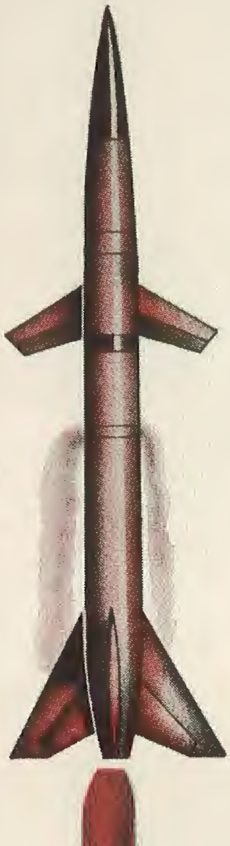
"Missile Away!"

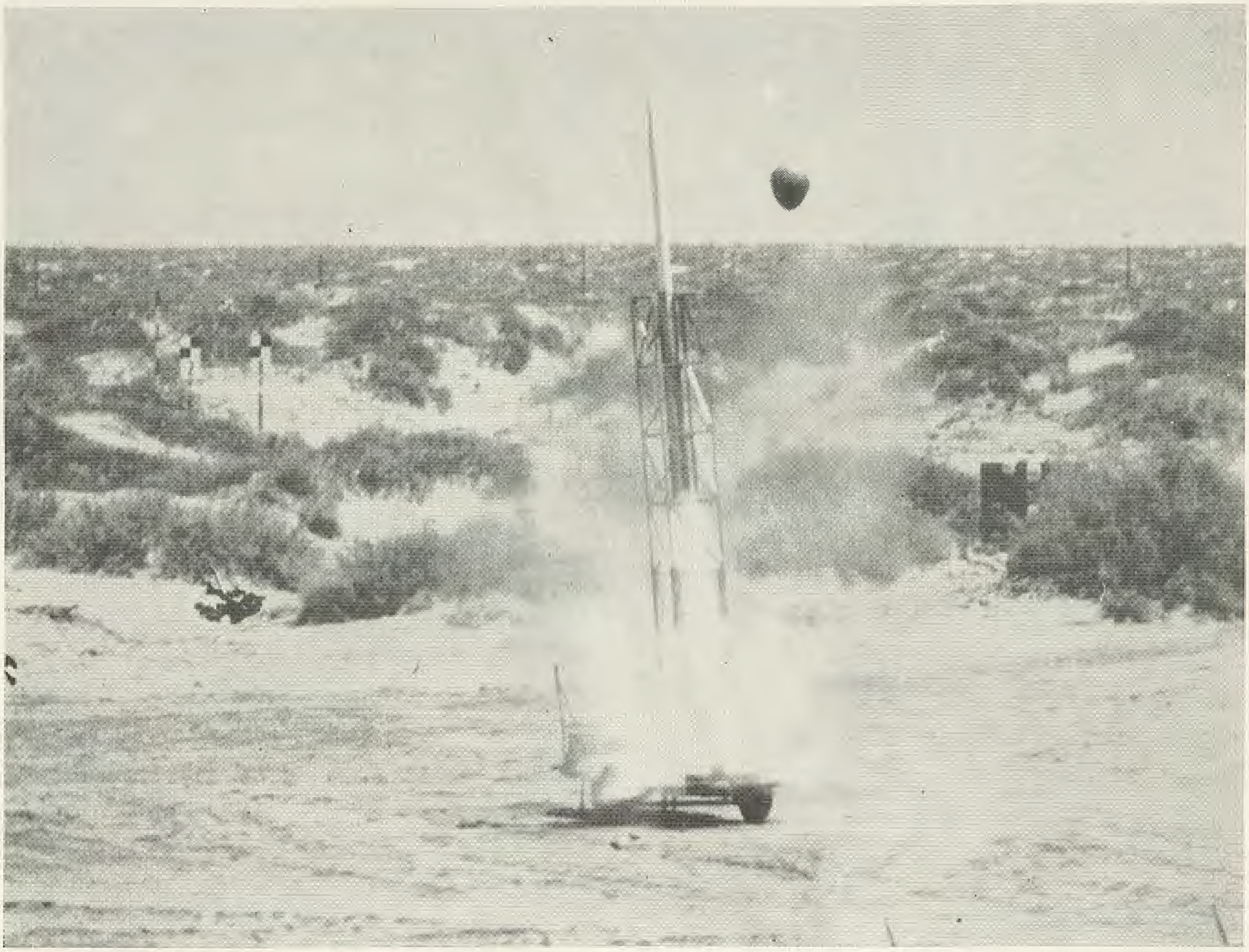
Vol. II, No. 2
SUMMER
1954

THE NEW MEXICO-WEST TEXAS SECTION
OF THE AMERICAN ROCKET SOCIETY



"HONEST JOHN"
(U. S. Army Photo)

"Adjacent to, and cooperating with White Sands Proving Ground"



Firing of POGO S/N-1 (above). Operation POGO represents a new approach to the problem of providing a target at high altitudes for surface-to-air missiles. Following the recent development POGO firings, their use as targets is expected to begin in the near future. This is one example of the services which PSL renders to the guided missile field.

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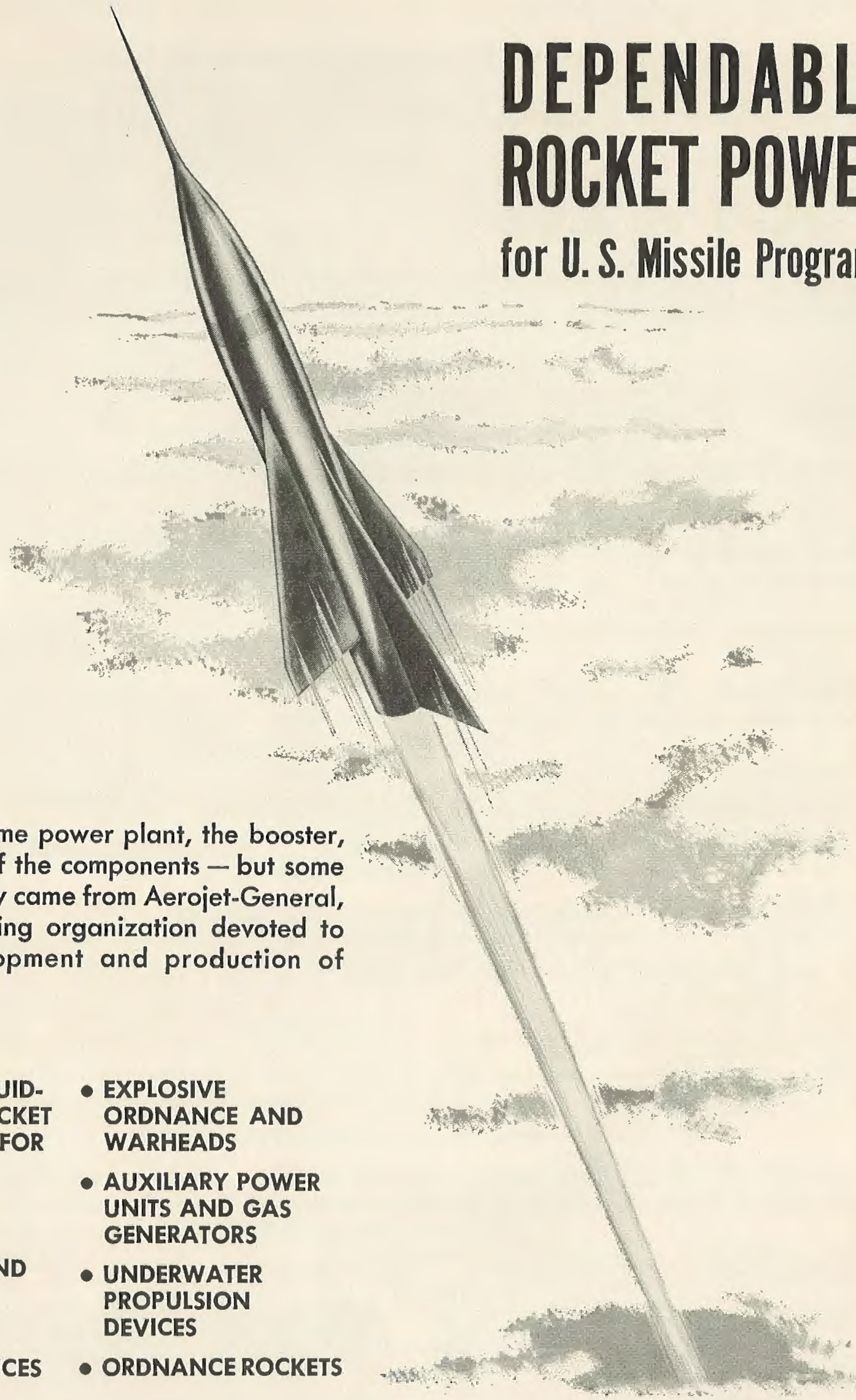

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THE GENERAL TIRE

"MISSILE AWAY!"

Vol. II, No. 2
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Editorial: the "garage gadgeteers"

BACK in 1895, the physicists laid down their pens, packed up their lab equipment, and solemnly announced to the world that all the mysteries of the Universe had been satisfactorily solved and explained, and that everything was in order.

Unfortunately, there were some people who didn't hear them say that. They went right on adding decimal places, so to speak, to what had already been done by working, for the most part, with their own facilities.

It wasn't very many years until several entirely new fields of scientific endeavor had been opened up by a group of amateurs. Along came obscure people with names like Wilbur and Orville Wright, Guglielmo Marconi, Lee De Forest, Albert Einstein, and Charles Proteus Steinmetz. And other people were playing around with spectra, weird elements that were unstable, and star-counts that were unusual. These people walked out of their private labs, their libraries and studies, and their basements, garages, and shops to demonstrate things that were formerly total impossibilities.

They are still doing it, by the way.

About a quarter of a century ago, the same sort of thing was going on in a field which concerns us all: rocketry. Who ever believed what that physics professor, Goddard, had to say? And who were those crazy fools who called themselves the "American Rocket Society"? Just a bunch of lunatics who were perfuming up the immediate neighborhood with noxious odors while causing fire hazards and disturbing the peace of a quiet Sunday afternoon!

They were amateurs, every one of them. An amateur, according to Webster, is one who cultivates a particular pursuit, study, or science from taste without pursuing it professionally. There are two kinds of amateurs, too. One type is illustrated by the crackpot who maintains that everybody else is all wrong and only he has the right answers if only the scientists would drop their stupid notions and accept his theories. There are plenty of those around.

But the second type of amateur is the one to watch. And that is the type of amateur we are talking about here.

As an experiment, subtract all the amateurs from the list of the World's Greatest Thinkers, Scientists, or What-have-you, and there is practically no list left. Every new field of science has been pioneered under amateur conditions. Mind you, the amateurs who did so relied heavily on the scientific results published by the professionals, but in a different manner than professionals.

How? What is different about the manner of approach? Why is it that a rank amateur can and very often does crack the toughest problem the professionals are faced with?

Perhaps the simplest answer is this:

The professional is a specialist, and he cannot easily escape his chosen path of reaction to a problem. He is bound by his specialty. He has, for example, accepted the post of research and development director of a large laboratory, and has thereby accepted what amounts to a social contract to use certain accepted methods based on certain accepted principles to achieve certain accepted end results.

The amateur, on the other hand, has no limitations which trap him. There are no pet theories which are absolutely necessary to him. He is free to explore at will. He doesn't cringe at the prospect of completely demolishing an accepted idea or method of doing something. He can start afresh. Again, we are speaking of the amateur who has the proper perspective on the problem, not the crackpot who maintains that the professionals are chowder-heads. The amateur whose work deserves to be watched is the one who says, in effect, "These professionals are no fools. They have the finest equipment available; they have lots of experience; and they've worked years on this problem which definitely merits a solution. I can't hope to compete with them, but I think there is a better way to attack the problem. Perhaps I can find a solution if I assume that their results have proved that their whole approach is impractical." And off he goes to try it. If the history of science give us any indication, his chances of solving the problem are pretty good.

Many fields of science have recognized the amateur, realizing that he is, in many instances, the path-finder who bulldozes ahead leaving the detailed investigation and mathematical theory behind for the professionals who will follow in his footsteps. These fields of science have recognized the need for low-accuracy, broad-scope investigation as well as high-accuracy, narrow-range work. They are supporting their amateurs instead of ignoring them. They realize that by lowering their sights and communicating their results to a semi-technical level they are encouraging more work in their fields.

We know of several radio hams who were amateurs and who are now as respected as the most learned Ph. D. We also know personally several astronomers who started as amateurs. And we're acquainted with hot-rodders, who are essentially amateur automotive engineers. And there are high-fidelity music enthusiasts and jack-leg electronics men with their wire and gear strewn all over their living rooms. And there are week-end photographers. And there are the innum-

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"GARAGE GADGETEERS" — con't.

erable tinkerers who continually come up with the multitudes of little gadgets which make our lives easier and more enjoyable. This list is endless.

Twenty-four years ago, the American Rocket Society was formed by a group of amateurs for experimentation and dissemination of the results of those experiments. Their successes, coupled with those of amateurs all over the world, enabled the Germans to bombard the living hell out of London and Antwerp. There was Doctor Goddard, the physics professor from Clark University. There was James Wyld, who developed the regeneratively-cooled rocket engine. There was Frank Pierce, a subway conductor with a Sears-Roebuck machine shop in his basement, who machined and assembled the first of the liquid propellant rocket engines fired by the A.R.S. and there were others, like Lovell Lawrence, John Shesta, and the two previously-mentioned men who built the first four-barrelled "Black Betsy" engine which powered an airplane at supersonic speeds.

This work forms the foundation of our jobs today. However, rocketry shows trends toward becoming a narrow-range science entirely. We have our own language which threatens to cut off our communication with the amateur level. A large percentage of the work is very expensive and can be accomplished only with the support of the government. There is no legalized, respected niche for the amateur rocketeer.

Yet, in spite of the difficulties, the garage gadgeteers are in there pitching. They have their own groups, their own firing ranges, three-stage missiles, monopropellant motors, and inexpensive ways of doing the things the professionals do. But remember, they are not primarily interested in accuracy as the professionals are.

In spite of this amateur activity all over the world, the A.R.S., perhaps fearful of damage suits resulting from accidents, no longer conducts experimentation. Somehow, that fell by the wayside, leaving our Society as a group of professionals who pass around information coded in terms of technical language and complex mathematics. Such a thing does not encourage the amateur rocketeer. It places a definite restriction on him. In effect, the Society is perhaps saying that the work of the amateur is no longer important.

Maybe it's time we of the A.R.S., returned to garage gadgeteering. Maybe there is some way experimentation can be carried on without leaving the Society open to liability. Perhaps some arrangement could be made for hobby insurance or group bond. Is this what President Andrew G. Haley had in mind when he proposed the group insurance idea to the National Board of Directors on February 1, 1954? The question of said insurance was tabled for discussion at a later meeting, and nothing further seems to have come of it. However, we'd like to hope that this was his intention. We are sure there is an agency—Lloyds' of London, for example—who would be willing to offer such insurance or bonding. Hobby insurance is available from many insurance corporations in this country. Most of us would not complain at all if part of our annual dues went toward this. Even if we were not engaged in the experimentation ourselves (which is certainly fun and which certainly improves our effectiveness professionally), it would be gratifying to know that we were lending our support to such a thing.

However, if the A.R.S. does not want to get back into experimentation again, we think it certainly should do something about monitoring and advising experimentation carried on by other groups, giving technical help where possible and setting up and enforcing rigid safety precautions which must be followed in any work with rockets. There is no doubt that stiff safety regulations will have to be followed and tight control exercised. But amateur rocketeering needs this if it is to keep from hurting its experimenters and the general public.

We'd like to draw a parallel here with other types of garage gadgeteering. At one time the hod rods were a menace on city streets and open highways. Young kids were being hurt and killed riding in hot cars. It did no good to try to keep people from building souped-up automobiles; they built them anyway because of the strong American trait which makes every man with a wrench or a hammer into a gadgeteer who wants to go faster or do a better job. What happened to the hot rodders, and why are they known today as some of the safest drivers on the American roads? They were recognized; state police and sheriffs offices provided them with tracks to race on, set up safety and technical regulations, and started exercising control over the hot rods by giving the gadgeteers a lawful channel through which their energies could be dissipated. Result: the hot rodders may crack the world's speed record at Bonneville salt flats soon.

The amateur rockets are flying today. They'll keep on flying. It seems to us that the A.R.S. can step in and fulfill a very civic and technical duty by carving a place for the amateur in its ranks. Maybe it's time we did this for a number of reasons:

1. It might substantially increase our membership.
2. It would provide us with new blood, eager to forge ahead on the problems we face.
3. It has a good chance of advancing the art of rocketry. While amateur experimentation may not solve the problems of today's rockets, it may open up entirely new or overlooked vistas and techniques. We may have unwittingly worked ourselves into a blind alley; this might be a good way to find out!
4. It would provide a safe channel for the outlet of the amateur energy.
5. It would serve to help bind rocketry together in an approach to a common goal.
6. It would heighten member interest and help convince the general public that rocketeers, both pro-

fessional and amateur, are not crackpots and wild-eyed mad-scientists, and would help dispel this belief forever.

Maybe we should put part of rocketry back into the hands of the experimenters where it made its amazing start. Maybe we should recognize the amateur for what he is: a man who tries to build the best possible bridge from What Is to What Should Be, not from What Is to What **Could** Be.

It seems rather strange to us that there are several rocket societies in this country. Why do people form other societies when one already exists? Could it be because **the** rocket society, the American Rocket Society, does not offer them what they want from a society? Is this one reason why student interest in the A.R.S. lags?

The other rocket societies carry on experimentation. Those that don't are interested in space flight. Have we in the A.R.S. neglected these two things; have we pushed them into the background, not giving them their proper perspective?

The Pacific Rocket Society flies missiles; the Reaction Research Society flies missiles; the Reaction Missile Research Society flies missiles; the Philadelphia Astronautical Society publishes a journal and has set up a Lunar Symposium; all are intensely interested in the commercial and space flight applications of the rocket. But why separate groups? Could the A.R.S. take a tip from these organizations insofar as space flight and backyard research goes?

These are merely questions we throw out for discussion. Many will feel that we should not expose the A.R.S. to the taint of amateurs; many will feel it is a long-needed thing.

But if those of us in the A.R.S.—and other professional rocketeers—ignore the amateur rocketeer, if we fail to listen to what he has to say, if we don't seriously consider his work and results, if we don't welcome him into our midst and our Society, if we don't give him impetus and encourage him, if we just sit back and say in effect, "X is true, and **only X can be true,**" we are taking the awful chance of missing out on becoming the first amateur astronauts or transport rocket men. We'll risk running competition with the dinosaurs and the Dodo bird for the greatest degree of extinction. —G. H. S.

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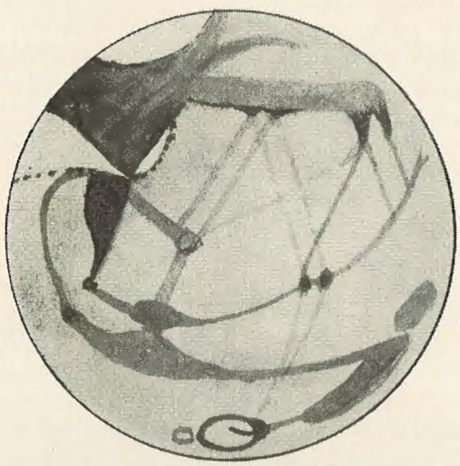
MARS



by

Prof. Clyde W. Tombaugh

Flight Determination Laboratory
White Sands Proving Ground, N. Mex.

Illustrations by the author and by W. J. Wagoner

Mars, one of the first worlds certainly to be visited by future rocketeers, is one of the most intriguing objects in the sky. So much may be seen on its surface, yet so little is known about it. One of the world's foremost astronomers gives some new concepts of the red planet in this timely article—an exclusive—based on his forthcoming book.

MUCH has been said, much more has been written, and theories and conjectures are without number; but the red planet, Mars, still remains one of the most mysterious and fascinating worlds in the sky. This year, as Mars swings to within 40-million miles of our home planet, Earth, astronomers the world over, both professional and amateur, will be watching it.

The planet Mars is an interesting little world to study. The author has had the privilege of watching this tiny globe through telescopes since 1918, and certain portions of the planet are perhaps better known to him than parts of the Earth.

In the telescope, a remarkable amount of detail can be seen if the observer has the patience and persistence to watch for the occasional flashes of good seeing which bring out the wealth of fine markings. Green areas are visible which undergo a seasonal change remarkably similar to the seasonal changes of vegetation here on Earth. These are best explained as regions covered with vegetation of a very hardy type, perhaps comparable to our lichens and mosses. Also, white areas are seen which undergo great changes. The polar caps experience slow, progressive shrinking with the coming of Martian summer, and are then observed to reform in Martian autumn by successive deposits of what may well be hoar-frost. Other white areas over the disc are very ephemeral in character, forming suddenly and disappearing rapidly—particularly near the morning and evening limbs in any Martian latitude. Some of these are thin deposits of hoar-frost on the ground; others are clouds suspended in the thin Martian atmosphere. On occasion, these clouds are seen to extend beyond the terminator (day-night boundary) or are even slightly detached from the sun-lit portion of the planet. Measurements indicate these clouds may be 10 to 17 miles above the surface. The caprices of Martian weather are most interesting to follow (as if our own weather were not freakish enough at times!) Pronounced changes have been seen to occur within twenty minutes of time. Five-eights of the Martian surface is reddish-ochre desert, the hue varying from light golden to reddish in different regions—undoubtedly the result of some type of geologic differences. There are no oceans on Mars; the only possibility of any free water on the planet is an observed narrow, bluish band surrounding the north polar cap during late Martian spring.

These details, of course, are better observed during oppositions—that is, when the planet is closest to us. But what is an opposition, and how often do they occur? And what causes them? Referring to the diagram (Fig. 1), the orbits of the Earth and Mars are shown as circles (in actuality, they are ellipses which are very close to circular). The orbits of Mercury and Venus, the two innermost planets, have been eliminated in the drawing for clarity. The progression of the Earth and Mars around their orbits causes the two planets to come close to each other—or in "opposition" from the sun in the solar system sky—every two years and two months on the average. This is the "synodic period" of Mars.

As can be seen from the drawing, when oppositions occur in February, Mars is in aphelion (farthest from the sun) and the minimum distance from Earth is 62-million miles. At these times, the disc of the planet subtends only 14 seconds of arc; in the February oppositions, we observe the seasonal phenomena attending the summer of Mars' northern hemisphere. When oppositions occur in August, Mars is in perihelion (closest to the sun), and the minimum distance is 35-million miles. At that time, the disc subtends 25 seconds of arc, and the spring and summer developments are better observed for the southern hemisphere than for the northern one. Such an opposition will

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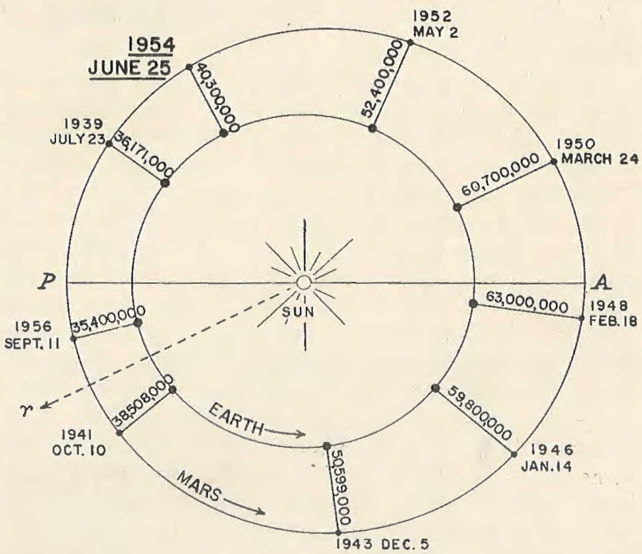
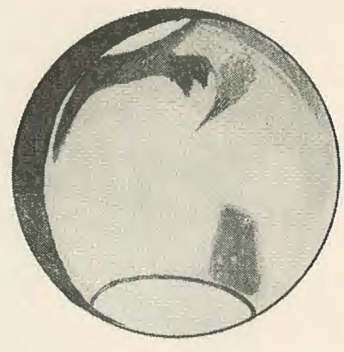


Fig. 1: The Oppositions of Mars (from Dr. R. S. Richardson).

Facing: Drawing made by the author April 8, 1950 (Mars date: July 4) showing the north polar cap (at bottom), double canals, and the Syrtis Major (dark patch at left) cut by a wedge of cloud.



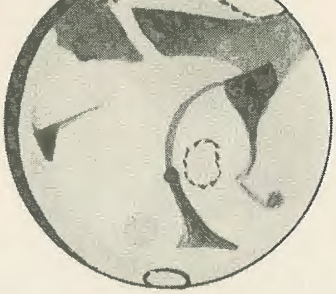
The usual and unusual appearance of the same area on the Martian surface. The drawing on the left was made on April 9, 1933 (Mars date: June 21). The shrunken north polar cap and surrounding blue band is half-concealed by the north polar mist which has engulfed the entire arctic region. The drawing on the right, made December 24, 1932 (Mars date: May 4) shows the north polar cap before there has been much shrinking in the chilly northern spring season. The Mare Acidalium (just above the north cap) is only moderately dark because the water vapor had not yet been released and the seasonal darkening had not yet set in.

occur in September of 1956. This year (1954), minimum distance occurs on July 2; the disc will subtend and angle of nearly 22 seconds of arc. Unfortunately, Mars will be extremely low in the southern sky for observers in our northern hemisphere. The markings on the disc will be blurred from our own atmospheric disturbances, and the planet will not be above the horizon for as many hours in the night.

On our July 2, it will be October 2 on Mars. The southern cap will then be fairly large, but only partially exposed to our view due to the tilt of the axis of Mars. But we will be able to observe a number of things which are due to the physical conditions on Mars.

It is these physical conditions which help make Mars the type of planet that it is, and we are intrigued with the idea of visiting this distant world which is so like—yet so unlike—our own home planet. The mean distance of Mars from the sun is 141 million miles—1.524 times more remote than the Earth. Moreover, its orbit is considerably more eccentric than the Earth's so that its distance from the sun varies from 128 million to 154 million miles in the course of its year. Accordingly, Mars receives from 1.9 to 2.7 times less solar energy than the Earth at these respective limits. The climate of Mars must therefore be inevitably colder—but not quite as cold as those figures would indicate, because the carbon dioxide content in its atmosphere is nearly double that of the Earth, and because the Martian daytime is nearly always clear. Thus, the available solar energy would be absorbed more efficiently. There are also signs that the Martian nights may be somewhat cloudy or hazy, thus holding in some of the daytime warmth. It so happens that the summer solstice of the Martian northern hemisphere occurs when Mars is farthest from the sun. Summer in the southern hemisphere occurs when the planet is at its closest approach to the sun. This important fact explains the considerable difference in the seasonal behavior of meteorological and vegetal phenomena in the two hemispheres. The temperature is only a few degrees above freezing at noon during the northern summer; this may permit free water to exist around the edge of the northern cap for several weeks under low atmospheric pressure. In Martian May, the north polar region hazes over so that one can only faintly see the dark blue band surrounding the white core. This haze dissipates in Martian June. This phenomenon around the north cap occurs every Martian year. In contrast, neither the bluish band nor the late spring haze is observed around the south polar cap in its late spring. Temperatures as high as 70 degrees F. have been measured in the sub-antarctic region of Mars during its perihelion summer, and the small amount of water would therefore evaporate more readily. Also, all of the real green and bluish maria are found in the southern hemisphere; the maria of the northern hemisphere are of much less areal extent and also less colorful, being mostly gray, black, and brown. Thus the vegetal ecology and meteorology is determined by the size, shape, and orientation of the orbit. The orbit also determines the length of the Martian year, which is equal to 687 of our days.

The size and mass of the planet are of great importance also because they determine the force of gravity at the surface, and, together with temperature, determine the planet's ability to retain gases of various molecular weights. This strongly affects the chemistry of life, meterology, and the whole pattern of geologic evolution of a planet. The diameter of the solid surface of Mars is 4215 miles, slightly over half that of the Earth, and only 1/20th that of Jupiter, the largest planet. Since Mars has no seas, it has as much land area subject to chemical weathering as the Earth, but only one-eighth the volume and one-tenth of the mass to supply the constituents of a secondary atmosphere from within, such as the volcanic activity which continually adds to the Earth's atmosphere.



Again, the usual and unusual appearance of an area. The usual appearance (left) was seen April 21, 1937 (Mars date: August 10). A round, whitish area is visible just to the lower left of the dark inverted triangle of the Syrtis Major, a common occurrence. The north polar cap is at minimum size. The right drawing however, made April 2, 1952 (Mars date: July 21), shows unusual developments. The nearly vertical dark strip with dark nodules (oases) just left of center is a very short-lived development and is infrequently seen. It coincides with the passage of water across this region. Further to the left is a large, pentagonal-shaped white area known as Elysium, which shows sharp demarcation of whitening by bounding canals and which is one of the best proofs of the reality of the canals. This also indicates that the canals are fracture lines in the Martian crust.

Lastly, there are two other factors of great physical importance: (1) the axis of rotation of Mars is inclined 24 degrees from the perpendicular to the plane of its orbit, a factor which gives an intensity of seasonal range very comparable to that of the Earth. However, the seasons are nearly twice as long because of Mars' longer year. (2) Mars rotates on its axis in 24 hours, 37 minutes, and 22 seconds. Consequently, nearly the same region is on the Martian disc at the same hour the following night if observed through a telescope. It requires 38 days for the entire longitude to pass in review across the central meridian of the disc. The length of the rotation period strongly affects the daily range in temperature and the ensuing meteorology. Since there are no great bodies of water on Mars, there would be no great differences in the specific heat of the substances of its surface to cause strong monsoon affects. There could only be weak monsoons between maria, desert, and polar caps. Because of this and the fact that it is a fairly rapidly rotating planet, Mars must be a world of simple, mild planetary winds.

Astronomers have seen and confirmed many types of finely detailed markings on the surface of the planet. These markings appear to run in fairly straight paths, intersecting at various points. The intersections are sometimes quite prominent as spots on the surface, and have been called "oases." The fine markings, known as canals, are fairly evenly distributed over the disc of the planet, cutting across maria and desert alike. The exact nature of the canals of Mars is essentially a mystery, and will probably remain as such until men set foot on the planet. However, the amount of free water which could conceivably be present on Mars does not indicate that these canals are filled with running water, as is the common interpretation.

Having studied the geology of the Earth and observed Mars for many years, the author has advanced what he considers a plausible theory to account for the canals of Mars. The lack of free water in the atmosphere which precludes any sort of water erosion to the extent known here, the proximity of the asteroid belt, and the apparent groupings and linearity of the canals has led to the theory that the canals are the result of the impact of large asteroids on the surface of Mars.

Considering the fact that we must now see Mars as it has been all during its lifetime due to the absence of oceans and erosion, the oases which are the intersections of canal systems are probably the impact points of large asteroids which have struck the planet with extremely high velocities, thereby cracking the planet's crust in much the same way as a pebble cracks the windshield of a car. As an experimental proof of this theory, the author spent a Sunday afternoon with his son's BB gun firing pellets at a thin glass globe filled with sand—a target which closely approximates the crust and interior conditions of the planet. The results of this experiment showed sunken areas at the intersection of crack systems, double canals, plateaus, and other general features observed on the geological surface of Mars.

Observational data confirms the fact that many of these canal intersections and oases on Mars are sunken areas. Clouds have been seen to form right up to the edge of sunken areas, the Syrtis Major area in particular and covering plateaus to their edges which are bordered by canals.

These sunken areas and the cracks of the canals would certainly provide a haven for simple forms of plant life able to withstand the extremes of the Mar-

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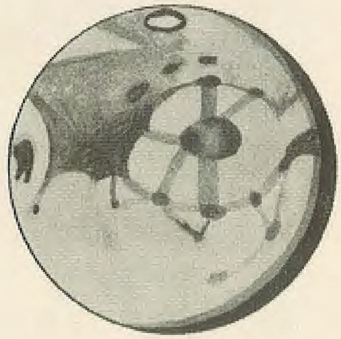


Drawing made November 2, 1941 (Mars date: Jan. 23) shows the south polar cap in perihelion summer and the prominent Solus Lacus region, nicknamed the "Eye of Mars". If the round, dark oases represent the impact depressions of asteroids in the past, then the Solus Lacus is the scar of the largest one to have hit the planet Mars.

tian climate. This vegetal growth probably accounts for the fact that we are able to see the canals at all, and why some canals are prone to disappear from view during certain Martian seasons.

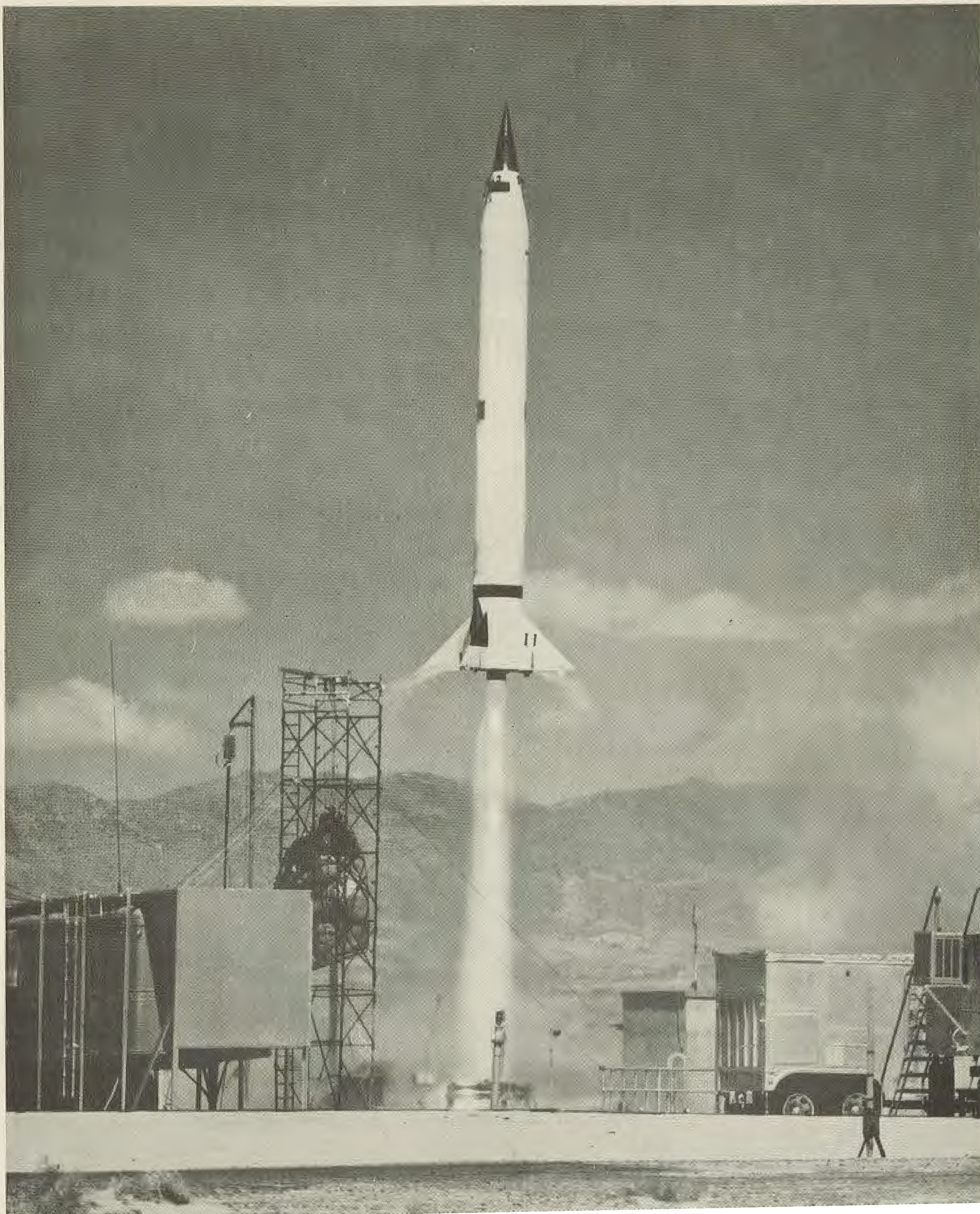
Although many of these facts can be deduced from observations of Mars from this planet, it may well be that the real answer to the mysteries which surround the planet Mars will only be solved by actually going there to see for ourselves. With Mars at its closeest approach of 35 million miles, the best telescopes here on the Earth can only hope to bring it effectively to within 50,000 miles of the observer. (700 power viewed under conditions of best seeing). A telescope mounted in or near a manned Earth satellite would not be affected by the shimmering unsteadiness of our atmosphere, but would still be restricted by optical limitations such that Mars could be brought to only about 15,000 miles. This, of course, is a great deal better than we can do today, and much can probably be learned. But for finding out just exactly what is on the surface of Mars, it appears we will have to go there. And that last 15,000 miles will be the hardest!

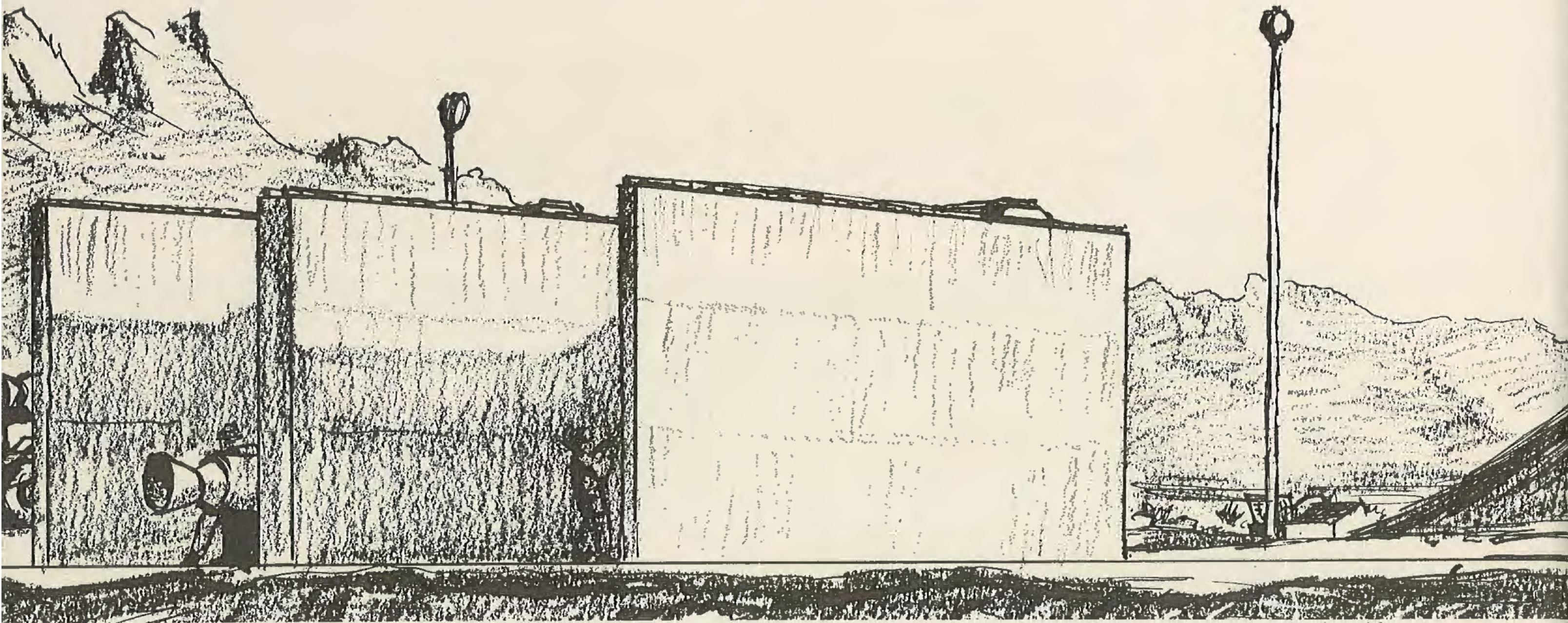
That is why many of the mysteries of this planet will probably be clarified by an actual voyage to the planet. At the present time, the rocket appears to be the only method which will allow mankind to set foot on the Martian deserts and learn at last what is there.

Why make a trip to Mars? If it is for no other reason than to satisfy mankind's innate curiosity about this strange planet, it might be amply justified. It would certainly be one of the finest achievements of the human race to be able to walk the surface of another world. But most important in the author's opinion, it would provide us with an entirely new philosophy concerning our Universe and would give us a different insight into the structure and meaning of life itself. What higher goal could we aspire to? ● ●

record breaker —

U. S. Navy's **Viking No. 11**, fired May 24, 1954 — Maximum altitude: 158 miles.
(U. S. Navy Photo)





the 300,000 lb. static test stand

By ALBERT T. FINNEY
(Operations Engineer, D300K, WSPG)

A new bastion of concrete joins the ranks of rocket engine test stands at White Sands Proving Grounds, but the D300K is just a little different . . . and considerably more versatile!

ANILINE-RFNA, Alcohol-Lox. These and many others are names which catch the attention of scientists and engineers who search for fuels which will propel tomorrow's ballistic rockets on their courses through the upper atmosphere. An especially warm topic of discussion and conjecture is the fire-breathing combination which will finally transport man to the moon and beyond.

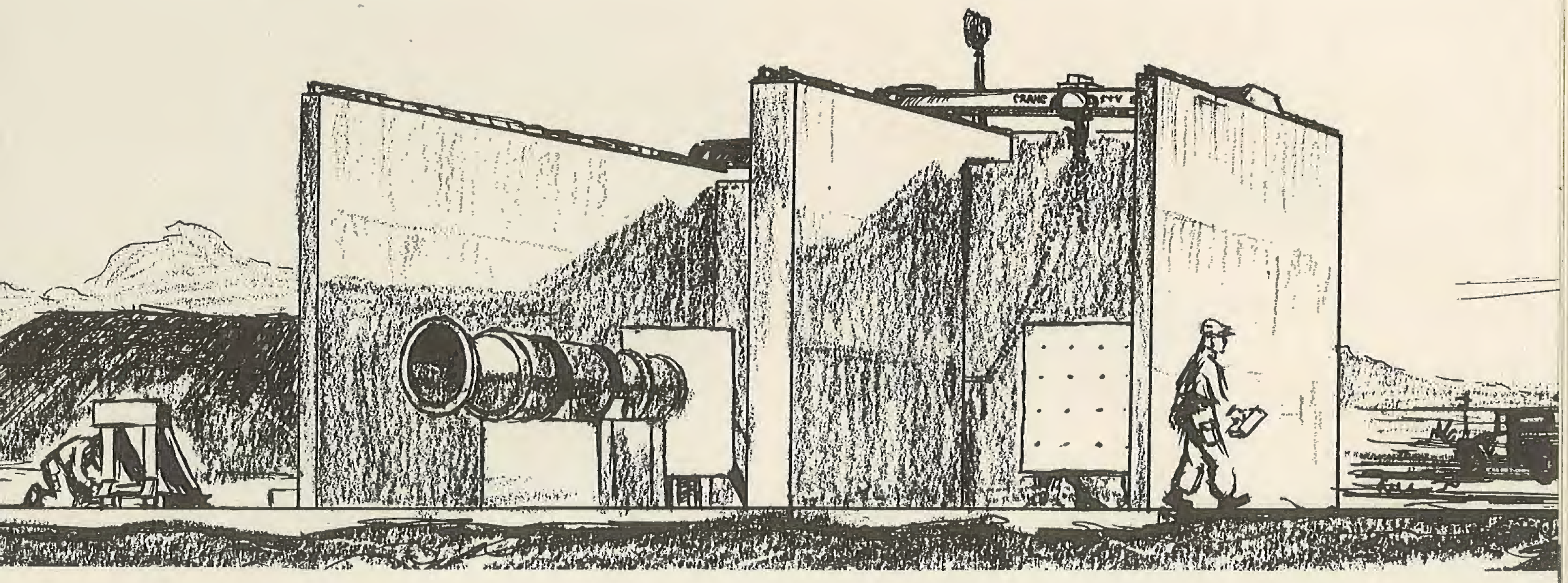
It's a good bet that when the first spaceman does set foot on some Lunar prominence, a liquid fuel will have provided the "go" to make the trip possible, but it's an equally good wager that a solid propellant motor will lend its terrific punch in the initial stages of the journey to push the traveller to escape velocity.

At WSPG, solid propellant motors have been making their presence felt daily in the complex testing of a variety of missile systems. Until very recently, howver, the solid propellant rocket had no counterpart of concrete and steel to match the intricate piles of masonry in which liquid motors are static-tested as a part of the Proving Ground mission. Recognizing the need for static testing of solid motors, WSPG planners initiated action in 1952 for the design and construction of a large multi-celled Solid Propellant Test Area. Actual construction of the facility began in mid-1953 with official acceptance of the facility by the Proving Ground taking place in January, 1954. Thus began the promising and versatile career of the Dual 300,000 lb. Static Test Facility, or—as commonly abbreviated—the D300K.

In relation to the geography of WSPG, the D300K is located two miles southeast of the main cantonment approximately 1,000 feet off the desert road. Unlike its neighbors, the 500K and 100K test stands, the 300K facility cannot be distinguished by tall steel superstructures, since solid propellant static shoots are commonly conducted in the horizontal plane. For this reason, the area as viewed from passing vehicles will appear to be nothing more than an inconspicuous collection of concrete walls; this is the case until the ten second siren announces, with a coyote-like wail, that a firing is emminent. The ear-splitting blast which follows then removes all doubt as to the nature of the activity within.

Although the official nomenclature of the 300K contains the word "dual", this only covers part of the distance in describing the varied nature of the facility. Actually, the test area proper is sub-divided into five separate test sites. Four of these are conventional type bays enclosed on three sides by reinforced concrete walls approximately 12 feet high. The fifth test area is an open concrete pad whereon boosters and rocket motors are subjected to a miscellany of hair-raising experiments such as penetration by rifle and machine gun bullets, and prolonged exposure to extremes of temperature.

Although the center pad at the 300K is the site of the more glamorous experimentation, most of the routine day-by-day test operations will be conducted in the four test cells, the two largest of which are rated at 300,000 lbs. of thrust or higher, far above the power producing capacity of any boosters now in use by the Ordnance Corps. This structure is principally dependent for its strength upon the rugged thrust



superstructure which extends down through the floor of the bay to a depth of four feet where it is attached to a large concrete thrust block.

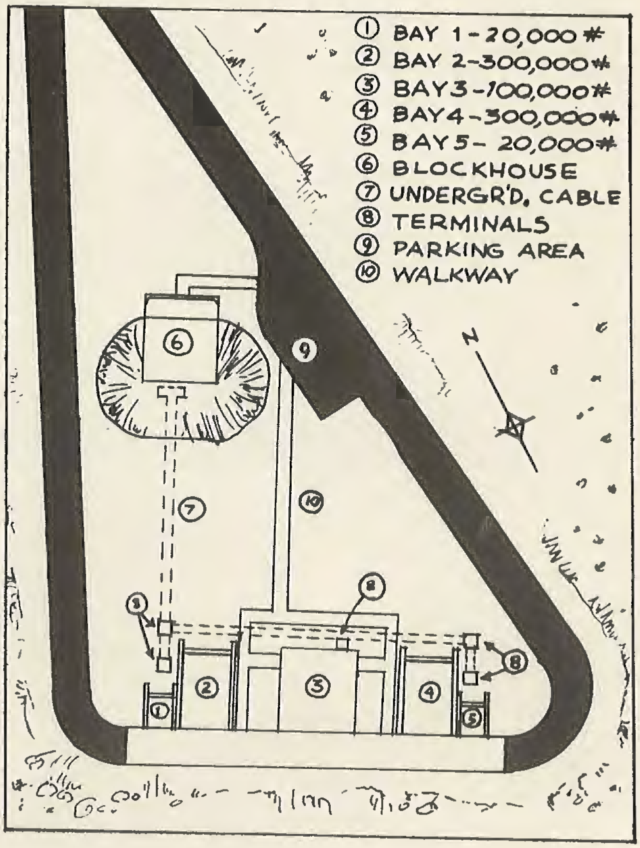
For testing of boosters in lower ranges of thrust, two smaller bays are available, each of these boasting a steel superstructure capable of withstanding 20,000 lbs. of force. In the event that an unusual type of mount is desired, these superstructures are designed for quick removal and replacement by any alternate structure desired.

Hub of all activity at the 300K is the large blockhouse which is enclosed by 12 inch walls and ceiling of reinforced concrete. In addition, an earth barricade extends around the structure on three sides and also covers the top. All of the recording instruments which are employed in gathering such data as thrust, pressure, burning rate, and chamber temperature, are mounted in the spacious blockhouse control room. Running the length and width of the control room are a number of covered cableways which bear conduit from the main cable trench to various points in the control system. Slightly smaller than a midget auto track, the underground cable trench is one of the more striking features of the installation. Approximately 4½ feet high and 3 feet wide, the trench extends underground from the control room to each of the test pads.

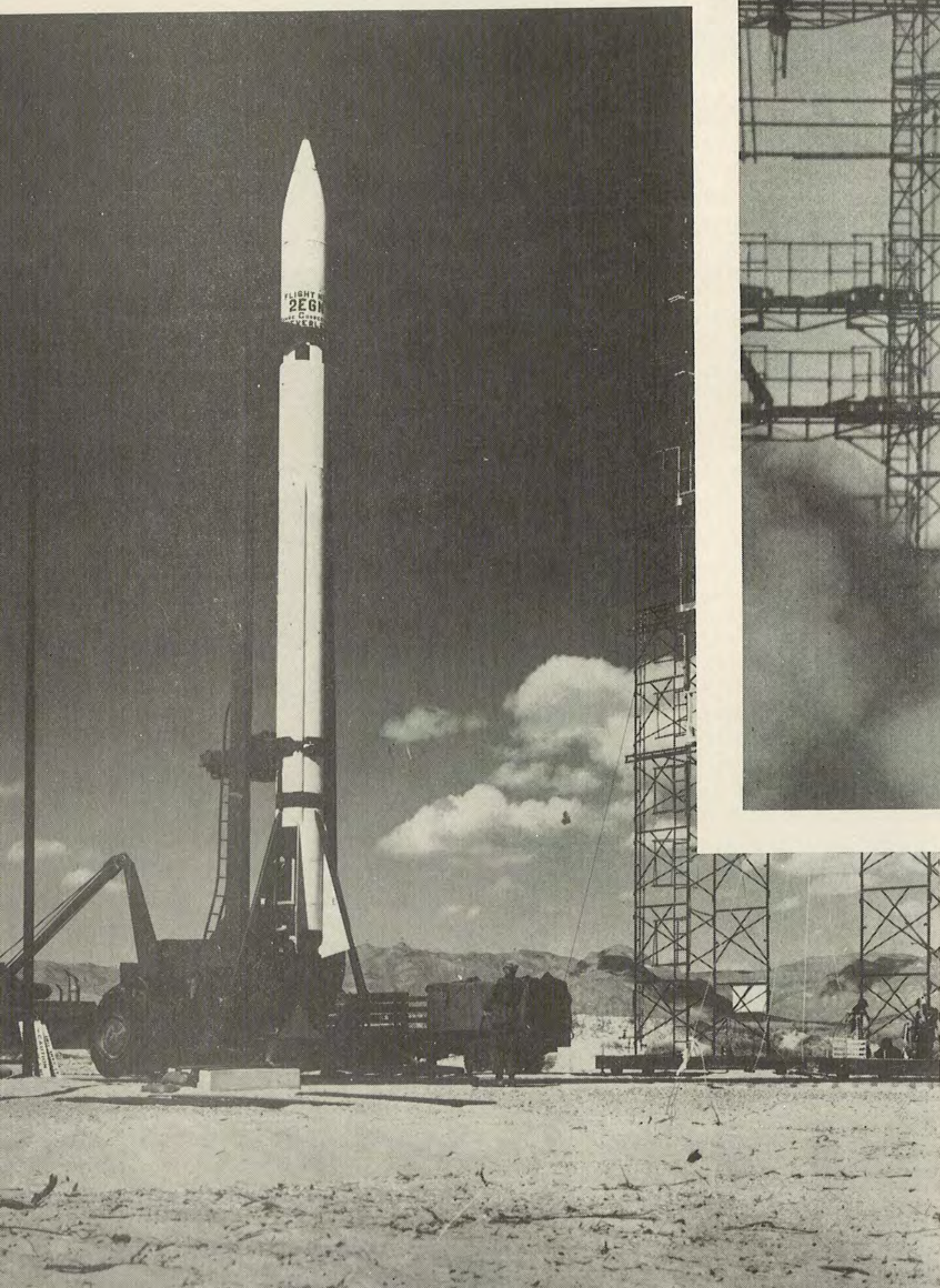
Current planning calls for a number of control and instrumentation inovations which will be employed at the 300K. Among these are an automatic data reduction system as well as a television monitoring rig which will permit complete visual observation of the test pits and adjoining area. The latter is necessary since the blockhouse permits no vision of the test area for occupants of the control room.

Slightly apart from the field of solid propellants is the Drone Engine Evaluation Program which is currently being conducted in one of the 20,000 lb. test cells. Daily, 75 horsepower motors disturb the peace on a special static runup stand as trained mechanics measure performance parameters and scrutinize each engine for any telltale symptoms which indicate that an overhaul is in order. The versatility of the facility and crew in conducting testing over a range of separate fields is amply demonstrated in this program.

In future operations, it is expected that the D300K will play host to many of the giant solid propellant units which are now on the drafting boards and which will strain the thrust absorbing capacity of the stand to its maximum; thus, with the blast of rocket motors mingled with the whine of air engines, WSPG's newest static test facility promises to rate high in future output of both work and noise.



"Missile Away!"



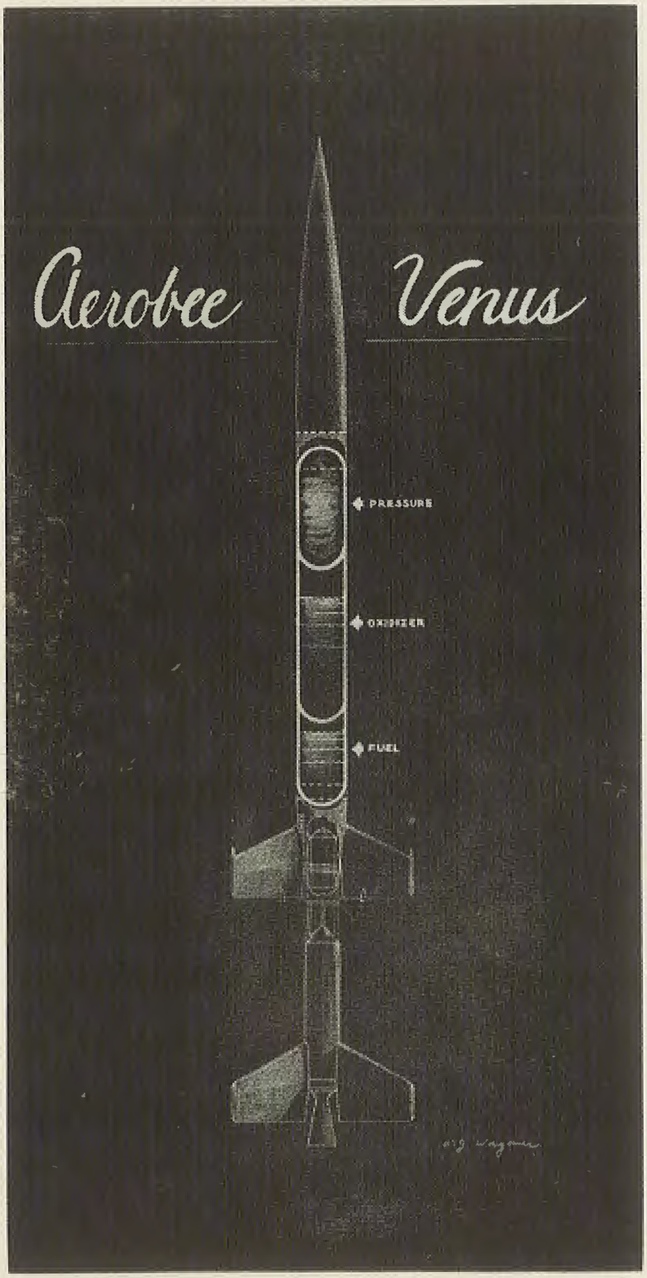
presents:

the CORPORAL

STRUCTURES

By ROBERT L. NATHAN

Propulsion, guidance, propellants, payload . . . all are well-known factors of rocketry. But a rocket will go nowhere at all if its airframe or structure is neglected. Here, then, are the basic elements of rocket structures.



THE structural design philosophy of a rocket powered guided missile is primarily determined by the mission to be accomplished by the vehicle. The body design is influenced by such requirements as aerodynamic smoothness, warhead effect desired, range, speed, and the packaging of instruments, controls, electronics and propulsion system. The present philosophy dictates that the airframe be built around the propulsion system. If the design is to incorporate fins and/or wings for stability and control, it is advantageous to obtain maximum smoothness and minimum aerodynamic thickness in these surfaces.

The entire structure must be sufficiently strong to withstand the tremendous "g" forces which may be encountered during flight. Because of the limitations of practical size and existing propulsion systems, it is generally true that the smaller the missile, the larger the stresses to be met. A small, rapidly accelerating vehicle may pull 25 or more "g's" through its longitudinal axis during take-off and, if it is a tracking-type missile, violent maneuvering will effect large forces through all axes.

Another point to be considered in the design: the structural components should be such that they will lend themselves to the speed and ease of economical mass production. While economy is desirable, it sometimes is necessary to sacrifice it in favor of weight saving advantages and simplified and rapid production techniques.

Some of the methods used to obtain the desired structural and light weight characteristics in present missile configurations are:

1. The use of integral propellant tanks where the tank performs a dual function: tank walls and structural skin.
2. Mounting integral tanks end to end or separating them with simple truss and ring structures. When the latter method is used, electronics, guidance, or control packages may be mounted between the tanks and the section covered with non-stressed panels which may be used for equipment access.
3. Stressed skin construction with lightweight frames which eliminates the added weight of numerous bulkheads.

4. Cast or forged sections for ogival or more complicated geometrical shapes.
5. The addition of necessary internal or external tunnels for carrying electrical or propellant lines may be used to add body rigidity.
6. External airfoils may be manufactured by machining forged or cast shapes or by applying a metal skin to a lightweight, cast, internal former. In the case of symmetrical airfoils, it is possible to use extruded sections.
7. The use of light weight substitutes for metal parts. (One manufacturer has fabricated fiberglass pressure vessels which offer a considerable weight saving).

Where strong, light materials are needed, corrosion-resistant metals must also be considered due to the chemical action of some rocket propellants. Aluminum and aluminum alloys will serve in some cases, but stainless steel must be used where more strength or different corrosion-resistant properties are required. However, as stainless steel is one of our more critical materials, development of a suitable replacement is being sought. Not only are stronger and lighter materials needed, but there is also a necessity for materials which will withstand the very high body temperatures due to aerodynamic heating encountered at Mach numbers above 2. Aluminum and magnesium alloys cannot perform efficiently in a structure at temperatures in excess of 350°F. Steel alloys will withstand elevated temperatures, but these materials are heavy and difficult to incorporate into an efficient structure. Titanium and its alloys are capable of operating efficiently at temperatures of 400°F to 650°F and show promise in their alloy developments of increasing this range, possibly to 1000°F.

As a typical example of how a missile is constructed, the Aerobee sounding rocket may be used. This missile is a free flight, fixed-fin-stabilized, research test vehicle, powered by a helium pressurized liquid propellant rocket motor. Initial guidance is provided by a vertical tower from which the rocket is launched by a Jato booster rocket.

The major components of this vehicle are: the nose assembly, the tank assembly, the tail cone assembly, the motor and the fin assemblies.

The nose consists of a spun aluminum shell provided with a removable nose tip fitting and an aft ring fitting for attachment to the tank assembly. The nose not only furnishes an aerodynamic frontal shape for the vehicle, but also serves to house a 150-pound payload in an essentially airtight compartment. The weight of the payload is supported by a casting at the forward end of the tank assembly. This permits the nose skin to be designed primarily for aerodynamic loads.

The tank assembly is an integrally-welded unit consisting of the pressure, oxidizer, and fuel tanks. Included in the assembly are the associated plumbing

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GUIDED MISSILE STRUCTURES . . .

lines, launching rail riding lugs, and other accessories. The tank shell is the outer surface of the sounding rocket. No fairings are utilized; however, the circumferentially-welded joints are covered with tape for aerodynamic smoothness when necessary. The pressure tank is cylindrical in shape. It is of welded stainless steel construction throughout. The oxidizer tank is cylindrical with an elliptical aft head. The aft head of the pressure tank serves as the forward head of the oxidizer tank when they are welded together. The fuel tank is similar to the oxidizer tank, with the aft head of the oxidizer tank serving as the forward head of the fuel tank.

A skirt is welded to the forward end of the pressure tank to house plumbing and to provide an attachment point for the nose cone.

Three fins are provided to stabilize the missile during flight after it has left the 140-foot tower. These fasten to the tail cone assembly by means of screws and attachment fittings.

The tail structure assembly is attached to the aft end of the tank assembly and provides for the attachment of fins as well as for transmittal of the booster-rocket thrust to the vehicle.

The Jato booster rocket is mated to the sounding rocket by a thrust structure attached to the forward end of the Jato unit. This structure incorporates a conical section for deflecting the sustainer-system exhaust flame away from the booster rocket during the boost phase. Three legs, to which the thrust ring is attached, are welded to the conical section. The thrust ring incorporates three guide pins which engage sockets in the vehicle tail structure. Three fins are mounted on the booster in line with the sounding rocket fins.

Although the Aerobee's structure is simple, it serves as an example of the general type of airframe utilized with the majority of sounding rockets and ballistic missiles. Details on airframes for other types of rockets and missiles are under the wraps of military security and, for the most part, cannot be discussed publicly.

However, technical people and research men working in the field of aircraft and missile structures are well aware of the tremendous problems which will be introduced in the realm of high-supersonic and hypersonic flight. A revolution in structural materials, design methods, and construction is in the offing. Temperatures in excess of 3000°F. will be encountered in the foreseeable future, and research is presently going on regarding feasible methods of cooling, thermal shock resistance, and many others. But the airframes specialist and the structural engineer are working hand-in-hand with other scientists in the rocket, guided missile, and aircraft industry, work which will allow man and his devices to fly higher, faster, and further. ●

CRASH survival

by

LT. COL. JOHN P. STAPP, U.S.A.F.

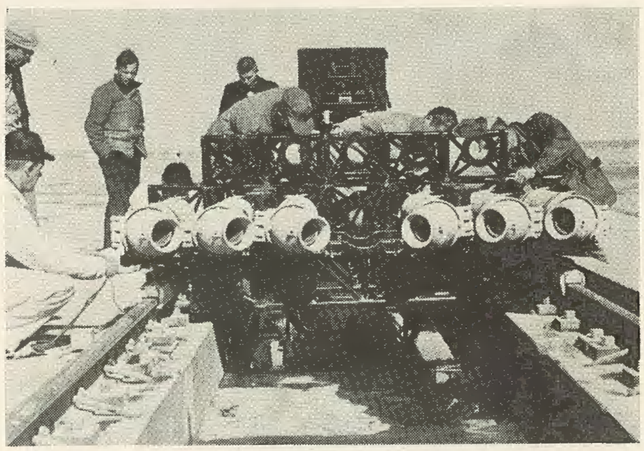
The pioneer work done by Lt. Col. Stapp in the field of crash survival has shown some interesting things. But once the tolerances of a human being to acceleration, jolt, impact, and wind blast have finally been determined, it will have been done once and for all. After all, there will be no new model to test for a long, long time!

ALTHOUGH the discussion of horizontal linear decelerations seems 90° out of phase and in the reverse direction to the aims of the American Rocket Society, the basic problem of human tolerance to linear forces remain the same, whether it involves a rocket take off to outer space or survival of a crash.

The subject of "Crash Survival" is one which is presently of interest to the pilots and passengers of high-speed aircraft which have been developed since the last world war; but conversely it will be of extreme importance to those who in the future must survive extreme acceleration at the initiation of prospective interplanetary travel.

Ever since the advent of fairly high-speed mechanical forms of conveyance, an atmosphere of awe has shrouded accidents which have occurred to occupants of these vehicles. This awe was prompted by incidents wherein the accidents were identical, but the injuries were so diverse as to leave one completely uninjured and another a fatality.

From even a cursory investigation, it was apparent that a pattern must exist which could permit survival to one and death to another. At Edwards Air Force Base after the late war and with the cooperation of the Northrup Aircraft Company, a 1500 ft. track was laid along which a rocket-propelled sled could move under controlled conditions of deceleration. Through the use of this sled it was anticipated, and rightly so, that a true picture could be thereby shown of exactly what happens to the human being when restrained by a safety belt in an aircraft in conditions of a crash landing. The sled, propelled by rocket motors, reached a speed of some 250 miles an hour and would coast for a fraction of a second after burn out—finally entering a series of mechanical brakes which could be applied in a multitude of patterns.



The world's fastest moving ground object. Riding this test sled, Col. Stapp reached 421 mph. Only six of the possible twelve rockets are shown mounted in the photo of the rear of the sled.
(U. S. AIR FORCE Photo)

With these brakes impeding the travel of the sled in terms of "G's" of deceleration, the occupant of the sled rode in one of four positions: seated with back to direction of travel, seated facing direction of travel, lying prone with head toward direction of travel, and lying prone with feet toward direction of travel. Results clearly showed that with the proper restraining

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CRASH SURVIVAL — con't.

harness the optimum for passengers would be the backward facing seated position with reference to direction of travel. However, the highest experimental deceleration was experienced by a human subject seated facing forward, who sustained over 45 G's for a duration of one-fourth of one second. This would be equivalent to driving an automobile at 150 miles an hour and stopping at a distance of 19 feet. The subject was restrained by 8000 lbs.-test nylon webbing straps arranged in the configuration of two shoulder straps, a lap belt and an inverted "V" tiedown strap to keep the shoulder straps from pulling up the lap belt.

Further experimentation of crash survival has been carried out at Holloman Air Force Base with a much larger sled powered by higher thrust rockets and employing an arresting system using a water trough between the rails where water is caught by a scoop and thrown to either one side of the sled or directly ahead of it. Dams of a light material along the water-way present a variance of the level of water which produces a pattern of arresting force that is controllable.

The 180-degree reversal of the direction of the flow in the water scoop produces the maximum in the arresting force, and the 90-degree deviation of the water flow produces the minimum arresting force.

With this sled, speeds approaching sonic have been obtained, and the effects on its occupants of the opening of the canopy of high speed aircraft has been investigated. This sled also has been useful in determining the effect of jettisoning personel from aircraft into high speed air streams prior to parachute opening.

In the main, it was found in all experiments that if the human body be properly restrained by a harness and all parts of it free from striking any objects, it is capable of surviving forces of acceleration far in excess of the stress analysis of any aircraft structure presently made by man.

In other words, crash survival, or the survival of a highly accelerated take-off, does not depend upon the human body's ability to withstand the force applied, but upon its ability to withstand the mangling effects of the device which is housing him as it is destroyed by these same forces.

Therefore, the problem has been relegated from the field of human mechanics to the field of structural mechanics. Man can withstand so much more acceleration than the mechanical devices in which he travels that there is indeed a great distance to be spanned in the improvement in aircraft structural design before he need worry about his own physical ability to keep up with the advancement of transportation.

LETTERS *to the Editors*

NOTE: With the inception of this feature in "Missile Away!" it is our intention to publish important and pertinent correspondence relative to editorials, policies, articles, and other features of the magazine. If you, as readers, wish to comment on the contents of this magazine, we urge you to do so, especially regarding the editorials. It is our desire to be absolutely fair by publishing both sides of arguments and questions. If you don't like what you see in this magazine, please let us know.—THE EDITORS.

* * *

Dept. of Aeronautical Engineering
Forrestal Research Center
Princeton University
Princeton, New Jersey
April 8, 1954

Dear Mr. Stine:

Several reasons motivate me to write to you. First, I wish to congratulate you and your staff on the superb makeup and content of the March 1954 issue of Missile Away. It is the first issue I have seen, and it is an excellent one.

Second, I would like to have your permission to give wider circulation to the amusing set of definitions under "Misfires" by reprinting the particular page in JET PROPULSION, with an appropriate credit line, of course. Please let me know as soon as possible. Actually, I have released it for the May-June issue, but I can stop its appearance any time before April 19.

My next comments pertain to your editorial. I think it is a mistake to insist that, as far as you are concerned, the name of the Journal will never be JET PROPULSION. Please remember that the new name is now entered in the Patent Office, it is registered with the Post Office, it is catalogued by public and private libraries, and it is referenced in technical papers. With respect to technical papers that may be offered for publication in JET PROPULSION, all references to papers that appear after January 1, 1954 **must** carry the new name. If such papers are now being prepared by authors who are members of your section, please advise them that no deviations are allowed from this ruling. We must have consistency in the referencing of technical publications. With respect to papers that may be offered to other periodicals, papers over which we have no control as to format, we can only ask for your cooperation.

I would like to add some comments on the rocket versus jet argument to which you devoted the largest part of your editorial. The views which follow are my own, but I believe they are not far from the views of most of the members of the National Board of Directors.

1. The ARS does not intend to confine itself to the propulsion field, as your editorial implies. It welcomes the efforts of its members to introduce more papers and lectures on pertinent aspects of guidance, control, flight instrumentation, field testing, airframes, aviation and space medicine, aerodynamics, etc., into the programs of national and section meetings and into the Journal. The present Editor-in-Chief of the Journal has taken this position officially by the statement of scope published at the front of each issue of the Journal. A breakdown of the papers published in the last two years will confirm this. The present Program Chairman has vigorously solicited papers on these non-propulsion subjects and will continue to do so. The Executive Secretary has been making strong efforts to attract membership from the electronics and instrumentation fields as a positive step in the desired direction.
2. The ARS is not willing to assert the unqualified superiority of the rocket guided missile over the ramjet guided missile, or even over the turbojet guided missile. Your editorial leads one to believe that the only worthwhile guided missile is a rocket-propelled one. Maybe so, and as individuals some of us may agree with you. But, as a Society we do not intend to adopt so partisan a position. Moreover, in our attempt to emphasize more strongly the subjects of guidance, control, field testing, etc., it is not easy to distinguish in these respects between the ramjet missile or turbojet missile and the rocket missile. We propose to accept all types on an equal footing.
3. The ARS does not hold the official view that its principal goal is the achievement of space flight, nor does it wish to channel all its technical meetings and its publications in that single direction. This is an important goal, but only one of the goals of the Society. The Officers and Directors of the Society have decided to respect the view of the space flight enthusiasts, but to give equal respect to the views of those who joined the Society in order to promote the development of jet propulsion for more immediate purposes and who feel that space flight is far from being just around the corner.
4. The ARS refuses to assert that the ramjet is useless for space flight. There is one school of thought, represented by a paper that appeared recently in the Journal, that believes the ramjet may eventually be superior to the rocket in the initial phase

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of the thrust program of a space vehicle. Still other possibilities may develop in the future for the utilization of ramjets in space vehicles. The ARS leadership feels that it cannot perceive so far into the future as to make a ruling on this question. If the New Mexico-West Texas Section feels that it is able to make a definite decision on this question, we of the National Office will respect its views but we have no authority to adopt them in the name of the whole Society.

5. The National Officers and Directors deplore the mention of civil wars or states' rights in your editorial in connection with the above issues. We feel that this is a democratically operated Society and that there are constitutional procedures for making your views effective. If you can persuade enough of the national membership that space flight is our principal goal and that the rocket is the only power plant to use for the purpose, then it can be written into the By-Laws of the Society. We think that no useful purpose is served by talk of civil war. The National Office is faced with very difficult problems of raising funds, increasing membership, and augmenting the services of the Society to its members. This is the only "war" to which we would like to devote our energies.

Sincerely yours,
Martin Summerfield,
Editor-in-Chief

April 12, 1954

Dear Mr. Stine:

I was very much interested and pleased with your editorial in the March issue of "Missile Away!" on "Whither Now, Rocketeers?" It seems to me you have very ably outlined the particular organizational problem of the Rocket Society as it now stands, and have done it with much insight.

I am calling the editorial to the attention of the editor of Jet Propulsion, with the suggestion that he might wish to reprint it in that publication.

Yours sincerely,
/s/ G. Edward Pendray

Dear Harry:

Let me add my congratulations to those which I know you have already received on the March issue of "Missile Away". It's a fine job and a very high precedent for the other Sections to emulate. I know a lot of work went into it, but I know that you are proud of the result.

I would like to add a few comments on your editorial. I'll be just as blunt as you were. I hardly think that the alleged split in factions, which you mention, exists to the degree which you intimate. ARS is concerned with the entire field of jet propulsion including air-breathing engines, but it is most certainly also concerned with guidance, control, radar, environmental testing, geophysics of the upper atmosphere, space medicine and all other related subjects. I personally have spent the last three months calling principally on manufacturers of guidance and control equipment in order to reinforce our membership in that area and, I might add, have used the forthcoming meeting at W.S.P.G. as a major illustration of our scope.

I want to clear up one other point: The "query card" on circulation which you mention is categorized according to the standard Audit Bureau of Circulations classification. "Missiles" and "rockets" are classified under aircraft.

As far as your criticisms of the National Office go, my suggestion is that you continue to make them as you wish—although your quotation of the Cleveland-Akron Section was a bit unfair. At any rate, the Board reacts to your voice. I suggest that you direct specific criticisms to specific places and people, however.

I'm looking forward personally to seeing all of you at the September meeting. It doesn't look as if I'll be able to get down there any sooner.

Sincerely,
James J. Harford
Executive Secretary

Dear Mr. Stine:

The March 1954 issue of Missile Away! contains one of the best shots of an aborted round that I've ever seen. I wonder if it would be possible to get a glossy for reproduction in Aviation Week, plus some notes on the firing and what went wrong.

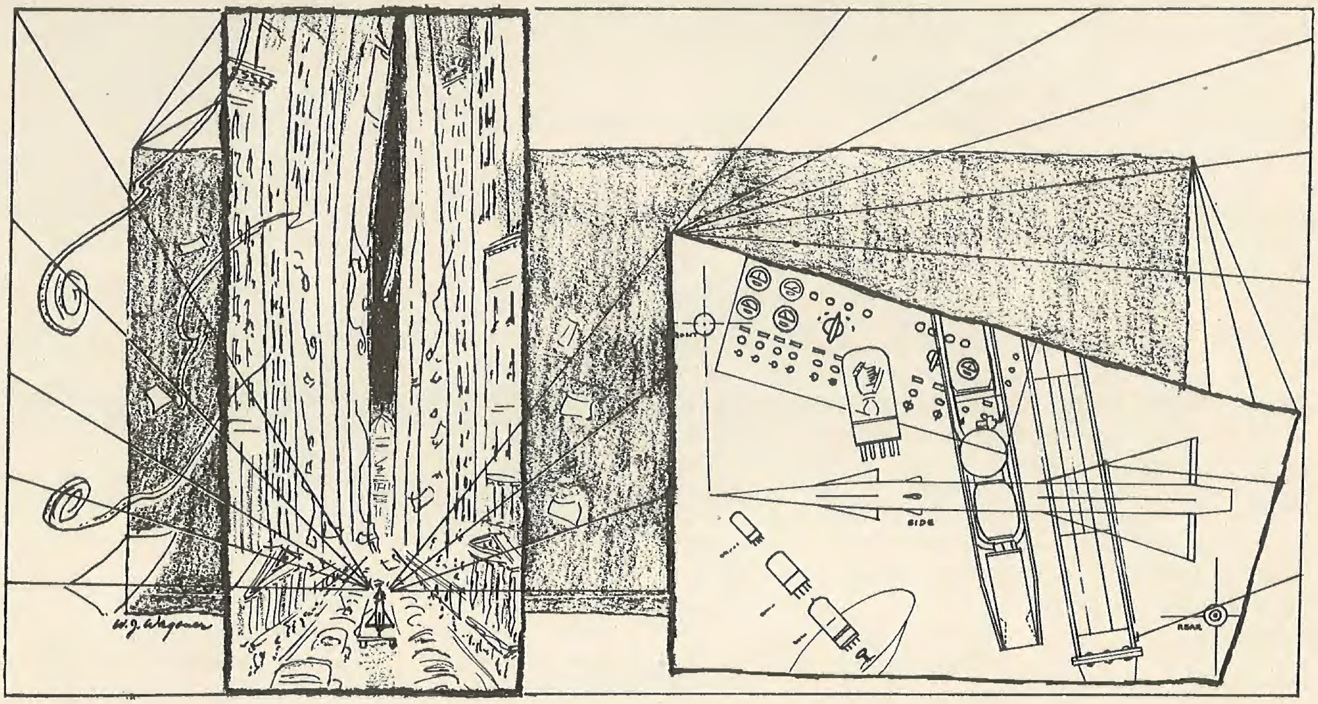
I'm referring of course to the V-2 explosion in the double-page center spread.

The job you people are doing on the section publication is an excellent one. I've admired it often, but have never taken the time to tell you so. This should make up for that neglect.

Sincerely,
David A. Anderton
Engineering Editor
Aviation Week

ED. NOTE: Space restrictions have prevented publication of the story of Aerojet-General, **"Up In A Hurry."** It will appear in the Fall Issue. The same problem prevented us from publishing many of the fine articles submitted for this issue, but we wish to assure authors that their articles will definitely appear in "Missile Away!" They have now become part of our "over-set" inventory, assuring that we will have articles for future issues. As such, the authors not appearing this time provide a legacy which will help this magazine to grow and improve.

guided missiles



& wall street

By Charles Donivan

EARNINGS for companies connected with the development and manufacture of guided missiles continue upward. Earnings of 12 leading aircraft companies in 1953 reached $116,600,000 compared to $81,700,000 in 1952. Unfilled orders amount to $11.6 billion compared to $11 billion a year earlier. The stock of DOUGLAS AIRCRAFT (NIKE) reflects this prosperity moving from 79 in Jan 1954 to a high of 133. The present price is about 124. The stock of GENERAL ELECTRIC CO. (HERMES) has moved spectacularly from 66 in 1953 to a 1954 high of 124. A three for one split of this stock has been approved and in spite of its recent rise is still being recommended "BUY" by security analysts. BOEING AIRPLANE (BOMARC) declared a 2 for 1 stock split (effective 22 May) and increased the quarterly dividend from $0.75 to $1.00. A merger between GENERAL DYNAMICS and CONVAIR has been approved. Under the plan Convair stockholders will receive 4/7 of a share of General Dynamics for each share of Convair held. A merger is also rumored between MATHIESON CHEMICAL (control of Reaction Motors, Inc. and maker of hydrazine) and OLIN INDUSTRIES. A new stock appears on the ticker tape for the first time this month. CHANCE VOUGHT AIRCRAFT, INC. (Regulus) formally a wholly owned subsidiary of UNITED AIRCRAFT was formed and 1 share of its stock distributed for each 3 shares of United Aircraft. United Aircraft's earnings in the first quarter of 1954 amounted to about $2.30 per share compared to $1.75 for the corresponding 1954 quarter. GLENN L. MARTIN CO. (VIKING) reports earnings of $1.10 per share for the first quarter of 1954 compared to $0.82 for the like 1953 quarter. NORTH AMERICAN AVIATION CO. (REDSTONE) reports earnings of $1.77 per share for the first quarter of 1954 compared to $0.77 for the like 1953 quarter and $0.49 for the like 1952 quarter. PULLMAN CORP. (KELLOGG) reports net income of $1.91 per share for the first quarter of 1954 compared to $1.24 per share for the like 1953 quarter. GENERAL TIRE AND RUBBER'S AEROJET Division showed a 35% sales increase and further strengthened its position as the World's largest commercial developer and manufacturer of rocket motors, components and propellants. At the end of November 1953

(next page, please)

it had a 143 million dollar contract backlog, up 40 million from the year before. SPERRY'S new missile, the SPARROW is now on a regular production schedule, and Navy personnel are being trained to use it for both the Atlantic and Pacific fleets. Two of these missiles are carried under each wing of the Douglas twinjet Sky Night fighter and launched against enemy aircraft. Production is now underway at Bristol, Tenn.

The US Air Force has under construction a $157,-500,000 development center for testing supersonic aircraft, guided missiles and aircraft engines. Known as the "Arnold Engineering Development Center" it is located near Tullahoma, Tenn. Current plans call for the installation of three major test facilities for (1) Aircraft engines (2) gas dynamics (3) Propulsion wind tunnel. The FLUOR CORP. LTD. was selected to build the first unit—the test facility—where all types of aircraft engines may be tested under simulated flight conditions—up to 80,000 ft. altitude and at temperatures as low as—120°F. Its capacity is 8 times that of the Wright Field facilities, the largest testing laboratory to date.

BELL TELEPHONE LABS have developed a battery which converts sunlight to usable electric current. This may some day be useful for guided missiles. • •

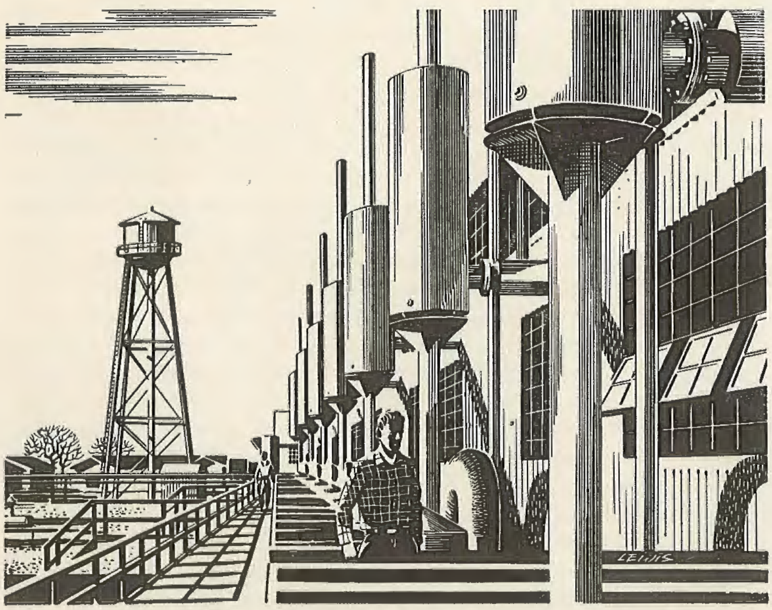
AMERICAN ROCKET SOCIETY AND W. S. FEDERAL CREDIT UNION JOIN HANDS FOR MUTUAL BENEFIT

No longer need money stand between you and membership in the American Rocket Society. The W. S. Federal Credit Union has recently made it possible to make a small loan to pay the membership fees in the American Rocket Society.

For a fee of twenty-five cents you can join the Credit Union. The Credit Union will then lend twenty dollars ($20) to member applicants or fifteen dollars ($15) to associate member applicants. Five dollars will be used to purchase a share in the Credit Union. The full $20.00 (twenty dollars) or $15.00 (fifteen dollars) must be repayed but the last five dollars can be refunded to the borrower upon cashing in the Credit Union share. The only charge will be 1% per month on the unpaid balance and the payments can be arranged to suit the borrower.

It is hoped that applicants will take advantage of this service. The American Rocket Society needs and wants new members and the White Sands Federal Credit Union is using this method to attract new members. The five dollars will be cheerfully refunded when the Credit Union Share is cashed but the smart Rocket Society member will keep the share and use it as the start of a savings plan.

Let's all join!! • •



MISSILEMEN INSIST SOME FIRINGS

FLIGHT TEST DATA REDUCTION

IN order to better understand guided missile research and development, let us take a look at the main features. After construction of the basic missile, evaluation testing must be accomplished in order to prove the design. Due credit is given to those who prepare and fly the bird, but the unsung heroes who do the work (the true-blue and underpaid few), the very backbone of guided missile testing, are the people of data reduction.

As an aid to the peons who are ignorant of these little known persons of science, let us delve into their innermost work.

In order to qualify as a full-fledged member of a data reduction group, a woman must be between the ages of 18 and 26, have two eyes, and be willing to work overtime at night on special projects. A man must have received his Bachelor of Science degree in any phase of engineering plus having completed at least one-half of the work required for a Master's degree. If educational requirements as stated are not fulfilled, the man must put in a four-year apprenticeship period. Outside activities such as part-time employment are a great aid in paying room and board during this apprenticeship. Other minor requirements are:

1. A man must have served at least four years during a major war in any one of the armed services providing it was the Air Force.

2. He must be between the ages of 19 and 22.

3. He must be a family man, single, with at least three children.

At the end of each three-month period of employment, a physical is required which includes eyeball calibration.

One of the main functions of the people in data reduction is the literal transcription of a thin, flexible, transparent sheet of cellulose acetate or nitrate or similar material coated with a light-sensitive emulsion. Local terminology refers to this as **film reading**. Recently, a new invention called a Recordak has been put into use and has been found to be a tremendous labor-saving device. The now-outmoded, time-consuming method of holding the film up to the light and reading it with a magnifying glass had been the general practice for the last 50 years. The new procedure, now under qualifying tests, requires one person be placed directly in front of the Recordak, recently patented as Johnny's Little Data Reducer's Helper (henceforth referred to as the JLDRH) with both arms free to actuate the electronic controls of the machine. The roll of thin, flexible, transparent nitrate is then placed on the uppermost side of the JLDRH on rollers on top of which is a light source. Power is then applied, and through various servomechanisms, electronic computers, and controllers, an image of what had previously been recorded on the light-sensitive emulsion is reproduced on a non-homogeneous, translucent screen. The information appearing on the screen is then verbally transmitted to an associate seated to the left of the JLDRH. Care must be taken that each frame is quickly recorded without delay or hesitation so that the cellulose nitrate (or acetate, as the case may be) does not flame-out due to over-exposure. The recorded data is then carefully guarded during transfer to the data calibration laboratory.

Two men are stationed in the laboratory awaiting the delivery of the recorded data. After proper revelation of security classification credentials, the data is deposited and the two original project engineers return to the reading room (the **film** reading room) for more visual analysis of the blurrs and blobs, and the calibration engineers commence their project. This step in the procedure requires the use of calibration curves solvable only through 5th and 6th order equations. For some of these curves, it would be impossible to solve by mere equations. As a typical example of what is meant by calibrating data, let us take some common readings. The original data appears thusly: 3 bags of alfalfa, 2 pigs, 4 hamburgers (2 with and 2 without) and a fifth of scotch. Decoding the calibrations would show that the missile was at 65,000 feet doing Mach-3 with the booster still attached and flying a zig-zag evasion course. After a complete calibration, the data is sent to the checking panel. If the data is not returned in five days, an all-out effort is made by the laboratory personnel to ascertain the location of the data. If found, it is transmitted to the proper authorities. If not located within a reasonable amount of time, an entire rework procedure is put into effect.

Numerous other functions are performed by this jack-of-all-trades group. One of the most important of these is the planning and scheduling of farewell parties. By the varied activities of this group, the men and their families are continually busy and happy. The senior men in the group are capable of taking over any project referred to the group. Many times these men take over in the event that the leaders go on vacation, and assume the position of Substitute Organizational Bosses, most usually referred to as S.O.B.'s. This close and informal association between the leaders and subordinates breeds contempt and makes for better working conditions.

Equal in importance to any function of the group is the complete and final analysis of all test data. It is planned for sometime in the future.

Further detailed information may be found in a number of political pamphlets distributed locally. Available at your immediate request are the following brochures: Noted at Northrup; Take a Chance at Vought; Your Need—Lockheed; The News of Hughes, Do Well—Try Bell; Diggins at Douglas; More with Martin; and Your Fare—Convair.

AN ENGINEER

An engineer is one who passes as an exacting expert on the strength of being able to turn out with prolific fortitude strings of incomprehensible formulae calculated with micrometric precision from extremely vague assumptions based upon debateable figures obtained from inconclusive tests and quite incomplete experiments carried out with instruments of problematic accuracy and by persons of rather dubious mentality with the particular anticipation of disconcerting and annoying a group of hopelessly chimerical fanatics altogether too frequently described as the Technical Staff.

"RARE BIRDS OF THE AMERICAN SOUTHWEST"

Compiled by R. K. Audoburne

EUROPEAN MAN-O-WAR BIRD; **Deutschlandeus Gigantus:**

Field Marks: 45-50 feet tall, tail span 11-12 feet. Markings vary but are usually a symmetric black and white pattern. Flies very rapidly with a tendency toward a nearly vertical path. Has occasionally been observed over 100 miles above the earth.

Similar Species: The Fie Kingbird is slightly smaller with a definitely narrower tail span.

Voice: Starts quietly but builds up to a deafening roar as it flies away.

Range: Originated in Northern Germany but has migrated to the U. S. within the past ten years. Most recently observed in southern New Mexico. Sightings almost entirely restricted to a region north of El Paso, Texas. However, one report has been recorded from Juarez, Mexico.

Comments: It is possible that the species has become extinct since no recent observations of a reliable nature have been reported.

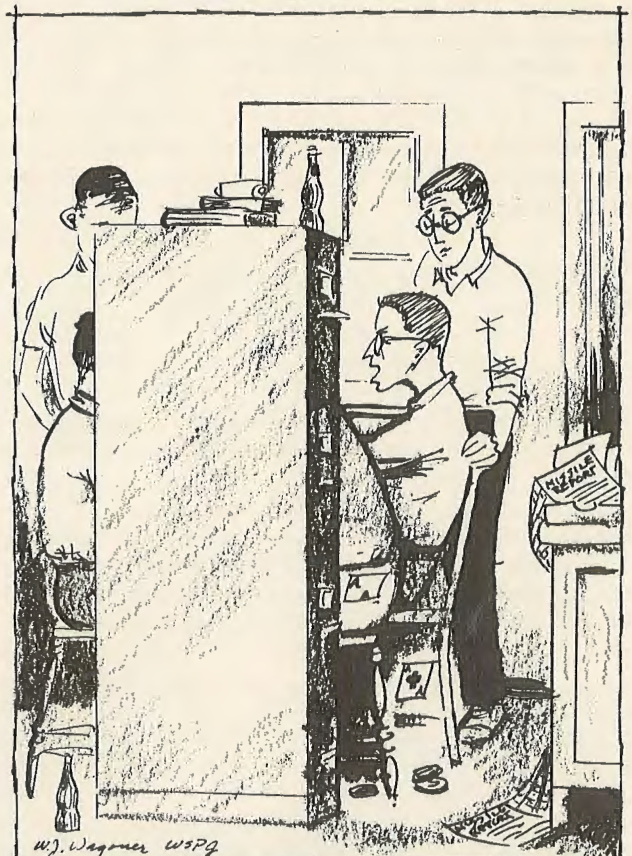
Other Names: Veetoo, Ayfour.

THE BOSS

A Boss has absolutely nothing to do . . . except!

1. Decide what to do and tell somebody to do it.
2. Listen to why it should not be done, or done by somebody else, or done differently.
3. Follow up to see if it has been done and discover that it hasn't.
4. Inquire why and listen to excuses.
5. Follow up a second time only to discover that it has been done but done incorrectly.
6. Point out how it should have been done, but conclude that as long as it has been done it may as well be left as it is.
7. Consider how much simpler and better the thing would have been done if he had done it himself in the first place.
8. Discover that by doing it himself he would strike at the very foundation of the belief that the Boss Has Nothing To Do.

TOP LEVEL MISSILE CONFERENCE



"Ja, ja, das lox valve . . . er, I'll raise you five Heinrich!"

POST-SHOOT CONFERENCE

WE'RE sorry we missed President Andrew G. Haley when he was down in Phoenix late in April. During a phone call he made to us here, he indicated he would try to make our April meeting, but court proceedings in Arizona prevented him from doing so. We will certainly all look forward to meeting him perhaps at the September Semi-Annual Meeting in El Paso.

The El Paso Meeting, by the way, is taking shape. James J. Harford, the A. R. S.'s busy executive secretary, has been hard at work lining up several dozen firms who will present displays. Dr. Noah S. Davis also indicates in a recent letter that there will be about two days of technical papers. Further plans are still tentative, but we will notify all NM-WT Section members by executive letter of the final arrangements for the Semi-Annual A.R.S. Meeting, September 22, 23, and 24 in El Paso.

Our membership committee deserves a vote of thanks from the membership. They spent several weeks compiling a **complete** list of White Sands Proving Ground people eligible for membership in the A. R. S. The information went to President Haley, who has gone to considerable personal effort to send an engraved invitation for membership to each person. And the invitations are simply beautiful. They have been instrumental in increasing our membership in the last few months.

The British Interplanetary Society's Secretary, Mr. L. J. Carter, wrote us a nice note about "Missile Away", and mention of the B. I. S. brings up another point: In their yearly dues subscription drive (This might be something for the ARS to consider: billing **all** members at the first of the calendar year) they ask for donations to their publication fund. Although "Missile Away!" is supported by advertising—we would not turn down a dollar donation to our own Publications Fund. Although this magazine is offered free to our membership, we would certainly appreciate any interest shown by members who cannot contribute directly to the contents.

A well-known local cartoonist, whose cartoons of WSPG rocketeers in action always draw a laugh, recently initiated an unclassified rocket project. The name? What else? Operation Pogo!

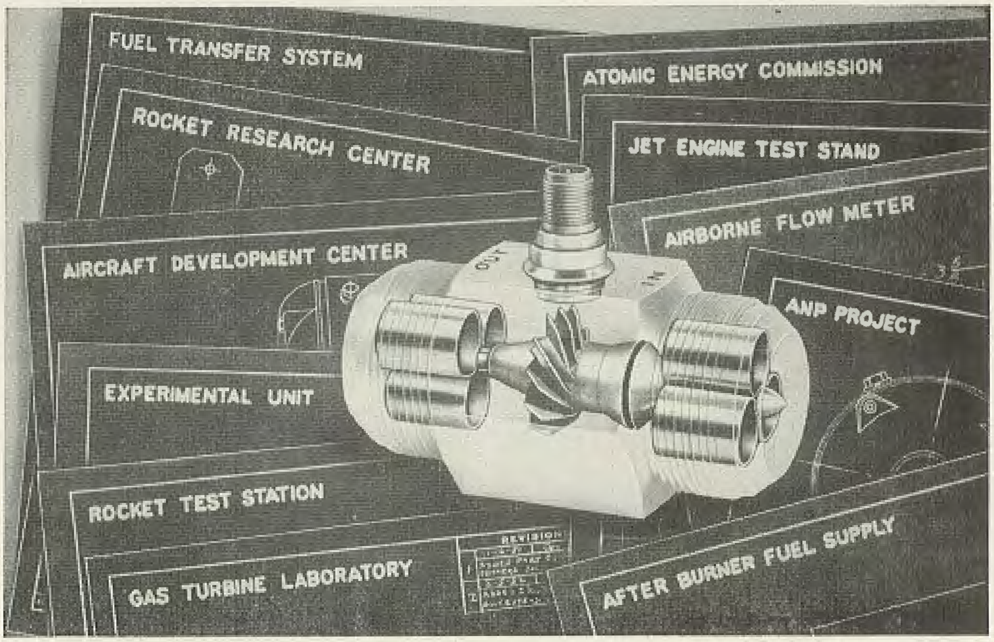
We have recently welcomed to membership in the NM-WT Section three members of the extremely active local experimental group, the Reaction Missile Research Society of Las Cruces. These boys are doing a fine job of rocket experimentation. They have published a journal and distributed several executive reports of activities. Latest indications are that they are hard at work on the following items: (1) a one-ton solid propellant booster (2) a supersonic ram-jet, which will be boosted to speed by the foregoing solid unit, (3) a 300-lb.-thrust ethylene-oxide monopropellant motor, (4) their own firing range on the desert outside Las Cruces, and (5) methods of missile-borne telemetry, optical tracking, and range communication by radio. Several reports are that they are also working on a three-stage upper atmosphere sounding rocket. Very worthy projects. The R.M.R.S. has our good wishes for the best of luck!

"Six bloody but unbowed heads" have now become dozens. This magazine now represents a Section-wide activity, contributed to and supported by the members **en toto.** Our staff has grown by leaps and bounds, our contributors have increased, and "Missile Away!" is now here to stay. This is all a result, of course, of the tremendous response we have received from the advertisers who appear in this issue. Gentlemen, to each of you — contributors and advertisers alike — go our fervent thanks for your belief in this magazine and its future. We will not let you down; "Missile Away!" will continue to grow as the only semi-technical magazine devoted solely to rocket-powered devices, astronautics, and the hundreds of allied fields which are now banding together to make this Age of Rockets the best and biggest of all.

Our apologies are due to the members and guests who showed up at the May 27th meeting in hopes of hearing Dr. Lincoln LaPaz of the University of New Mexico speak on meteoritics. We sincerely hope that some unavoidable situation prevented Dr. LaPaz from appearing as our featured speaker, but no word has been received from him as yet. Edward H. Dingman, Clyde W. Tombaugh, and Dudley M. Cottler stepped in to save the day by giving three extremely interesting and timely talks on **Un-manned Satellites, The Opposition of Mars,** and **Chain Radar** respectively. Our thanks to these Section members who saved us from a very embarassing situation!

Sometime when you see a jet bomber go overhead at very high altitude, stop and think that there is not an anti-aircraft gun is existence which will touch it. Then imagine that the insignia on that plane is not that of the U. S. A. You will really begin to appreciate the surface-to-air guided missile which can not only outclimb said bomber but out-speed it as well.

POTTER FLOWMETER FIRST IN ROCKET RESEARCH



This unique flow sensing element, able to withstand high pressures and high or low temperatures, has brought a new standard of accuracy to flow measurement in test and research work. Resistant to highly corrosive liquids, it is also being used in most jet and rocket test projects.

ROCKET RESEARCH INSTALLATIONS throughout the United States and Canada have adopted the Potter Flowmeter as their standard for accuracy. Simplicity, stability, dependability and ruggedness, combined with an ability to operate in either the vertical or horizontal position are only a few of the features that have caused leading research groups to specify Potter for all new installations.

ROCKET PROPELLANTS are measured easily and accurately with the Potter unit, which withstands high or low temperatures, high pressures and strong acids. Liquid oxygen, fuming nitric acid, hydrogen peroxide and other liquids considered "hard to handle" are being measured by Potter systems with safety and precision.

FAST RESPONSE—ten milliseconds on the average and even less for some units—makes the Potter element particularly well suited to rocket testing. The electrical output of the sensing element is a frequency signal which lends itself readily to telemetering systems.

Twenty-eight inch rotating disc scale gives Potter-Brown Flow Indicator superior legibility.

RATIO CONTROL SYSTEMS using Potter elements, regulate flow of fuel and oxidizer or catalyst to combustion chamber, making it possible to obtain maximum thrust for the weight of fuel carried.

ACCURATE READING of flow rates has been made possible through the development of instruments whose precision approaches the Potter sensing element. The Potter-Brown Precision Flow Indicator has a scale with a graduated length of 28 inches, marked with as many as 500 divisions. Since the flowmeter is linear, legibility is excellent at high or low flow rates. If necessary, the effective scale length can be doubled by using a dual scale.

RECORDING FLOW on either a circular or strip chart provides permanent test records. The Potter-Brown Strip Chart Recorder, having a graduated chart width of ten inches and available in a variety of chart speeds provides accuracy, convenience, and ease of reading.

CONFIDENTIAL labels are on many of the projects in which Potter equipment is being used; but many users are able to give reports on the operation of their Potter flowmeters. If you are measuring flow and you are not already using the Potter Flowmeter, ask your associates and acquaintances in the industry about this new method of measuring flow. Their experience may help you to solve your flow measuring problems.

FOR FURTHER INFORMATION. State whether you are interested in indicating, recording or controlling flow rate. Watch for important news on the new Potter Airborne Flowmeters for measuring rate and total flow. Write to:

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