OCTOBER 3, 1960

missiles and rockets

E MISSILE/SPACE WEEKLY

A Modest Proposal for Survival

An Open Letter to:
RICHARD NIXON and JOHN KENNEDY

AN AMERICAN AVIATION PUBLICATION

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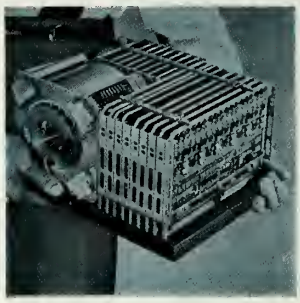

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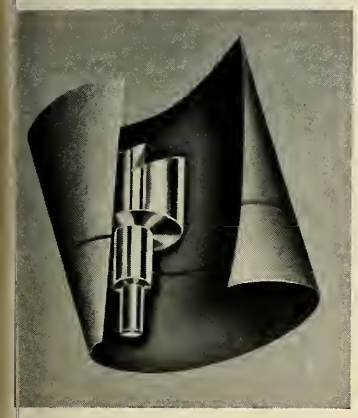

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ature's way of protecting certain little mphs of the insect world is to tuck them ay in tough but cozy cocoons. Here ey snooze in silken comfort, oblivious to nd, rain, snow, and everything else that ells weather.

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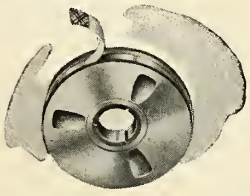

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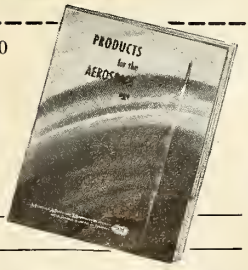

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THE MISSILE / SPACE WEEKLY

missiles and rockets

October 3, 1960 Volume 7, No. 14

Published each Monday with the exception of the last Monday in December by American Aviation Publications, Inc., 1001 Vermont Ave., N.W., Washington 5, D.C.

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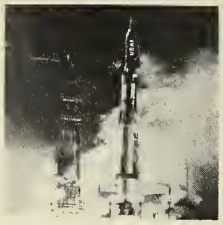
Printed at the Telegraph Press, Harrisburg, Pa. Second Class postage paid at Washington, D.C. and at additional mailing offices. Copyright 1960, American Aviation Publications, Inc.

Subscription rates: U.S., Canada and Postal Union Nations—1 year, $5.00; 2 years, $8.00; 3 years, $10. Foreign—1 year, $10.00; 2 years, $18.00; 3 years, $26.00. Single Copy rate—$.50. Subscriptions are solicited only from persons with identifiable commercial or professional interests in the missile/space industry. Subscription orders and changes of address should be referred to Circulation Fulfillment Mgr. M/R, 1001 Vermont Ave., N.W., Washington 5, D.C. Please allow 4 weeks for change to become effective and enclose recent address label if possible.



THE COVER

Artist's conception of Dyna-Soar launch atop specially adapted Titan ICBM. Note fins on first stage of booster. First flights are due by 1963. *See p. 16.*

OCTOBER 3 HEADLINES

SPECIAL REPORT ON SOUNDING ROCKETS

NUCLEONICS

ELECTRONICS

ADVANCED MATERIALS

SPECIAL FEATURE

DEPARTMENTS

31,098 copies this issue

letters

Overclassification?

To the Editor:

In the Sept. 5 M/R, COUNTDOWN mentioned that extremely clear color photos were made of a Russian missile warhead on July 7 in the Pacific. These photos were supposedly so clear that the type of material (ablating) used on the re-entry vehicle could be identified.

Why were these photos and the type of material classified by the Pentagon? Are we afraid the Russians will learn what material they are using? Or are we afraid our Western allies may find out?

This sounds to me like the perfect example of the asinine classification of material and withholding of information that goes on every day and in many instances harms the furtherance of technical advancement in many fields by private industry.

There may be a logical explanation and I hope there is. But to the readers of the article I'm sure it sounded ridiculo

I enjoy each and every issue of y fine magazine.

Bob Kietzman
Long Beach, C

Underclassification?

To the Editor:

I enclose a security notice ("O Security Regulations") published by Department of Defense in Washing D.C., copies of which were recently fo one morning on the desks of all perso in the missile plant where I am emplo

They were placed there (in g faith) by the plant security group du the off-work hours.

The Sept. 19 issue of M/R had arrived in my mail basket.

I immediately began a quick per of it, as usual, when it fell open to p 41—and behold the map of the showing all ICBM bases present and posed, hardened or soft, plus *Polaris* sile Depot and other missile test cent

How do we reconcile publishing this information with the enclosed noti I realize this was released by Washing probably published elsewhere, etc., do we *have* to make it easy for the e onage agents of a foreign power? this carrying "freedom of the press" the *nth* degree? I have been in the mis business several years, but did not alre have all of the information disclosed that map. Our government again sh that amazing *lack of coordination* wh has existed for so many years. Woul this be good material for Kennedy Nixon to chew on in the present c paign?

It seems to me that "security" in country will remain a farce as long security positions are passed out as litical plums.

Henry S. Mack
North Wilmington, Mass

Reader Mack is correct—all the formation on the map was released b number of different official agencies. a free country where projects are put to open bids, and anyone can wan through a cornfield with a camera, i impossible to keep the Russians from m ing similar maps. Therefore the gov ment would appear to be right in relea the information for publication so that American people can know, too.—Ed.

Titan Coverage

To the Editor:

Just a note to tell you what a b up job I thought you did with the spe report on *Titan* in the Sept. 5 issue. Baar's lead-off article was not only moving but quite comprehensive, as the entire series, and I wanted to v my congratulations before any more t passed.

William B. Harwood
Director, Information Serv
The Martin Company
Cocoa, Fla.

BENDIX G-20

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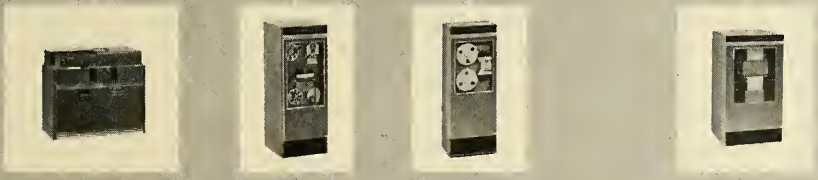

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Censorship in the Campaign?

Top Democrats are complaining that the Eisenhower Administration is "withholding" from Senator Kennedy information relating to national security. The clampdown reportedly came during a recent visit to SAC by the senator. Supposedly the word went out in conjunction with Vice President Nixon's call for a "truce" on all campaign material which would tend to indicate the U.S. is weak in Khrushchev's eyes. But there is no confirmation of the truth of the Democratic complaint.

Typhon Getting Off Ground

The Navy's super-secret *Typhon* antimissile system is presently moving into the flight-testing stage. An offshoot of the *Talos* air defense missile, the long-range *Typhon* will have integral ramjet propulsion.

Battle of the A-ICBM's

In the budget skirmishing for FY '62 a bead is being drawn by the Air Force on the Army's *Nike-Zeus*. The reason is still money: the estimated $10 billion to $15 billion to produce the system in quantity. The heat of attacks being made publicly indicates that the future planning for the A-ICBM is reaching the "moment of truth" in DOD's budget department.

Around the Corner: Pershing II

Pershing II—the Army's proposed 1000-mile tactical missile—is understood to be only a short way around the bend, if the Administration wants to move quickly. Present schedules call for deploying the first operational 450-mile *Pershing I's* in late '62. COUNTDOWN is told *Pershing II's* could be in the field by about mid-1963.

Midas Shot Due Soon

Look for another *Midas* IR surveillance satellite shot soon. First try last May was a partial success. Next bird will contain an R&D payload.

Operational Intelligence

The Air Force discloses that the countdown for operational *Atlas* ICBM's can be advanced now to within eight minutes from lift-off—without degrading their alert status.

INDUSTRY

Another Boost-Glider

McDonnell Aircraft is working on an AF contract for the design of a boost-glide flight-test vehicle. No details yet whether it is tied in with the *Dyna-Soar* or represents a follow-on version.

Print Office

McCormick Selph Associates and ITT have agreed on a joint manufacturing and marketing venture involving a new exploding bridgewire system called XBS . . . A pact has been signed by McGraw-Edison and Standard Oil of Indiana for joint R&D of fuel cells to find an oxidizer for hydrocarbon, alcohol or hydrogen fuel . . . Boeing is ready to set up a new enterprise to capitalize commercially on research discoveries.

Big Sounding Rocket Buy

Marquardt's Cooper Development Division has won a $417,000 Army contract for 600 meteorological rockets. For an up-to-the-minute report on the expanding sounding rocket market, see page 19.

INTERNATIONAL

$11 Million Question

Britain's Peter Thorneycroft (minister for aviation) has wound up talks with Australia on the idea of forming a space research "club." The club would be composed of British Commonwealth and West European nations who would cooperate in the launching radio and TV communications satellites from Woomera. Key to the plan is whether the Aussies will agree to contribute $11 million to the scheme. Right now the Australian defense department is balking at the idea, if it has to provide the money.

British Moon Vehicle

Hawker Siddeley's Advanced Projects Group is designing moon exploratory equipment—including a vehicle for an unmanned probe and a caterpillar-tracked conveyance holding a crew of 12. The group also has a proposal for a winged, recoverable space booster.

Japan Starts Weather Rocket

Japanese Science and Technology Agency is proceeding with a three-year plan to develop a camera-equipped weather observation rocket. Camera would be installed in the warhead to take photos from 1000 kilometers. Primes for the program are the Mitsubishi Heavy Industries and Fuji Precision.

Soviet A-Plane

U.S. intelligence agencies reportedly have pictures of a Russian nuclear-powered aircraft undergoing ground tests. The craft is said to be a modified Bounder with a 200-ft. fuselage and 80-ft. wingspan.

Sunburned Eskimos?

Latest idea bouncing around Soviet scientific circles is to create a belt of potassium particles around the earth—to increase the sun's intensity upon the earth. The belt consisting of 1.75 million tons of potassium would be installed at an altitude of 1200 km between 70° and 90° north latitude.

A
Modest Proposal
For Survival

An Open Letter to Richard Nixon and John Kennedy

September 27

A FEW MONTHS from now a new administration will take charge of the nation's affairs. These days, these times, cry out for new and vigorous leadership.

The people of the United States desperately need to know where they stand, where they are going. More than anything they need to have objectives.

It is apparent today to virtually every thinking military and industrial leader that America as a whole does not have now, and has not had in the past four years, any grasp of what is at stake in the "exploration" of space.

There is almost no general conception of the fact that this exploration is linked technologically and strategically with the future military strength of the nation.

Our aircraft fly on the edge of space. Every ballistic missile we fire from land, sea or air will go through space. We are only a step from reconnaissance and communications via space. Only a step from spacecraft.

Yet the public has been lulled by the ambiguities of the Eisenhower Administration into believing that space really has no strategic importance. It is merely a scientific curiosity, an area to be explored for exploration's sake, with possibly some gains in television and weather forecasting.

Meanwhile, Russia forges ahead. Her military strength at least equals ours. Combined with Red China, it probably excels. Russia's initial space exploits have been greater than ours. They are providing the means for spectacular strategic exploitation of space in the years immediately ahead. This is the danger.

Redirecting our national defense and space programs will be no simple or easy task for the incoming administration. It will take courage and boldness and imagination.

We, at MISSILES AND ROCKETS, believe that such redirection must be accomplished. We sincerely feel that the national survival may well depend upon what the next administration does to ensure our world leadership in both the military and space fields.

As yet the election campaign has not produced a real debate on these most critical of issues. The American people do not realize there is such an issue.

They have no general awareness of the enormous technological changes that are taking place, no awareness of the dangers they create.

A Cosmic Curtain barring us from space would make the Iron Curtain seem like Calico.

With the thought foremost in mind that the nation needs firm objectives in defense and space, that we must have hard goals to strike for, the editors of MISSILES AND ROCKETS here propose a nine-point defense and space platform to start the next four years.

We should like to emphasize that it is only a proposal and only a start. We offer it to help fill a void which desperately needs filling. During the next four years it must be modified and amplified because it will inevitably be overtaken by technological achievements as yet unknown.

We offer it to you, Mr. Kennedy and Mr. Nixon, as a "working paper." We ask that you reply to this open letter, stating your views and making your stand quite clear on these two closely related problems.

We ask that you bring these vitally important issues into the open so that American voters may know your intentions. ¤

The Proposal

1. Recognize as national policy that we are in a strategic space race with Russia.

2. Expedite present space projects to provide a new and bold program with the following goals;

Manned space platform—1965
A U.S. citizen on the moon—1967-68
Nuclear power for space exploration—1968-69
A spacecraft which can take off from earth, travel to and in space, return and land under its own power—1968-69.

3. Recognize that "space for peaceful purposes" is possible only if "freedom of space" is ensured; hence that the U.S. military must be given a predominant role in developing and carrying out the projects necessary to guarantee freedom of space.

4. Establish pre-eminent strategic, tactical and defensive forces with representation from all services.

5. Recognize the necessity of greater defense funding to accomplish this, including a supplemental budget in January, 1961, to make it possible to:

Speed up to a maximum degree the construction of ICBM launching bases, Polaris submarines and the Mach 3 missile-carrying B-70.
Provide the Army with funds to begin the immediate procurement of already-developed modern missiles, other weapons and airlift.

6. Establish further-on defense spending by need and not by budget ceiling.

7. Streamline defense regulations and procedures to make industry's role in the U.S. defense and space effort more effective.

8. Take what steps may be necessary to establish and promote national scientific objectives.

9. Re-establish decision-making in the U.S. defense and space organizations.

A Cosmic Curtain Barring Us from Space Would Make the Iron Curtain Seem Like Calico

THE OPEN LETTER on these pages was sent to the two Presidential candidates by registered mail on Tuesday, September 27.

Their replies and/or reaction to the "Modest Proposal for Survival" will be published in succeeding issues of the magazine.

We know that you, our readers, have a great interest in what the next administration does in the space area; and an even greater stake in having these questions discussed openly and forthrightly.

MISSILES AND ROCKETS, therefore, is opening its pages to provide a badly needed forum. Contributions from you, our readers, are welcomed. We think your opinion is vital.

All submissions will be treated in confidence and anonymity will be strictly respected where requested.

All letters should be addressed to:

Countdown for Survival
Missiles and Rockets
1001 Vermont Ave., N.W.
Washington 5, D.C.

SEE EDITORIAL PAGE 50

Ike's 'Off-limits' Speech Clouds Space Policy Picture

AS THE NATION'S CAPITAL got back to work after two weeks of rapt attention to bigger affairs at the U.N., some of the aftermath of the sound and fury became clear. If there were no great victories, neither were there any great defeats.

We had not won over the new African delegations to a discernible degree, but neither had Khrushchev succeeded in abolishing the U.N. There were no major shifts in world power. A spectacular space triumph hinted at by Moscow Radio had failed to materialize, at least by M/R's press time.

One reaction to the speech made by President Eisenhower, however, seemed evident. His words implying that space was "off limits" to the military were being taken seriously in at least some quarters.

It had been taken for granted by almost everyone interested that the National Aeronautics and Space Administration would cooperate closely with the Air Force in its future *Discoverer* shots. Particularly was this thought to be true because the Air Force may quite easily place a primate in orbit before NASA does, and information gathered from such a success would be highly valuable to NASA space scientists.

However, within a few hours of the President's proposals concerning future space exploration, NASA officials not only denied that they would cooperate on the *Discoverer* shots, but denied that they had ever intended to. They also indicated that this would be the future policy.

The following is the text of the President's remarks concerning space:

Another problem confronting us involves outer space.

The emergence of this new world poses a vital issue: Will outer space be preserved for peaceful use and developed for the benefit of all mankind? Or will it become another focus for the arms race—and thus an area of dangerous and sterile competition?

The choice is urgent. It is ours to make.

The nations of the world have recently united in declaring the continent of Antarctica "off limits" to the military preparations. We could extend this principle to an even more important sphere. National vested interests have not yet been developed in space or in celestial bodies. Barriers to agreement are now lower than they will ever be again.

The opportunity may be fleeting. Before many years have passed, the point of no return may be behind us.

Let us remind ourselves that we had a chance in 1946 to ensure that atomic energy be devoted exclusively to peaceful purposes. That chance was missed when the Soviet Union turned down the comprehensive plan submitted by the United States for placing atomic energy under international control.

Proposals for Outer Space

We must not lose the chance we still have to control the future of outer space.

I propose that:

1. We agree that celestial bodies are not subject to national appropriation by any claims of sovereignty.

2. We agree that the nations of the world shall not engage in war-like activities on these bodies.

3. We agree, subject to appropriate verification, that no nation will put into orbit or station in outer space weapons of mass destruction. All launchings of space craft should be verified in advance by the United Nations.

4. We press forward with a program of international cooperation for constructive peaceful uses of outer space under the United Nations. Better weather forecasting, improved worldwide communications, and more effective exploration not only of outer space but of our own earth—these are but a few of the benefits of such cooperation.

Agreement on these proposals would enable future generations to find peaceful and scientific progress, not another fearful dimension to the arms race, as they explore the universe.

But armaments must also be controlled here on Earth, if civilization is to be assured of survival. These efforts must extend both to conventional and non-conventional armaments.

My country has made specific proposals to this end during the past year. New United States proposals were put forward on June 27, with the hope that they could serve as the basis for negotiations to achieve general armament. The United States supports these proposals.

The Communist nations' walk- at Geneva, when they learned that were about to submit these propos brought negotiations to an abrupt h Their unexplained action does however, reduce the urgent need arms control.

My country believes that nego tions can—and should—soon be sumed.

Our aim is to reach agreement all the various measures that will b general and complete disarmam Any honest appraisal, however, n recognize that this is an immense t It will take time.

We should not have to wait u we have agreed on all the deta measures to reach this goal before begin to move toward disarmam Specific and promising steps to end were suggested in our June proposals.

If negotiations can be resume may be possible to deal particul with two pressing dangers—that of by miscalculation and that of mo ing nuclear weapons stockpiles.

The advent of missiles, with shorter reaction times, makes meas to curtail the danger of war by calculation increasingly necessary. St must be able quickly to assure other that they are not preparing gressive moves—particularly in i national crisis, when each side t steps to improve its own defenses w might be misinterpreted by the ot Such misinterpretation in the abs of machinery to verify that neither preparing to attack the other, c lead to a war which no one had tended.

Today the danger of war by calculation would be reduced, in ti of crisis, by the intervention, wher quested by any nation seeking to p its own peaceful intention, of an propriate United Nations surveill body. The question of methods ca left to the experts.

Thus the vital issue is not a m of technical feasibility but the poli willingness of individual countrie submit to inspection. The United St has taken the lead in this field.

Today, I solemnly declare, on half of the United States, that we prepared to submit to any internati inspection, provided only that i effective and truly reciprocal. This we will take willingly as an earnes our determination to uphold the amble of the United Nations Chart "to save succeeding generations f the scourge of war, which twice in lifetime has brought untold sorrov mankind . . ."

At Huntsville conference . . .

NASA Launches Studies for Moon Ship

Von Braun group to invest several million dollars for industry studies; three main approaches to moon are outlined

HUNTSVILLE, ALA.—The National eronautics and Space Administration sponsoring a series of wide-ranging udies to help determine the nature of e launch vehicle that will follow *turn* and provide for a manned land- g on the moon.

Dr. Wernher von Braun's Marshall ace Flight Center will award about contracts in the $50,000-$200,000 nge on 14 aspects of future planning the next few months. Between 10 d 20 companies will receive invita- ns to bid. The studies will cover ese areas:

–Launch vehicle size and cost alysis, study of trends in launch ve- cle guidance and control systems, de- n study of homing systems for or- tal rendezvous.

–Studies on the C-2 *Saturn* con- uration, conceptual studies on launch hicles with thrust of 2 to 3 million s. with fully recoverage stages.

–Early nuclear flight vehicle design udy and preliminary design study for nuclear third stage in an advanced rsion of *Saturn.*

–A flight performance manual for bital operations, design criteria for bital operations and systems, design iteria and propulsion systems for or- tal launch vehicles and design criteria r lunar and planetary launch vehicles.

• **Approaching the moon**—H. H. oelle, Director of the Marshall Cen- r's future projects office, outlined the udy plans at the Center's two-day in- strial conference. There are three ap- oaches to the question of getting men the moon, Von Braun said. He listed em as:

–The brute force chemical ap- oach, using a *Nova*-type vehicle of million lbs. takeoff thrust. The major jection to this, he said, is cost. The *ova* program alone could cost more an the total present NASA budget.

–Orbital refueling and rendezvous, which seven *Saturn* launches could bit tanks of fuel to support a three- an mission to the moon and return ter a two-week stay. The objection here is the need for multiple *Saturn* launch facilities, since liquid hydrogen will not keep indefinitely and seven launches from a single complex might take up to a year.

–Nuclear upper stages, lifted by the basic 1.5-million-lb.-thrust *Saturn* booster. The objection here again is cost. The Center director estimated that a nuclear engine might cost 5 to 10 times as much as a chemical engine of similar power.

Later, Von Braun indicated he is leaning toward the nuclear solution. He told MISSILES AND ROCKETS that a 1500 megawatt reactor generating 80,000 lbs. of hydrogen thrust appears practical and it may be possible to get the reactor up to 4000 megawatts, which would give 200,000 lbs. thrust. If the higher thrust is impossible, the engines could be clustered, he remarked.

Source of Slippage Rumor

HUNTSVILLE, ALA.—*An overenthusiastic prediction by Dr. Wernher von Braun apparently was responsible for a report that the Saturn program is slipping.*

Von Braun told visitors to Huntsville at the dedication of an IBM 7090 computer last June that a new series of static tests would begin in "six to eight weeks."

Actually, according to information received by MISSILES AND ROCKETS, *Von Braun's subordinates were horrified by the statement and are hoping that everyone will forget it.*

Last week, in reply to a wire service query, NASA's Marshall Space Flight Center reported that the series actually will begin in November.

NASA spokesmen say the timing of the series is unimportant—that more data became available as a result of the last test, and the new series won't begin until the bird is completely modified into a prototype of the flight version, which still is to be flown next summer.

• **Launching outlook**—These other developments were reported at the conference, attended by representatives of 400 industrial, university, research and government agencies.

–Eight modified *Redstone* rockets are being produced for the early phases of the *Mercury* man-in-space program. The first two were assembled here and the other six by Chrysler Corp., with Reynolds Metals frames and Rocketdyne engines. All boosters have been delivered to Huntsville and four have been static-fired. The first *Mercury Redstone* is on the launch pad at Cape Canaveral, following a capsule-booster compatibility checkout here. The capsule at the Cape is the only one delivered so far. NASA officials say they're expecting delivery of the second capsule from McDonnell Aircraft in St. Louis "in a few days."

–Canadian-furnished topside ionospheric sounder will be one of eight satellites launched by the *Thor-Agena B* vehicle. Other items tentatively in the list are four *Nimbus* advanced weather satellites and the Polar Orbiting Geophysical Observatory *(POGO).*

–A series of five *Ranger* capsule launches, by the *Atlas-Agena B* vehicle, will begin next year. *Ranger* is a program for a rough lunar landing but the first two launches will not be aimed at the moon. They will merely test performance of components such as attitude control system, power supplies and communication equipment.

–The first ion propulsion system will probably be flight-tested in 1964, aboard a *Centaur*-launched spacecraft. Interplanetary probes may carry dual electrical propulsion-ion engines for the long pull and arc jets for short bursts of higher thrust, possibly for breaking into a planetary orbit.

–Air transport hasn't been completely ruled out for the Douglas S-IV second stage of the first *Saturn* vehicle. Oswald Lange, *Saturn* systems director, reported that he is extremely uphappy about the long time required to ship the stage by barge from the West Coast to Huntsville and thence to the Cape.

The Missile/Space Week

First Titan Base Activation Contract Awarded

The first subcontract for *Titan* ICBM base activation was awarded to Northrop Corp. last week by The Martin Co. The multimillion-dollar contract covers installation and checkout of missiles and ground equipment of the three-silo launch complex at Ellsworth AFB, Rapid City, S.D.

Meantime, the successful 5000-mile *Titan* shot on Sept. 28 used for the first time a refined guidance system which permits ground control of turn (or roll) in the first stage immediately after lift-off.

The data capsule ejected from the heavily instrumented dummy warhead was recovered in the target area.

A few hours later, the Army's *Pershing* suffered its first failure in seven launchings at the Cape. It was the first attempt to separate the *Pershing* and have its second stage fire. But the bird veered out of control and blew up.

Polaris Declared Still on Schedule

Polaris will still go operational this month in spite of two spectacular bloopers, Vice Adm. William R. Raborn has promised. The first missile launched from the Patrick Henry on Sept. 23 flopped ineffectually to the ocean floor without igniting; the second blew up. Although a piece of wreckage left a large dent between hatches in the deck, no casualties were suffered and damage was considered minor. Telemetry information is being studied to determine the cause of the two failures.

Decision Due on B-70 Strength

Decision as to number of prototype B-70's the Air Force will buy is "imminent," a DOD spokesman says, although production dates will not be set until the program is farther along. DOD officials implied that development would start in ample time to avoid further delays in the strategic bomber program—now scheduled to become operational in late 1965.

The AF is also looking into best methods of beefing up the development program; a decision as to the most feasible is expected shortly. There may be a substantial fund increase in both 1961 and 1962.

Aerospace Recruiting Gains Momentum

Personnel recruitment will be stepped up next month at Aerospace Corp., the Air Force's new in-house company replacing Space Technology Labs. President Ivan A. Getting said the key executive spots are now filled and a rapid buildup of technical teams is under way. Biggest problem has been how to get as much technical know-how as possible from STL without crippling it. Latest shiftover—Jack H. Irving, new Aerospace VP-general manager, systems research and planning. Irving formerly was deputy to STL's Allan Donavan, who now is Aerospace vice president and technical director. Getting also reveiled that the laboratories division, headed by Dr. Chalmers W. Sherwin, will play a bigger role in Aerospace than it did at STL.

European Space Program Awaits Ratification

The proposed European space research program may get going shortly insiders say, if six or more nations give it the nod. The embryonic European Commission for Space Research—spearheaded by an energetic U. of Paris professor—is meeting this week in London to complete its formal organization. Nations invited to join: Belgium, Britain, Australia, Denmark, Italy, The Netherlands, Norway, Sweden, Switzerland, West Germany, and France. Professor Pierre Victor Auger is executive secretary and chief protagonist. Some of the assets in the group: France's highly successful *Véronique*, and the possible resurrection of the impoverished British *Blue Streak/Black Knight* space program. Australia's participation would bring in the Woomera rocket range, to supplement the French range at Colomb Béchar.

Soviet Scientist Hints Man In Space Shot to Come Soo

A Russian will be in outer spac before very long, according to Vladim Timakov, vice president of the Sovi medical academy.

Timakov, in an interview with Tas said "there are no more problems co nected with (manned) space flights th cannot be solved by contempora science."

The Soviet scientist revealed co siderable information on the Red astr nauts. He said they are all jet pilo and of slight build, since "every gra of weight counts in space."

Their daily training schedule, h said, takes into account every minu and requires approximately one mont Training includes the study of astro omy, botany, medicine, electronics ar geography, as well as specially selecte sports.

"Special pills have been developed he said, "for correcting any nervo system irregularities in case of a departure from normal in the astr naut's organism while in flight." A cording to Timakov, however, the astr naut will not actually pilot the spa vehicle since "for safety reasons" spa flights will be controlled from earth.

Conjecture that the Russians m have already tried unsuccessfully launch a man into space was strengt ened somewhat by reports from Switze land that a radio ham may have r corded the voice of a Soviet rock pilot. A 37-year old radio technici reportedly made a 25-second tape r cording on January 17 of transmissio on the Russian satellite transmitti frequency. Due to the frequency us and reception characteristics indicati transmission from a "very fast-movin object, he concluded that the voi may have come from a rocket pilot.

The recorded voice reportedly r peated the Russian equivalent of on two-three (ras-dva-tree) several tim then faded away as it was apparent pronouncing other words.

Plasma-Coated Nozzles Take 5500°F Beating

Plasma application of metal co ings to experimental nozzles sho promising high-temperature characte istics at Rocketdyne's Solid Propulsi Operations, McGregor, Tex.

The plasma-sprayed metal powde have been instrumental in protecti nozzles from exhausts exceedi 5500°F. Alumina, tungsten and tungst carbide bond to the nozzles in app cation temperatures over 25,000°

Pre-election Moon Shot Still Possible

Latest probe effort fails with surprise fizzle of Able; backup available for another launch late this month

THE LAWS OF astronomy give the Eisenhower Administration one more chance to achieve an earth-moon trajectory before election.

A backup *Atlas-Able* vehicle and payload are on hand at Cape Canaveral and an attempt presumably will be made when the moon next comes near perigee, in the period Oct. 22-26.

The seventh in America's dismal series of moon-probe attempts failed Sept. 25 when the *Able* second stage failed to reach full chamber pressure and burned for only about 80 of the scheduled 110 seconds.

It was a case of the law of averages catching up with the hitherto reliable Douglas-Aerojet-General *Able*. Aerojet and *Able* had a perfect 15-15 record until then.

The cause of the engine failure was under investigation. It could have been in the engine itself, in separation or in the structure holding the nozzle in place.

The *Atlas-Able* vehicle, for which officials of the National Aeronautics and Space Administration never were enthusiastic, now has been plagued by three straight failures and, unless the next one succeeds, may become obsolete without ever achieving a successful launch.

NASA originally planned to fire only one *Atlas-Able*. The *Atlas* blew up on the launch pad in a pre-flight test in September, 1959—the same month the Soviets fired two successful moon shots.

In response to widespread public demand, NASA diverted an *Atlas* from the Project *Mercury* test program for use in a second *Atlas-Able*. That one, launched Nov. 26, 1959, failed when the fairing fell off the nose just as the second stage ignited.

• No reflection on Altair—Apparently no more *Atlases* were available for moon shots until this spring. At that time, Dr. Abe Silverstein, director of the NASA Office of Space Flight Programs, told the House Appropriations Subcommittee that the program had been delayed for a new environmental test of the payload package because of the vibration level of the third-stage rocket. Silverstein told M/R there was no reflection on the third-stage *Altair*, manufactured by Allegany Ballistics Laboratory, a Navy-Hercules Powder Co. installation. *Altair* has had more than 15 straight successes and apparently fired again last week.

U.S. Moon Probe Attempts

Vehicle	Launch Date	Results
Pioneer I (Thor-Able)	Oct. 11, 1958	Traveled 70,000 miles
Pioneer II (Thor-Able)	Nov. 8, 1958	Third stage failed to ignite
Pioneer III (Juno II)	Dec. 6, 1958	Traveled 63,000 miles
Pioneer IV	March 3, 1959	Achieved escape velocity, passed within 37,300 miles of moon and entered solar orbit
Atlas-Able I	Never launched	Vehicle blew up on pad September, 1959
Atlas-Able II	Nov. 26, 1959	Fairing fell off nose just as second stage ignited
Atlas-Able III	Sept. 25, 1960	Second-stage failure

The 387-lb., 39-in.-diameter payload was to have been put into a 5000-mile orbit about the moon—one of the few space spectaculars presumably within U.S. capability that Russia has not already accomplished. A twin-chamber hydrazine engine was carried to provide reverse propulsion. Each chamber was able to deliver 20 lbs. thrust. Fuel was carried to run the engines 1700 seconds.

The reverse thrust, designed to slow the craft as it neared the moon, operated by valving hydrazine across an aluminum oxide catalyst bed. Pressure is maintained by small nitrogen tanks.

Power is supplied by 22 solar-cell modules producing 1.3 watts under direct sunlight. The craft carried these experiments:

–A 1-lb. micrometeorite detector, consisting of a diaphragm and a microphone, to transmit to earth the sound of particle impacts.

–A 5-lb. package of six argon-filled cylinders ranged around a seventh cylinder wrapped in a thin lead shielding, which by ionization was to detect electrons in the energy range of 12 to 70 million volts (Mev).

–A 2-lb. box containing an ionization chamber and a Geiger-Mueller tube for measurement of total radiation—particularly in the medium-energy range.

–A 2-lb. scintillation counter for monitoring low-energy radiation.

–A 2½-lb. flux-gate magnetometer, similar to the instrument on *Pioneer V* that detected a measurable earth magnetic field out to 65,000 miles.

–A 4-oz. photoelectric cell to report when it is pointed at the sun—for use as a reference for the magnetometer.

–A 1½-lb. plasma probe experiment, consisting of an electrometer measuring the energy of protons passing through a slit, to measure intensity of the solar wind as affected by the electrostatic forces and magnetic field in the earth's neighborhood, and strong solar flares.

–Two packages weighing a total of 3½ lbs. to measure the energy spectrum of interplanetary protons and to measure any radiation trapped around the moon.

Tracking duties were assigned to Jodrell Bank, England; Millstone Hill, Mass.; South Pt., Hawaii; Goldstone, Calif.; Cape Canaveral and a small receiver operated by Space Technology Laboratories at Singapore. ¤

Air Force Brass Assails Army Zeus

SAN FRANCISCO—Army's *Nike-Zeus* switched roles here last week at the Air Force Association Convention. It was the target of a large number of pot-shots aimed by high AF brass.

They all agreed that an anti-ICBM was the "most critical current need for the nation's defense." But few thought *Zeus* was the answer, in spite of the fact that this is the only U.S. anti-missile system even close to production.

Lt. Gen. Roscoe C. Wilson, AF deputy chief of staff, dismissed the *Zeus* as an exceedingly imperfect solution, "prohibitively expensive," and "probably not the best approach to the problem." He said that trying to destroy a missile in the mid-flight phase of its trajectory offers the least prospects for a solution; he pointed out that the AF is concentrating its research on a launch-phase kill.

AFA directors, in drafting the Association's statement of policy, minimized the Army's *Zeus* effort and plumped for more vigorous antimissile research—deploring the "singular lack of imagination, determination and tenacity" in this area.

On the other side, Gen. Laurence S. Kuter, Chief of NORAD, said that his organization favors pushing *Zeus* as the best answer currently available. He urged an immediate start of production.

Still a third view was expressed by Dr. Edward Teller, of the University of California, who called the AICBM concept impossible and advocated surveillance and intelligence satellites as the best U.S. hope for preventing military domination of space by an enemy. "Such vehicles would be better protection than any anti-ICBM device we're likely to conceive now or in the future," the H-bomb physicist said.

• **First do the research**—There was a noticeable lack of speculative or wildly imaginative predictions on military uses of the space environment at this year's panorama here. Instead, there was the soft sell: learn more first through research about the space environment before going ahead with operational systems.

George Sutton, former ARPA chief scientist now with North American Aviation, Inc., took the stand that it is difficult to see how we can use spa for either offensive or defensive mea until there is much more research.

Sutton sees a gradual, but n radical, increase in funds for spa projects. He said that future projec will be selected much more carefu to give a longer lifetime before obs lescence. Next year, he added, the will be little money available for sta ing new projects.

James H. Doolittle, chairman of t board of Space Technology Labor tories, predicted that in the next deca our principal deterrents, both offensi and defensive, will be in space. H said space will have a role in the ta tical mission and that main defensi systems would be in reconnaissanc navigation, communications ar meteorology.

• **Planning and economizing**—B ter planning and management we called for to utilize our technologic advancements. "The pacing factor our progress today is not technolo but management," said Lt. Ge Bernard A. Schriever. "Unless it properly applied, we will lose the w of survival."

Maj. Gen. Kenneth P. Bergqui commander, AF CCDD, pointed o that revolutionary advances in the c structive power of weapons and in t speed and range of delivery syste have created a "crisis in commanc He said there is a real danger th command and control systems will "f between two stools," being neither r liable enough to permit us to laun a quick strike before being hit by surprise attack nor survivable enou to control our reaction after being h

From a program sense, Bergqu said, more attention must be paid planning in the early conceptual phas of these systems to insure that the ne is sound, the systems are achievab from the state-of-the-art viewpoint, a that sufficient analysis is conducted insure that the system is within reaso able or anticipated resources.

The need for economy was stress by several speakers. According to l Gen. W. F. McKee, vice-command AMC, industry can expect intensifi efforts to reduce costs and must l prepared to readjust accordingly.

Maj. Gen. O. J. Ritland, BM Commander, said efforts are alrea being made to cut the cost of puttin payloads in orbit.

How Dyna-Soar Will Look

THE AIR FORCE says that the manned version of Dyna-Soar "does not require acceleration" at this time and isn't being considered primarily as a competition with Russia to get a man into space. The configuration shown above was released by the Air Force at the AFA and is similar to the Dyna-Soar design first revealed in M/R (June 13, p. 18, and Aug. 15, p. 13). Experimental flights of the space glider are planned within three years, using a specially designed finned Titan as booster. (See cover.)

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SOUNDING ROCKETS SPECIAL REPORT

Market

by Jay Holmes

SOUNDING ROCKETS—an are often overshadowed by the more news worthy satellites and long-range mis siles—provide a steady and growin market for the U.S. propulsion indus try. A big new demand is developin abroad.

Government agencies are spendin about $6 million this year on smal rockets used for weather sounding, in vestigation of the upper atmospher and near-space, target missiles and de velopment testing of satellite systems Another $15 to $30 million will b spent on launch vehicles for the NAS *Scout* and the Air Force *Blue Scou* programs, designed for longer probe and orbiting small satellites.

Dozens of sounding-rocket vehicle are under development and test by th military services and the National Aero nautics and Space Administration. Bu nowhere in the government is there central repository of information o sounding-rocket performance, reliabi ity, costs and other factors.

To fill this gap, NASA's Langle Research Center last week receive bids from industry on a 3½-mont study of the data for 16 existing soun ing-rocket systems and individual pe formance, reliability and cost repor on 20 rocket motors. NASA spokesm said, however, that the study will n necessarily be limited to the moto and vehicles listed. The results will l made public as a NASA technic report.

A NASA official was asked wh such a job would be performed by industry contractor, who might find difficult to be completely impart about the value of a system if it h

SIX-STAGE research rocket is readied f firing at Wallops Island. Visible stages Honest John, Nike and Lance.

rowing at Home and Overseas

J.S. programs this year will invest $21 to $36 million in area providing profitable production work; weathermen seek bigger firing schedule

xperience or an interest in selling a ystem. The official, who preferred not o be quoted by name, said the work ill be closely monitored and any im- artiality would be recognized easily.

• **First unclassified list**—Pending the ASA study, MISSILES AND ROCKETS resents the first unclassified compila- on of sounding rockets as part of this pecial report. Performance figures are s given by manufacturers. Rocket per- rmance is based on unclassified gov- rnment reports. (See p. 26)

The proliferation of new rockets nd multi-stage systems results from e steady trend from solids to liquids. he *Aerobee*, a liquid system, was the nly research rocket flying a few years go. Now, dozens of solids have eached the point where they are com- etitive.

Aerobee-Hi is still in heavy use be- use its long use has made it ex- emely reliable. And, as a low-acceler- ion liquid system, it will not beat up sensitive payload. But *Aerobees* are xpensive; both NASA and the military ill be interested if solids can be de- loped to do the job cheaper and more liably.

• **Profit advantage**—Reliability is a quirement stressed repeatedly by unding-rocket users. To get it the rchaser is often willing to sacrifice rformance; the most popular rockets e obsolescent.

For the manufacturer, small sound- g rockets provide one of the few eas in the missile/space business here he can go into production— ten a more profitable endeavor than pensive research and development ograms.

Firing of small rockets is expected increase both in this country and road. The Committee on Space Re- arch (COSPAR) of the International ouncil of Scientific Unions is sponsor- g worldwide programs that will in- crease in frequency in the coming years.

Last month, from Sept. 16 to 22, research rockets were launched around the world in an International Rocket Interval observed for the second year as an outgrowth of the International Geophysical Year. Two such intervals will be observed next year. The greatest number of firings in September were for meteorological investigations in the altitudes from 15 to 40 miles.

• **Need will expand**—In this country, meanwhile, cautious moves are under way toward establishment of an operational meteorological network. Beginning Oct. 17, seven or eight rocket ranges will fire one meteorological rocket daily on weekdays for an entire month. The "rocket month" will occur once each season, building up to a time when 10 ranges will be taking part.

Meteorologists in the U.S. Weather Bureau and the military weather services want to bring the firing rate up to one shot a day from points on a grid 500 to 1000 miles apart across North America. To forecast weather accurately for jet aircraft operating at 60,000 ft., weathermen need detailed information on winds up to 200,000 ft.

Until now, the Army has been procuring most of the rockets and supplying many of them to agencies operating the other ranges. In Fiscal Year 1960, the Army bought 500 rockets. A spokesman for the Army at White Sands, N.M., said it is expected that procurement this year will be at about the same rate. If the firing rate is increased, other agencies will have to pitch in and buy some rockets.

Circulating in the Weather Bureau is a proposal to procure a relatively large supply of sounding rockets in FY '62.

• **Early models**—Up to now, about four-fifths of the rockets used for altitudes up to 200,000 ft. have been the Atlantic Research Corp. *Arcas*. The remainder were an uprated version of the *Loki*, an old Army antiaircraft missile.

However, neither the *Arcas* nor the *Loki* is completely satisfactory for an operational sounding-rocket system, Weather Bureau sources say. *Arcas*, an end-burning polyvinyl chloride motor, generates a thrust of 350 lbs. and burns 28 seconds, with a maximum acceleration of about 30g.

The low acceleration of *Arcas* treats the payload gently, contributing to reliability, and uses much of the thrust at high altitude, where the rocket is more efficient. But if there are winds aloft, they can cause a high degree of dispersion on the way up. This is not a serious problem on a national rocket range. But it creates difficulty in the neighborhood of a populated area.

Loki, on the other hand, burns at 2000 lbs. thrust for 1.9 second, giving maximum acceleration of 200g. The bullet-like ascent overcomes some of the dispersion problem, but the acceleration gives terrible punishment to the payload.

One Weather Bureau official calculated that the *Arcas* case will fall in an area 20 by 40 miles, while the *Loki* case can be counted on to fall in an area 10 by 25 miles. In both cases, the payload is returned by parachute.

An even narrower dispersion—5 by 20 miles—results if the *Loki* is fired from a 5-in. gun as in the Navy's High Altitude Sounding Projectile (HASP), just developed by the Naval Ordnance Laboratory, Silver Spring, Md. So far, however, NOL is using an older model of the *Loki*, which reaches only 20 miles altitude with the weather sonde, consisting of a temperature-measuring thermistor and a radio transmitter powered by a 6-volt battery.

• **Newcomer**—Another entry in the contest is provided by Rocketdyne's new *Aeolus* weather-sounding rocket,

ALTAIR fourth stage of NASA's Scout is given last-minute checks at Wallops before being raised to its final position atop the first three stages of the space exploration vehicle.

under development in a company-sponsored program. Rocketdyne reports that *Aeolus* is designed to reach just as high as *Arcas* with a rocket midway in performance between *Arcas* and *Loki*. *Aeolus*' motor burns at 660 lbs. thrust for 12.7 seconds, holding acceleration to a maximum under 30g for a 6-lb. payload.

Aeolus may not fare well in competition with *Arcas* and *Loki* immediately because an established rocket, with a long reliability record, will be preferred. However, if performance meets the claims based on design, it may eventually move into the picture.

For use very close to cities, at least two companies are studying the possibility of a consumable rocket. One obvious possibility would be a rocket with case and nozzle of heavy, paper-like material, which would burn up on the way down. Another is a paper rocket operating on the nozzleless principle. Neither of the companies involved is willing to go into details, on the ground that it is too early.

• **Next Class**—After the weather-sounding rockets, the next class of importance is those capable of lifting payloads into the ionosphere, which begins at about 70 miles altitude. For many years, that job was handled by the old *Aerobee*, a liquid rocket burning nitric acid and alcohol. For altitudes above 150 miles, Aerojet-General added a solid booster.

Recently, Aerojet has developed the *Aerobee Jr.* (*Aerobee 100*), which uses the solid booster and a scaled-down *Aerobee* motor. This utilizes the comparative economy of the solid booster to reduce the size—and thus cost—of the liquid engine, which burns IRFNA and JP-4 in the latest version. NASA has flown one *Aerobee Jr.* and has six on order. Aerojet says they cost about $20,000 apiece.

In an effort to produce an all-solid rocket that will compete with *Aerobee Jr.*, the Naval Research Laboratory—and later NASA—sponsored development of the *Arcon* by Atlantic Research Corp. However, NASA officials report, *Arcon* did not reach the altitude desired and was not procured.

Last spring, NASA gave Atlantic Research a $100,000 contract to convert *Arcon* to aluminized propellant and make some other changes to bring it up to the present state of technology. If the program is successful, the new *Arcon*—which the company calls *Archer*—may prove a serious competitor for *Aerobee Jr.*

Next along the line is a two-stage vehicle, *Nike-Cajun*, which is in wide use to lift payloads of about 50 lbs. to about 100 miles. The booster, taken from the *Nike-Ajax*, develops 50,000 lbs. thrust for 3 seconds. *Cajun*, a Thiokol rocket used in the *Pogo-Hi* target missile, gives 8100 lbs. thrust for 2.8 seconds.

For yet higher altitude, *Nike* is used with the *Asp*, a Cooper Development rocket to lift 50 lbs. to 150 miles. Some competition for *Nike-Asp* may come from *Nike-Apache*, using a new Thiokol upper stage that probably won't reach quite as high, but which Thiokol says will be more reliable.

• **Higher level**—Another layer of the ionosphere begins at about 187 miles up. A standard vehicle capable of going this far is the *Aerobee-Hi* (*Aerobee 150*). But it costs about $30,000. Everyone in the business is interested in a vehicle that will do the job cheaper.

The solid-liquid *Aerobee-Hi* holds a large volume payload and treats it gently with an acceleration that stays under 13g. A possible competitor under development is the *Iris*, an end-burning Atlantic Research solid. *Iris*, begun by NRL and continued by NASA, lifted 150 lbs. of test gear to 140 miles in its first test last summer.

Next on the ascending order is the *Exos*, a three-stage solid vehicle developed for the Air Force by the University of Michigan. The *Exos*, a combination of the *Honest John* Army missile motor, a *Nike* and a Thiokol *Recruit*, has lifted 80 lbs. to 300 miles. A later version of *Exos* uses as third stage the *Yardbird*, a Thiokol rocket that burns slower, reducing the g load on the payload, and lifts it a little higher. Since NASA now has no three-stage rocket in this performance range, it is possible that it may adopt *Exos*.

Continuing up the scale is the *Argo E5*, a five-stage vehicle produced by Aerolab Development Co. for Project *Jason*, the measurement phase of the Project *Argus* nuclear explosions in space. The *E5* lifted payloads to the 400-500 mile range.

Since then, NASA has switched over to *Argo D4*, which the Air Force called *Javelin*, for that class of experiment. The *D4*, also produced by Aerolab, gets up to 7-800 miles and has the simplicity advantage of having only four stages.

On the highest suborbital level, NASA is using the *Argo D8*, sometimes called *Journeyman*. In its first test Sept. 19, *Argo D8* lifted the 83-lb. NERV (nuclear emulsion recovery vehicle) payload 1200 miles up and 1200 miles down the Pacific Missile Range.

This year, NASA is concentrating on *Aerobee*, *Nike-Cajun*, *Nike-Asp*, *Argo D4* and *Argo D8* for its suborbital missions. The Air Force is using *Aerobee*, *Nike-Cajun* and *Exos*.

NASA will procure a few British *Skylark* rockets for missions in the Southern Hemisphere. It decided to fly *Skylarks* from the Australian range at Woomera rather than go to the expense of delivering U.S. rockets and establishing special launch facilities.

For the longest and highest suborbital missions, *Scout* and *Blue Scout* will be used—creating a fuzzy border line between sounding rockets and satellite launch vehicles.

Europe's Ambitious Plans to Explore

Extreme interest in small sounding rockets for upper-atmosphere research opens big market for U.S. makers

by S. Fred Singer

EUROPEAN COUNTRIES entering ne rocket and space research field have wo great advantages over the United tates, both arising from the fact that hey are largely indifferent to prestige onsiderations: They can afford to de- elop their best vehicles for scientific urposes, and they can spend time in eeking an economical approach to their pace research interests.

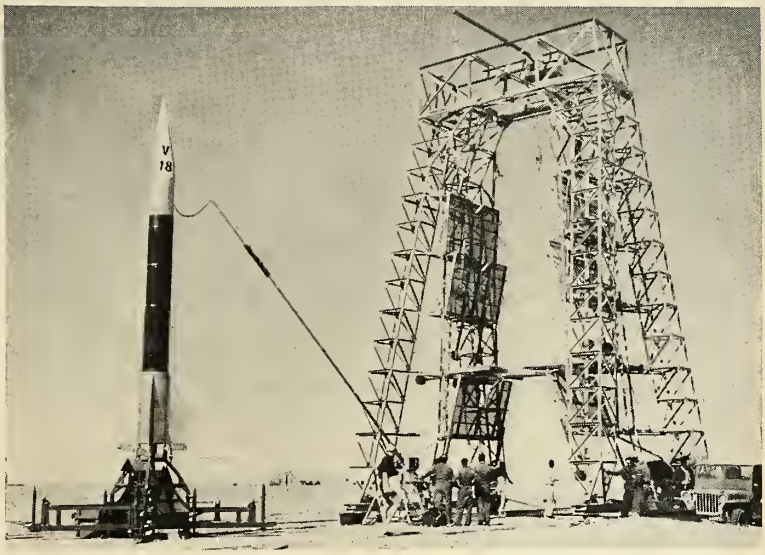
On the other hand, of course, many f the exciting problems are being at- acked in the United States and the oviet Union with advanced sounding ockets and satellites. For this reason, he European scientists interested in pper-atmosphere exploration and other pace experiments are spending much me and serious thinking on the design f the experiments and on the best ap- roach to them.

This philosophy was keynoted by ritain's Prof. H. S. W. Massey in his peech during the inaugural program of he August meeting of the International stronautical Federation in Stockholm. He suggested, in fact, a network of ounding rocket stations to probe the nportant problems of the ionosphere —and even the lower atmosphere from 0 to 50 miles, which is now beyond he reach of balloon-borne equipment.

With this in mind, it is interesting o see how various European countries re proceeding, each in its own way, to et up a sounding rocket program.

The Italians, for example, have tarted rocket tests on the island of ardinia and are planning, later this ear, to launch two *Nike-Asp* rockets ith various geophysical experiments. rofessor L. Broglio, of the University f Rome, has been mainly concerned ith problems of aerodynamics and re- ntry physics, while Professor G. Rig- ini, of the Astrophysical Observatory t Florence, has described the interest- ng results which can be obtained with ounding rockets during solar eclipses.

One of the projected experiments nvolves the release of sodium vapor s a means of determining winds in



UMBILICAL CONNECTION is set prior to a recent launching of the French Véronique rocket at Colomb-Béchar in the Sahara Desert.

the ionosphere, The luminosity will be tracked by optical ground stations located on the Italian mainland and on Sardinia.

• **Auroral exploration**—One of the most important locations for upper-atmosphere research is the auroral zone. At the present time, the only well established launching station for rockets is located in Fort Churchill on Hudson Bay. At this Canadian station many of the important IGY experiments were conducted.

The Canadian National Research Council is now carrying on a program which is based on a Canadian-built sounding rocket, the *Black Bart*. This rather large, single-stage solid-propellant rocket will be used first to measure the incidence of cosmic rays produced after solar flares, and to study auroral particles. Launchings are expected in the very near future.

Sweden and Norway also are considering launching stations in the auroral zone and hope to make similar experiments, but with greater emphasis on studying the properties of the ionosphere itself and evaluating propagation conditions in the polar zone.

• **U.S. rockets being chosen**—Both Sweden and Norway have pretty well decided to use American-built rockets, and plan to buy them directly from various suppliers in the United States. They have scientists who could construct small sounding rockets in their own defense laboratories, but they cannot spare the manpower from their more urgent defense problems and therefor prefer to buy available equipment.

Among the rockets which they are going to favor are the medium-sized *Nike-Cajun* and *Nike-Asp*, and the smaller *Arcas*, *Asp*, and *Phoenix* rockets. No final decision has as yet been made; the Scandinavians are studying very carefully the experience of various American experimental groups before making firm plans.

The projected Swedish launching station is located exactly on the Artic circle near the little town of Jokkmokk.

The range there has been in use as an artillery and military rocket range. The region is deserted enough so that no serious problems exist for sounding rockets which go to altitudes of 100 miles.

The Sweden Space Committee consists of a group of well-known physical scientists under the chairmanship of Professor Lamek Hulthen of Stockholm. The Secretary of the committee is Dr. E. A. Brunberg.

The Norwegians are considering a launching station on the west coast in the vicinity of the Auroral Observatory of Tromsö. Firing out over the North sea, they will be able to deal with rockets of any altitude without any serious safety problems.

The Norwegian approach is very much keyed to a small rocket with a small, near-portable launcher. The group concerned with these launchings is from the Norwegian Defense Research Establishment at Kjeller; it is primarily interested in the physics of the lower ionosphere. Its space committee consists of a distinguished group of scientists under the leadership of Dr. Odd Dahl and Professor Sven Rosseland. The secretary is Dr. B. Landmark.

• **Down-to-earth space talk**—Many of the European plans and problems were aired at the Stockholm Symposium.

The first session dealt with available small sounding rockets; in this session, various American speakers discussed the *Nike-Cajun, Arcas, Asp, Phoenix, Terrapin* and other proven vehicles. The British described their solid-propellant *Skylark*, and the Japanese gave a very detailed account of all of the work done in connection with the *Kappa* rocket.

The second session of the Symposium was devoted to a very practical discussion of questions of launching, range problems, instrumentation problems, both on the ground and in the rocket. This took the form of an informal panel in which the chairman debated certain technical questions with members of the audience who had experience, for example, in telemetering or in the design of launchers.

The third session was devoted to scientific plans. Here a number of scientists discussed the disciplines and problems in which small rockets could make an important contribution.

• **Variety of possible experiments**—Dr. M. Nicolet of Belgium described some of the unsolved problems of upper-atmosphere chemistry. He indicated, for example, how rockets carrying various reactive gases or metal vapors could be used to trace the photo-chemical processes which go on in the ionosphere. A great variety of such experiments could be attempted.

LONG TOM rocket, highly sophisticated sounding vehicle, shown at Woomera.

In some cases even small quantities of reactive gases could affect the properties of the atmosphere in an important way. Frequently, luminosities would be produced, which could be observed and tracked from the ground during the night. In other cases, the ionization in the upper atmosphere would be affected. It became clear that 20 to 50, or even 100 rocket experiments per year could well be carried out in this program alone.

Far more important in terms of numbers are meteorological measurements with small rockets. These were described by Dr. Bolin of Sweden, who pointed out some of the investigations which could be conducted at altitudes above 100,00 feet, inaccessible to meteorological balloons.

For meteorological purposes particularly, it is necessary to make synoptic observations at many points on the earth's surface. Dr. Bolin looked forward to several hundred or more rocket firings a year before some of the problems concerned—particularly those involving polar meteorology—could be cleared up.

• **Mysterious clouds**—An interesting subject touched on by Dr. Witt of Sweden was described the phenomenon of "noctilucent clouds," which exist at altitudes of some 50 miles. The origin of these clouds is not as yet settled. They are seen in the sub-Artic region, but rather infrequently. One school of thought holds that they are little ice crystals; others think that they may be dust particles. One way of investigating their origin would be to release dust particles from a rocket to see whether such clouds can be formed artificially.

Prof. Alfven of Stockholm described some of the important problems of the aurora which could be attacked by means of small sounding rockets. He stressed particularly the use of magnetometers—for example, some of the newer proton precession and electron precession magnetometers which developed recently in the United States. The magnetometer readings can trace out the distribution of electric currents in the aurora. Some of these currents have strengths of several hundred thousand amperes and important effects on the earth's magnetic field.

A vital topic is communication in the polar regions. Radio communication is often affected by solar outbursts of high-energy particles, so called solar cosmic rays. The earth's magnetic field focuses them into the polar zones; there they can produce sufficient ionization at low enough levels, between 50 to 80 km, to cause a radio blackout.

Dr. Hultqvist of the Geophysical Observatory of Kiruna in northern Sweden described how his group is planning to study the mechanism of polar-cap absorption and radio blackout in more detail by means of high altitude sounding rockets.

Finally, Prof. Tengstrom of Uppsala, Sweden talked about the use of rockets for geodetic purposes. Small light sources carried aloft could be used to triangulate over large distances. He showed how a chain of some dozen rocket launching stations across the earth could be used for more accurate map making and studies of the shape of the globe.

• **Big export potential** — What emerged from the Stockholm Symposium was, first of all, the extreme interest with which European scientists now regard the use of small sounding rockets as a tool for upper-atmosphere research and as a means for getting into space work.

Funds are becoming available to them in increasing larger amounts directly from their respective governments. For example, the Swedes hope to be supported directly by the Swedish parliament, rather than through the existing National Research Council. An important export market appears to be opening up for American-made rockets and instrumentations.

Four Nations Lead Foreign Progress

by Bernard Poirier

THE FOUR outstanding sounding rocket programs outside the United States and Russia—judged in terms of progress—have taken place in Australia, Canada, France and Japan.

The longest continuing effort has been accomplished by France, whose sounding rocket development started in 1939 and continued throughout World War II. A French research rocket developed during the war has design lines common to most sounding rockets used and developed since then.

Countries showing promise for the coming year include India, Italy, Argentina and Sweden. Of these, only Italy appears to have satisfactory government backing. Argentine rocketry is partially state-supported. Space research may get more recognition, however, if the November rocket symposium in Buenos Aires is as successful as anticipated.

Future military implications are obvious with the revelation of the French *Antares* rocket tests. Designed by the Office National d'Etudes et de Récherches Aeronautiques (ONERA) this four-solid-stage rocket evolved from the ONERA 56/39-22D, which had two liquid stages and two solid stages.

• **First act for France's IRBM**—The *Antares* first and third stages are made by SEPR. The new second stage was conceived by the Ruelle Naval Arsenal's Service d'Etudes et de Fabrications d' Engins Spéciaux. The last stage—solid-fueled and instrumented—was developed by ONERA. Rocket fuel is produced by France's Service des Poudres.

The May test of the *Antares* was conducted by the French Navy and ONERA on Levant Island primarily for the benefit of Sud-Aviation (one of the prime IRBM development contractors of France's S.E.R.E.B. organization), whose IRBM is symbolized as the *SS.BS.1*.

First-stage thrust was 44,080 lbs. for 5 secs; second-stage 4408 lbs. for secs., and third-stage 7714 lbs. for 6 secs. The fourth stage was fired the downward trek at an altitude 27.95 miles. It was during this period the 6¼-min. flight that the nose cone attained maximum re-entry velocity of 7286 ft./sec. at 15.5 miles altitude.

• **Classical vehicle design** — The *Véronique* is one of France's top meteorological vehicles for tests above 120 miles altitude. Designed by DEFA's Laboratoire de Récherches Balistiques et Aerodynamiques at Vernon, the liquid rocket develops 9000 lbs. thrust for 45 sec.

The *Véronique* is about 23 ft. long and is fueled by nitric acid and terebenthine. The fuel accounts for 2204 lbs. of the total 3286-lb. take-off weight. Its design closely parallels the French rocket developed during World War II.

A missile of similar appearance can be seen blasting off from Fort Churchill in northern Canada or from Woomera in southern Australia.

The two-year research in the Canadian *Black Brant* rocket was known by the code name *Snow Goose*. The design is by the Canadian Armament Research and Development Establishment at Valcartier, P.Q. The solid-fuel research and configuration evaluation was done by the Guided Weapons Division of Canadair, Ltd. of Montreal.

• **Second Hudson Bay era**—Bristol Aircraft Ltd. of Winnipeg manufactures the rocket's cylindrical casings.

The single-stage *Black Brant* has been successfully fired 125 miles northward into Hudson Bay from Fort Churchill launching sites. It develops 20,000 lbs. thrust for 20 secs. in reaching Mach 5 and a trajectory apogee of 60 miles.

• **Efforts Down-Under** — Britain's best offerings in missiles have been evaluated at Australia's Woomera test ranges. The Australian Weapons Research Establishment has tested the *Blue Steel, Bloodhound,* and *Blue Streak,* to name just a few.

The *Skylark* research vehicle has often shattered the stillness of the Koolymilka launch area 25 miles from the town of Woomera.

The *Skylark* was developed by the Royal Aircraft Establishment. The nozzles and cases are fabricated by Bristol Aerojet Ltd.; the case is made of 1% chrome molybdenum steel as spec. RS. 120, and the nozzle is formed of an asbestos-filled phenolic-resin composition.

Its fuel is ammonium picrate, ammonium perchlorate and polyisobutylene. The vehicle uses 5 lb.-thrust stabilizing air jets.

The 18-ft.-long *Raven* solid-fuel engine powers the single sustaining stage. A new booster called *"Cuckoo,"* developing 81,000 lbs./sec. for 4 secs., has been added to supplement the *Raven* and improve performance.

• **Woomera like Colomb-Béchar**—Several rockets of Australian design and construction include the sophisticated *Long Tom,* which has been mated as a subsequent stage to the *Blue Streak* in recent tests, and the versatile and less expensive *Aeolus* research rocket.

Both the *Long Tom* and the *Aeolus* are fabricated by the Weapons Research Establishment at Salisbury and have been tested at Woomera's ranges. Both Range A and Range E at Woomera are semi-arid and relatively uninhabited wastelands similar to France's Colomb-Béchar range in Algeria.

The two-stage *Aeolus* is initially powered by seven boosters in a cluster which cut off at .6 mi. while the vehicle coasts to over three miles after the first-stage boosters fall away.

• **Hulme reveals rocket data**—The second stage is fired to its burnout point near five miles at Mach 4.5. Top altitude has been given by Alan S. Hulme, Australia's acting Minister for Supply, as "between 150,000 and 250,000 ft. with payloads similar to the *Long Tom*".

The *Long Tom* is reputed to carry payloads of 100 to 150 lbs.

The 630-lb. first stage of the *Aeolus* has seven 5-in. motors fitted to a common cast aluminum-alloy thrust plate. The second stage's full weight is from 550 to 650 lbs., according to the payload carried.

• **Japan's Itokawa Laboratories** — The most impressive rocket efforts in the Orient have been spearheaded by Japan's Itokawa Laboratories, where one improved *Kappa* rocket has succeeded another. All have been successfully fired at the Akita Rocket Range.

The latest in the series—*Kappa 8*—was shown for the first time just before launching in an M/R photograph (Sept. 12, 1960, p. 43).

The two-stage *Kappa 8* reached a top velocity of 4918 mph and carried a 55-lb. payload to 124.2 miles. ⌘

Sounding Rockets—U.S.A.

Vehicle and Contractor	Stages	(Less Payload) Weight Lbs.	(Less Payload) Height Ft.	Performance Claimed (Sea Level Launch) (*Actual attainments)	Status
Loki-Dart, Cooper Development	One solid (2000 lbs., 1.9 sec.), can be fired from 5-in. gun	23	5	*8 lbs. to 40 mi., max. accel. 200 g	Completing development; Navy to fir from shipboard
Arcas, Atlantic Research	One solid end-burner (350 lbs., 28 sec.)	65	8	*6.5 lbs. to 50 mi., max. accel. 30 g	Operational; more tha 300 flown for man agencies
Weather Sounding Rocket, Rocketdyne	One solid (12.7 NS 660)	67	7	6 lbs. to 45 mi. max. accel. 30 g	Proposed
Judi-Dart, Rocket Power/-Talco	One solid (2400 lbs., 1.7 sec.)	25	5	*6½ lbs. to 60 mi. max. accel. 200 g	Operational; in use b several agencies
Hopi-Dart, Rocket Power/-Talco	One solid (3800 lbs., 3.5 sec.)	84	7	*10 lbs. to 40 mi. max. accel. 130 g	Vehicle fired witho dart
Viper-Falcon, Zimney	1. Grand Central Viper I (5.6 KS 5400) 2. Thiokol Falcon	279	12	*20 lbs. to 75 mi. max. accel. about 50 g	Two flown, three o order for Navy
Asp I, Cooper	One 5.3 KS 5800	216	9	*50 lbs. to 35 mi. max. accel. 48 g	Operational
Apache, Thiokol	One Solid (Cajun with improved polyurethane propellent)	188	9	*35 lbs. to 40 mi.	Completing development
Asp IV, Cooper	One solid (12.7 KS 2750)	208	9	25 lbs. to 90 mi.	Development
Hopi-Plus, Rocket Power/-Talco	1. Hopi; 2. Rocket Power, Hemi-Hopi (1900 lbs., 3.5 sec.)	100	11	10 lbs. to 60 mi. max. accel. 115 g	Development
Kiva-Dart, Rocket Power/-Talco	One solid Kiva (7800 lbs., 4.5 sec.)	237	9	*25 lbs. to 55 mi. max. accel. 110 g	Vehicle fired witho Dart
Aerobee 100 (Aerobee Jr.), Aerojet-General	1. Solid 2.5 KS 18000; 2. Liquid IRFNA, JP-4 (2600 lbs., 40 sec.)	1400	18	*120 lbs. to 60 mi. max. accel. 12 g	One flown; on NAS approved list. Scale down Aerobee-Hi
Arcon, Atl. Res.	One end-burning solid (945 lbs. 33 sec.)	213	13	60 lbs. to 60 mi.	Development comple but not procured; NASA approved list
Phoenix, Rocket Power/-Talco	1. Kiva; 2. Hopi	320	13	*11 lbs. to 200 mi. max. accel. 131 g	Development complet
Archer, Atl. Res.	One solid end-burning (aluminized Arcon)	About 220	13	40 lbs. to 85 mi.	Development
Aerobee 150 (Aerobee-Hi) Aerojet-General	1. Solid 2.5 KS 18000; 2. Liquid IRFNA, aniline-alcohol (4100 lbs., 50 sec.)	1900	23	*110 lbs. to 190 mi. *150 lbs. to 165 mi. max. accel. 12 g	Operational; 85 flo in 13 years; approv for NASA and services
Nike-Cajun, several manufacturers	1. Solid ABL Nike; (3 DS 50000); 2. Thiokol Cajun (2.8 KS 8100)	1350	22	*50 lbs. to 100 mi. max. accel. 52 g	Operational; on NA and Air Force approv lists; several hundr flown
Nike-Asp (Aspan 150), Cooper	1. Nike; 2. Asp I	1500	21	*50 lbs. to 150 mi.	Operational; on NA approved list; seve agencies using
Nike-Apache, New Mexico State College	1. Nike; 2. Apache	1480	21	50 lbs. to 150 mi.	Flights expected so in Army program
Skylark, Bristol	One Raven (12,000 lbs., 30 sec.)	2200	22	150 lbs. to 85 mi.	Development comple NASA to use Woomera launchings
Iris, Atl. Res.	1. Cluster of seven solids (total 18,000 lbs., 1 sec.); 2. End-burning solid (3800 lbs., 62 sec.)	1216	About 20	*150 lbs. to 140 mi. max. accel. 13 g	Development; 1 flo on NASA approved

Vehicle and Contractor	Stages	(Less Payload) Weight Lbs.	(Less Payload) Height Ft.	Performance Claimed (Sea Level Launch) (*Actual attainments)	Status
erobee 300 (Sparrow-bee), Aerojet-General	1. Solid 2.5 KS 18000; 2. Liquid IRFNA, aniline-alcohol (4100 lbs., 50 sec.); 3. Sparrow (1.8 KS 7800)	2000	27	*90 lbs. to 225 mi. *60 lbs. to 260 mi.	Operational; 18 flown; on NASA approved list
igh Altitude Sampler, RT-2 Sandia	1. Cluster of three Viper I and three Viper II (3.8 KS 8200); 2. Viper I	1620	14	*110 lbs. to 250 mi.	One flown for AEC
igh Altitude Sampler (HAS), Sandia	1. Nike; 2. Six Viper I's fired three at a time; 3. Viper I	3050	25	110 lbs. to 250 mi.	AEC flights planned
iotput, Douglas	1. Thiokol Pollux (45,000 lbs., 25 sec. and two Thiokol Recruits (1.5 KS 35000); 2. Hercules-ABL Altair (38 DS 3060)	8800	25	*150 lbs. to 200-250 mi.	5 flown in suborbital tests of Echo balloon
os, Univ. of Mich.	1. Honest John (40 KS 105,000; 2. Nike; 3. Recruit or Thiokol Yardbird (3.25 KS 17000)	5400	38	*80 lbs. to 300 mi.	3 flown; Air Force adopted as standard vehicle (Yardbird version)
trobee 200, Aerojet-General	1. Nike; 2. Solid 30 KS 8000	2600	18	200 lbs. to 200 mi.	Flights to begin soon for Air Force
trobee 250, Aerojet-General	One solid Aerojet Junior (a rocket about the same size as Sergeant)	9900	19	700 lbs. to 200 mi.	Proposed
trobee 350, Aerojet-General	One solid Aerojet Senior (NASA Algol, 36 KS 120,000)	23,600	30	900 lbs. to 300 mi.	Proposed
trobee 500, Aerojet-General	1. Solid 2 KS 36250; 2. Solid 30 KS 8000; 3. Asp I	1940	21	50 lbs. to 500 mi.	Development; flight tests in progress for Air Force
go E5 (Jason), Aerolab	1. Honest John; 2. Nike; 3. Nike; 4. Recruit; 5. Thiokol T-55 (1.3 KS 4800)	About 6800	About 52	*50 lbs. to 4-500 mi.	18 fired successfully in measurement phase of Argus nuclear explosions in space; on NASA approved list but not procured now
go D4 (Javelin), Aerolab	1. Honest John; 2. Nike; 3. Nike; 4. Altair	6750	47	*50 lbs. to 7-800 mi.	2 flown; on NASA approved list; replaced Jason because achieved higher altitude
trobee 1000, Aerojet-General	1. Honest John; 2. Solid 5 KS 50000; 3. solid 30 KS 8000	7040	33	50 lbs. to 1000 mi.	Proposed
go D-8 (Journeyman), Aerolab	1. Thiokol Sergeant with two Recruits; 2. Grand Central Lance (7 KS 39000); 3. Lance; 4. Altair	13,932	62	*83 lbs. to 1200 mi.	1 flown last month in first NERV launching; on NASA approved list
rongarm, Univ. of Mich.	1. Honest John; 2. Nike; 3. Nike; 4. Yardbird; 5. JPL Baby Sergeant (5.4 KS 1700)	About 6850	About 57	*20 lbs. to 1140 mi.	Under review; 1 of 5 launchings successful in Army program
rcheron, Aerolab	One Pollux with two Recruits	10,000	20	*2200 lbs. to 50 mi.	1 flown for Air Force last month
ailblazer, NASA	1. Honest John; 2. Nike; 3. Lance; 4. Thiokol T-40; 5. Thiokol T-55; 6. Langley Res. Center 5" spherical			Mach 25 re-entry tests (Stages 4-6 fire downward)	Several fired, prime contract to be awarded soon
te Scout Jr., Aeronutronic	1. Thiokol XM-33 (Castor, 27 KS 55000); 2. Hercules X-254 (Antares, 37 DS 14500); 3. Aerojet 30 KS 8000; 4. NOTS 17-in. spherical			*32.8 lbs. to 17,000 mi.	1 flown last month (Blue Scout series is Air Force version of Scout)
out, NASA-Chance-Vought	1. Aerojet Algol (Senior)); 2. Castor; 3. Antares; 4. Altair	36,000	65	112 lbs. to 3700 mi. 150-200 lbs. in orbit	
ttle Joe, NASA	1. Four Pollux and four Recruits in cluster	35,000	20	*2000 lbs. to 55 mi.	Four flown in tests of Mercury capsule
trobee 1500, Aerojet-General	1. Aerojet Junior; 2. Solid 30 KS 8000	10,500	25	50 lbs. to 1500 mi.	Development (company-sponsored); 2 to be flown
e Scout I, Aeronutronic	1. Aerojet Senior; 2, Thiokol XM 33; 3. Antares		60	500 lbs. to 1000 mi.	Development
e Scout II, Aeronutronic	1. Aerojet Senior; 2. Thiokol XM 33; 3. Antares; 4. Altair (same as NASA Scout except for addition of 4th stage guidance)	36,000	65	50 lbs. in orbit	Development

"Why do we like Missiles and Rockets magazine? The answer is simple. Missiles and Rockets deals exclusively with astronautics. Missilery and outer space exploration today is an industry by itself, long divorced from aviation," R. R. Drummond, (left), Chief, Structures Research. He is shown here with Managing Editor Howard and E. L. Strauss, Supervisor of Non-Metals Research, examining extreme high temperature test examples of ceramics and plastics being developed for re-entry vehicles.

WHY DO SO MANY KEY PEOPLE AT THE MARTIN COMPANY READ MISSILES AND ROCKETS

1,087 Paid Subscriptions! In 1959, Martin ranked sixth among all military prime contractors. Its missile/space projects included Titan, Dyna-Soar, and Bullpup, among others. Therefore, it is not surprising to find 1,087 paid subscribers to M/R concentrated at Martin. And since many M/R subscriptions have high pass-along readership, M/R penetration involves many times that number of readers.

Some of the many reasons why M/R commands intense readership at Martin are given in the picture story. They were obtained as a result of a recent visit to the company by M/R Managing Editor, William Howard (insert).

These comments and those of other key readers in missile/space companies show again what M/R has known all along . . . that the missile/space industry is an industry by itself, complete and distinct from aviation . . . with rapidly changing requirements that demand *undiluted, weekly* technical/news reporting. Missiles and Rockets deals *exclusively* with this market—and the deep, penetrating readership and acceptance it has earned document its leadership in the missile/space field.

"News to the missile engineer must be news and must be technical . . . on a frequent basis—not a month old. From concept to proven flight—it takes thousands of parts from hundreds of companies to put a bird in the air." J. Lennard, Scientist, Research and Development

"Today's missile and astronautics engineer must know the products and capabilities of the other companies throughout the industry. Here's where Missiles and Rockets magazine fills the bill."—R. Allen, Scientist, Cryogenics, Research and Development.

Technical Countdown

ELECTRONICS

Automatic Defense System Studied

Work has begun on applied research program aimed at an ultimate combat operations control system to provide U.S. decision-makers with continuous evaluated data on potential enemy strength, intent, and actions, and proper counter-actions. Initial contract for $392,090 was awarded General Electric's TEMPO by ARDC.

New Coding Techniques for Space

More efficient and sophisticated coding systems may be the answer to long-range space communications with reasonable transmitter powers. According to Kenneth Uglow, EMR/ASCOP, such methods would bring data transmission closer to theoretically ideal efficiencies.

Military Electronics Growth to Drop

A decrease in the present rapid growth rate of military electronics is predicted by Electronic Industries Association. They say annual increases will run only about 8-10% during the next 5-10 years.

Transistors Out for Nuclear Instrumentation?

Transistors are too susceptible to radiation effects to be used in instrumentation of nuclear-powered spaceships, according to some involved in atomic work. Even with reasonable shielding or distance-isolation, they feel, radiation levels would still be too high for reliability.

Polaris Guidance to be Minified

Navy's goal in miniaturizing *Polaris* IRBM guidance reportedly is to produce a 40-lb. package. Present system weighs roughly 250 lbs., but MIT's Dr. Charles S. Draper says the 1500-mile A-2 *Polaris* will carry a considerably smaller system.

Measurement Facilities Rival NBS

A new engineering measurement standards lab at Douglas Aircraft's Santa Monica Div. is said to be second only to the National Bureau of Standards in facilities for its three fields of interest: microwave transmission, fluid pressures, and ac and dc circuits. In radio-frequency measurements from 10 mc to 40 gc the lab will have an accuracy capability of ± 5 parts in 100 million, says Douglas.

Thermoelectric Space Power Next

Nine hundred ganged aluminum concentrators, assembled in groups of 28 and occupying 100 sq. ft., will be used by Hamilton Standard for its prototype 100-watt solar space-power system. Being designed under an Air Force WADD contract, the test model will use the 4-in.-dia. collectors to focus sunlight on thermocouples. Estimated temperature may reach 1000°F at heated end and 400°F on low end. A 1500-watt follow-on prototype will use 7000 reflectors over 700 sq. ft.

Electronics to Extend Man's Brain

Intellectronics—extension of the human intellect by electronics—will become our greatest occupation within a decade, according to Dr. Simon Ramo. "Increasing the nation's brain power (by electronic aids to education and machine augmentation) is even more urgent for our national position and for the welfare of civilization than space conquest," he says.

GROUND SUPPORT EQUIPMENT

LARC's Assigned to Project Mercury

Three of Army's LARC amphibious lighters have been delivered to Canaveral for use with Project *Mercury*. The crane-equipped lighters will be used to recover any capsules that fall short and impact in the surf or marshes around the Cape.

'GSE' On Way Out?

Air Research and Development Command is changing to ASE (aerospace support equipment) as a more inclusive and descriptive designation for weapons system support equipment.

Super-Speed Wind Tunnel for Space Research

Prototype model of a plasma-jet wind tunnel expected to produce continuous speeds of 18,000+ mph and temperatures of 25,000°F was displayed at the AFA Aerospace Panorama. The XFA (crossed-field excitation) tunnel is under development by Allis-Chalmers and MHD Research Inc.

'Cool Suit' Developed for Fuel Handlers

A transparent protective suit with built-in air conditioning for handlers of missile fuel and others in hazardous environments has been demonstrated by Bendix Corp. A shoulder pack provides oxygen for breathing and cooling.

MATERIALS

Copper: Indispensable for Power Tubes

Copper accounts for up to 90% of all material used in its klystron tubes, says Varian Assoc. Using nearly a half-million pounds annually of OFHC—oxygen-free (99.99% pure) high-conductivity copper made only by American Metals Company, Ltd., the microwave-tube manufacturer considers the material so essential to its operations that it keeps a constant reserve of from 50,000 to 75,000 pounds in stock at all times.

Materials Research Division Formed at NASA

A new office, presided over by George C. Deutsch, will establish areas and levels of materials research and development appropriate for direct support in and out of the National Aeronautics and Space Administration. The division, which will maintain a continuing review of materials requirements, is evidence of NASA's recognition of the importance of materials research.

PROPULSION

4000-year Orbit Life

After pushing *Echo* into orbit, the burned-out *Thor-Delta* third-stage rocket settled into a nearly circular orbit of its own. Douglas scientists estimate that the Allegany Ballistics Lab's *Altair* will circle the earth until about the year 6000 A.D.

Air Force Plant 78 Gets Funds

Continuation of work on the *Minuteman* first-stage engine production facility is the announced purpose of a $17-million Air Force award to Thiokol Chemical Corp. The plant will ultimately cost $30 million. The present fund is in addition to an earlier $1 million assigned for preparatory work.

300-kw Thermionic Generator by '67?

AEC thinks it could produce such a system in seven years—but neither NASA nor DOD has ordered development

by William Beller

THE ATOMIC Energy Commission believes that starting today it could produce a 300-kilowatt nuclear-powered electrical generator—with no moving parts—for space use inside of seven years.

So far, however, neither the National Aeronautics and Space Administration nor the Department of Defense has put down a requirement for this long-leadtime item which could be urgently needed for space programs in the late 60's.

Largest nuclear-powered generator being developed now is the SNAP 8 turboelectric device, which will put out 30 kilowatts at a specific weight of 50 pounds/kilowatt.

The 300-kilowatt generator would be a thermionic one, using electrons for its working fluid.

It would weigh less than seven pounds a kilowatt; refinements would probably bring this figure down to four pounds per kilowatt. Thus, the eventual system weight would be about 1200 lbs. Such a system could provide a powerplant having the capability for interplanetary operations.

Next year the AEC probably will release a practical curium-242 thermionic system rated at a few watts and weighing less than a pound. This indicates that the technology of the thermionic generator is now fairly well unde stood. This small power system wou be useful in probes for communic tions and scientific work.

If a stumbling block remains in t way of making higher energy ther ionic converters, it is the problem getting fuel-element materials that w withstand the elevated operating tem eratures needed for a lightweight s tem.

• **The ideal generator**—The b electric generator for space wc should have high power and ener densities. These should be, respective more than 0.1 kilowatts per pound system weight, and 0.2 kilowatt-ye per pound.

Next, the system should have long and uneventful life, be compati with the space environment, and h no feature that would disturb the hicle in which the electric genera functioned or harm personnel, in event that the vehicle is inhabited.

These features imply system quirements such as the following, s Lt. Col. G. M. Anderson (USAF), AEC's Chief of Systems for Nucl Auxiliary Power (SNAP):

–Operation at high temperature that waste heat can be rejected fr a small-area radiator, and theref from a lightweight one.

–Use of a fuel material with h energy-density—such as stochiome uranium carbide to be used in a sn compact fast reactor. The reactor sho be able to fission a relatively large nu ber of the atoms in the fuel.

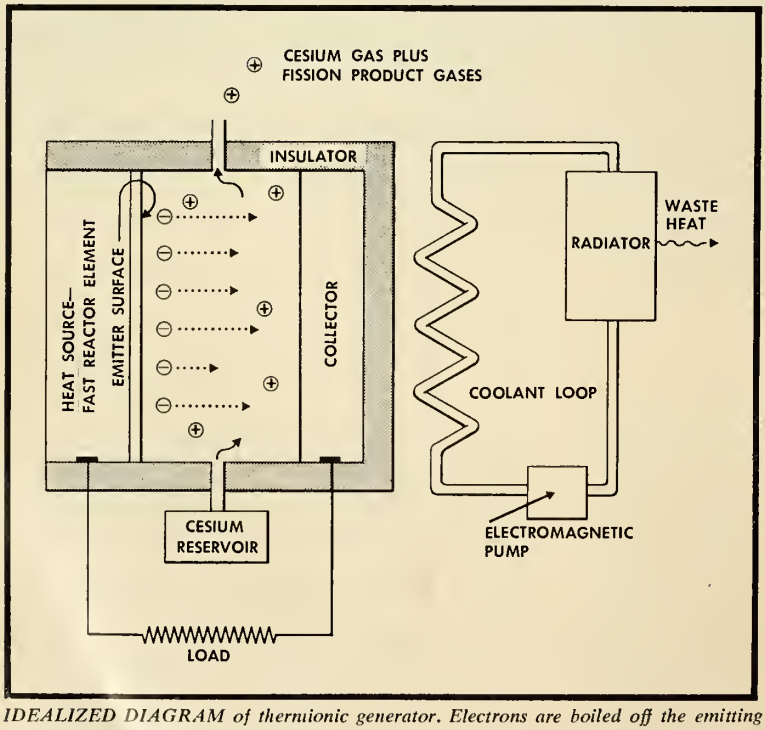
–Shielding integrated into the s tem to get the smallest overall wei

–Equipment that is rugged and liable.

–The smallest number of mov parts.

–Small or no heat transfer to vehicle.

• **Nuclear diode called best**— modest powers, the thermionic gen tor seems to be the energy source able to satisfy the set of requireme Low power units, those up to about



IDEALIZED DIAGRAM of thermionic generator. Electrons are boiled off the emitting surface by a nuclear heat source, migrate to collector, and from there go through the load back to emitter surface. Cesium gas minimizes space charge and acts as a flushing agent for fission-product gases. Coolant loop absorbs waste heat from collector.

ectrical watts output, would use a idioisotope heat source; larger units, ose from a few hundred watts out- t and into the megawatt range, would e a small compact reactor.

The cycle of the thermionic con- rter can be compared with the me- anical engineer's Rankine cycle, in hich a working fluid such as water is ated, changes to a gas, does work, d is condensed. In the converter, a rking fluid of electrons is heated, iled off, condensed, and does work. e analogy suffers from one permuta- n: the working fluid of electrons es its work after the condensation.

The converter consists of an elec- n emitter or cathode, a space through hich the electrons flow, and an elec- n collector or anode. Electrons with- i the cathode are heated either by otope decay or nuclear fission to an ergy level high enough to boil them , that is, to a point above the sur- e work function.

The electrons migrate across the erelectrode space and are collected the anode, which has a work func- n less than the cathode. The electron eam then completes the cycle by wing through an external load.

This description omits an obvious tical point—the nature of the inter- ctrode space. Here, two views have en taken: in the first, the electrodes e very close together; in the second, e spacing is held moderate and an ized gas is introduced. It now ap- ars that fairly close spacing plus an ized gas such as cesium will yield e best results.

The prime function of the cesium o reduce the space charge, in effect, act like a space-charge grid. Secon- rily, the gas functions as a flusher for ding the interelectrode space of fis- n-product gases. If left alone, these es would coat the collector and nificantly reduce the converter's pow- output.

• **Who's in the field**—Typical work the close-space vacuum-type diode the SNAP program has been con- cted at the Thermo Electron Engin- ing Corp. (TEECO) of Cambridge, ss., under the direction of Dr. orge Hatsopoulos, the company's sident. Work on the cesium-vapor de for the SNAP program has been ried out by Dr. Ned Razor of omics International.

"Each of these investigators has de significant contributions toward veloping the thermionic converter and ning its theory," says Anderson.

At the same time, work has been ng on at The Martin Co. in develop- isotopic heat sources. In a parallel dy, Atomics International has been estigating the compact reactor as a

"Grossly Inadequate?"

"The fact of the matter is that there is . . . no policy for utilizing nuclear power resources (for space applications).

"Not only is it important to note that there is no specific program but the development of a 30-kilowatt unit is grossly inadequate for the 1960's. As I said earlier, nuclear electric power sources in the range of 1 megawatt are needed, that is, 1000 kilowatts as compared to 30."

Statement by Senator Clinton Anderson before the U.S. Senate on Sept. 1, 1960

heat source.

A number of other organizations are doing government-sponsored work on the thermionic generator. They include: Los Alamos Scientific Laboratory, General Atomics, General Motors, General Electric, Radio Corporation of America, and the Massachusetts Institute of Technology.

• **A working model**—Teeco has made a two-stage isotope-heated thermionic generator in the form of a cylinder. It has a close-space vacuum diode at each end face. This is a demonstration model.

The housing is made of titanium. Three sapphire rods maintain an interelectrode spacing of about 30 microns. The emitter is a Type "B" Phillips cathode (barium-strontium-carbonate impregnated tungsten); and the collector is a coated molybdenum piece. The vacuum is improved by a getter.

A critical step in fabricating the model was the simultaneous accomplishment of emitter activation and coating of the collector surface to obtain the proper work functions.

The test results are as follows: upper cell—emitter temp., 2100°F; max. power, 0.35 watts; potential, 0.35 volts; and work function, 2.239 volts. Lower cell—emitter temp., 2200°F; max. power, 0.175 watts; potential, 0.30 volts; and work function, 2.594 volts.

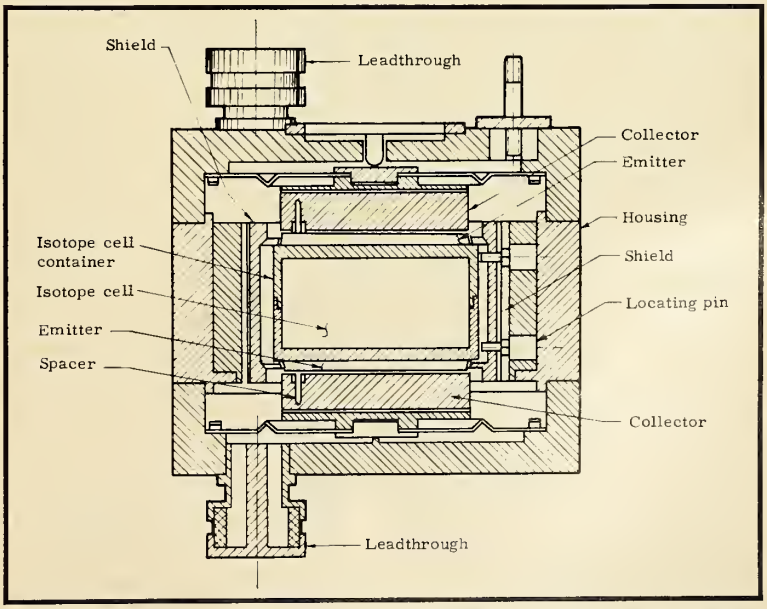
A second isotope-heated demonstration model is being built by the company. This unit will probably be fueled with curium-242 and is expected to include enough improvements and additional energy to bring the output up to four watts.

If such a unit could be built with a lifetime of one year, it would be equivalent in energy content to a ton of nickel-cadmium batteries. (Such a battery is assumed to have about 20 watt-hours of energy per pound.)

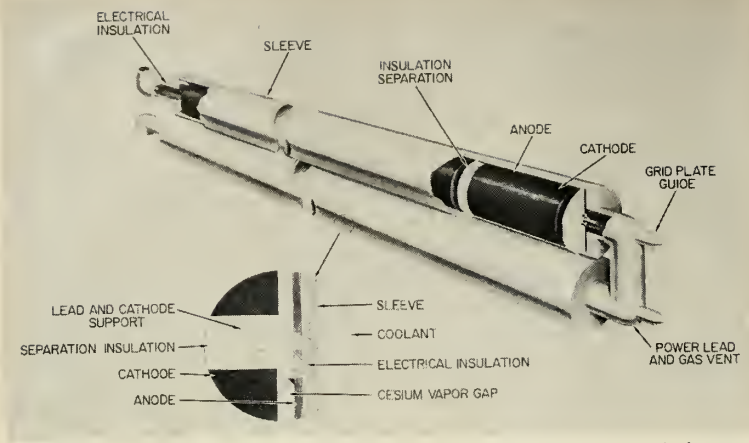
• **Selecting the reactor**—In general, the reactor chosen for thermionic converter applications should operate at a high temperature for an extended period. This permits long operation combined with small radiator weight.

If possible, the coolant loop should be eliminated. If this is not feasible, the waste heat from the collector and other sources should be removed by a liquid metal circulated by an electromagnetic pump.

The reactor should be kept as small



CROSS SECTION of two-stage close-electrode thermionic generator being developed by Thermo Electron Engineering Corp. Estimated operating characteristics: emitter temp., 1500°K; power output, 4 watts; overall efficiency, 4%; and total weight, 9 ounces.



THERMIONIC CONVERSION fuel element. By a series connection of the stages within the fuel element—making the cathode of one stage the anode of the next—the voltage can be built up.

as possible, to hold down shielding weight and complexity.

The reactor should be of reasonable cost. This means there should be a low investment in fuel. Thus, if a fast reactor is used, U-235 should be considered, rather than the more expensive U-233 and Pu-239. These latter two elements are also potentially more hazardous than U-235.

In brief, here are some of the characteristics and objections to possible thermal reactor systems:

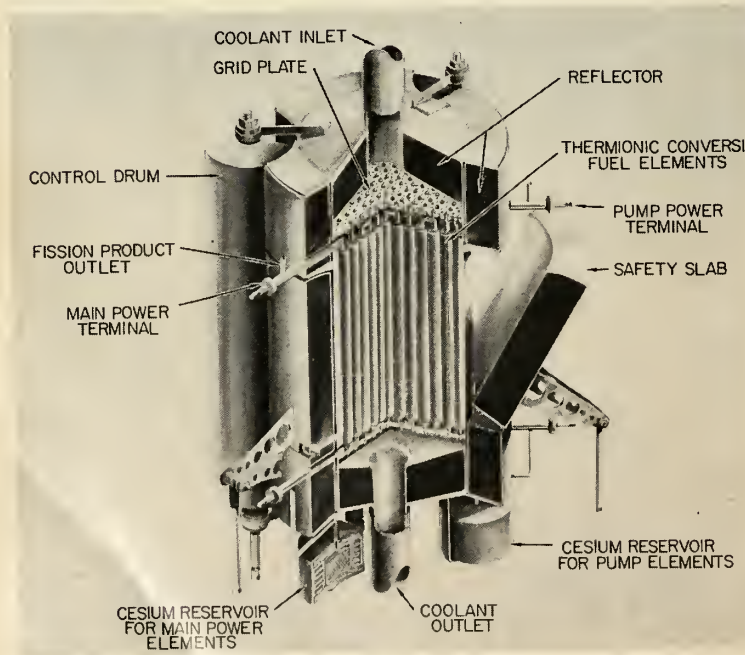
(1) Water-moderated. Small core, incapable of high-temperature operation.

(2) Hydride-moderated. Small core but hydrogen dissociates and is lost through any known cladding at typical operating temperatures.

(3) Beryllium moderated. Larger core than (1) and (2) but has poor physical properties at elevated temperatures, and melts at 2240°F.

(4) Beryllium-oxide moderated. Larger than (3) but strength properties hold up better than (3) at elevated temperatures.

(5) Graphite-moderated. Excessive



THERMIONIC REACTOR. Groups of fuel elements can be connected in series thereby yielding the desired voltage output.

size. Strength and other physical properties show up well at elevated temperatures, even over 4000°F.

The fast reactor system as opposed to the thermal permits a wider selection of materials favorable to solving converter problems. Also, the long mean free path of the fast neutron helps avoid local power reactions in a many celled thermionic unit. Here are some of the characteristics of fast reactor systems:

(6) Liquid-metal-fueled. Low fuel loading, but operational and materials problems are severe. Reactor is smaller than (1) through (5).

(7) Uranium-carbide-fueled. Has reasonably low critical mass for a reactor of this type. Physical properties can be improved by adding other refractory carbides such as zirconium carbide.

(8) Uranium-nitride-fueled. Slightly smaller reactor than (7) but physical properties are not as well known.

• **Selecting a radioisotope** — One two isotopes appear to be suitable for use in a thermionic converter: curium 242 and plutonium-238. The one considered by AEC to have the most promise, chiefly on the basis of safety, is curium-242; this is being selected for development into hardware.

On the basis of economy, the artificial and the fission waste isotopes are inviting. Of these, curium-242 in the compound form Cu-242-Ni has a maximum power density of 810 watts/cc cm, a half life of 162 days, and is an alpha emitter.

Alpha particles are, of course, the easiest to shield. The disadvantage of such radiations is the vapor pressure they build up, which in the instance of close-space electrodes could pose difficult design problems.

Too short a half-life results in a complicated design; too long a half-life results in a low power density. At least 100 days half-life is desirable.

Thus the features of an isotope that make it suited for thermionic use are easily stated: high power density, moderate half-life, low cost, good availability, low shielding requirements, and low vapor pressure.

When really high electrical power are needed, those of the order required to give thrust to a spacecraft, the turboelectric or thermionic nuclear systems in the high temperature range have to be used. Only the 30-kilowatt turboelectric system is under active AEC development (M/R, Aug. 1960, p. 39). Yet if a static source of reliable and long-time high power with high specific power and energy density is wanted, then the reactor-powered thermionic converter in the foreseeable future would appear to have the market to itself.

C-E-I-R Gets First IBM STRETCH

NEW YORK—The first IBM TRETCH-class computer for commer- al use will go to C-E-I-R, Inc., of Ar- ngton, Va.

Capable of 75 billion computations day, the custom-engineered IBM-7030 ata Processing System represents e ultimate in computer technology ithin the present state of the art, ac- rding to International Business Ma- hines Corp.

So versatile is this ultra-high-speed stem that whole complex problems eviously impractical or impossible to lve will be processed rapidly and onomically. IBM says this "total ap- oach" to problems adds a new dimen- on to scientific problem-solving.

Announcement of the contract sign- g was made jointly in New York last eek by the two firms. Delivery of the stem is scheduled for 1962. It will be stalled in C-E-I-R's new Los Angeles search center.

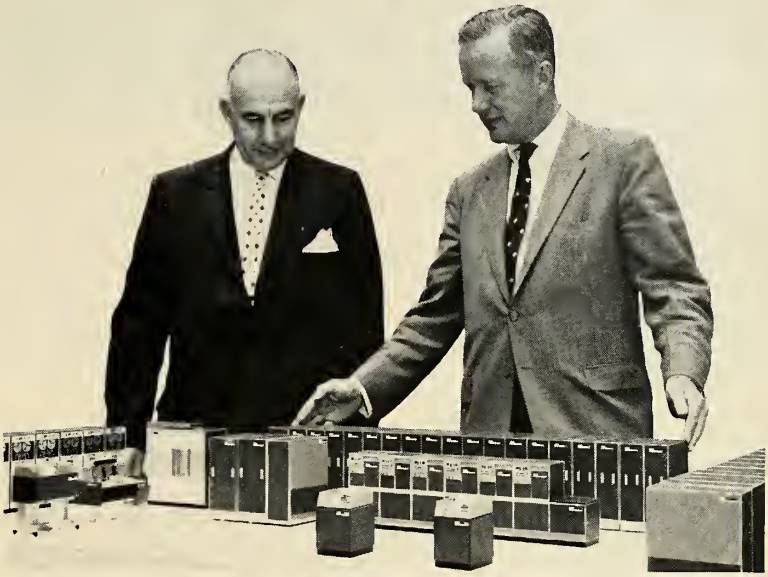
A remarkable sidelight to this ven- re is the fact that the value of a TRETCH complex is more than uble C-E-I-R's current annual gross $6 million. Monthly rental for the stem, said IBM, is over $300,000.

• **Sign of confidence** — C-E-I-R ecializes in providing research and mputer services to both industry and e government. Already the largest in- pendent company of its type in the S., the six-year-old corporation has own very rapidly. Its average annual owth has been about 65%; this has en maintained largely on the strength a continuous sharply rising sales rve and more recently by merger with eneral Analysis Corp. of Los Angeles July and with Engleman & Co. of ashington last week.

Signing of the new contract for TRETCH is even more pointed evi- nce of the company's confidence in continued development and progres- e expansion.

Full significance of what a commer- lly available STRETCH facility will an to both C-E-I-R and its West oast clients is best shown by the capa- ities of the system itself.

The fully transistorized IBM-7030 a rapid-access system that achieves 2-million computations/sec. rate rough the principle of simultaneous eration. That is, its six-magnetic-core rage units can be operated at the ne time. Data retrieval from storage quires 2.18 millionths-sec.



TYPICAL STRETCH-TYPE data processing system configuration is demonstrated with these models by IBM's DP Division President G. E. Jones (right). C-E-I-R's president, Dr. H. W. Robinson, has just signed a contract to lease the IBM-7030 complex for its Los Angeles research center for "over $300,000 per month."

A radically advanced random-access magnetic-disk storage is employed. Over 1.25-million alphabetic characters can be stored or retrieved from the disk storage in 1 sec.

A specialized computer, called the Exchange, within the system serves as a switching center to assure peak efficiency in handling input-output devices. The exchange controls data transfer between 32 separate channels and the main core storage. All sections operate simultaneously.

Another unit in the system boosts effective memory speed by anticipating instruction and data requirements. Acting as a reservoir, it lines up instructions and data a fraction of a second ahead to permit process continuity to the arithmetic and logical unit.

A temporary interrupt also is possible in system operation to permit priority data processing. All other parallel functions, however, can continue without a break.

• **Far faster than earlier systems**— The system, says IBM, has more self-checking and self-correcting capabilities than any other data processing system today and is compatible with all other equipment employed with previous IBM computers.

Seventy-five times faster than the well-known IBM-704, STRETCH will occupy about the same area of floor space—2000 sq. ft. The system is 15 times faster than the highly touted 7090, recently introduced.

The startling speed of STRETCH is expected to result in an extremely low unit cost of work performed, according to C-E-I-R. It is this virtue that can make such a costly rental system pay off for the company.

Success of the operation can only be assured if C-E-I-R can provide high accuracy and faster solutions for clients at costs well below those incurred with their own lower-capacity machines.

IBM feels its new system offers all of the characteristics necessary to meet these demands.

The system was designed to handle inputs and outputs from remote stations. C-E-I-R's L. A. facility will be equipped with data links to the offices and plants of all of its future clients and to other C-E-I-R research centers. All of the necessary programers, analysts, and other professional personnel will be provided by the firm at the center to support customer services. ⁂

Photometric System Boosts Tracki

Monitoring assembly developed by OPTOmechanisms, Inc., for Air Force makes highly accurate velocity readings, will enhance cameras

by Charles D. LaFond

A NEW PHOTOMETRIC monitoring system for recording light reflected from a tumbling satellite has been developed to derive angular velocities with great accuracy. It is currently being tested by the Air Force's Cambridge Research Center.

Designed originally for use in correcting tracking-antenna alignment and for visual observation of satellites, the compact lightweight system has been tested successfully both at Cambridge and Patrick Air Force Base in Florida.

The system developed by OPTOmechanisms, Inc., of Mineola, N.Y., may be used for detection of objects in space, velocity measurements of missiles and rockets, measurement of background illumination and celestial observation and navigation. It can obtain readings accurate to 1 part in 1000 or better.

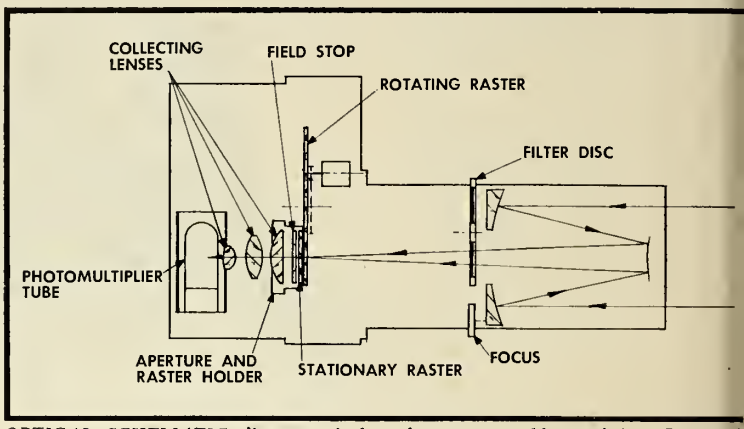
Use of such a system will enhance the effectiveness of ballistic cameras for satellite observation.

The system is portable, carries a spotting telescope for boresighting and visual inspection of the field of view. Total weight of the system is 62.5 lbs. Extremely versatile, the photometric system employs interchangeable lenses from 12-in. to 80-in. focal length and also permits interchangeability of detectors for infrared, ultra-violet, or the visible region.

Mechanically it is designed to be used on a stationary mount where signals can be recorded when an object traverses the field of view, or it can be supported on a radar tracking system or theodolite for measuring illumination intensity. The system includes a control box and strip-chart recorder capable of handling two channels.

System threshold sensitivity based on tests so far have found it to be equivalent to an eighth magnitude star during the dark portions of the twilight.

Detection of first magnitude stars was achieved during the full daylight region while second and third magnitudes were detected during limited daylight. This was over a 1° field of view for daylight operation and a 5° or larger field of view for twilight detection. Increasing the diameter of the objective automatically provides higher sensitivity.



OPTICAL SCHEMATIC diagram of the telescope assembly used in OPTOmechanisms' Photometric Monitoring System.

• **15.5 lb. telescope**—The photometric system is comprised of two major subsystems: the telescope and the recorder control box.

The telescope subsystem is a 15.5-lb. electro-optical assembly containing the optics and a photo detector. The telescope is a 25-in. focal length reflecting system and it has a focusing adjustment knob and filter wheel containing 4 filters that can be inserted in the field of view at will. An adapter ring is included which allows for the interchangeability of the telescope.

The spotting scope provided on top of the subsystem is used for alignment and viewing and permits variable magnification from 2½ to 8 power. It provides tapered cross hairs for boresighting.

The 47-lb. recorder-control box subsystem permits remote operation of the telescope assembly. Its two-channel recorder (Brush Instruments Mark II) is a pen-type containing variable speed paper drive, 2 dc amplifiers, and 2 event markers for time reference.

In the control portion of the ele tronics assembly is included a prote tion circuit for the photomultiplier th automatically removes high volta from the photo tube and energizes warning light when the telescope pointed at a high source of illumin tion, such as the sun or moon.

• **Optical configuration**—Reflecti optics in the telescope collects light lumination from the sky and focus it in the plane of a rotating raster. T raster disc is driven by a synchrono motor through a gear reducer. Bla and transparent wedges equally spac throughout the raster are provided.

The image will appear as appro mately a point on the raster. Consta rotation of the raster lines causes modulation of the illumination of t point image with a frequency roughly 2 kc. The image, followi modulation, passes through a station raster containing black and transp ent lines 0.004 inch thick.

The image is somewhat smaller th the raster line thickness and as it pas on the raster its light is modulated a frequency dependent on the rate travel of the object. Raster lines adjusted such that they are perpend ular to the path of the object.

Each cycle of modulation, that one dark and one transparent line,

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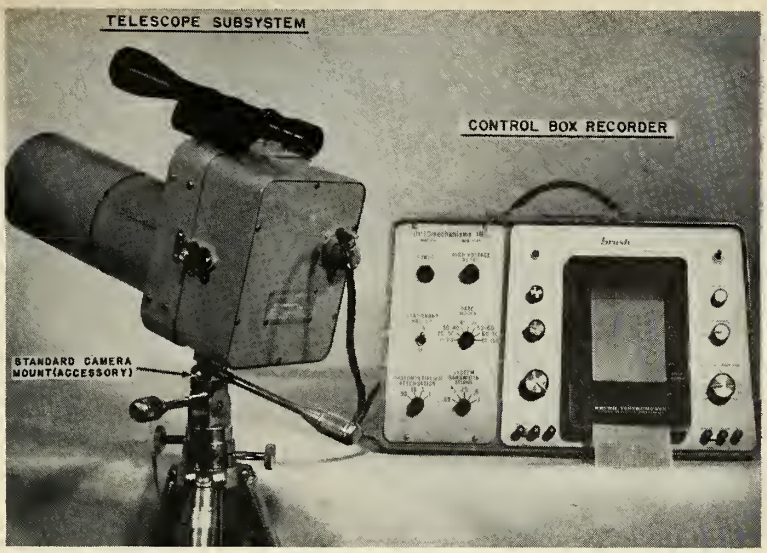


uivalent to 1.1 min. of arc. Thus, a satellite travelling at the rate of 50 n. of arc per second would have a ultant frequency of modulation of 4.5 cps.

If the telescope assembly is mounted c a continuously rotating mount the s tionary raster is removed.

An interchangeable aperture can b placed behind the stationary ras- t to decrease the field of view of this s tem, and variable field stops are s plied from ¼ degree to 5 degrees i addition to rectangular apertures of ¼ degree by 2½ degrees or 1 degree b 5 degrees.

Collecting lenses located between the f al plane of the scope and the photo- m ltiplier tube gather light rays from a point within a maximum of 5° fi d of view and present them on a ¼- i diameter circle at the photo cathode.

Light rays from a point source are d ocused when they arrive at the ca- th de to minimize output variations d to the varying sensitivity of the p to cathode. To reject a majority of n se components the signal received by the photomultiplier is filtered first by a -kc filter. The signal is then ampli- fi and connected to a cathode fol- lo er. Thus, output of the telescope su system is of low impedance reduc- in noise and pickup signals and allow- in the use of a remote control system.

• **Silent sensitivity**—According to its developers, the system employs circu parameters in the photomultiplier su h that the only major noise source is e shot noise caused by sky currents, an thus, the very high sensitivity ac eved in the system.

A number of noise rejection techni es have been employed to mini- mi noise degradation. For example, wh n mounted on a continuously track- in mount the system employs a field of vie as small as practicable to mini- mi the possibility of observing a bri t star.

Minimum field is determined by the tra ing mount. Thus, if its inaccuracy is 5 min. of arc, then the minimum fie of view is 10 min. of arc.

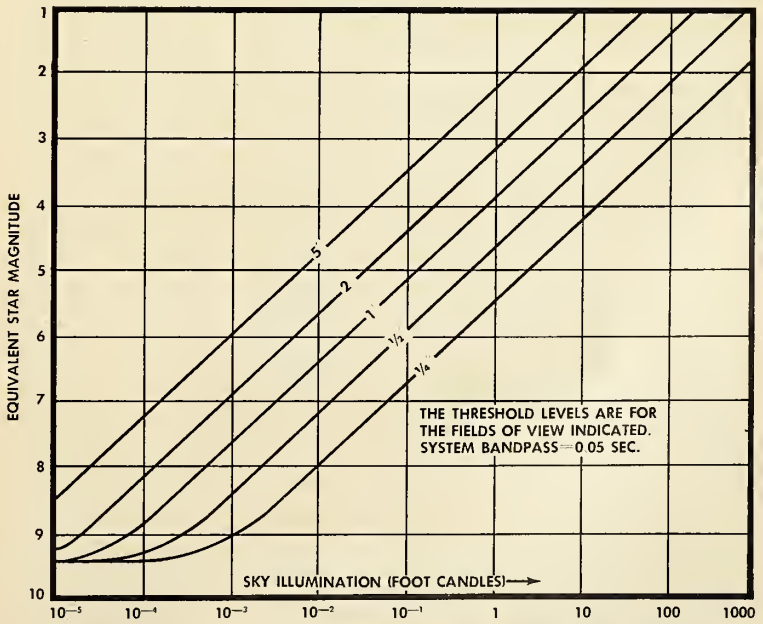
Recorded star signals are reduced by the integrating nature of low-pass electronic filters, having a variable time constant from 0.05 to 1.0 sec. Therefore, when following an object such as a satellite, the duration of an interfering star's signal may be very short and thus its effect will be negligible due to the low-pass filtering circuits.

When the telescope's operational mode is stationary, rejection of star signals is accomplished more readily by the use of the stationary raster. Slow moving objects such as stars, haze or varying sky illumination are rejected since they do not produce the secondary modulation frequencies caused by the fast angular rate of the satellite being observed.

Through the use of 2-kc electronic filters microphonic noise as well as amplifier flicker are minimized by the use of a 2-kc carrier frequency.

Photo-tube noise generation has been minimized through the use of less than 900 volts for the multiplier power supply.

Such a photometric monitoring system eliminates the need for human visual observation. This of course in-



SYSTEM LIMITATIONS are indicated by these computed threshold sensitivities for various angular fields of view as dependent on the sky illumination levels.

creases the reliability and performanc of a ballistic camera by having a shut ter dependent on the actual amoun of light reflected by a satellite.

• **Automatic record**—The operato no longer observes the sky. Beside the permanent record displayed by th recorder of reflected illumination vs time, output also is available as a high level signal of low impedance. Thi can be used to control the grid of a thyratron to change automatically th timing of a camera shutter, varying i in a programed manner to correspon with the intensity of satellite-reflecte illumination.

Employed in this manner the syste is fully automatic, wherein the shutte is opened automatically to a relay whe the satellite enters the field of view an is then energized in a coded fashio to correspond with the satellite's re flected illumination.

During the dark portion of a satel lite's travel, the shutter will remai closed until the satellite's signal reache a predetermined level which can be se by the operator.

In the past, when satellite observa tions were made with a ballistic camera the shutter was automatically or manu ally opened and closed in a coded fash ion, but when a fast tumbling satellit passed through the field of view man problems arose.

A large number of coded shutte operations cannot be observed on th ballistic plate during the dark perio of a satellite's motion. Thus, the aut matic code is ineffective when the dar period of a satellite is appreciable. Ma ual shutter operation is almost manda tory thus requiring actual visual obse vation.

Under these circumstances, opt mum performance is not likely.

Also, when a satellite's illuminatio is too weak or is not visible, great dif culties are encountered in manual tracking a satellite with a telescope determine the dark and light portio of the space vehicle's travel.

With OPTOmechanisms' new sy tem it is believed that even satellit of extremely low reflected light m now be monitored and recorded f subsequent analysis.

First development contract for $2 000 was let in June 1959 for a prot type based on AF-Cambridge specific tions. OPTOmechanisms added se eral features, including the daylig application and delivered the first equi ment in six months.

Two have been delivered to d for test and evaluation. Reportedly, the subsystem is accepted by the A Force, another 20 will be ordered the end of this year for installati around the country.

Nucerite Shows 'Impossible' Resistance

A FAMILY OF ceramic-metal mposites developed by Pfaudler Co., ochester, N.Y., division of Pfaudler ermutit Inc., promises to solve many gh-temperature corrosion and erosion roblems.

The composites consist of a ceramic mponent (Nucerite) physically and emically bonded to structural metals ch as steel, nickel-based alloys or the ore refractory metals.

Nucerite formulations have resisted tack by corrosive vapors at 1300°F, d it is expected that this temperature ill soon be exceeded by several hun-ed degrees.

Nucerite's other physical character-ics are equally impressive.

The ceramic component in rod form ithstood more stress without perman-t deformation than mild steel. A test mple, 0.020-in. ceramic on 0.5-in. el plate, took a 1200°F instantaneous mperature differential without visible mage.

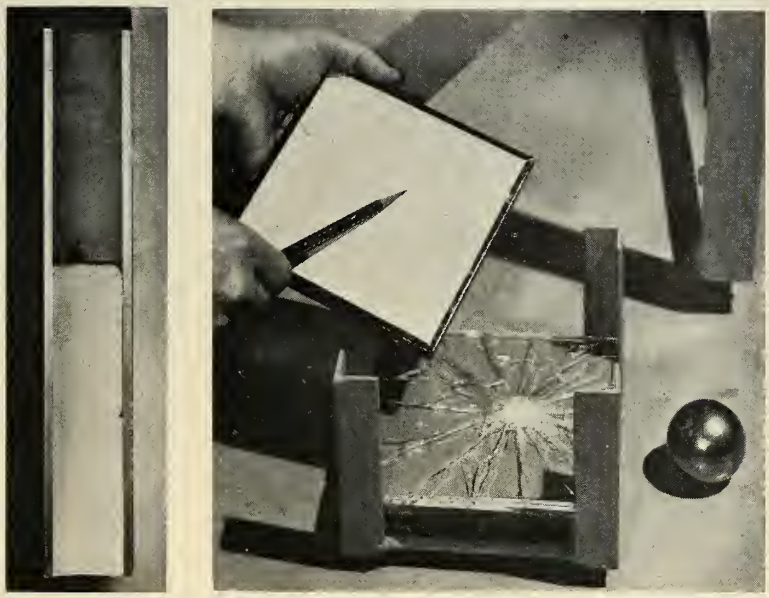
Nucerite has protected molybdenum m oxidation in a 1600°F oxyacety-he flame. A .22 caliber rifle, fired from distance of 25 ft., left a small crush ark on the 0.020-in.-deep surface of a cerite panel—without exposing the se metal.

According to Pfaudler, the unique operties of Nucerite are the result closely controlled nucleation and ystallization within a ceramic formu-lion. Agents are used which act as nters of nucleation during a heat-ating cycle. The final structure con-ns a large number of very small ystals.

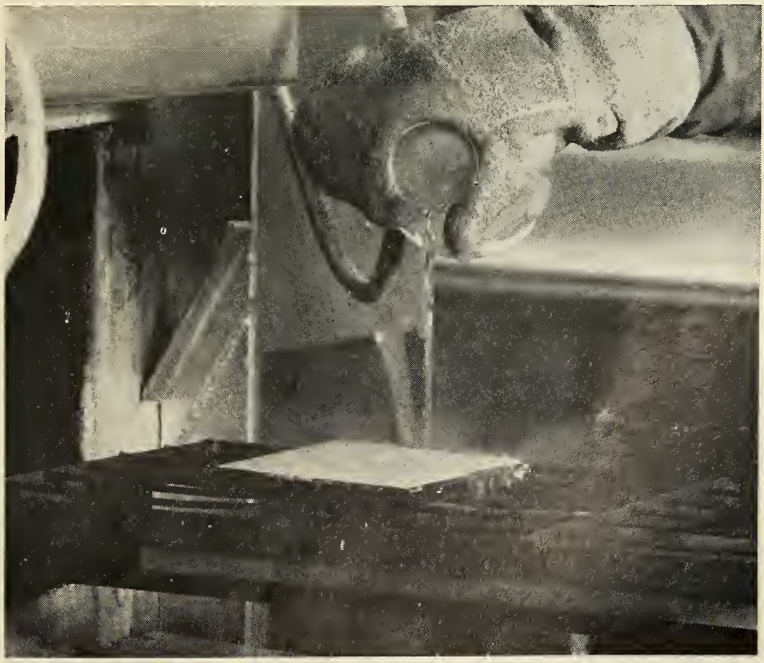
• **Base metal application**—The cer-amic formulation is sprayed on a ound-coated metal. This composite heat bonded and results in a glassy ating. A series of critical time-temp-erature operations complete the Nucer-ite process. Once applied, the coating extremely difficult to remove.

Nucerite is still in the develop-mental stage although small reaction ssels and heat exchanger parts have b-n treated. Company spokesmen say t-t a considerable amount of effort is r-uired before the Nucerite process c- be transferred to full-scale produc-ti-n.

The idea of such coatings was t-ned "impossible" as little as three y-rs ago by some leading ceramic ex-p-ts. Pfaudler has filed patent applica-ti-s on the development. ⌘

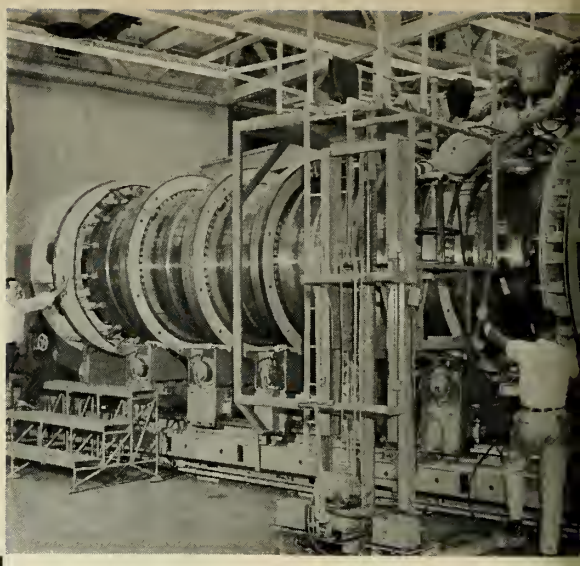


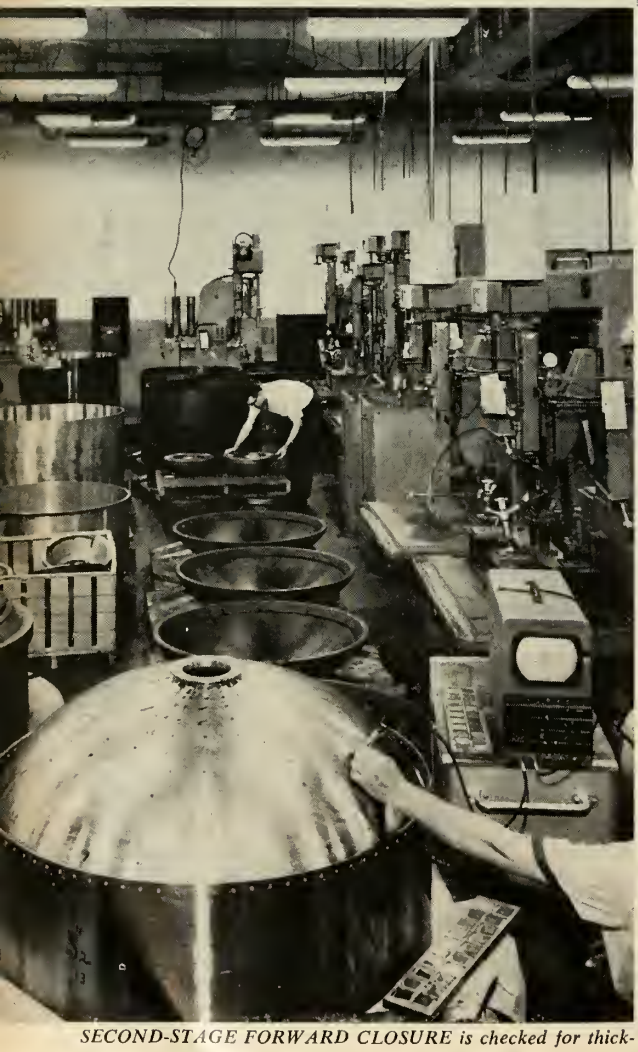
HYDROGEN CHLORIDE GAS at 1200°F corroded the metal portion of a nickel-base alloy pipe while the Nucerite area remained unaffected. On the right the 10.8-ft./lb. impact of a steel ball left the Nucerite surface slightly crushed. The shattered safety glass, 3/8-in. thick, took the same impact force.



THERMAL SHOCK of 1200 F△T, caused by pouring ice water on a Nucerite plate at 1250°F, resulted in no visible damage to the ceramic coating.

Fabricating Minuteman Cases At Allison





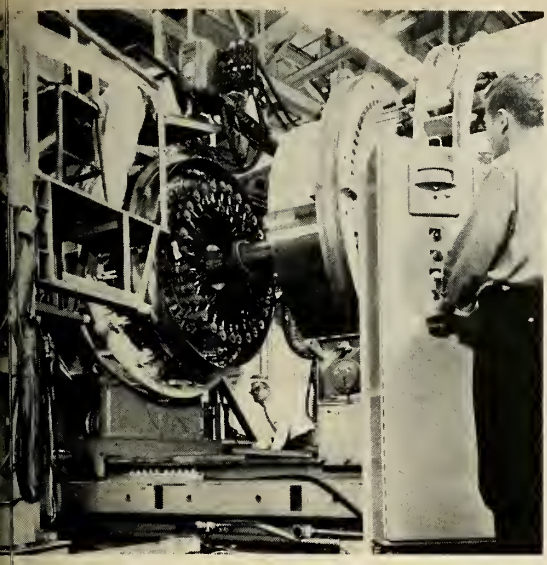
SECOND-STAGE FORWARD CLOSURE is checked for thickness at Allison. The fixture adjacent to the dome stabilizes closure configurations during heat treat.

STARTING WITH high-strength steel ring and dor forging, Allison Division of General Motors is turning c first-stage *Minuteman* motor cases in a series of massi machining and welding operations.

Developed by Allison for Thiokol, the cases ha achieved 100% reliability in all silo and test firings to da From the beginning, Allison has been using an extrem "clean" steel. Precise controls from the formation of t ingot to the finished cases has produced a high uniform of tensile strength.

Each completed case is instrumented with strain ga during hydrostatic test to determine stresses at all criti areas—before shipment to Thiokol.

The firm is currently engaged in a cost reduction progr which includes new fabrication techniques.



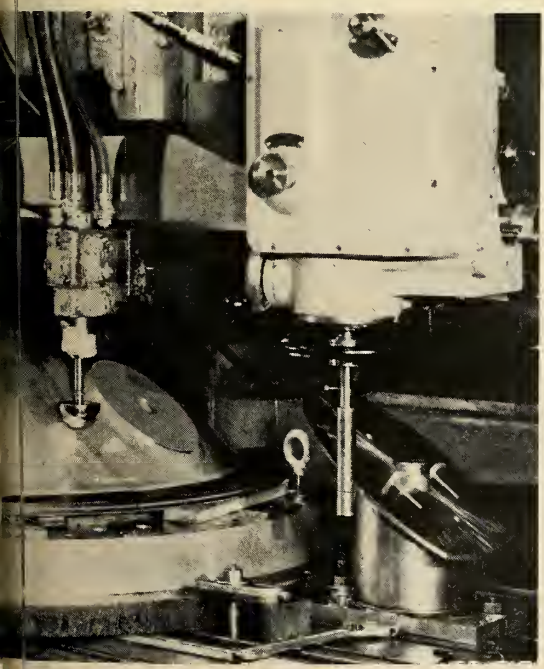
BOVE LEFT: *CYLINDRICAL SECTIONS are welded together while rigidly fixed in position. Intermediate operations such as weld grinding and inspections are also handled.*

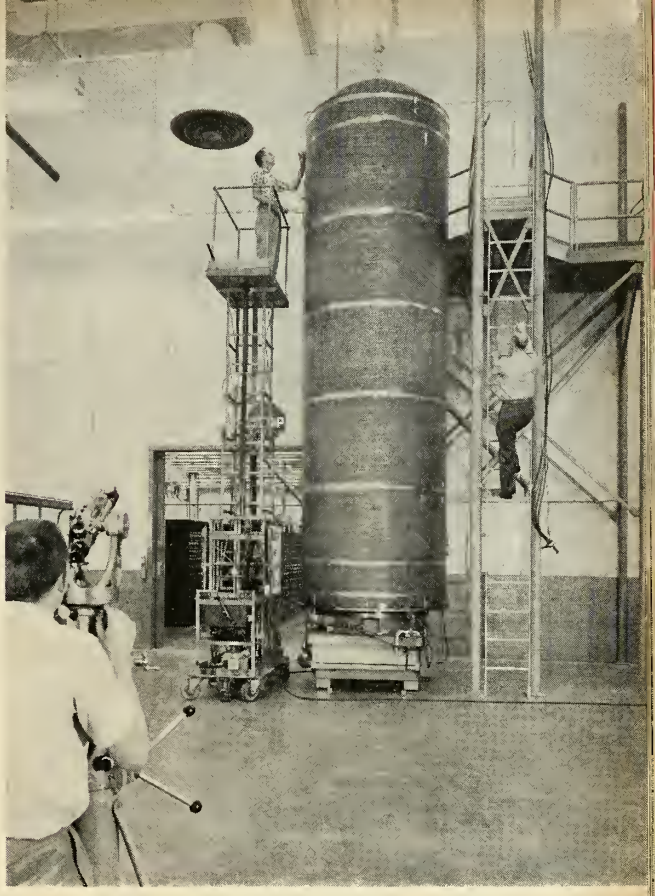
BOVE RIGHT: *INTERNAL BACK-UP FIXTURES brace the cylinders during the joining process. Close control is kept over the welding variables of filler feed and power.*

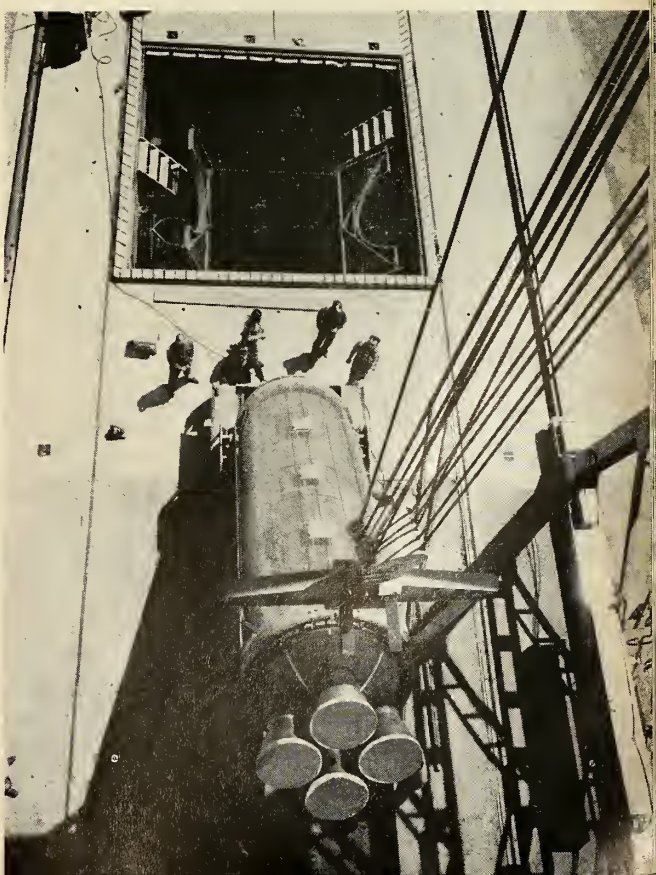
ELOW: *TEMPLATES AND TRACERS aid in the machining of the closure dome. Reinforcement is provided at the nozzle adapter junction by machining the outside of the closure.*

OP RIGHT: *OPTICAL INSTRUMENTS are used to check the dimensional inspections on a finished case. This chamber stands 22 ft. high and measures 65 in. in diameter.*

OTTOM RIGHT: *LOADED FIRST-STAGE motor moves out of a Thiokol casting pit. The engine is subjected to radiographic inspection before being shipped to firing bay.*







ARS Meeting Hits Lack of Research

Record space power conference hears demands for more investment by industry if space materials are to be found

SANTA MONICA—The largest conference on space power systems ever held concluded here with agreement that the common denominator of all systems now under consideration is a lack of knowledge of materials. And the high temperatures at which most systems must operate are beyond the capability of materials now in use, especially for extended periods of time.

Dr. Abe Zarem, Chairman of the American Rocket Society's Power Systems Committee, and president of Electro-Optical Sysetms, Inc., criticized U.S. "earth-based industry" for delays in developing the lightweight power sources needed fro advanced space vehicles.

"There is a lack of patient dollars in industry," Zarem said, "and we seem to require a quick financial return on money invested before we're willing to conduct long-range basic research." He pointed out that the government's investment of "patient dollars" in support of research has made possible present advanced power systems.

"Materials research is one area which must be pushed with all possible speed," Zarem added, "and the biggest obstacle here is one of communication between parties concerned and the proper allocation of priorities."

"A vast intensification of research and development effort in the area of energy conversion and advanced power sources is essential, not only to the military posture of this country, but also to the peaceful needs of more efficiently utilizing the limited resources which we possess on earth," he stressed.

"The exotic power packages being researched today may produce a billion-dollar industry before 1975," he predicted.

• **Emphasis on research**—Technical sessions at the conference covered highly specialized fields in energy sources development, including therm electricity, thermionics, photovolta cells, e-chemical cells, dynamic engin and plasma generators, systems for n clear auxiliary power, and a session applications, safety and advanced s tems.

Approximately 75 papers were p sented at the conference, on subje ranging from the theoretical physics solar cells to the safety aspects of nuclear power package. Seven pap were presented by North Americ Aviation's Atomics International Di sion on the SNAP programs, w emphasis on SNAP II.

One of the more theoretical a futuristic of the recent ARS meetin the conference heard a number of scriptions of current systems, but c centrated on basic research proble and findings.

The immediate future will see po systems based on solar energy

hotovoltaic converters only, according
N. W. Snyder, of the Institute for
efense Analysis. "Power levels ex-
ected of the systems will immediately
ictate two design requirements," he
id, "these being the stabilization
ethod and the array design."

• **100-watt dividing line**—Those ve-
icles requiring less than 100 watts
ave been spin-stabilized, reducing com-
lexity of the stabilization subsystems.
he increased number of solar cells re-
uired boosts both weight and cost of
e array by a factor of four, Snyder
id. *Pioneer, Explorer, Tiros, Transit,*
nd *Courier* were designed in this
anner.

Above 100 watts required power,
ehicle stabilization is necessary, with
ttendant solar orientation of solar ar-
y panels. Designed in this fashion
re *Midas, Samos, Ranger* and *Advent.*
he 100-watt power requirement is not
n exact transition point from one
esign to another, Snyder said, adding
at the weight of non-working solar
ells must be evaluated against the
eight of the orientation subsystems.

• **Ranger system**—Power system for
e *Ranger* spacecraft was described
a paper by Jet Propulsion Laboratory
ientists. Using oriented silicon photo-
ltaic cells, the *Ranger* is equipped
ith an attitude control system to al-
w solar radiation to strike the cells
rtically.

Primary silver-zinc batteries provide
wer during launch phase, prior to
n acquisition, and during guidance
aneuvers when the solar power is
adequate to power the craft.

The solar cells convert solar radia-
on—in the 0.4 to 1.4 micron wave-
ngth region—to electrical energy.
ese cells are mounted in an alumi-
m honeycomb support structure fab-
cated from 0.0007-in.-thick foil and
nded into a 3/8-in.-high honeycomb
ucture by epoxy resin.

Sea-level earth efficiency of the cells
about 12%. A six-mil-thick glass
ver is epoxy bonded to the 1 x 2 cm
lls to increase their emmissivity from
33 to 0.85.

• **Advent's power**—A similar de-
led breakdown was given by Richard
. Karcher, of General Electric's Mis-
e and Space Vehicle Department, for
e *Advent.* The vehicle will be used
a network of communication satel-
es in 24-hour orbits.

A constantly earth-oriented antenna
ll be maintained by an attitude con-
l system. Power will come from
otovoltaic cells distributed over one
e of each of two paddles deployed
opposite sides of the vehicle. Al-
ugh the paddles will be free to
ate about one axis with respect to
sun, the entire vehicle will be
ped on each orbit to reorient the
ddles for the next pass. This is to
avoid using slip rings in the assembly. The flip action will take place at high noon, and will involve a rotation about one axis only.

Energy storage during non-illuminated portions of the orbit will be accomplished with nickel-cadmium batteries. The chosen orbit, of a modified sinusoidal type, is expected to include a maximum darkened period of 75 minutes.

As in the *Ranger, Advent's* paddles are a series of laminations consisting of a honeycomb base, solar cells, bonding layer and glass cover. About 70 mils of fused silica are expected to be required to provide adequate mass for reducing ambient electron energy to 145 kev, the threshold of tolerance for silica cells.

Based on a 28-volt system, the arrays will contain about 70 cells in series, and the series strings then paralleled to produce the required power.

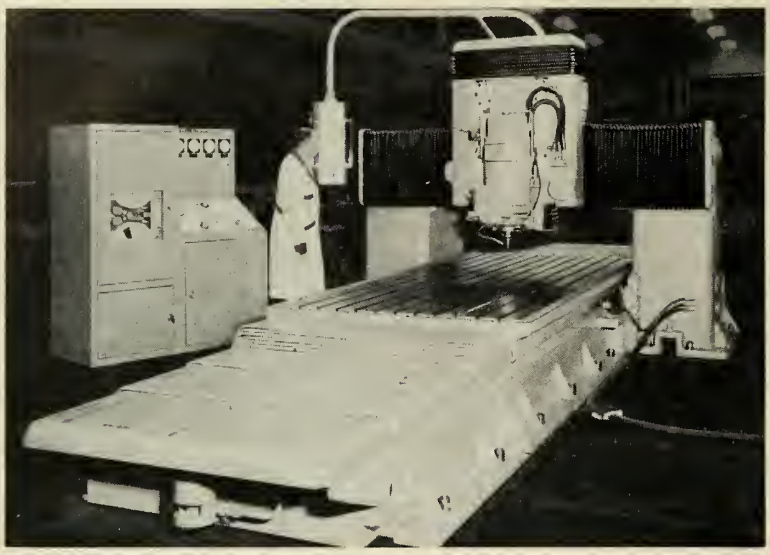
• **Versatile SNAP**—Uses of SNAP systems in space vehicles over the next 10 years were spelled out by Atomics International Div. of North American Aviation. J. R. Wetch and J. G. Lundholm estimate that the first use of the SNAP package will be with the *Atlas-Agena B* vehicle, and that it will also be used through the *Saturn* and *Nova* series of boosters.

When the performance of the SNAP packages was measured against various payload and propulsion parameters, it was concluded that any of the "workhorse" boosters expected to be in use over the next decade could easily boost a SNAP unit and a sizeable useful payload into various orbits and trajectories.

Electrical propulsion, coupled with a 3000-lb. SNAP system generating 70 kw, could place a useful payload of 1000 to 2000 lbs. into a 24-hour orbit after being boosted by an *Atlas-Centaur,* according to the authors, there after leaving the entire SNAP package free for wide-band communications work. The electric propulsion device could subsequently be used for orbit corrections.

Two project engineers from the Allison Division of General Motors presented a paper on Stirling cycle engines for space power, pointing out that the engine's characteristics are well suited to application where engine efficiency is a vital consideration in over-all system weight. They specified satellite solar power as a potential application.

M. D. Parker and C. L. Smith pointed out the moderate temperatures prevailing even at high efficiencies, and the operating environment in which the engine's moving parts operate, contributing to long life. They emphasized that no breakthroughs are required and that reliability is maximum.



Tape Controlled Milling Machine

The No. 200 Series "ECCOMILL" Continuous Path, Tape Controlled Milling & Profiling Machines, have been developed by Ekstrom, Carlson & Co.

The series of the traveling table, vertical spindle, bridge-type design, covers a broad range of sizes with multiple axis control.

Among its features are anti-backlash, recirculating, ball-bearing precision screws on each axis and anti-friction, unit-type recirculating roller bearings on the table. The saddle and vertical slide operate on hardened and ground ways and the DC Milling Head provides continuously variable spindle speeds from 15 to 6000 RPM.

Circle No. 225 on Subscriber Service Card.

Submarine O_2 Valve

A differential pressure-regulating valve for submarine high-pressure electrolytic oxygen generating systems has been designed by The Garrett Corp.'s AiResearch Manufacturing Division.

The unit is installed in a by-pass line around a feedwater pump supplying distilled water to electrolytic cells. The valve can regulate 50 to 4000 psig inlet water pressure to the cells, maintaining a fixed differential of 50 ±5 psi above generated oxygen pressure sensed by a valve bellows assembly.

Circle No. 226 on Subscriber Service Card.

Quick Start 2-oz. Motor

A subminiature motor, measuring 1 7/32 in. long and weighing only two ounces has been announced by The A. W. Haydon Co.

Featuring almost instantaneous starting and stopping characteristics, this unidirectional or reversible 400-cycle a. c. timing motor, designated as the 25100 series, incorporates a phase-shift network providing one winding ninety degrees out of phase to assure rapid starting, smooth operation, and ease of reversal.

Circle No. 227 on Subscriber Service Card.

Fibrous Titanate

"Tipersul," fibrous potassium titanate, a new crystalline fiber material for high-temperature applications, is available from E. I. DuPont de Nemours & Co.

The small, white crystalline fibers useful to 2200°F are available in lumps and loose fibers, as well as blocks, sheets and paper forms made by standard felting techniques. Curbed or odd shapes are also available.

Circle No. 228 on Subscriber Service Card.

Environmental Refrigerant

Isotron 13 for low-temperature environmental refrigeration applications is being produced by Pennsalt Chemicals Corp.

Isotron 13 (monochlorotrifluoromethane) can be used to produce temperatures below –100°F. It will be particularly useful in low-temperature research and testing where exceptionally low environmental temperatures are desired.

Circle No. 229 on Subscriber Service Card.

Center of Gravity Locater

An aid for the Vibration Test Laboratories, which can reduce set-up time as much as 90%, is being marketed under the name of "Cee-Gee Locator," by Auto-Control Labs. Inc. The instrument quickly and accurately positions the center of gravity of test specimen and fixture axially along the center of force of the vibration exciter within 1 gram-inches.

Circle No. 230 on Subscriber Service Card.

High Temperature Sensors

Aero Research Instrument Co. has developed a complete line of thermocouple-type temperature sensors for use up to 4000°F.

The devices, of both non-cooled and cooled types, measure liquid, solid and gaseous temperatures. Some of the sensors are usable in oxidizing atmosphere up to 4000°F and intermittently higher.

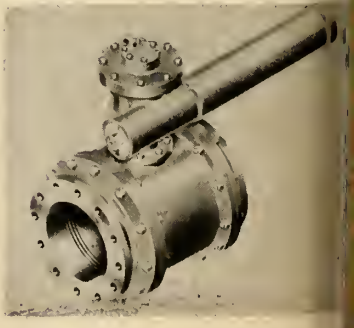
These probes are designed for such typical applications as measuring the temperaures of exhaust gas in an afterburner, molten glass, fuel pins in a nuclear reactor, missile nose cones and combustion processes.

Circle No. 231 on Subscriber Service Card.

Cryogenic Ball Valve

Built to handle liquid oxygen in a missile fueling system, a KOEHLER Dayton ball valve from Koehler Aircraft Products Co. weighs approximately 1100 lbs.

Valve body and full ball closure are of stainless steel; through proper choice of seal materials the unit may be quickly adapted to handle a wide



ariety of liquids such as water alcohol ixtures, liquid nitrogen, natural or ynthetic lube fluids, hydraulic fluids, nd most fuels.

The valve actuator uses gaseous itrogen as the operating medium and ncludes hermetically sealed limit witches to provide remote (electrical) ndication of valve position.

Circle No. 232 on Subscriber Service Card.

hree-in-one Amplifier

A Model 1100 amplifier now avail- ble from Cubic Corp. combines in one ackage the features of three individual nits: a differential-input wideband DC mplifier, a bridge balance circuit, and

well regulated strain-gauge power pply.

In instrumentation applications here a self-contained power supply is t essential, two DC amplifiers can be mbined in a single unit, boosting om 8 to 16 the number of amplifiers at can be mounted abreast in a ndard 19-in. rack.

Circle No. 233 on Subscriber Service Card.

ny Servo Gearhead

A high-precision miniature servo gearhead has recently been added to t line of gearheads made by Exact Engineering and Manufacturing Co.

Almost one thousand different ratios a available from 3.08:1 to 16,384:1 i Model E11. These ratios are ob- ned by using from two to seven gear sges, and a motor output pinion with e ier 10, 12, 13, or 15 teeth.

Circle No. 234 on Subscriber Service Card.

Beryllium Monitor

In conjunction with the U.K.A.E.A., Pssey Nucleonics Ltd. have produced a portable radiation monitor, designed fo comfortable transportation by two mn, capable of detecting beryllium in an aggregate containing less than 0.1% BeO.

Transistorised, shockproof and im- pvious to extremes of temperature an humidity, the equipment is pow- ered by eight U2 type dry cells stored in the monitor. The sensitivity is such that 0.004% BeO doubles the normal background rate.

Circle No. 235 on Subscriber Service Card.

Sealed Rotary Switch

An RSA Rotary Switch has been introduced by the Denver Division of Hathaway Instruments, Inc.

The magnetically operated, hermetically sealed contacts are rated at 10 million operations each at 100 ma current. They are gold-plated for low contact resistance and sealed in nitrogen for insurance against corrosion. The contacts will interrupt up to 500 ma, 115v AC with a decrease in rated life. Each contact is double-ended so that circuits requiring isolated contacts in a rotary switch configuration now become feasible.

Circle No. 236 on Subscriber Service Card.

Ferrite Materials

Two recently developed ferromagnetic materials, completing a series of magnesium-manganese-aluminum ferrites, are now available to designers of isolators, circulators, duplexers and other microwave devices, from Motorola Inc., Military Electronics Division.

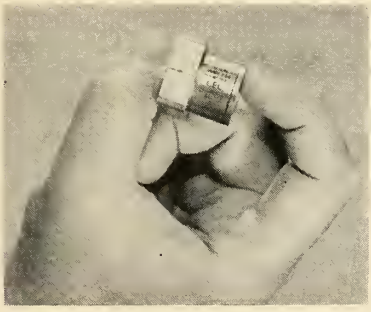
Types M-092 and M-112 microwave ferrites, complete a family of four ferrite materials designed for general nonreciprocal device applications.

Circle No. 237 on Subscriber Service Card.

Miniature Strain Gage

The smallest temperature-compensated strain gage accelerometer available has been developed by the Transducer Division of Consolidated Electrodynamics Corp., a subsidiary of Bell & Howell Co.

The Type 4-202 is a linear, un-



bonded, strain-gage bi-directional instrument, designed for measuring accelerations perpendicular to the mounting surface. Weighing less than 3 oz., the 1-cu.-in. accelerometer's linearity and hysteresis qualities are conservatively rated at less than ±0.75% of full-range output.

Circle No. 238 on Subscriber Service Card.

new literature

INSTRUMENT CATALOG—Statham Instruments, Inc., has published a 32-page General Catalog with concise descriptions of Statham pressure transducers, linear and angular accelerometers, load cells, amplifiers, power supplies, bridge balances, strain gages and force/displacement transducers.

Circle No. 200 on Subscriber Service Card.

TAPE ANALYZER—A four-page bulletin on the Automatic Tape Analyzer is available from Graver Water Conditioning Co., a division of Union Tank Car Co. The bulletin, WC-127, covers all facets of the unit, including method and principle of operation, potential applications and basic specifications for the instrument, and the Milipore Filter (R) tape used as the testing medium. It also gives design data, including components and materials of construction.

Circle No. 201 on Subscriber Service Card.

LOAD CELL STANDARDS—An eight-page Technical Bulletin TD-103 on precision high-capacity force standards has just been released by Gilmore Industries, Inc. The bulletin discusses the various types of secondary standards available for force measurement, as well as the reasons why the confidence factor decreases as the secondary standard accuracy approaches the accuracy of the primary standard.

Circle No. 202 on Subscriber Service Card.

WINCHES AND HOISTS—Breeze Corporations, Inc. has released a catalog file covering its line of winches and hoists. All pertinent data and drawings are shown for rescue hoists, heavy duty cargo hoists, hook drives, hand-operated hoists, combination winches and hoists and various hooks and accessories including a remote release cargo hook.

Circle No. 203 on Subscriber Service Card.

MISSILE TRAINING AID GUIDE—"A Guide To The Selection of Panel Type Training Tools" has been made available by Burton-Rodgers, Inc. The book establishes procedures to use in determining the type of missile trainer required for specific applications. Over 20 photographs and many charts aid the training coordinator.

Circle No. 204 on Subscriber Service Card.

LANGUAGE LABORATORY — A brochure outlining a new concept in language laboratory components has been published by Switchcraft, Inc. The components offer a convenient, simplified, portable and low-cost language laboratory set-up.

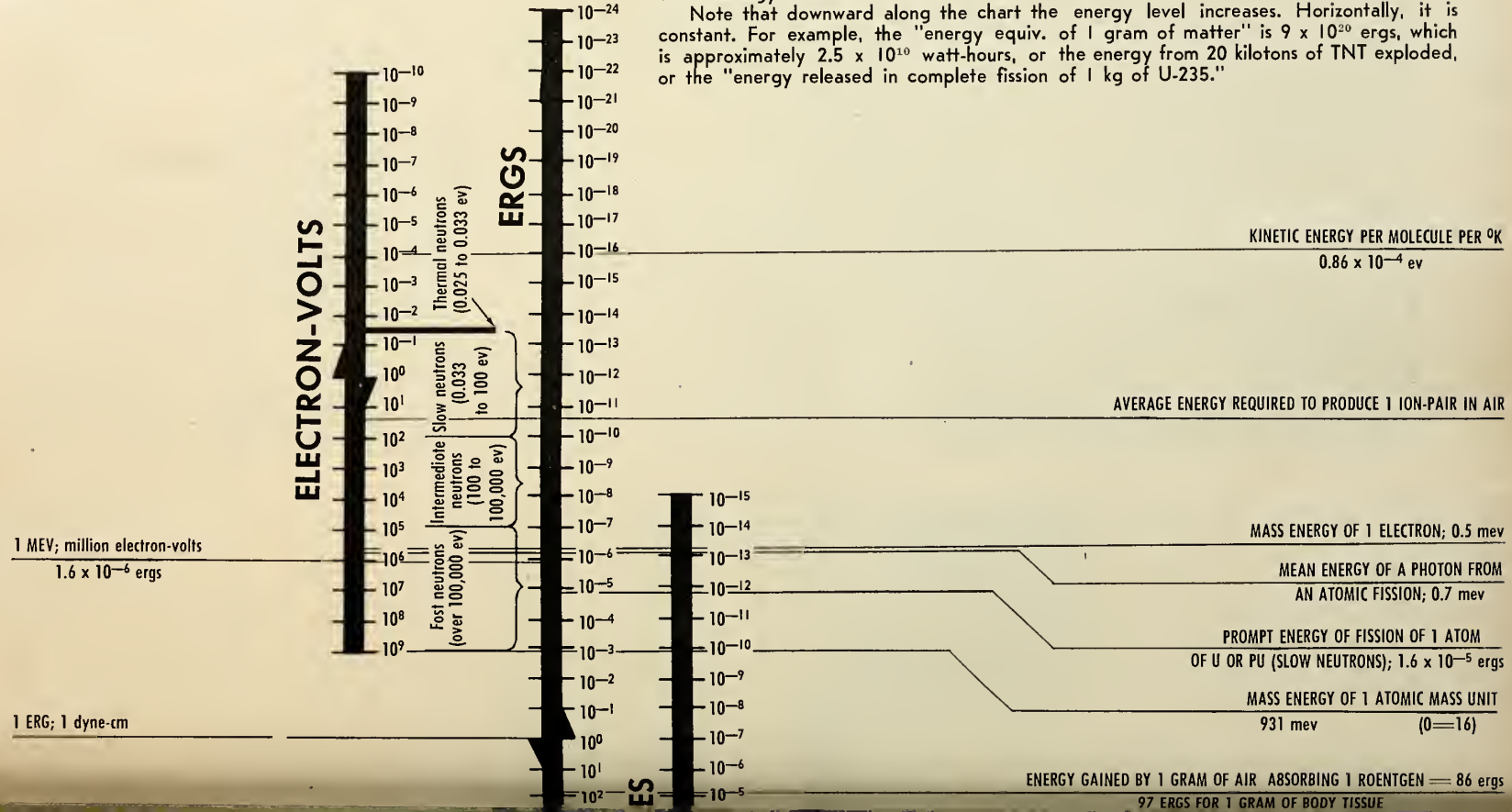
Circle No. 205 on Subscriber Service Card.

THE ENERGY LEVEL OF THINGS

J. R. Williams
Air Force Special Weapons Center (ARDC)
Kirtland Air Force Base, New Mexico

OFTEN THE ENERGY UNITS used in one scientific field are not easily put into perspective by workers in another field. Thus, while certain units are utterly familiar to particular specialists, other units seem to exist only to confound. This chart has been designed to relate several commonly used units and to give "real life" benchmarks to a few of the energy levels.

Note that downward along the chart the energy level increases. Horizontally, it is constant. For example, the "energy equiv. of 1 gram of matter" is 9×10^{20} ergs, which is approximately 2.5×10^{10} watt-hours, or the energy from 20 kilotons of TNT exploded, or the "energy released in complete fission of 1 kg of U-235."



(30 Cal., M2—151 gr. bullet, 2800 fps, 2626 ft-lb.)

[2]1 BTU; 1.055107×10^{10} ergs

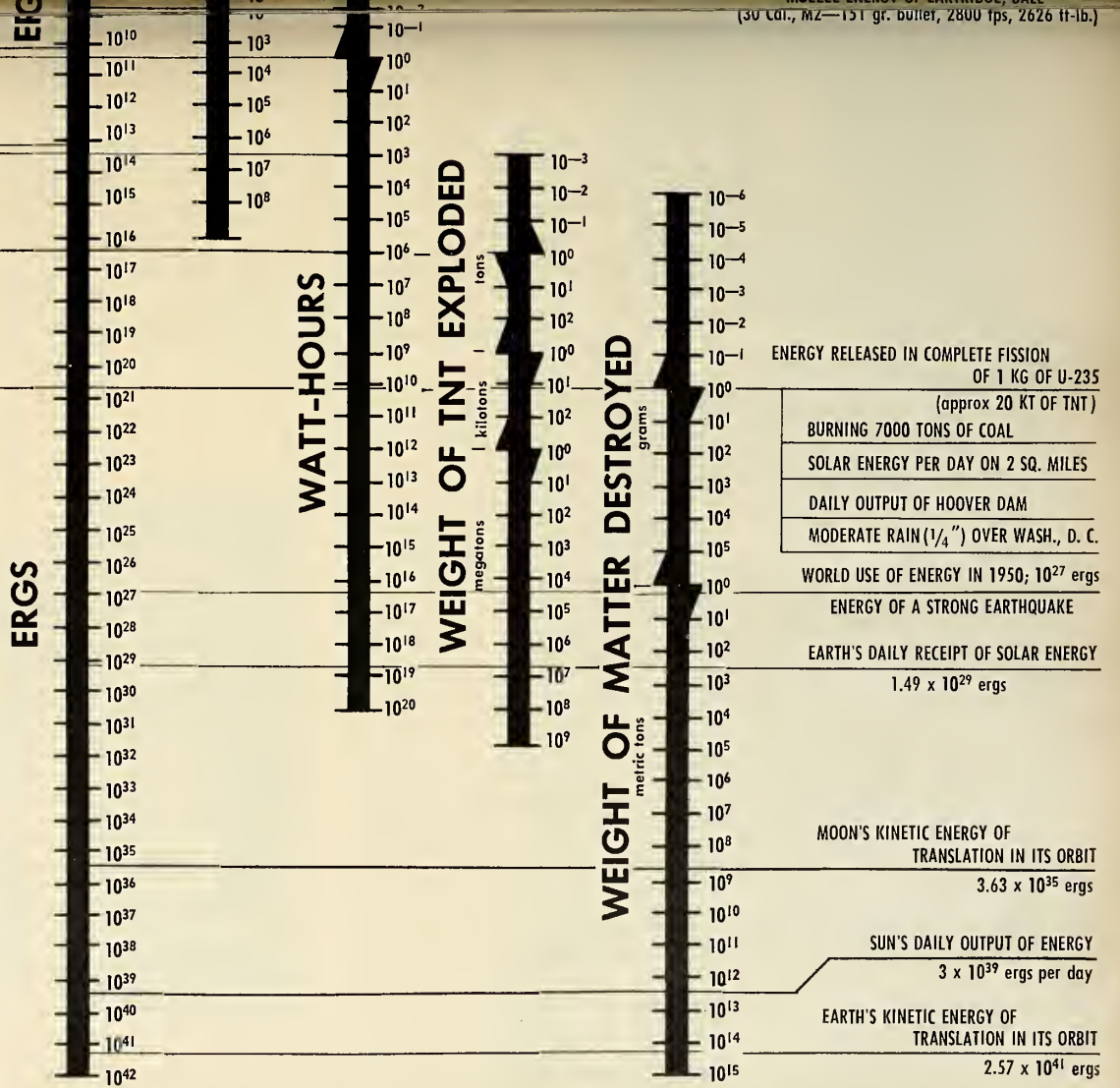
[3]1 WATT-HOUR ABS.
3.6×10^{10} ergs, by def.

[4]1 HORSEPOWER-HOUR; 2.6845×10^{13} ergs

1 KILOWATT-HOUR· ABS.

ENERGY OF 1 TON OF TNT; 4.2×10^{16} ergs

ENERGY EQUIV. OF 1 GRAM OF MATTER
9×10^{20} ergs



NOTES

[1]1 I T calorie = 1/860 international watt-hour, by def.

[2]1 BTU = 251.996 I T calories, by def.

[3]1 watt-hour, international = 1.000165 watt-hours, abs.

[4]1 metric horsepower-hour = 2.648×10^{13} ergs

contracts

NASA

Horkey-Moore Associates, a division of Houston Fearless Corp., Torrance, Calif., for design and fabrication of a systems test fixture for ground checkout of the *Ranger* spacecraft. Amount not disclosed.

$2,771,720—Hayes Aircraft Corp., Birmingham, Ala., for fabrication of ground support equipment for the *Saturn* launch complex at Cape Canaveral. (Augments a $4,241,400 contract let Aug. 1 to Hayes.)

NAVY

$3,543,019—Remington Rand Univac Military Div., St. Paul, for research and development leading to an advanced computer and hardware ($1,924,019) and continued development of an electronic data processing system and related equipment ($1,619,000).

$2,000,000—General Electric Co., for production of fire control directors for the *Tartar* weapon system.

$1,100,000—Sanders Associates, Inc., Nashua, N.H., for the *Eagle* missile seeker system development program. Subcontract from Bendix Corp.

$947,000—Westinghouse Electric Corp.'s Electronic Tube Div., Pittsburgh, for specialized microwave tubes to be used in the new *Typhon* weapon system. Subcontract.

$500,000—The American Optical Co., Southbridge, Mass., for production of Mark 13 target detecting devices used on the *Sidewinder 1-C* missile.

AIR FORCE

Northrop Corp. was awarded a multimillion-dollar subcontract from The Martin Co. for *Titan* base activation at Ellsworth AFB, S.D. Amount not disclosed.

$17,000,000—Thiokol Chemical Corp., Bristol, Pa., for continuation of work on the *Minuteman* first-stage solid-propellant engine.

$7,500,000—Sylvania Electric Products Inc., Buffalo, for development and engineering of the command communication subsystem of the radio launch control system for the *Minuteman*. Subcontract from Boeing Airplane Co.'s Aero-Space Div.

$6,000,000—Douglas Aircraft Co., Santa Monica, for components, spare parts, engineering and technical data for the *MB-1 Genie* rocket.

$2,000,000—Lear, Inc., Santa Monica, for the north-seeking gyro in connection with the *Minuteman*. Subcontract from North American Aviation, prime contract for the guidance system.

$1,500,000—Pacific Automation Products, Inc., Glendale, Calif., for procurement of custom cabling to be used in the *Atlas* silo bases. Subcontract from Convair Astronautics.

$1,000,000—Space Technology Laboratories, Los Angeles, for *Project Advent*, a communications satellite.

$1,000,000—Leach Corp.'s Relay Div., Los Angeles, for relays for the tactical launch control equipment of the *Atlas* series "E" missile. Subcontract from Hallamore Electronics.

$1,000,000—General Electric's Rocket Engin Section, Cincinnati, for research and de velopment of the company's plug nozzl rocket engine concept.

$730,945—The M&T Co., Philadelphia, fo non-personal services for on-site opera tion, maintenance and supply suppor for SAGE utility systems. (Two con tracts).

$500,000—Electradata Corp.'s Airite Div., Lo Angeles, for production of titanium ves sels for the *Titan*. Subcontract fror The Martin Co., Denver.

$421,180—John E. Fast & Co., Chicago, fo capacitors to be used in guidance an control systems of the *Minuteman*. Sub contract from North American Aviatio Inc.'s Autonetics Div.

$52,990—National Research Corp., Cambridg Mass., for one year's study, constructio and experimentation on photoemissiv devices which convert the sun's energ to electric power.

ARMY

The Budd Co., Philadelphia, for develop ment of high-performance solid-prope lant rocket motor cases. Amount n disclosed.

North American Aviation, Inc., has awarde its Rocketdyne Div. a contract for lim ited production of solid-propellar boosters to be used in fabrication an flight testing of *Redhead-Roadrunner*, new target missile system. Amount n disclosed.

$2,600,000—Hazeltine Corp., for 37 new tran portable 40-ft. radar antennas.

$2,000,000—Goodyear Aircraft Corp., Akro for additional work on the *Nike-Zeus*.

$1,500,000—Western Electric Co., New Yo City, for further work on the *Nike-Ze* system.

$417,000—The Marquardt Corp.'s Cooper D velopment Div., Monrovia, Calif., for pr duction of 600 meteorological rock systems.

$409,841—International Builders of Florid Inc., Coral Gables, for construction buildings to be used in support of t *Polaris* program.

MISCELLANEOUS

General Vacuum Corp., E. Boston, Mas for design and construction of a ne large-scale vacuum facility. Awarded General Electric's Research Laboratori

$2,500,000—Fruehauf Trailer Co.'s Milita Equipment and Missile Products Di Detroit, for manufacture of various typ of ground support equipment.

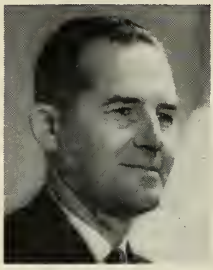
review

OPTICAL INDUSTRY DIRECTORY, 19 issue. The Optical Publishing Co. Len Mass. $7.50.

About four hundred instruments, co ponents, raw materials, and services i portant to the optics industry are list Current information concerning 12 American company sources capable furnishing these items and a compl catalog of all corrected lenses, both c mestic and foreign, are included.

The scope of the Directory has be considerably expanded over previc issues. Photographic, photoelectric, a infrared devices and advances in the strumentation of space technology ceive more detailed coverage.


LONGMIRE


KARSCH


HORTON


STONE


CROMPTON

Richard H. Horton: Joins National Research Associates, Inc. as director of Plans and Marketing. Was previously supervisor of powerplant design at General Electric's Large Jet Engine Division.

Lt. Gen. C. S. (Bill) Irvine (USAF-ret.): Elected to the board of directors of Idaho Maryland Industries, Inc. He is also vice president and director of planning of Avco Corp. and a director of Houston Fearless Corp.

Harvey A. Druker and **Victor Schwab:** Join Navigation Computer Corp. as application engineers. Druker was formerly project engineer on digital systems with Briggs Associates, Inc.; Schwab was a digital design engineer with Remington Rand Univac.

Dr. Charles E. Crompton: Named director of the Advanced Development Section in the Isotopic Power Department of The Martin Co.'s Nuclear Division, concerned with advanced applications of radioisotopes as a source of heat and electricity.

Myron D. Lockwood: Elected vice president of Sperry Gyroscope Co. He joined the firm in 1945 as a project engineer and has been manager of the Surface Armament Division since 1957.

Robert G. Nunn, Jr.: Former assistant general counsel at NASA, appointed special assistant to NASA administrator **T. Keith Glennan.**

Dr. John H. Pearson: Appointed director of advance research planning for Allied Chemical's General Chemical Division.

Herbert L. Karsch: Former manager of Aerospace operations for General Motors Corp.'s Defense Systems Division, joins Ford Motor Co.'s Aeronutronic Division as manager of Space Technology Operations' Space Systems. He succeeds **Ralph P. Morgan,** named special assistant to **Dr. Donal B. Duncan,** general operations manager.

Lt. Gen. Charles B. Stone, III (USAF-ret.): Appointed a vice president of American Brake Shoe Co. and a group executive for the companies newly-formed Hydraulics Group. He will have overall responsibility for two divisions, Denison Engineering and Kellogg, and two subsidiaries, Raymond Atchley, Inc., and Hydel, Inc.

C. Edward Bold: Named manager-marketing operation for the General Electric Co.'s Special Programs Section. Was formerly manager-sales for the defense system-oriented section.

Stuart E. Weaver and **Harry B. Horne:** Elected vice presidents of The Marquardt Corp. Weaver, former vice-president, engineering, for Northrop Corp.'s Radioplane Div., will be in charge of marketing research; Horne will continue as director of corporate planning.

Thomas H. Mansfield: Former manager of Hughes Aircraft Co.'s Guidance and Controls Dept., appointed chief engineer at Servomechanisms/Inc.

Henry S. Loeber: Named sales manager to direct the marketing of Chester Cable Corp.'s products.

Milton Jennis: Formerly manager of manufacturing engineering of W. L. Maxson Corp., joins the Cross-Malaker Laboratories of Mountainside, N.J., as projects director.

Robert V. Schmidt: Former vice president of United Research Inc., appointed chief of Research Marketing for Northrop Corp.'s Norair Division.

Dr. Conrad L. Longmire: Former alternate division leader of the Theoretical Division of the Atomic Energy Commission's Los Alamos Scientific Laboratory, joins the staff of the Avco-Everett Research Laboratory. He will be engaged in research pertaining to ballistic missile defense.

Irwin Klugler: Joins Computer Systems, Information Technology Division of Lockheed Electronics Co. as a senior mathematician assigned to the Mathematical Analysis Dept. Was formerly with Technical Operations, Inc. involved in work on Project *Omega.*

Frank W. Lehan: Space Electroni Corp. received the annual IRE Profe sional Group on Space Electronics an Telemetry award in recognition of h "valuable contributions to space ele tronics and telemetry." The award, base on Lehan's work in phase-locked loo receivers and narrow-band informatio transmission systems, was made at rece PGSET Symposium.

Walter W. Kunde, Jr.: Former directo of engineering for Communication Acce sories Co., named chief engineer Hermetic Seal Transformer Co.'s Tex Components Division.

Edward J. Verity: Appointed manag of the marketing research department Garlock, Inc. Was formerly vice presider and general manager of Clayton Skif Inc., Toms River plant.

John K. Rondou: Former vice pres dent and general manager named pres dent and general manager of Comput Measurements Co., a division of Pacif Industries.

Earl J. Handly: Promoted to the newl created post of division planning manag for Raytheon Co.'s Industrial Componen Division. Was formerly market plannir manager for the division.

Norman Burstein: Former sales ma ager of Temperature Engineering Cor elected vice president-marketing.

Dr. Charles R. Kelly: Member of th professional staff of Dunlap and Asso ciates, Inc., appointed director of th corporation's experimental laboratory.

Gifford K. Johnson: Appointed exec tive vice president of Chance Vought Ai craft Inc. He has been with the compar for the past 10 years and was a key ma in the firm's recent diversification activ ties.

Jack H. Zillman: Elected vice pres dent of Consolidated Electrodynami Corp.'s data processing divisions, r sponsible for operations of Consolidated Datalab, DataTape, Transducer and Ele tro Mechanical Instruments. Was pr viously vice president and general ma ager of Daystrom, Inc.'s Pacific Divisio

—when and where

OCTOBER

th National Seminar of American Society for Industrial Security, Statler Hilton Hotel, Dallas, Oct. 3-5.

stitute of Radio Engineers, Professional Group on Communications Systems, Sixth National Communications Symposium, Utica, N.Y., Oct. 3-5.

E Annual Meeting of the Professional Group on Nuclear Science, "Solid State Radiation Detectors," co-sponsored by Oak Ridge National Lab., Gatlinburg, Tenn., Oct. 3-5.

th Conference on Radio Interference Reduction, Sponsors: Armour Research Foundation, U.S. Army, U.S. Navy, USAF, IRE Professional Group on Radio Frequency Interference, Chicago, Oct. 4-6.

efing Session on Opportunities in Space-Age Technology, American Management Association, Hotel Astor, New York City, Oct. 5-7.

merican Ceramic Society, Refractories Division, Bedford Springs Hotel, Bedford, Pa., Oct. 6-8.

Btish Institution of Radio Engineers, SW Section, Aviation Electronics and Its Industrial Applications, Bristol College of Science and Technology, Oct. 7-8.

AME Rubber and Plastics Conference, Lawrence Hotel, Erie, Pa., Oct. 9-12.

Ntional Electronics Conference and Exhibition, Hotel Sherman, Chicago, Oct. 10-12.

AS Human Factors and Bioastronautics Conference, Biltmore Hotel, Dayton, Ohio, Oct. 10-12.

Society of Automotive Engineers, National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Oct. 10-14.

IE/ASQC Reliability Training Conference, Southwest Area, Lake Texoma Lodge, Kingston, Okla., Oct. 10-15.

merican Vacuum Society, Seventh National Symposium, Cleveland-Sheraton Hotel, Cleveland, Oct. 12-14.

merican Ceramic Society, Glass Division, Bedford Springs Hotel, Bedford, Pa., Oct. 12-14.

merican Society for Quality Control, 15th Midwest Conference, Broadview Hotel, Wichita, Kan., Oct. 14-15.

Society for Photographic Scientists and Engineers, Revolution in High-Speed Processing, Oct. 14-15.

AME-ASLE Lubrication Conference, Statler-Hilton Hotel, Boston, Oct. 17-19.

Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Oct. 17-18.

42nd National Metal Exposition and Congress, Trade and Convention Center, Philadelphia, Oct. 17-21.

American Ceramic Society, 13th Pacific Coast Regional Meeting, Ambassador Hotel, Los Angeles, Oct. 18-21.

Conference on Hypervelocity Projection Techniques, University of Denver, Institute of the Aeronautical Sciences, Denver, Oct. 20-21.

ASME-American Society of Mining, Metallurgical and Petroleum Engineers, Fuels Conference, Daniel Boone Hotel, Charleston, W.Va., Oct. 24-25.

Medical and Biological Aspects of the Energies of Space Symposium, sponsored by USAF Aerospace Medical Center, (ATC) Granada Hotel, San Antonio, Tex. Oct. 24-26.

Sixth Annual IRE Electron Devices Meeting, Shoreham Hotel, Washington, D.C., Oct. 26-27.

NOVEMBER

First National Die Casting Exposition and Congress, Detroit Artillery Armory, Detroit, Nov. 8-11.

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

MISSILES AND ROCKETS, published every Monday with the exception of the last Monday in December at Harrisburg, Pennsylvania, for October 3, 1959.

1. The names and addresses of the publisher, executive editor, managing editor and business manager are: Publisher, Edward D. Muhlfeld, Washington, D.C.; Executive Editor, F. Clarke Newlon, Washington, D.C.; Managing Editor, William E. Howard, Washington, D.C.; Business Manager, Leonard A. Eiserer, Washington, DC.

2. The owner is: American Aviation Publications Inc., 1001 Vermont Ave., N.W., Washington 5, D.C. Stockholders owning 1% or more of total amount of stock: Wayne W. Parrish, Washington, D.C.; Leonard A. Eiserer, Washington, D.C.; Eric Bramley, Washington, D.C.; Jay Shuler, Springville, N.Y.; Robert R. Parrish, Chicago, Ill.; E. J. Stackpole, Harrisburg, Pa.; Fred S. Hunter, Washington, D.C.; A. H. Stackpole, Harrisburg, Pa.

3. The known bondholders, mortgagees, and other security holders owning or holding 1% or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholders or security holder appears upon the books of the company as trustees or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed through the mails or otherwise to paid subscribers during the 12 months preceding the date shown above was: 28,833.

LEONARD A. EISERER,
(Signature of business manager)

Sworn to and subscribed before me this 22nd, day of September 1960.

RETTA B. LUDDEKE,
Notary Public.
(My commission expires Nov. 14, 1962)

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editorial . . .

The Issue of Space and Defense:

How Long Must It Be Ignored?

THE OPEN LETTER on Page 10 of this issue asks that both candidates for President bring the space/defense issue out into the open; that they make known their views clearly and unequivocally.

The hour grows late. We strongly suggest that the second televised debate on October 7 is not too soon to start.

When the President made his speech at what has been called the "rump summit" at the United Nations last week, he must have been acutely conscious of his nation's weakness in defense and space exploration—two vital areas where Russia is strong.

This may explain why at certain points he was weak where he could have been strong and indecisive where he could have been sure.

Were he secure in our military strength and certain of its superiority, Mr. Eisenhower might have felt unembarrassed in leaving an opening for a reconciliation with the leader of the Soviets.

Were we not all wondering at just what moment the Russians will announce their next spectacular space triumph, he might have been more realistic in his proposals governing space.

The truth is that we are not strong enough in either area—defense or space conquest—to be forthright.

What is equally important, neither candidate seeking to be the next President has made these subjects an issue for the campaign and neither has clearly set forth his stand on them nor seems inclined to.

Mr. Kennedy has remarked vaguely that we must spend more money to build up our defenses.

Mr. Nixon seems to feel that if he doesn't mention the problem it will go away.

In his remarks at the U. N., Mr. Eisenhower made four proposals for space: that there should be no territorial claims to celestial bodies; no warlike activities on these bodies; that there should be no weapons of mass destruction permitted in space; that the U. N. should verify in advance all launchings.

The daily press referred to his remarks as declaring space "off limits" to the military. The effects of that are already apparent. Certain officials at NASA are now wary of admitting that they participate in explorations carried out by the military, fearful of Administration displeasure.

The truth is that just as missiles have become synonomous with defense, so has defense become forever linked with space.

Space has a strategic value beyond our present comprehension. Every indication points to the fact that the Russians understand this only too well. They are not concerned with weather forecasting, with reconnaissance (which they don't need) or with communications. They are concerned with getting man into space, man on the moon. These achievements have strategic value.

Our national goal has been "space for peaceful purposes."

We suggest that "freedom of space" would be a better goal.

Freedom of Space, like freedom of the seas, denotes regulation, security and equality of usage.

"Peaceful purpose" could mean what Khrushchev defines it to mean if his nation gets there first with enough strength to keep others out.

The world didn't get freedom of the seas by wishful thinking and we won't get freedom of space that way either. We'll get it by being strong enough to defend freedom there.

IF THIS DEFENSE of the freedom of space can be under the aegis of the United Nations, as it should be, that is fine. But who will provide the United Nations with the weapons and the space force necessary to do the policing? The Russians? Perish the thought.

This issue of defense and space is not remote and it should not be dealt with vaguely. It is an immediate problem. It may soon be a matter of survival.

Clarke Newlon

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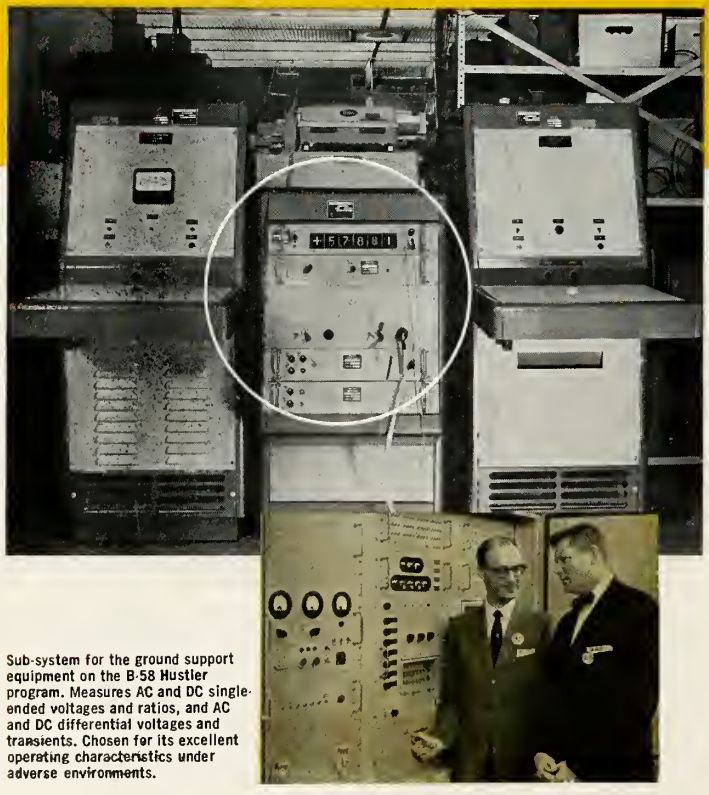

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