. High-speed computers are the only answer to the problem of reducing and evaluating test results of this magnitude.

For example, Dr. Rudolph Hoelker, deputy chief of the Aeroballistics Lab. and a former member of Germany's Peenemunde rocket group, said that 20 years ago a simple V-2 missile trajectory calculation required 3-4 weeks and tied up 12 scientists. Today, using the new equipment and introducing many more factors, actual running time for a complete solution would be 30 sec.

Use of computers in studying test data and simulating flight trajectories has minimized guesswork in developing the *Saturn* booster. So much so that only 10 test flights, including four orbital, will be required before the 3-stage vehicle is designated operational.

• **New techniques introduced**—Two new system techniques will be used in operating the 7090 to increase efficiency and to aid operators and programers. Called SPOOK and FORTRAN, they are updated versions of developed computer procedures.

To better utilize the fast operating speeds of 7090, SPOOK (Supervisory Program Over Other Kinds) supervises, controls, and monitors a computing job permitting maximum effective use with minimum machine preparation.

An IBM-developed shortcut to programing, FORTRAN (FORmula TRANslation) "machine language" permits a programer to write a program without learning the language of the particular IBM computer. Consisting of 32 types of statements, it is a relatively simple language. The program, when complete, is processed by a FORTRAN translater. This changes it to an optimized machine-language program to which the computer will respond.

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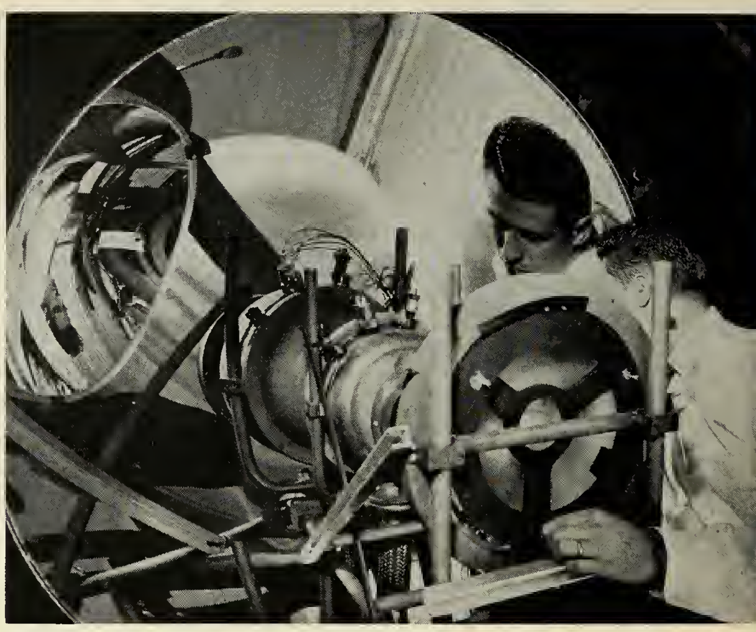
Air Force Outlines Broad Effort i



SPECTRALLY SELECTIVE surfaces are studied in solar facility at Electro-Optical Systems, Inc., under AF contract, making use of concentrated solar radiation.

LOS ANGELES—The extent of the Air Force solar power program has been spelled out by Wright Air Development Division, which has about 30 contracts outstanding for solar power conversion devices and accessories.

The most active contractors appear to be Electro-Optical Systems, Inc., Sundstrand Turbo, AiResearch, General Electric, and Hoffman Electronics.

As part of its requirement to supply power for satellites used for communications, early warning, weather and navigation, WADD is investigating several methods of solar energy conversion to electrical power. Among them:

- Photovoltaic: represented by the solar cell system now in use on a number of satellites. This is the most reliable and efficient method we now have, according to WADD.
- Photoemissive: a direct conversion method which uses an anode to collect electrons emitted from a photoemissive surface when struck by sunlight.
- Photolytic: characterized by the regeneration systems of fuel cells which operate on a chemical reaction due to photolysis.
- Solar-thermal: the collection of sunlight via a mirror and focusing system, which heats a boiler containing a working fluid. This in turn operates a turbine to generate electricity. A thermocouple arrangement would also fall into this category.

William C. Savage, Senior Research Engineer, Flight Vehicle Power Branch, WADD, told the American Rocket Society here that WADD's program aims to provide system engineers with sufficient data to permit attainment of objectives in advanced flight vehicles now being built.

According to Savage, the photovoltaic systems now being used represent the most reliable and efficient method of sunlight conversion, and additional development is expected to increase these advantages even further, although other avenues are being pursued.

In the photovoltaic field, Hoffman Electronics is developing a 500-watt silicon cell system capable of full orientation. One of the major disadvantages of previous systems was that constant orientation toward the sun was not practiced. NASA's *Explorer VI*, Savage pointed out, exhibited an overall efficiency of 1½%. A similar design, fully oriented, would have an efficiency of 6½%, or allow reduction of the required number of solar cells by 75%, without power loss, over an unoriented system.

The Hoffman system will have a maximum deflection of ±10 degrees from the normal. The angular variation represents only a slight variation in power output. The system will be "kicked" from one limit to the other, coasting in a five-degree dead space. Studies have been conducted on low impedance and low friction slip ring type connections which permit movement of the paddles relative to the vehicle.

Liquid metal electrical connections were investigated by Hoffman, and it was found that a mercury ring contained in a circumferential groove inside a Teflon bearing, (working against a shaft made of metal which will not alloy with mercury), was feasible and would best satisfy electrical connection requirements.

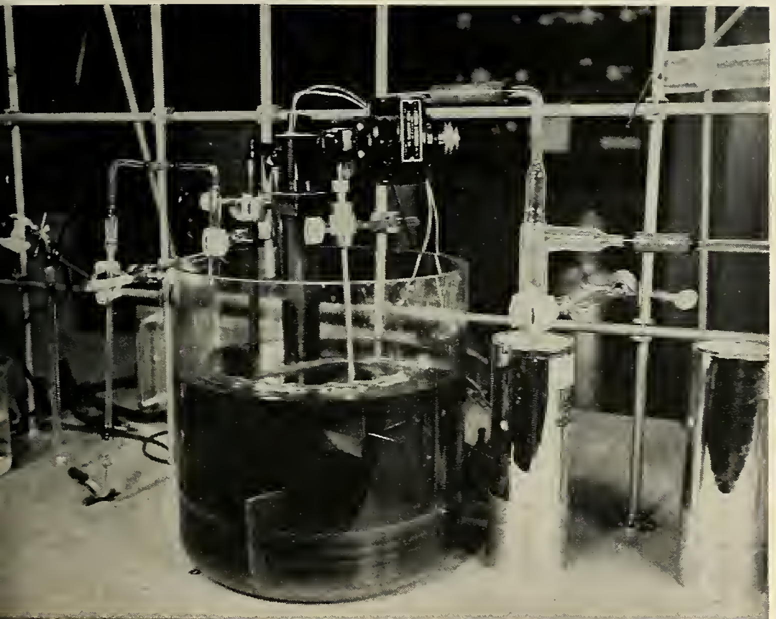
The company also studied mercury bearings, "but concluded that a loose fit of metal on Teflon and the mercury bearing would be best."

Conventional slip rings would have high frictional forces due to the requirement for added brush pressure under vacuum conditions. For the design contemplated, torque due to viscosity was calculated to be 10^{-4} dyne-cm for each liquid ring per centimeter length. The loss of liquid metal for a bearing shaft clearance of .006" was figured to be 0.7 kg./year.

- **Energy storage**—Cited as "one of the major areas for improvement in the solar power system, energy storage has gotten considerable attention from WADD, said Savage. Presently used nickel-cadmium batteries, although having the best cycle lifetime, are relatively poor—since for reasonable life the storage capability is estimated to be about one watt hr./lb. of battery for a 6000 cycle life having a 10% discharge/charge cycle. WADD is now establishing accurate design criteria for life under various charge/discharge cycles.

Tests are being conducted on fifty type F nickel cadmium batteries simultaneously, with an electronic solar cell simulator assuring charge conditions

olar Power Research



PHOTOLYSIS OF WATER vapor in presence of mercury vapor is carried out at Electro-Optical as part of WADD-sponsored research into solar energy conversion.

that accurately duplicate system operation.

Photovoltaic system design also considers the optimum series-parallel arrangement of cells in each subassembly to obtain maximum reliability. Savage pointed out that a static system can suffer a failure with a minimum reduction in performance, while a dynamic system failure usually results in total loss of usefulness.

• **Photovoltaic research**—The 6½% efficiency referred to above is based on silicon cells whose efficiency averages 8%. WADD has contracted with Westinghouse for development of 15% efficiency laboratory model silicon cells, and with Hoffman for investigation of manufacturing methods to produce high-yield 12% cells.

These improvements can be accomplished by reducing contact and sheet resistance, accurately controlling impurity diffusion, improving surface coating and cutting reflection losses.

In addition to the research on silicon cells, a similar program is under way at the Radio Corporation of America to study gallium arsenide. Indications are that the cost of this type of cell will be no less than silicon, and that it has greater brittleness. It does, however, offer higher potential efficiency, and can operate at higher temperatures.

Other high-temperature materials for photovoltaic applications are being investigated at Harshaw Chemical on cadmium sulfide cells. Efforts thus far have sought to determine the effect of impurities on cell efficiency and characteristics. Highest efficiency obtained in laboratory tests so far has been 7%. The material shows promise as a low-cost cell, when compared with a polycrystalline cell.

Shockley Transistor is making a theoretical analysis of the electrical and physical parameters applicable to the design of solar cells. Through this study, WADD hopes to determine the basic reasons why cells fall short of their theoretically predicted maximum performance.

Electro-Optical Systems has a contract for the reduction of cost per kilowatt and pounds per kilowatt through the use of light concentrators.

A standard light source and evaluation technique is being set up by Mount Vernon Research, which will closely simulate a 59000 black body or solar spectrum. Problems with noise, heat dissipation and protection of personnel from ultraviolet radiation are anticipated in this development program. At present, varying efficiencies are reported for the same cell, depending on the test technique used to measure characteristics.

• **Other methods studied**—Photoemission phenomena are being studied at RCA despite their anticipated low efficiency; low cost and potential advantages through use of light flexible structures may increase the method's attractiveness. RCA's program calls for selection of optimum materials, fabrication of three laboratory models and investigation of their characteristics.

Electro-Optical Systems and Physics Engineering and Chemistry Corp. are carrying out studies into the photolysis of water, using inorganic salts as sensitizers. WADD feels that the process, if carried out efficiently, may lead to a regenerative fuel cell, or may also result in a source of oxygen and hydrogen for other uses.

Present research is quite basic in nature, and primarily designed to demonstrate the phenomena. Electro-Optical is also investigating the photolysis of water vapor in the presence of mercury vapor.

In the solar-thermal field, WADD contractors are working on:

• A 500-watt solar thermionic system, supported by Advanced Research Projects Agency, being developed by General Electric.

• A 500-watt solar regenerative fuel cell, being developed by Sunstrand Turbo.

• A three-kilowatt Stirling cycle engine being supported by ARPA and under development by the Allison Division of General Motors.

• A Rankine cycle advanced working fluid turbine system, being designed by Sundstrand Turbo.

• Supporting programs on solar collectors, orientation, radiators, heat storage and zero gravity, under investigation by Electro-Optical Systems and several other contractors, whose final arrangements are still under negotiation.

Thermionic buttons are under study by General Electric, which is determining the characteristics of a 500-watt system through fabrication and test. One of the problems of the thermionic system is its need for great accuracy of orientation; another is heat storage during periods spent in darkness. Orientation requirements are about $\pm 5^1$.

One method being considered for maintaining temperature of the thermionic buttons during darkness is to close an iris at the entrance to the black body cavity in which the buttons are located.

The 500-watt regenerative fuel cell being developed by Sundstrand Turbo is an attempt to minimize the energy storage problem. Thus far, little has been done to combine the regenerative chamber and the fuel cell, WADD says, because of low yield from the regeneration process and poor operation of a mechanical separator.

In Sundstrand Turbo's' design, nitric oxide and chlorine are combined for the production of power—with the resulting product of the cell, nitrosyl chloride, being decomposed by the action of solar energy into its original constituents.

It's hoped that the Allison solar power system, a three-kilowatt dynamic Stirling cycle engine, will have an efficiency of 23%, if the anticipated engine thermal efficiency of 34% is attained. This engine will use gaseous helium as a working fluid and operate between temperatures of 1250°F and 180°F. Thermal heat storage using lithium hydride will be used during periods of darkness.

Potentially smaller volume and lighter weight is expected from a 15-kw Rankine cycle advanced working fluid system being developed by Sundstrand Turbo. The advantages can be realized at an overall system efficiency of 15%, provided an adequate high-temperature heat storage system can be evolved.

The emphasis in this project is to design components which will operate satisfactorily with the higher temperatures possible with use of such fluids as rubidium and potassium.

In addition to these, an advanced solar systems study, in the 1-to-30 kw range, is being undertaken by AiResearch, with the goal of optimizing weights, sizes, working fluids and cycles.

Using a mercury working fluid, Thompson Ramo Wooldridge is working on a contract to demonstrate a 1-kw solar power system. The solar power unit demonstrator (known as SPUD I) will operate on a Rankine cycle.

WADD's heat transfer group has underway projects covering problems of collectors, boilers, radiators, heat storage, and zero gravity.

Tests to investigate the zero gravity problem are being conducted aboard Air Force aircraft, and on some missile flights.

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Check additional openings listed to the left, and write to Mr. Thomas H. Sebring, Div. 73WZ.

MISSILE & SPACE VEHICLE DEPARTMENT

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Solid Aging Study to Up Reliability

by Frank G. McGuire

MENLO PARK, CALIF.—The aging of solid propellants is being studied at Stanford Research Institute in a program that may play a key role in major missile systems.

At present, reliability of solid-propellant motors can be guaranteed for less than five years, although it is hoped that *Polaris* and *Minuteman* motors will be useful for longer periods. Reliability is considered "relatively" certain for 10 years; knowledge is lacking about the proper functioning of solids beyond a decade.

SRI points out that it's tough to predict the reliability of a weapon system when its primary propulsion unit is a more or less unknown factor.

Much basic research and development work is being done to determine the reliability after storage of such missiles as *Minuteman*, *Polaris* and *Skybolt*, but there are no conclusive answers yet, according to Stanford spokesmen.

• **Money-savings**—With knowledge of "life" or condition, SRI feels, it should be possible to set up a general program for selective replacement of solid-propellant motors in stored missiles to insure maximum reliability.

The researchers say that the program, based on non-destructive testing of each motor, would cost less than a total replacement program—based on entire production runs after a fixed aged period—and would guarantee a higher, more uniform reliability level.

This would be more efficient than replacement of motors after a specified time lapse, they believe, and would substantially reduce costs of a maintenance program.

Polaris and *Minuteman* both utilize motor casings which also serve as external missile frames, and hence require removal of a major portion of the missile's structure during motor replacement. In the method proposed by SRI, the guidance and control sections would be removed, the motors replaced with fresh spares, and the missile put back in its silo or launcher.

Meanwhile, the aging motor could be returned to a propellant loading site, the propellant removed from the casing by use of high-pressure water streams (or a solvent), and the expensive case reloaded with fresh propellant.

It has also been suggested that motors approaching the age limit be used in training shots, rather than go through a possibly expensive motor replacement program.

To establish a selective replacement program, Stanford says, missilemen must be able to answer these questions:

• What is the condition of each motor?

• How will this affect its behavior?

• Is this behavior acceptable in terms of overall reliability levels established for the missile?

• **Search for a yardstick**—Unfortunately, says SRI, there still is no "clock" or "age meter" which can show the condition of a rocket motor propellant after aging effects.

SRI hopes its "age meter" development will fill the need.

Being developed in a program for Edwards AFB, Calif., the device consists of a ceramic plate or transducer to which an electrical signal is applied. This signal creates ultrasonic vibrations in the plate which are absorbed by the propellant. Changes in the propellant vary the degree of energy absorbed and the resulting effect provides an electrical measure of the change.

The increase in types of propellants is heightening the need for a yardstick to indicate when they become of marginal reliability.

• **Three choices**—Norm Fishman, project leader, suggests this yardstick could take several forms: a surveillance program which would spot-check missile age groups by actual firings; accelerated aging and study of specimen missiles; or development of an acceptable "age meter."

The surveillance program is expensive: it calls for over-production of motors that would be fired at specified time intervals to give an indication of the quality of motors in the same age group.

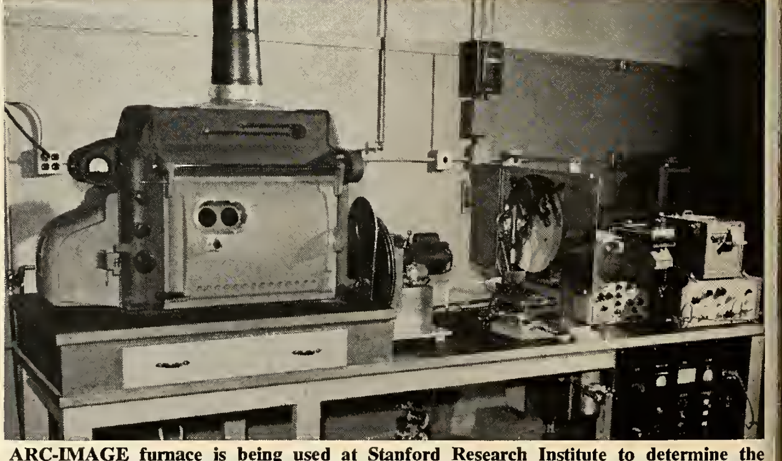
Accelerated aging and study of specimen missiles is less expensive—but assurance would have to be obtained that the data were applicable to standard units.

However, any "age meter" requires a certain amount of full-scale surveillance in order to calibrate the device against actual performance.

• **Symptoms**—Some of the manifestations of aging are degradation of the polymeric binding fuel, creep, chemical interchange, loss of ignitability, cracking of the grain, and slumping of the star points. Some environmental factors of aging are temperature, oxidation and/or moisture.

Cracking of the grain, when it occurs after ignition, can cause "catastrophic" pressure rises. In some composite propellants, migration of fuel fragments to the surface of the grain makes ignitability more difficult. A similar occurrence in a double-base propellant considerably enhances ignitability and also changes the performance of the propellant.

According to test data, ballistic properties of the propellant usually are affected less than physical properties or



ARC-IMAGE furnace is being used at Stanford Research Institute to determine the ignitability of propellants after varying periods of aging.

ignitability of the grain after aging. Motors which have been stored for some time may show no change in thrust, although the burning duration may be somewhat extended. Erosive burning and increased burning rate stems from softening of the propellant, however.

Various preventive methods have been suggested for combating the degradation of motors: A complete sealing of motors in a chamber, including dessicant packages in the motor container, coating the grain surface with a protective spray and storing in special gas atmosphere.

• **Unique tools**—Since beginning work on the propellant-aging problem in 1953, SRI has based its approach on fundamental consideration as well as direct practical investigation. SRI's type of study usually is so unique that there is no readily available or adaptable test equipment. Therefore, new techniques must be developed and hardware improvised. Test equipment is often constructed piecemeal, as the need arises, and sometimes dismantled immediately after its mission is over.

Equipment developed to further the propellant program includes arc-image furnaces, high-strain rate-test machines, creep and stress relaxation equipment, an automatic recording densitometer for low-temperature use, electron spin resonance equipment and sonic test equipment.

The history of the optical densitometer typifies this approach to research: It was necessary to determine the mechanism of low-rate embrittlement at low temperatures; several approaches yielded no conclusive results. The lab constructed an automatic recording optical densitometer within a few hours. A few more hours were spent showing that crystallinity was not a factor. Then the machine was dismantled.

In a novel application of the arc-image furnace, SRI scientists are determining the ignitability of propellants after various durations of aging. Radiant energy from a carbon arc is transmitted through a mirror and shutter system and focused onto a propellant specimen. Comparison of the energy required to ignite fresh and aged specimens of propellant is a valuable indication of future reliability of the ignition system. As well as determining ignition energy requirements, this test covers other aspects of ignition behavior.

In its study of creep properties, SRI has developed a test machine to automatically and continuously measure creep under constant load. Accurate to 0.005 in., the equipment utilizes a strip-chart recorder for data readout. An attachment allows measurement of stress relaxation behavior as well.

Rover Support Work Tops Busy Build-up at Los Alamos

Laboratory is now spending $8 million for new building—another $14.3 million is in planning stages

LOS ALAMOS, N.M.—More than $3½ million is being spent at Los Alamos Scientific Laboratory on support facilities for the Project *Rover* nuclear rocket program. A hot cell facility, a remote-controlled inspection building, a shop and equipment checkout building, and a non-destructive test building are under construction.

About $8 million is now being spent for new building at LASL, with more than $14.3 million in additional construction, (part of it also for Project *Rover*), on the drawing board or planned for the next fiscal budget.

Four of seven buildings now being built here are totally or partially committed to support of *Rover*. The 60,000-sq.-ft. hot cell is an addition to the chemistry-metallurgy building at LASL, and will cost $2,872,400 to construct. When fully equipped, its total value will be about $4,623,000—more than half accounted for by *Rover*.

Specially designed hot cells in the structure will be used for post mortem examination of radioactive components removed from nuclear propulsion test reactors at the Nevada Test Site. This examination will cover both radiochemical and metallurgical aspects.

The hot cell, now 10% complete, is expected to be finished in February.

The remotely-controlled inspection building, known as Kiva #3, will be complete by September. ("Kiva" is the local New Mexican Indian word for "a building," and should not be confused with Kiwi, the test reactor in the *Rover* program.)

Kiva #3 will have an environmental chamber for testing *Rover* mockup systems used in temperature coefficient studies. Capability of the chamber ranges from −85°F to 700°F.

In addition to this chamber, other critical assemblies can be accommodated in the *Kiva*, operated by remote control and observed through closed circuit television. The 5000-sq.-ft. building is more than 30% complete.

LASL has just broken ground for a shop and equipment checkout building designed to handle *Rover* engineering projects. A 4400-sq.-ft. addition has already been proposed to supplement the originally-planned 8000-sq.-ft. building. Completion is anticipated by mid-November.

The non-destructive test building will contain an electronics laboratory and space for several types of test equipment. Construction is expected to be completed by September.

• **Other construction**—In addition to these *Rover* support facilities, other projects at LASL are also booming. A PHERMEX X-ray facility, a power reactor test building, and a computer center are in various stages of completion.

Four buildings make up the X-ray facility, which totals 37,010 sq. ft. and is expected to cost over $3,500,000 when fully equipped. Construction is 25% complete, and should be finished by November.

The power reactor test building, costing $1,821,900, is nearest to completion of all current building projects. Major parts of the facility were completed in March, and a shielded test pit is over 70 percent finished. Included in the structure are a reactor control room, offices, laboratories, and two reactor assembly rooms.

Highest priority during the current boom has been placed on the computer center, which will house Stretch, the world's fastest computer. The contractor has 180 days to complete the ultra-modern 9000-sq.-ft., one-story structure, with a $1000 daily penalty levied for every day over the scheduled 180. The $399,580 building, when completed, will house the $4,300,000 IBM computer.

Stretch will be used to work on calculations relating to the *Rover* program, upon completion of the computer facility.

• **Future projects**—A $4,886,000 facility is planned to house Turret, LASL's planned high-temperature gas-cooled reactor. Construction on this facility is scheduled to begin by March, 1961.

Next month, engineering design will begin on a new plutonium fuel service and development facility. The building, costing over a half million dollars, will be used in investigations of plutonium, with the objective of using the material as a reactor fuel in forms other than alloys. Construction would begin about January, 1961.

A nearly $7-million reactor core test facility at LASL is in the budget for next year, slated for use in the next stage of the plutonium reactor program.

—when and where—

JUNE

Fourth National Convention on Military Electronics, sponsored by IRE Professional Group on Military Electronics, Sheraton Park Hotel, Washington, D.C., June 27-29.

Institute of the Aeronautical Sciences, National summer meeting, Ambassador Hotel, Los Angeles, June 27-30.

JULY

Metallurgical Society of American Institute of Metallurgical Engineers, Conference on the Response of Materials to High Velocity Deformation, Estes Park, Colo., July 11-12.

Third International Conference on Medical Electronics, sponsored by Institution of Electrical Engineers, Olympia, London, July 21-27.

Pennsylvania State University, R&D Management Development Seminar, University Park, July 24-29.

Denver Research Institute, Seventh Annual Symposium on Computers and Data Processing, Stanley Hotel, Estes Park, Colo., July 28-29.

AUGUST

Fourth Global Communications Symposium, co-sponsored by IRE, Prof. Group on Communications Systems and Army Signal Corps, Statler-Hilton Hotel, Washington, D.C., August 1-3.

Massachusetts Institute of Technology, Special Summer Program on Modulation Theory and Systems, Cambridge, August 1-12.

American Astronautical Society, Western National Meeting, Olympic Hotel, Seattle, August 8-11.

American Institute of Electrical Engineers, 1960 Pacific General Meeting, Cortez Hotel, San Diego, Calif., August 9-12.

ASME-AICHE Heat Transfer Conference and Exhibit, Statler-Hilton, Buffalo, N.Y., August 15-17.

XIth International Astronautical Congress, Stockholm, Sweden, August 15-20.

Cryogenic Engineering Conference, University of Colorado and NBS, Boulder, August 23-25.

German Rocket Society, Annual Meeting, Hanover, Germany, Aug. 26-28.

University of Connecticut, Eleventh Annual Basic Statistical Quality Control Institute, Storrs, Aug. 28-Sept. 9.

SEPTEMBER

13th General Assembly of the International Scientific Radio Union, University College, London, Sept. 5-15.

Society of British Aircraft Constructors Show and Flying Display, Farnborough, England, Sept. 6-11.

Electronics Industries Association, Second Conference on Value Engineering, Disneyland Hotel, Anaheim, Sept. 7-8.

Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Sept. 7-9.

American Chemical Society, 138 National Meeting, New York, Sept. 11-16.

—names in the news—

MAURO

Dr. John A. Mauro: Appointed consulting optics engineer by the Ordnance Department of General Electric Co. He transfers from the company's General Engineering Laboratory where he helped to design optical subsystems for *Polaris* fire control and guidance.

Gerald L. Solley: Named manager of Lytle Corp.'s newly-opened San Diego Services Division.

Dr. Harner Selvidge: Former western corporate representative of Bendix Aviation, appointed vice president and general manager of Meteorology Research, Inc.

James N. Edwards and **Alex Marco:** Join Space Electronics Corp.'s technical staff. Edwards was formerly with Hughes Aircraft Co. and is the holder of two patents in electronic circuit design. Marco was previously with Gilfillan Brothers.

Arthur S. Baker: Elected manager of marketing administration for the General Electric Rectifier Component Products Section. Formerly served as manager of marketing administration for the Audio Products Section, Radio Receiver Department.

Zeus Soucek: Appointed vice president-eastern division at Grand Central Rocket Co.

DUCKOR

Lewis M. Duckor: Elected vice president-engineering for Colvin Laboratories, Inc., responsible for coordinating all design, development and engineering functions. Was previously with Lockheed's Missiles and Space Division as senior research engineer in instrumentation.

R. W. Powell: Manager of Aerojet's Avionics Division, named chairman of the Aerospace Industries Association's Electronic Equipment Technical Committee.

Z. R. S. Ratajski: Joins Kearfott Division, General Precision, Inc., as chief of research and advanced development, Precision Components' Division.

Dr. Robert V. Meghreblian: Appointed chief of the Physical Sciences Division at the California Institute of Technology Jet Propulsion Laboratory, replacing **Dr. Melvin Gerstein. Dr. Hadley Ford** named chief of JPL's chemistry section, and **Dr.**

John Laufer, chief of the gas dynamics section.

Dr. Robert L. Tanner: Former head of Stanford Research Institute's Antenna Research Group, elected manager of the Electromagnetics Laboratory. He replaces **Dr. Seymour B. Cohn,** who is now vice president and technical director of the Rantec Corp.

Arthur A. Warford: Former plant manager and chief chemist for Core-Lube, Inc., joins Macco Products Co. as manager-customer services.

George E. Comstock III: Former engineering section head-Tape Transports, elected chief engineer for Potter Instrument Co.

P. Eugene Laliberte: Named director of marketing in the Electronics Division of Stromberg-Carlson.

Jack H. deKruif: Formerly of Hughes Aircraft Co., appointed vice president of marketing and sales for Warner Electric Brake & Clutch Co.

Dr. Herman A. Bruson: Formerly director of research, organic chemicals, elected vice president-research, Chemicals Division of Olin Mathieson Chemical Corp.

Dr. Pei Wang: Former research associate at the University of Wisconsin and senior engineering specialist, named to the newly created post of engineering manager in charge of device services for the Semiconductor Division of Sylvania Electric Products, Inc.

Samuel P. Crago: Formerly with Hamilton Standard Division of United Aircraft Corp. joins The BG Corporation as vice president and general manager.

Perry Addleman: Elected to the board of directors of Standard Kollsman Industries, Inc., replacing **Victor E. Carbonara,** retired.

L. R. (Bob) Hoffman: Named manager of Lockheed Aircraft Corp.'s new corporate office on Boston's "Space Highway."

John N. Robinson: formerly with Tennessee Product and Chemical Corp., joins the technical service engineering staff of Metal Hydrides Inc.


REGNIER

Norman J. Regnier: Named program manager for an advanced semiconductor reliability study being conducted by Motorola Semiconductor Products Division for Autonetics, a division of North American Aviation, Inc., as part of the *Minuteman* program.

Dr. Miles C. Leverett: Manager-development laboratories for the General Electric Aircraft Nuclear Propulsion Dept., named president of the American Nuclear Society for 1960-61.

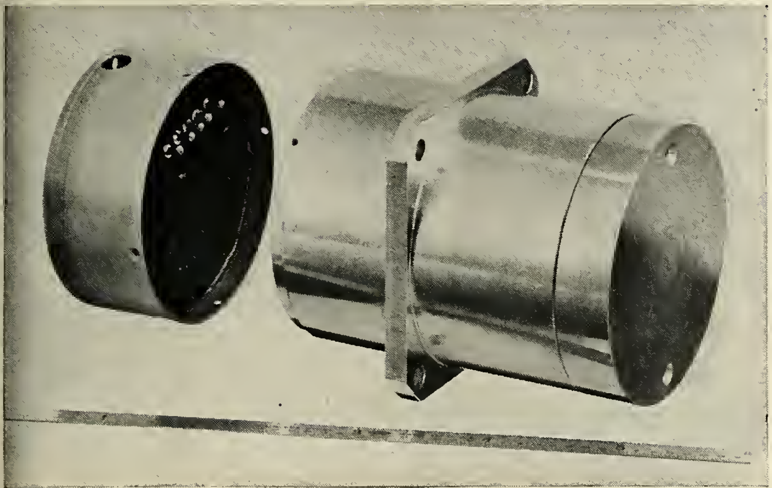
Clyde W. Kaericher: Former director of administration at Minneapolis-Honeywell Regulator Co.'s inertial guidance plant at St. Petersburg, joins Telex, Inc., as vice president in charge of corporate affairs.

Lawrence T. Garnett: Former assistant cheif engineer of the electronic controls division of Manning, Maxwell & Moore, Inc., joins Robertshaw-Fulton Controls Co.'s Aeronautical and Instrument Division as senior development engineer.


BEAM

Hugh C. Beam: Named president and general manager of Western Design, a division of U.S. Industries, Inc., replacing **C. W. Sponsel.** Prior to joining the firm, he was vice president-marketing, Hoover Electronics Co. and manager of the Electronics Division, Rheem Manufacturing Co.

Dr. Josef Roesmer: Joins Nuclear Science and Engineering Corp. as advanced scientist in the Chemistry Department.



Solid-State Inverter Gyro

Gyro Dynamics Division of Darco Industries has introduced a solid-state inverter gyro enclosed in a single housing. The solid-state inverter is designed to operate from a 24 to 32 volt DC source, but source voltages of 12 to 50 can be utilized and are permissible.

With nominal source voltages, the solid-state inverter converts the input voltage to a squarewave A.C. signal of approximately 60 volts, peak to peak. Signal frequency and voltage is regulated and maintained to within 1% when operated from a variable source of ±5%, and with ambient temperatures of −65° to 200°F.

The gyro wheel is assembled into the floated chamber, which is hermetically sealed and floated in the fluid medium. Stainless steel pivots are secured to the floated chamber on the output axis. The top pivot is hollow and provides lateral support for the torsion bar restraint. The complete assembly is double bearing supported in the gyro inner case assembly.

The viscous shear-damping mechanism provides an essentially constant damping coefficient from −65°F to +165°F without the use of a heater. Rate gyros having damping coefficients within ±0.2 of nominal have been produced for this temperature range.

All gyros are hermetically sealed and have been operated at altitudes in excess of 200,000 ft.

The potentiometer pickoff mechanism consists of a fully floated mechanical amplifier, providing a nominal ratio of 4:1. This makes it possible to provide an instrument with resolution capabilities up to ±1/300 of maximum rate (600 total turns on the potentiometer) with a gimbal deflection of only 3°. Minimum cross coupling and a high natural frequency are additional advantages.

Circle No. 225 on Subscriber Service Card.

Voltage Regulator

An on-off temperature control combining the proven mercury tube and reliable germanium transistors is being manufactured by Vap-Air Division of Vapor Heating Corp.

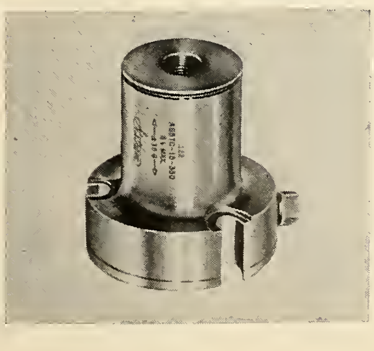
This combination enables the highly accurate mercury tube to switch loads up to 10 amps at 28 volts dc with no moving parts. Various housings are available for uses up to 350°F.

Circle No. 226 on Subscriber Service Card.

In-Flight Accelerometer

A linear accelerometer, Series A65, is now available from Statham Instruments, Inc. The In-Flight instrument responds flat within ±5% from static to 830 cps.

The unit embodies Statham's un-



bonded strain gage principle, with the resistive elements arranged in a complete Wheatstone bridge. It provides the accuracy, reliability and long service life characteristic of the unbonded strain gage.

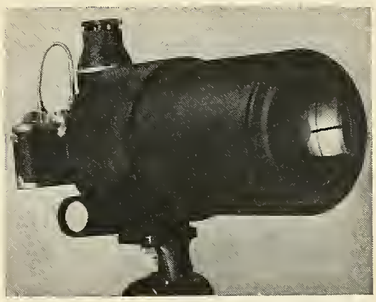
Model variations are available in a wide range from ±7.5g to ±150g. Requiring an excitation of 5v DC or AC, the new accelerometer has a nominal output of ±20 mv. Its combined non-linearity and hysteresis is less than ±1% of full-scale output. The instrument is rated for ambient temperature limits of −40° to 200°F.

Circle No. 227 on Subscriber Service Card.

Telefold Lens From ARC

A Telefold lens designed to offer a long focal length system in a very short, light-weight package is available from Atlantic Research Corp.

The three-pound lens is only ten inches long and just over five inches in diameter. The lens uses a catadioptric system which permits a 42 in. focal length to be folded into the 10 in. tube,



and incorporates a focusing system that permits its use for objects from two feet to infinity.

Designed to be used with a single lens reflex focusing camera, the Telefold lens can be adapted for use on television cameras, and on 8-mm, 16-mm and 35-mm still and movie cameras.

Circle No. 228 on Subscriber Service Card.

Optical Proving Rings

High accuracy in load measurement is now possible with an Optical Proving Ring developed by Steel City Testing Machines, Inc. Air Force experience indicates a repeatability of 1/20 of 1% of full-scale deflection.

Load is applied along the axis of the two bosses on the ring. An accurately divided scale contacts the upper edge of the ring and moves up or down through the field of a microscope as the ring is deflected. The microscope is attached to the lower portion of the ring and contains a reticle scale which serves as a vernier, appearing superimposed over the moving scale. The combination of scales is graduated to twenty millionths (0.00002) of an inch. By estimating to half graduations, readings to ten millionths of an inch are obtained. Readings are taken directly without the need for adjustment during use.

Circle No. 229 on Subscriber Service Card.

Paper Tape Converter

A computer device to transfer data from punched paper tape to magnetic tape is available from International Business Machines Corp.

The IBM 7765 converter writes magnetic tape that can be read by a computer at 15,000 or 22,500 characters a second. Companies transmitting data with paper tape devices thus can achieve computer input at several times the speed of the fastest direct paper tape input.

Circle No. 230 on Subscriber Service Card.

UHF Command Receiver

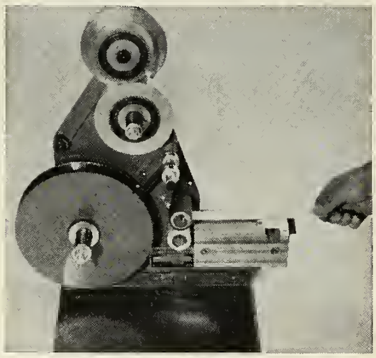
A transistorized UHF command-destruct receiver has been introduced by RS Electronics Corp.

Model 2620 is approximately one-fourth the size, and one-third the weight, of RSE Model 2610 subminiature tube command receiver, and requires only 1.5 w of input power. This receiver operates in the 400 to 550 megacycle range, has a sensitivity of 5.0 mv, a total volume of 16.8 cu. in. and a weight of 1 pound.

Circle No. 231 on Subscriber Service Card.

Adhesive Laminator

A laminator designed to make any electrical insulation pressure-sensitive right on the production line is being produced by Minnesota Mining and Manufacturing Co.



Insulating materials, such as mica, metal foil and fish paper, formerly held by typing or jigs may now be made pressure-sensitive, allowing easy positioning during production runs, eliminating expensive, time-consuming operations.

The laminator features feed spools for the double-coated tape and the insulating material, with a take-up spool for the tape separation liner. The tape and insulation are laminated together as they are removed from the dispenser.

Circle No. 232 on Subscriber Service Card.

Temp-shock Chamber

Conrad, Inc. announces the availability of a temperature-shock, temperature-humidity control chamber featuring independent refrigeration, heating, and humidity systems for the left half and the right half of the chamber. A front-to-back movable separator partition divides the chamber. The partition is controllable from a power hoist. This permits use of the chamber as one common test space, or with the partition lowered, as two independent chambers.

The temperature range is +500°F to −100°F. The humidity control range is 20% to 98% from 35°F dew point to +185°F dry bulk limits.

Circle No. 233 on Subscriber Service Card.

Circle No. 14 on Subscriber Service Card.

Light Threaded Fastener

A lightweight version of its high-strength 900-degree threaded fastener has been developed by Standard Pressed Steel Co.

The high-temperature joint is 20 to 30% lighter than the TM 9 bolt-and-locknut combination that SPS introduced two years ago for applications up to 900°F.

Similarly rated at 220,000 pounds per square inch minimum tensile at room temperature and tested out at 170,000 psi tensile at 900°, the new 922 series sheds weight via reductions in dimensions of the 12-point external wrenching nut and bolt head. The mechanical strength and fatigue properties of these lightweight assemblies are equal to those of the heavier counterparts.

Circle No. 234 on Subscriber Service Card.

Quick-Connect Couplings

Jack & Heintz, Inc. is entering into volume production of quick-connect couplings. The line of aviation couplings with immediate availability will include, Self-Sealing and Open-Type Quick-Connect Couplings for AN flared tube, pipe, hose and special connections.

ROTOLOCK will be available in production sizes from ¼ in. through 3 in., with no limit in size for special designs. The range of materials includes aluminum, stainless steel, carbon steel and plastic. The couplings can be used for the quick connection of hoses, pipes or tubing in systems handling fluids ranging from air through exotic fuels.

Circle No. 235 on Subscriber Service Card.

new literature

POTENTIOMETER SUMMARY. A 4-page summary brochure on Bourns Trimpot and Trimit leadscrew actuated potentiometers is now available. Designed for quick reference, this brochure summarizes key information on 16 standard models including resistances, terminal types, power ratings, operating temperatures, and dimensions. Cutaway drawings of Models 200, 220 and 224 illustrate the internal construction and show outstanding design features. Prices up to 50 pieces are also included in this brochure.

Circle No. 200 on Subscriber Service Card.

SPACE FACTS—A handbook of basic and advanced space flight and environmental data for scientists and engineers has been published by General Electric's Missile and Space Vehicle Dept. The 60-page pocket-sized book contains tables, graphs, and illustrations plus short descriptions of some of the problems and considerations of space vehicle design and associated areas (communications, propulsion, bio-astronautics, etc.).

Circle No. 201 on Subscriber Service Card.

HEAVY TUNGSTEN ALLOYS. Properties, applications, fabrication methods, and available sizes and shapes of three grades of tungsten alloys are given. Published by Kennametal Inc., the 8-page bulletin also describes the firm's explosion forming capabilities.

Circle No. 202 on Subscriber Service Card.

MECHANICAL VACUUM PUMPS —A brochure on a line of oil-sealed rotary vacuum pumps has been published by Consolidated Vacuum Corp. Included are physical and operational data, and information on the construction, maintenance, and pump selection featured in the new line.

Circle No. 203 on Subscriber Service Card.

SAFE/ARM INITIATOR—A four-page brochure describing their new Safe/Arm Initiator systems has been released by McCormick Selph Associates. Applications include missile destruct; initiation of solid and liquid propellant rocket motors, high explosive trains, warheads, pyrocore, mild detonating fuse and, in fact, all types of propellants and explosive charges. The brochure describes the Safe/Arm system and its operation; shows a comparison of conventional vs. Mc/S/A Safe/Arm concepts; gives advantages of the system and, provides firing and arming characteristics as well as environmental data.

Circle No. 204 on Subscriber Service Card.

MICROWAVE EQUIPMENT—A catalog providing 32 pages of information on microwave receiver front ends including data on a number of waveguide and coaxial mixer-preamplifier assemblies has been published by LEL Inc. Other products described include solid-state, miniature and sub-miniature IF amplifiers, TWT amplifiers, octave RF amplifiers, beacons and AFC units.

Circle No. 205 on Subscriber Service Card.

PYRINDICATOR BULLETIN—McCormick Selph Associates have released the first in a series of bulletins on their Pyrindicator test unit. The Pyrindicator is designed to aid in testing electro-explosive circuits. In operation, a Pyrindicator is substituted directly in any system in place of the explosive device it is designed to simulate, i.e., explosive bolt cartridge, squib, igniter, detonator or other electro-explosive unit. The system may then be operated and checked; the Pyrindicator recording that the circuit has been operated.

Circle No. 206 on Subscriber Service Card.

contracts

NASA

$1,510,000—Electronic Associates, Inc., Long Branch, N.J., for an advanced general-purpose analog computer.

NAVY

$7,500,000—Hughes Aircraft Co., Culver City, for building guidance systems for *Polaris* missiles.

$2,500,000—Aerojet-General Corp., for production of the *Tartar* missile solid-propellant rocket engine.

$144,958—Atlee Corp., Waltham, Mass., for production of tube shield liner inserts designed to protect sensitive electronic vacuum tubes from vibration, shock and overheating.

$120,000—Siegler Corp.'s Hufford Division, for ground support equipment components for the *Terrier* system.

$50,000—Gladding, McBean & Co., Los Angeles, for improvement in techniques of manufacturing ceramic radomes used with the *Sparrow III*. Subcontract from Raytheon Co.

AIR FORCE

Control Data Corp., Minneapolis, for two Model 1604 large-scale solid-state computers to be used as part of the ground-based data receiving stations for *Discoverer*, *Midas* and *Samos* satellite systems. Subcontract from Lockheed's Missile and Space Division. Amount not disclosed.

$2,156,000—Missile Systems Corp., Los Angeles, for equipment related to the nation's nuclear armament program and our atomic retaliatory capabilities.

$115,150—Barnes Engineering Co., Stamford, Conn., for infrared missile radiometers and ancillary equipment.

$93,500—The Pfaudler Co., Rochester, N.Y., for investigation of methods of producing metallic coatings used to protect certain components from extremely high temperatures.

$61,700—Benson-Lehner Corp., Los Angeles, for high-speed plotter system.

$34,952—University of Colorado, Boulder, for design, fabrication and test of rocket-borne lunar orientation device.

$25,931—Control Equipment Corp., Needham Heights, Mass., for study and experimental investigation of the influx rate, size, mass and velocity of the extraterrestrial particles entering earth's atmosphere.

ARMY

$2,586,918—The Williamson Co., Cincinnati, for 1586 *Hawk* missile containers. Work to be performed at Madison, Ind.

$2,199,965—Sperry Rand Corp., Salt Lake City, for research and development on the *Sergeant*.

$1,869,998—Sperry Rand Corp., Salt Lake City, for industrial product and production engineering services on the *Sergeant* missile.

$1,500,000—General Electric Co., Burlington, Vt., for safing, arming and fusing equipment for the *Little John* rocket.

$1,219,204—Budd Electronics Inc., for three antenna filter groups which are part of the AN/TRC-24 radio relay equipment.

$1,153,520—Poorvu Construction Co., Inc., Wellesley Hills, Mass., for construction of a physics laboratory at Laurence G. Hansom Field.

$1,080,000—Massachusetts Institute of Technology, Cambridge, for 12 months basic and applied research in the field of electronic and monecular physics and communication.

$1,050,709—Gilfillan Bros., Inc., Los Angeles, for radar sets and related equipment.

$1,025,000—Raytheon Co., Waltham, for the *Hawk* missile system.

$902,708—Hayes Aircraft Corp., Birmingham, Ala., for engineering, design, fabrication, modification and rework ground services equipment for *Saturn*.

$838,210—Chrysler Corp., Detroit, for *Jupiter* missile ground support equipment.

$714,264—Chrysler Corp., Detroit, for modification services on the *Redstone* system.

$655,519—Sperry Rand Corp., Salt Lake City, for *Sergeant* missile ground handling and test equipment (two contracts).

$230,398—Douglas Aircraft Co., Santa Monica, for *Nike-Hercules* launching area items.

$141,945—Sperry Rand Corp., Salt Lake City, for engineering services for *Sergeant* missile system.

$136,735—Gilfillan Bros., Inc., Los Angeles, for *Nike* system components.

$112,604—Douglas Aircraft Co., Santa Monica, for *Nike* system repair parts.

$103,350—Consolidated Electrodynamics, Pasadena, for recording oscillograph, galvanometers.

$73,952—Solar Aircraft Co., San Diego, for *Saturn* model 1 10MV variable-speed free power turbine.

$66,606—Hayes Aircraft Corp., Birmingham, Ala., for engineering, fabrication and manufacturing services for *Saturn* missile second-stage adapter.

$63,735—Ampex Data Products Co., Atlanta, for system-recorder/reproducer for *Saturn*.

$44,000—Brown Engineering Co., Huntsville, Ala., for closed circuit TV system for *Saturn* program.

$37,630—A. J. Etkin Construction Co., Oak Park, Mich., for construction of launcher site improvements, vicinity of Detroit.

$37,426—Brown Engineering Co., Huntsville, for engineering and fabrication services for *Pershing*.

$36,800—U.S. Steel Corp., Los Angeles, for rocket motor containers.

Going to Lions or Dogs?

To the Editor:

When you launched your salvo of philosophical missiles in the June 13 editorial ("Nuclear Testing—Morals vs. Survival"), you might have anticipated retaliation by your readers. I, for one, take violent exception to certain of your editorial statements. It's not that I quarrel with your conclusions, but merely with the "morally" questionable path by which you reached them!

To quote the first paragraph of your editorial:

"It is easy for people who have no responsibility for defending this country or its allies to call for a complete cessation of nuclear weapons testing. *From a moral point of view, they are right.*" (Italics are mine.)

If I may presume to so state, that second sentence is hogwash of the purest ray serene. If the people to whom you refer are "from a moral point of view . . . right," how could there exist any such thing as a *"responsibility* for defending this country"? It is precisely because there *does* exist such a responsibility, or strict moral duty, to defend this country that these people are wrong—dead-wrong, to be sure, and "from a moral point of view." It is precisely because patriotism *is* moral or "virtuous" (characteristic of a man, "vir") that treason and disloyalty are *im*moral and vicious. Precisely because it *is* moral to defend this country against unjust aggression—if need be, even to the extent of employing horrendous thermonuclear weapons—the pacifism of one who "would rather crawl on his knees to Moscow than risk the holocaust of thermonuclear war" is hideously *im*moral.

I fully agree when you state that "war and the weapons of war aren't moral." You would have done well, however, to add for completeness, "Likewise these things are *not im*moral." It's the *use* of war and the weapons of war that is either moral or immoral depending on the historical context. Clearly, nuclear testing in itself is a quite indifferent means "from a moral point of view." If such testing is an effective means for safeguarding our country by deterring unjust aggression—and it *is* such a means—then it is a good and "moral" means which we would be fools to ignore. But if nuclear testing is, in addition, the *sole* effective means of guaranteeing our continued ability to deter unjust aggression, then it is immoral *not* to resume such testing! Can anyone suggest an alternative means effective in deterring unjust aggression by a hostile power whose repeatedly avowed intention is to "bury" us? What alternative is there to "carrying a big stick" when we deal with an enemy whose every diplomatic, economic and military maneuver is dictacted by a relentless drive for domination of the world?

To set "morals" in opposition to "survival," as you have done in your editorial, bespeaks a fundamental confusion of means and ends—something not uncommon in this age of moral relativism gone "hog-wild." If we subvert the moral order by subordinating "morals" to "survival," we become almost indistinguishable in our crassness and cynicism from the enemy threatening us—in which case we may as well throw away our missiles since we lack anything worth fighting for! Survival and non-survival, like war, can be moral or immoral depending on the context. "From a moral point of view" the early Christian found non-survival preferable to a survival dependent on sacrifice of principle: he chose rather to "go to the lions" than to "go to the dogs." What a dramatic contrast he provides to our decadent, muddle-headed, A.D. 1960 pacifist on the one hand; and to our morally bankrupt, modern materialist on the other!

Yours for sane conclusions soundly arrived at,

Gerald J. Tomis
Boston

Ioways

To the Editor:

On page 39 of your May 16 issue you say "No mention of Dr. James Van Allen of Iowa State University."

Dr. Van Allen is not at Iowa State University. He is the head of the physics department of the State University of Iowa, Iowa City, Iowa. I know this seems very confusing.

Iowa State University is the new name for the Iowa State College of Agriculture and Mechanics Arts, Ames, Iowa.

We are very proud of Dr. Van Allen and his work at the State University of Iowa, at Iowa City.

Clarence F. Schmarje
Schmarje Tool Company
Muscatine, Iowa

So are we—and glad to get I.S.U. and S.U.I. sorted out.—Ed.

All That's Needed

To the Editor:

After reading several recent M/R's, I find you've got all the dope I need to stay atop missile/space developments. Thanks for cutting down (from 3 publications to 1) my "on the job" reading.

Richard Hopewell
Orlando, Fla.

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editorial . . .

More Money for Defense

The recent actions and the apparent temper of the Senate leave little doubt that the U.S. defense budget will be substantially increased for the coming year.

The military money bill as passed by the Senate—$40.5 billion—is $1.2 billion higher than the House version and $1.3 billion more than the President wanted.

While the House has tended to go along with the Administration, and while the Senate additions must be compromised in committee and then passed by both houses, it seems reasonably certain that a fair measure of the increases will stick.

In the Senate they have the sure support of Sen. Symington and the indicated support of Sen. Lyndon Johnson. Both of these gentlemen are running for President and can command considerable support.

The additional money will probably go, as was pointed out on this page May 30, for stepped-up production of *Atlas, Titan* and *Minuteman;* for additional *Polaris* subs; for reinstatement of the B-70 and a speed-up of the ballistic missile, *Skybolt,* which it will carry; for more emphasis on *Minuteman* and *Polaris,* itself; for a hurry-up of *Samos* and *Midas,* the Air Force reconnaissance and early warning satellites.

Three things are influencing Congress in this move to both increase and speed up our defense program: first, an honest belief that we are behind in our military strength and—if not slipping further—certainly not catching up fast enough; second, the fact that the nation's state of preparedness—particularly in missiles—will most certainly be a major issue in the coming election campaign; and third, that our foreign relations position is at its worst in peacetime history, and continuing to deteriorate.

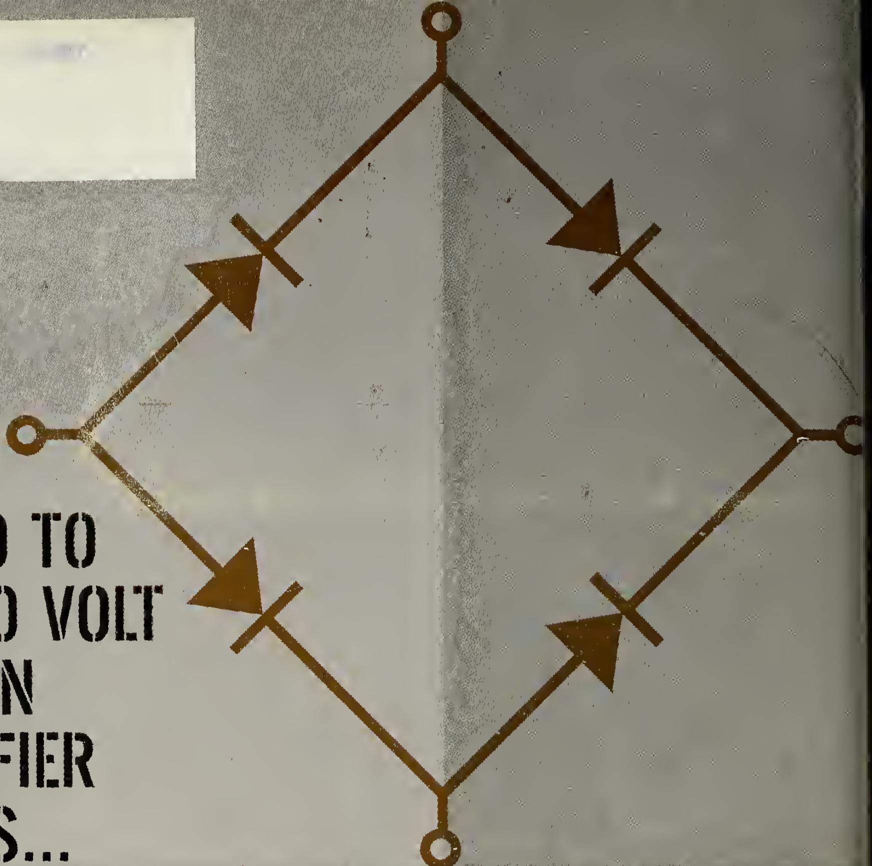
As a consequence of this last item, we see the Soviet government reverting to Stalinist tactics and attitude while Communist China chides Russian leaders for not reviling us even more. We have lost face in the Orient and, worse, have caused a friendly Japanese government to do likewise, thus contributing to tremendous Communist gains there. We have lost the faith and trust of our allies; while it would not be correct to say we stand alone, it is certainly correct to say we do not have enthusiastic international support.

In such a situation we have no alternative but to be strong, not only militarily but in the other fields where our strength will be most felt—the exploration of space, research and development, scientific education and industrial progress. We might halt, for a time, the worship of consumer goods for consumer goods' sake.

Whatever money Congress appropriates in addition to that requested by the President may or may not be spent by this Administration, just as the White House may or may not face squarely the position into which the nation has slipped.

But a new administration will take over in six months, midway of the fiscal year. Then, in any case, we will have some hope of positive action to restore our strong position among the nations of the world.

Clarke Newlon



NEW! 12,000 TO 30,000 VOLT SILICON RECTIFIER SERIES...

with no voltage derating over entire range −55°C to 175°C!

Ten new Very High Voltage silicon cartridge rectifiers rated from 12,000 to 30,000 volts are now available in production quantities from P S I.

Designated 1N3052 through 1N3061, the new units are added to the existing P S I line to provide 19 EIA types with voltages ranging from 1,000 to 30,000 volts.

NOTE THESE OTHER FEATURES:

1—Easy to mount, compact, light weight
2—Non-metallic electrically "cold" case
3—All welded construction
4—Meet all applicable MIL specs
5—*Lowest voltage drop—highest current ratings—best reverse leakage characteristics of any available types*

This new series is ideally suited to radar modulator and power supply applications.

Like the widely accepted 1N1730 series (1,000 to 5,000 volts) and the 1N2382 rectifier series (4,000 to 10,000 volts) the new types are of special significance where light weight, unusual ruggedness and high reliability are of prime importance.

Write or wire for detailed specifications, prices and delivery schedules.
NEW CONDENSED PSI CATALOG ALSO NOW AVAILABLE!

ELECTRICAL SPECIFICATIONS

MAXIMUM RATINGS			
TYPE NUMBER	PEAK AND CONTINUOUS INVERSE OC VOLTAGE −55°C to +175°C (Vdc)	EQUIVALENT RMS VOLTAGE (Vdc)	FORWARD DROP AT 100 mAdc AT 25°C (Vdc)
1N3052	12,000	8,450	70
1N3053	14,000	9,900	75
1N3054	16,000	11,300	80
1N3055	18,000	12,700	85
1N3056	20,000	14,150	90
1N3057	22,000	15,500	95
1N3058	24,000	17,000	100
1N3059	26,000	18,350	105
1N3060	28,000	19,750	120
1N3061	30,000	21,150	125

*Half Sine Wave, Resistive or Inductive Load. For higher Ambient ture derate average rectified current lineary to zero at 175°C.

OTHER SPECIFICATIONS

1. Inverse Current at Rated Inverse Voltage: 10 μA Max at 25°C an Max at 100°C.
2. Maximum Non-Recurrent Surge Current: .008 second, 2.5 Amps
3. Operating Temperature Range: −55°C to +175°C.

PSI

Pacific Semiconductors, Inc.

A SUBSIDIARY OF THOMPSON RAMO WOOLDRIDGE INC.
12955 CHADRON AVENUE, HAWTHORNE, CALIFORNIA