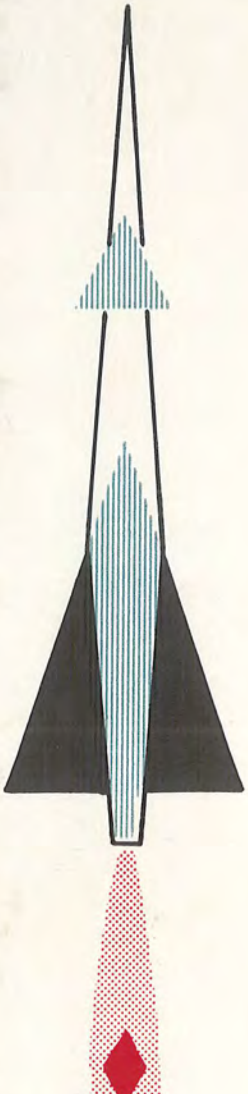
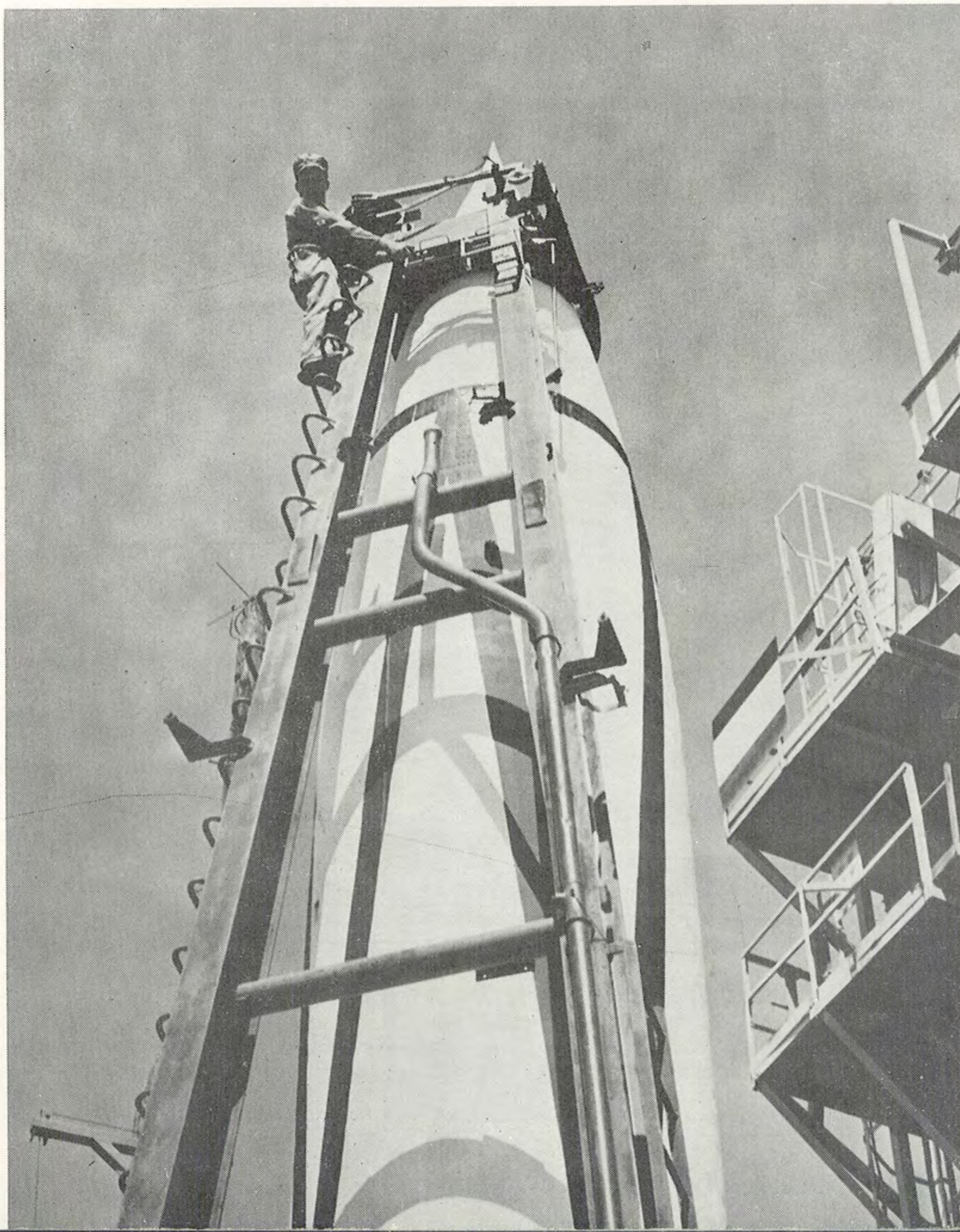


"Missile Away!"

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

Featuring:
German Missiles,
beginning a series.

Vol. III, No. 4
WINTER
1955-56
35c



"MISSILE AWAY!"

Vol. III, No. 4
WINTER
1955-56

CONTENTS

SPECIAL SUPPLEMENT: Binder for German missile series.
(ARS NM-WT Section members only)

BOARD OF EDITORS: G. Harry Stine, Lewis J. Stecher, Jr., Dudley M. Cottler, Mrs. D. M. Cottler.

BOARD OF MANAGERS: Russell K. Sherburne, R. Gilbert Moore, Kieth Hennigh, Lawrence W. Gardenhire, Leon B. Hart.

Copyright 1955 by the New Mexico-West Texas Section of the American Rocket Society, Inc. "Missile Away!' is the official Section publication and is published quarterly in the Rocket Capitol of the World. It is mailed free to all Section members and to national ARS officers. Subscriptions to all others: 35 cents per issue or one dollar per year. Subscriptions and extra copies may be obtained from the Circulation Department, "Missile Away!", P. O. Box 1242, Las Cruces, N. M. This fee is to cover printing, mailing, and handling costs. Material herein may not be used except by "Jet Propulsion", the Journal of the American Rocket Society and other ARS sectional publications without written permission of the Section Board of Directors. The NM-WT Section is a non-profit organization affiliated directly with the American Rocket Society, Inc., and does not necessarily endorse the services or products of firms subscribing to advertising in this publication. Please address all correspondence to "Missile Away!", P. O. Box 1242, Las Cruces, New Mexico. Printed in Las Cruces, New Mexico, by the Bronson Printing and Publishing Company.

We realize that sometimes you are just too busy to go out to see the newest advancements in electronic test equipment and instrumentation. You can get a fair idea of the capabilities of a new instrument by studying catalog sheets and published literature, but there is no substitute for an actual on-the-spot demonstration! The Neely Mobile Lab was designed to give you actual working demonstrations right at your doorstep!

As a part of Neely Enterprises service to the Western electronic industry, the Mobile Lab makes periodic, regularly scheduled trips through California, Arizona, Nevada and New Mexico. It is staffed by qualified engineers who will have the answers to your questions. Be sure to watch for the Mobile Lab in your area!

Remember, there is a Neely office near you!

IN CALIFORNIA:
LOS ANGELES
3939 Lankershim Blvd.
(North Hollywood, Calif.)
Phones: STanley 7-0721
POplar 6-3811

SAN FRANCISCO
2830 Geary Blvd.
Phone: WA 1-2361

SACRAMENTO
1317 Fifteenth St.
Phone: GI 2-8901

SAN DIEGO
1029 Rosecrans St.
Phone: AC 3-8106

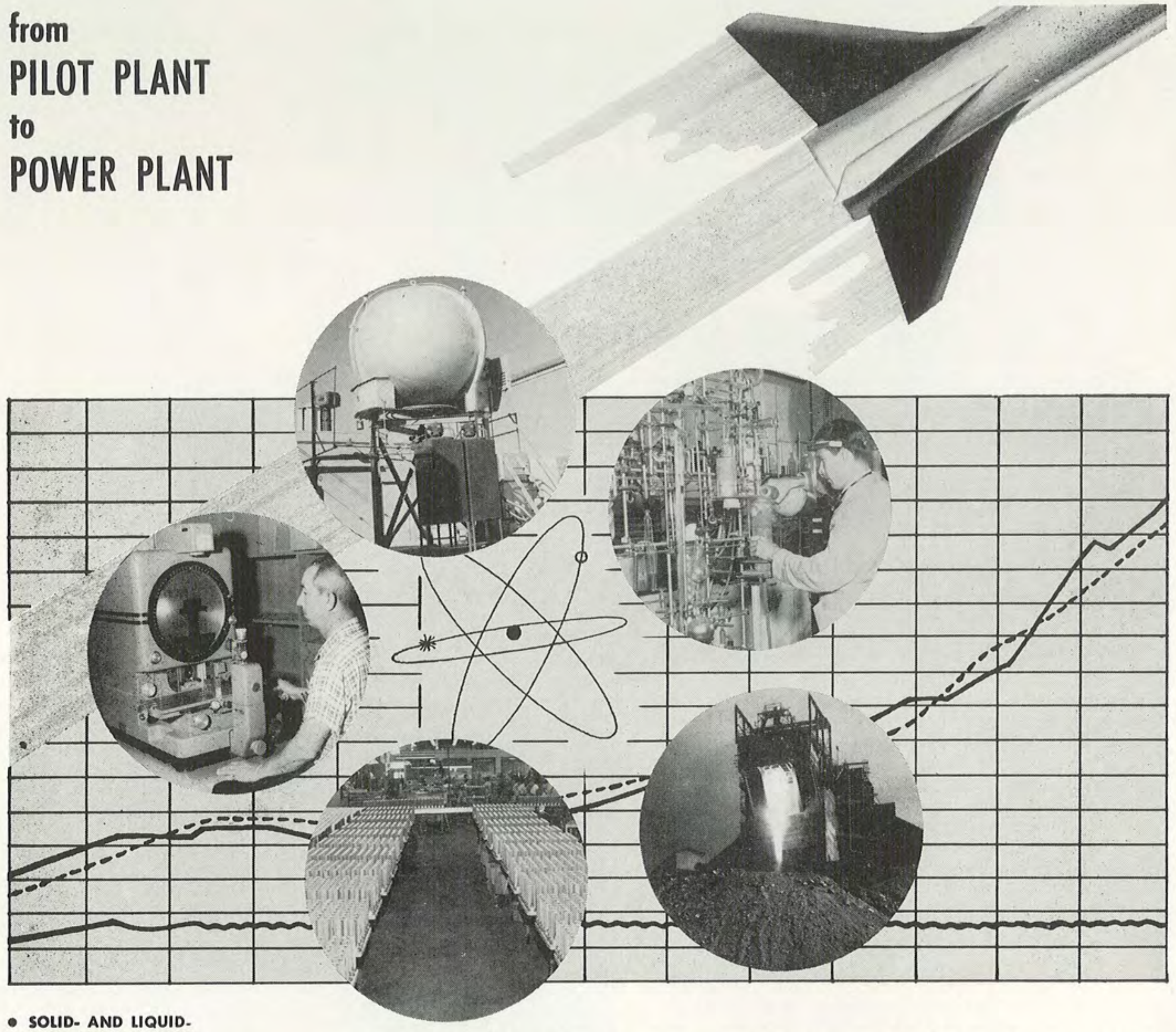
IN ARIZONA:
PHOENIX
641 E. Missouri Ave.
Phone: CR 4-5431

IN NEW MEXICO:
ALBUQUERQUE
107 Washington St., S.E.
Phone 5-5586

NEELY ENTERPRISES *Electronic Manufacturers Representatives*

3939 LANKERSHIM BOULEVARD • NORTH HOLLYWOOD • CALIFORNIA • STanley 7-0721 • POplar 6-3811

from
PILOT PLANT
to
POWER PLANT



- SOLID- AND LIQUID-PROPELLANT ROCKET POWERPLANTS FOR MISSILE AND AIRCRAFT APPLICATIONS
- AEROBRAKE THRUST REVERSER (SNECMA)
- AUXILIARY POWER UNITS AND GAS GENERATORS
- ELECTRONICS AND GUIDANCE
- ORDNANCE ROCKETS
- EXPLOSIVE ORDNANCE AND WARHEADS
- UNDERWATER PROPULSION DEVICES
- ARCHITECT-ENGINEER SERVICES FOR TEST FACILITIES

QUALITY CONTROL FOR ROCKET ENGINE RELIABILITY

Today, as never before, rocket power is a dominant military requirement. Aerojet-General propulsion devices are used from Pole to Equator. They must operate with the flick of a switch at any altitude, any attitude, over extreme temperature ranges.

But the price of optimum reliability is maximum vigilance. At Aerojet, this means the uncompromising control of every characteristic of every engine, every component in research, development and production.

There are no short cuts to certainty. Aerojet uses all the techniques of modern quality programs — new-design control, acceptance sampling plans, statistical analysis, quality auditing. In actual test-firings of complete rocket systems, Aerojet has spent over six million man-hours since 1942.

The results are unique in the rocket propulsion field: *Aerojet products in field use have an overall measured reliability of 99.6%.*

AEROJET-GENERAL NEEDS: Chemical Engineers • Chemists • Electronic Engineers • Mechanical Engineers • Physicists and Aeronautical Engineers

Aerojet-General CORPORATION

A Subsidiary of
The General Tire & Rubber Company
THE GENERAL TIRE
AZUSA, CALIFORNIA
SACRAMENTO, CALIFORNIA

MORE POWER FOR AIR POWER

THE NEW MEXICO-WEST TEXAS SECTION
OF
THE AMERICAN ROCKET SOCIETY, INC.

EXECUTIVE BOARD

President: Dr. Russell K. Sherburne, Box 548, State College, N. M.
Vice-President: G. Harry Stine, 1100 Circle Drive, Las Cruces, N. M.
Secretary: Kieth Hennigh, Box 1135, State College, N. M.
Treasurer: Lawrence W. Gardenhire, Box 112, State College, N. M.

BOARD OF DIRECTORS

Capt. Levering Smith, NOMTF, WSPG, N. M.
Henry F. Flamm, 1730 South Alamo, Las Cruces, N. M.
Dudley M. Cottler, 1790 S. Chaparro, Las Cruces, N. M.
R. Gilbert Moore, Box 442, State College, N. M.
George L. Meredith, 901 Reynolds Blvd., El Paso, Tex.
Allen Niles, NOMTF, WSPG, N. M.
Maj. David G. Simons, 406 Lovers Lane, Alamogordo, N. M.
William T. Hancock, Box 446, Mesilla Park, N. M.
Herbert L. Karsch, 215 Oxford Drive, Las Cruces, N. M.

CHAIRMEN

Program Chairman: R. Gilbert Moore
Membership Chairman: Harry Davis
Public Relations Chairman: Henry V. Hardin
Librarian, Historian, & Archives Custodian: Ivan L. Carbine

AMERICAN PHENOLIC CORPORATION
CHICAGO 50, ILLINOIS
Announces the Appointment
OF THE

E&M

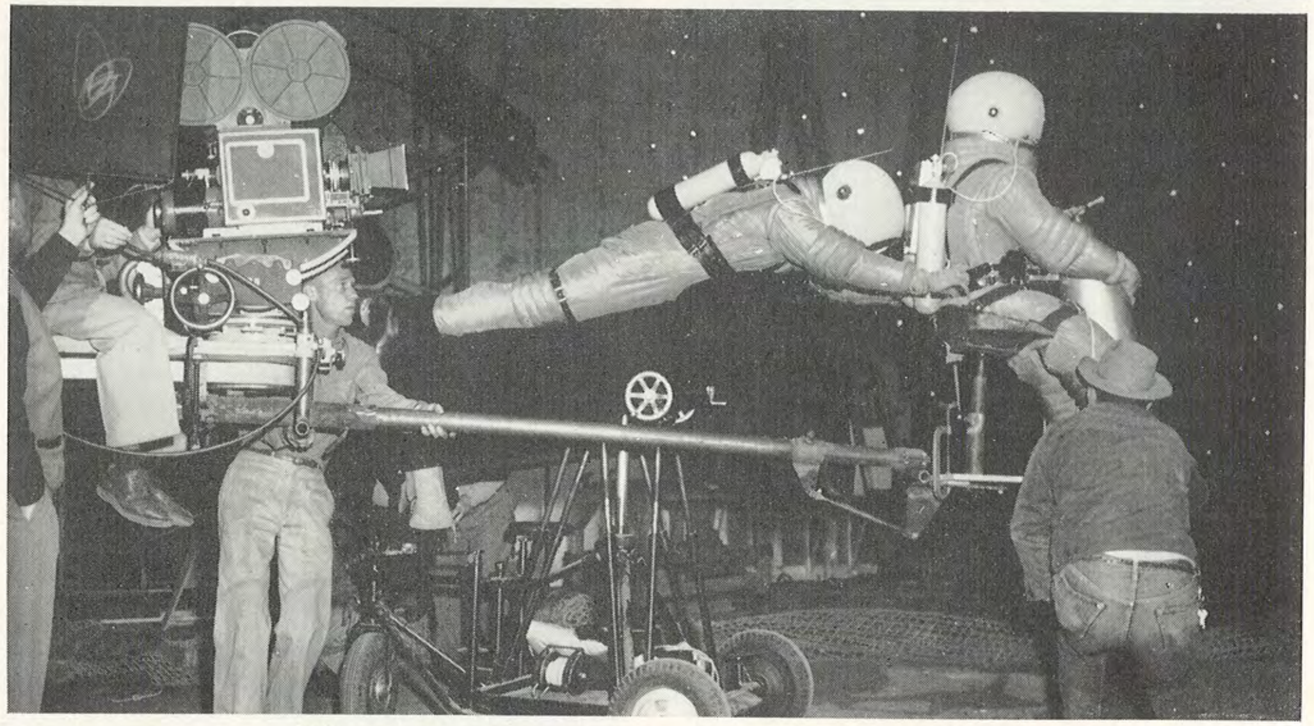
ELECTRICAL & MECHANICAL SUPPLY CO., INC.
2000 TEXAS STREET — EL PASO

As Industrial AMPHENOL Distributor
for
RADIO FREQUENCY CONNECTORS
ARMY & NAVY AN CONNECTORS

See our display at 2000 Texas Street or Dial 2-4614 in El Paso

"HOLLYWOOD AND SPACE TRAVEL"

editorial



. . . Wherein we present a long, pictorial editorial regarding how rocket people appear to the outside world—as visualized by the movie moguls in Hollywood. Our apologies if we do not pull our punches, but we feel such a thing is long overdue. It's time credit was given where it is due, and vice-versa . . .

BACK about 1948, a former engineer and graduate of the United States Naval Academy known as Robert A. Heinlein journeyed to Hollywood with a desire to make a motion picture about man's first trip to the Moon. Now Heinlein is, by nature, a careful and meticulous man, a trained engineer, and a person who has followed the technical portions of space flight with zeal and enthusiasm. Under his own name and various pen-names, he has attained the enviable position of being the finest science-fiction and space travel (fiction) writer.

In 1952, he came to White Sands for a second time to witness the last firing of a V-2 rocket, and members of the New Mexico-West Texas Section had the chance to meet him and hear him talk about some of the problems he encountered in fulfilling his desire to make a moon-flight picture. The evidence of the fact that he not only did it, but helped produce a classic motion picture, is the resulting film, "Destination Moon", which was shown before the Section in 1954.

For those of you wishing to get some idea of Heinlein's problems, see "Shooting Destination Moon", by Robert A. Heinlein, **Astounding Science Fiction,** June, 1950.

"Destination Moon" not only made its "nut" (the production costs of the film paid for by the tickets of eager movie-goers), but it started a new trend in Hollywood. Prior to that time, the movie moguls had been content to turn out such gems as the numerous Flash Gordon episodes based more on thud-and-blunder action than scientific fact. Of course, the British and the Germans had turned out **"Things To Come"** and **"Frau Im Mond"** long before the war, and those two pictures showed considerable evidence of adherence to scientific fact.

Hollywood (we use the term collectively to denote various producers, writers, and film studios) suddenly discovered that "Science Pays Off," particularly space flight. So they jumped in with both feet.

It is extremely unfortunate that the writers they chose for their screenplays had, for the most part, very little apparent knowledge of rockets, space flight, astro-

(next page, please)

"HOLLYWOOD AND SPACE TRAVEL"

nomy, or even simple high-school physics. And the screenwriters, in their search for plots and story lines, made the sad mistake of delving back into old science fiction stories of the "space opera" type one step above the thud-and-blunder type. And the producers and directors, once they had the screenplay in their hands, further modified it and effectively ignored the technical advisors. Some of their technical advisors were quite capable people; however some of them evidently lacked the persuasive powers needed to make sure that certain things were correct.

Several fine motion pictures were turned out during this period of space travel rampant. Very few people who saw "The Day The Earth Stood Still" will forget the careful handling of the material, the impact of the ideas and concepts, and the unusual use of very low audio frequencies in portions of the film requiring tension-building. To be sure, there were some portions where poor writing showed up, but the viewers were content to forgive it in the face of an otherwise excellent job.

But there were produced some singularly poor movies as well. They were accompanied on release by blatant publicity terming them as "factual".

The movies of space flight in themselves did not do as much harm as the publicity attending them. However, the balderdash passed off as technical and scientific fact in the films caused many rocket people to object.

Now those of us who work with rockets for a living cannot expect motion picture people to know all the angles of rocketry and space flight, just as we could not be expected to know the fine points of the motion picture industry. Yet we call upon the advice of motion picture experts in making a film on White Sands; in a like vein, there are people available to act as technical consultants for Hollywood. As a matter of fact, the immediate locale around Hollywood probably contains more rocket experts than any other part of the world.

The Spring 1955 issue of this magazine contained an editorial dealing with the accuracy of newsmen covering rocket developments—and scientific developments in general. Much of that material also applies to motion picture making. Movies which are wildly inaccurate and which portray rocket people and future space travellers as customarily lying, cheating, disobeying orders, and maintaining a semi-ignorant attitude toward something they should know better about, do not do those of us in rocketry any good.

It would not be right to merely offer destructive criticism to the people in the motion picture industry. Such tearing down will not help solve the problem of getting better space travel movies in our local theaters, movies which can help rather than hinder the rocket and guided missile program of this country. Nor will it help straighten out the kinks which have developed in Hollywood's concepts of scientific people and how they live and work. The constructive notes we might offer would be as follows:

1. Find a screenwriter who knows science as well as human beings. There are very few of them employed presently in Hollywood. But there are thousnds of capable and qualified science writers throughout this country. Check with the scientists and engineers themselves to find the one who is best. Then hire him. And send him out among scientific and technical people for awhile so he will know how they act and think and live. The cost will be a pittance in comparison to the boxoffice return of a picture which is true to life.

2. Hire a technical director who knows what he is talking about. If in doubt, check again with the people working with the real thing; they will know. Then **listen** to him, for you have hired him to make sure the movie is correct.

3. Play the "spectacular" if you must, but don't drag it in by the heels.

4. A science film can be accurate and rewarding without having a sky-high budget for sets, costumes, props, and fancy photography. Some of the best films have been made on small budgets, mainly because the persons involved from the grips to the producer were interested in making the **best** film they could, knowing it would make its "nut" because of that.

Perhaps we have no business making such suggestions. But, if Hollywood continues to make science and space travel movies, we offer them anyway . . . because we **like** to see a good movie, and want to see more of them.

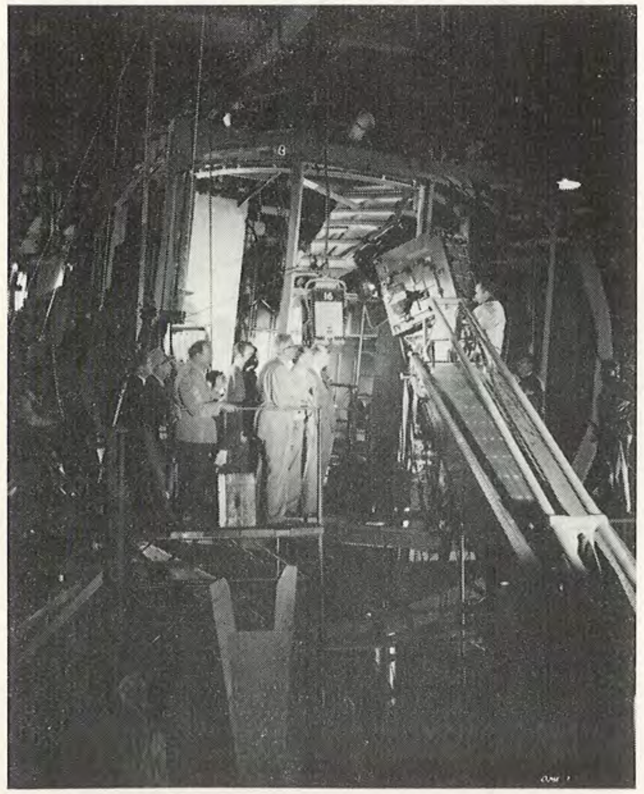
—G. H. S.

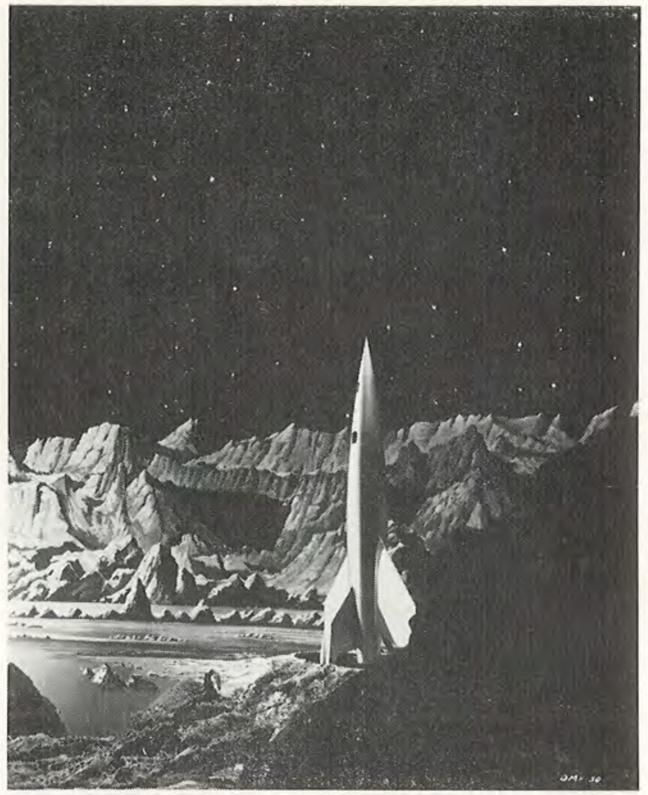
During the filming of "Destination Moon", actor John Archer hangs in his space suit suspended from wires as the crew prepares to make a shot. Note the camera in its "roundy-roundy", a gimbal arrangement specially built for this picture.

"DESTINATION MOON"

People on the Moon without space suits? No, just the set of "Destination Moon" with the crew shooting a scene in the crater Harpalus.

This maze of steelwork is a space ship cabin (on Earth) constructed on structural steel and mounted in a set of double gimbals two stories above the ground. To shoot scenes in this huge Erector set, the camera had to be mounted on a giant boom.





The space ship Luna stands in the crater Harpalus on the Moon. The ship is, of course, a model, and the backdrop is a blow-up of a Bonestell painting.

This is the crater Harpalus, 24 miles in diameter with 8000-foot peaks. It was situated on a 30 x 60-foot sound stage, showing that realistic scenes based on known fact can be shot on film.

The following is a verbatim statement put out by Paramount Pictures Corp. as advertizing for "The Conquest Of Space". It is an example of the type of publicity which hurts our profession, particularly when associated with the type of film it was. It shows, both on the part of the publicity men and the producers who okayed the releases, that a little knowledge can be dangerous. Many of the statements are made with a bland disregard of the facts and the simple laws of physics. It is no wonder that this type of motion picture provides hilarious entertainment when it is shown at White Sands; laughter can be wonderful relaxation.

PARAMOUNT'S "Conquest of Space" is unquestionably one of the most unusual pictures ever made in Hollywood.

To begin with, none of the action in the story takes place on earth, all of it occurring on The Wheel, a man-made space station some 1100 miles above the earth, and the planet Mars.

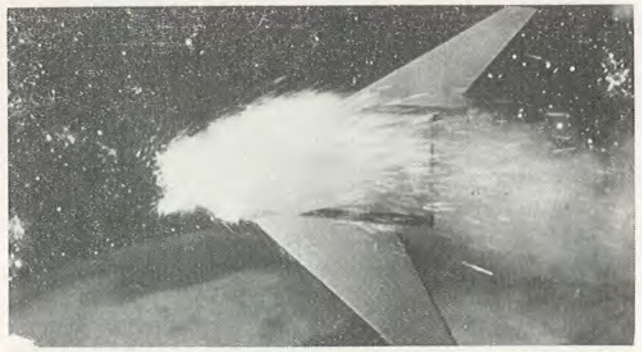
Finally, it is the first in what Producer George Pal calls "science-fact" pictures. By this, Pal means the story is based on all available scientific data concerning the possibilities of inter-planetary travel. While it may be hard for some to believe, many scientists claim that man will conquer space in the not-too-distant future. These men—no crackpots, we might add—claim that to do it man will first have to build a space station some 1075 miles above the earth where the pull of gravity no longer exists. Using this Wheel—so-called because it resembles one—as a base of operations, man will then build a space ship capable of flying to the moon and other planets.

Thus, the picture does not, according to Pal, fall in the general category of "science-fiction," a field in which he is a recognized pioneer and authority. On the contrary, all of what takes place can and will happen, according to many noted experts.

Against this colorful and bizarre background, the writers have woven a strong, human and compelling drama. More than a scientific study of space travel, it is the personal story of brave men and their terrifying fight against the unknown.

STORY

"Conquest of Space" is the story of a group of Army volunteers who lead a fantastic existance on The Wheel, man-made satellite that hangs in space and rotates around the earth every two hours. Their assignment is to build a space ship for a flight to the moon but later they receive orders to proceed directly to Mars. Colonel Merritt, leader of the group, tries to reason with his superiors, points out that Mars is several million miles further than the moon, insists the mission is senseless and hopeless. He reluctantly agrees to head the expedition when he is told the purpose of the trip is to find raw materials to supplant those that are vanishing from the earth. Merritt, his son—an Army captain—and three enlisted men take off for Mars. The story builds to an exicting and suspenseful climax as Merritt, suffering from "space fatigue," starts losing his mind. • • •



A Critical Review of "Conquest of Space"

by James Post

THE plot of the movie was to me quite interesting and is in some respects logical. In this report, I will tell you of some of the illogical respects along with the good ones.

The design of the space ship was good, but a few objects were left unexplained. Of these was the raising of the ship after landing on Mars. It showed no sign of a mechanism for lifting. One thing that I noticed (which might have been arranged automatically in the controls) was the rockets' firing control. They used the same three knobs to fire the main engines attached to the gliding wing as they did to fire the rocket itself.

I took particular notice to the asteroid and the meteors passing the ship on the way to Mars. In the absence of atmosphere, they should not have glowed in red streaks as they did. The asteroid on the other hand, could have been glowing from volcanic action, though it is not very probable.

Along the line of meteors was the collision with the space wheel. In the movie, men were being hauled apparently (except from suffocation) uninjured from the damaged area. With all the pressure inside, and hardly none outside, it would be perhaps more gruesome, yet more logical, for the men to be violently crushed through the holes.

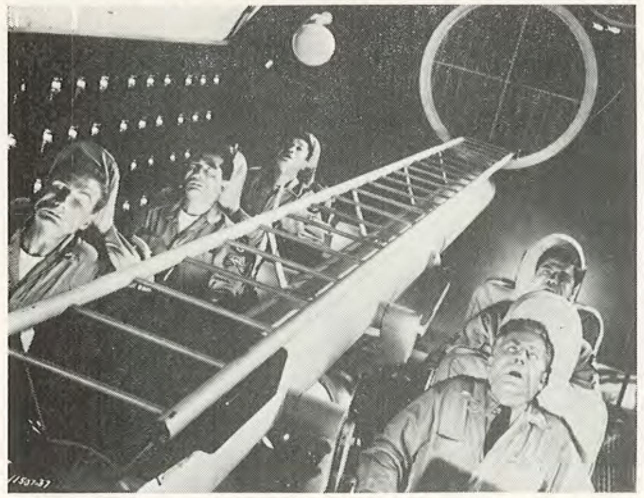
Of the idea of "free fall" or floating, they gave the opinion that things always float up. The man who was killed by the meteor for no reason at all floated immediately upward away from the space ship. In the first place, when he was hit his magnetic boots were grappling the side of the ship. No one was shown turning them off. Yet as soon as he was shown again, he was floating out on the life rope.

The ending largely resembled the end of "Destination Moon" with the ship speeding out of sight toward home.

On the good side, however, were the views of the planets from above. I considered them quite good. The Martian landscape, though, was a bit overdone.

(ED. NOTE: We asked Mr. Post to review "The Conquest of Space" because he is liable to be one of the men who actually does it someday. James Post is 12 years old, lives in Las Cruces, and, when asked what he is going to do, will tell you, "Be a spaceman" The above review is his in its entirety and was untouched by the editorial staff.) • • •

"THE CONQUEST OF SPACE"



The crew of the space ship in "The Conquest of Space" lies pinned to their seats under a terrific acceleration which appears to be coming from a direction at right-angles to the ship.

When a meteor smacks the space station, all hell breaks loose in the mess hall.

"Free-fall" in the space ship. From the looks of things, this space ship is mostly "space". Certainly doesn't look anything like the interior of a modern plane, which might be a distant ancestor.

The pay-off: with every ounce accounted for, a stowaway is discovered after the ship is in trajectory to Mars.

U. S. Naval Technical Mission in Europe

Technical Report No. 237-45

Survey of German Activities In The Field of Guided Missiles

The editors of "Missile Away!" are proud to present the first of a series of articles extracted from the report of the U. S. Naval Technical Liaison Mission which went into Germany in 1945. Much of the information has been published elsewhere, but the Editors felt that a complete resumé of German activities in the field of guided missiles would not only be useful but of historical value. The entire Report, graciously made available to this magazine by Herbert L. Karsch, who was a member of the group, will appear in sections in future issues. Each will be designed, as this one has been, for removal from the magazine in order that they may all be accumlated in the special binder provided with this issue. Every guided missile under development or in operational use by the Germans will be extensively covered, including exhaustive surveys of their propulsion, guidance, and airframes. We suggest you save these articles for valuable reference material.

THIS report is a compilation of such data as is available in this theater on German activities in the field of guided missiles. Its object is to tie together the efforts of German Scientific personnel into one correlated review for information and reference. The report is made up of two sections: Section I, originally conceived as a check-off list for the investigators in the field, is essentially a tabulation of basic data for the purpose of providing a ready reference; Section II endeavors to cover the individual projects in some detail or to draw attention to captured documents and equipment available for intensive studies.

Comprehensive coverage of the electronics and propulsion fields as related to guided missiles has resulted in the publication of the following reports by NavTecMisEu: Technical Reports Nos. 158-45, Electronics as Applied to German Guided Missiles; 134-45, Rocket Power Plants Designs and Construction by Walter-Werke-Kiel; 194-45, Summary of German Rocket Power Plants; and 236-45, General Survey of Rocket Motor Development in Germany. In view of the contents of these complementary reports, no attempt has been made to exhaust their respective subjects in this basic guided missile survey.

Germany, contrary to the reasoning of other countries, had not in any sense failed to lay the groundwork of fundamental research for producing a complete series of potentially satisfactory antiaircraft controlled missiles; however, the basic work did not manifest itself as usable "flak" because the actual construction and experimental testing were neglected until too late. It is obvious now that the foregoing resulted from underestimation of the damage the Allied air forces could inflict, from a misconstrued confidence in their standard counter weapons which were even then obsolete, and from over confidence in the damage, both physical and psychological, which their V weapons were effecting.

It is interesting to note that it was the ground-to-ground self controlled missile, i.e., the V weapons, which was selected to receive the lion's share of the energy devoted to testing and developing of guided missiles. Even in minds chained to the utility of conventional weapons, the obvious strategical employment of this type could not be overlooked. However, in selecting what at that time must have appeared to them a fantastic innovation, they did not recognize the implications pointing to related weapons which were to become vitally important.

It must be borne in mind that the magnitude of the German's basic research program was tremendous and and that it was equally thorough for all types of controlled missiles. Once they realized the defensive potentialities of various types of this new weapon, a program was inaugurated, which if given six more months uninterrupted time might well have resulted in the achievement of what had become a basic policy: **to drive bombers from the sky at altitudes below fifty thousand feet.**

In justification of the above, the picture of the history and magnitude of German effort in this field is included. The idea of increasing the accuracy of a weapon by controlling it to its target was conceived during the first World War. This thought manifested itself in the form of an aerial bomb guided in range and azimuth by signals transmitted down a wire which unreeled as the missile fell. Projects related to the above lay dormant until World War II, when the modern controlled missile program made its appearance in the form of the FX high angle bomb and Hs glide bomb series in the Mediterranean. However, the intervening time was not wasted, as it was during this period between wars that the experimental rocket groups were most active. One faction of these groups later formed the nucleus of the Peenemunde personnel.

The FX and Hs missiles were predicated on the assumption that the Luftwaffe would maintain air supremacy and while this condition existed they were used to good advantage. Contrary to the popular idea, that the Allies succeeded in effectively jamming the radio control used in these missiles consequently arresting their use, the contributing evidence from enemy operational and development personnel is definitely negative. It appears that a routine strike against an airport by Allied airmen had the good fortune of unknowingly destroying all enemy aircraft modified to carry the missiles, and that by the time new planes could be made available, the fuel shortage had effectively put the Luftwaffe out of operation. Our radio jamming activities are said to have been effective on one channel of one frequency. The effort did not put an end to the use of the Strassburg-Kiel radio control unit, but it did succeed in stimulating the enemy's thought and subsequent development activities relative to new control systems. Their first reaction was the return to the wire control method of transmitting intelligence. This was closely followed by programs designed to cover all eventualities.

With the increase in Allied air power, axis interest began to focus on the development of controlled antiaircraft missiles. This interest grew rapidly, and a highly competitive development program for AA missiles expanded with the steady increase of Allied aerial might until at one time in 1943 there were under development in Germany 48 different antiaircraft missiles. To counteract the increasing abuse Allied air power was delivering to German industry, it was necessary to streamline the program to produce greater emphasis and efficiency. Therefore, the 48 different antiaircraft development projects were surveyed and after an analysis as to completion of development and effectiveness of the missiles, all but 12 of the 48 were discontinued. The remaining 12 were to be carried through to full development for operational use.

During the period of growth of the Allied air power, the heretofore visualized need of long range remote controlled or self controlled missiles for area bombing became an actual necessity. Resulting from the successive defeats the Luftwaffe was suffering, and it became less and less advisable to send bombing squadrons against the enemy; therefore, increased effort was placed on the development of supersonic missiles which were visualized as early as 1936 as potential weapons. These were hastily and prematurely thrown into the fray. In addition to the development of long range supersonic weapons, there was simultaneously carried out through developmental to operational use the V-1 weapon or "buzz bomb". The V-1 was the first long range missile operationally used as a self-contained, non-piloted guided or controlled weapon. It is estimated that over 20,000 of these were used against the Allies.

As a substitute for the V-1, the BV series of glide bombs were developed as an inexpensive long range (100 miles) bomb for area bombing. Approximately 400 of these were built and tested, but they were never put to operational use due to a shortage of suitable bombers to carry and launch them.

During this same period, the development of the A series, i.e., V-2 missiles, for supersonic speed ranges was carried on in spite of continual handicaps caused by Allied bombings. A large modern well-equipped missile development and testing center was established at Peenemunde on the Baltic Sea. This station which cost 300 million gold marks for the initial installation was started in 1936 and was reported in operation in 1937. Regardless of Peenemunde's tremendous size and its influence on the program, it in no way portrays the extent of the energy being exerted by other governmental agencies and commercial firms within the Reich. After the expenditure of a tremendous amount of money and energy on this project, the A-4 missile went into operational use in 1944. It is estimated that 3000-5000 of these missiles were built.

To increase range, the A-4b was made by the simple addition of wings to the A-4. This approximately doubled the A-4's range. With the ultimate operational range in sight for the A-4b, design work was immediately started on more radical weapons. **There is little of humorous nature in the statements so often heard that the Germans intended to bombard New York from launching sites in Europe, as two missiles, the A-9 and A-10, were under development for use against the U. S. in the early months of 1946.** This contemplated use was scientifically possible and undoubtedly would have been realized had time permitted.

The German guided missile program during the last stages of the war provided for development of every conceivable basic type, one classification of which follows:

(a) Surface launched to air targets
(b) Air launched to air targets
(c) Air launched to surface targets
(d) Surface launched to surface targets
(e) Underwater launched to underwater targets
(f) Underwater launched to surface targets
(g) Underwater launched to air targets

Every known type of remote control, self-seeking or homing device, and proximity fuse was being developed or exploited for use in guided missiles. This included radio control, wire control, radar, continuous wave radio, acoustics, infra red, light beam, magnetics, etc. It was in this field, however, that the missile program was suffering the most serious difficulties.

All types of jet propulsion were being incorporated into the power plants of the missiles which were being built to fly at speeds both subsonic and supersonic.

Work on the science of controlled missiles was being carried out in every area visited in Allied occupied territory, from the border of Denmark to Switzerland and from the coast of France to the Russian zone of occupation. It is a known fact that some work was being done in Denmark, Norway and Poland, and it is estimated that 50% of the total German effort in this field was in what is now Russian-occupied territory, to which investigators have not had access. **The results of the enemy's guided missile work are evident on the targets in England, Belgium and Holland.**

From observation of the enemy's work, it is concluded that:

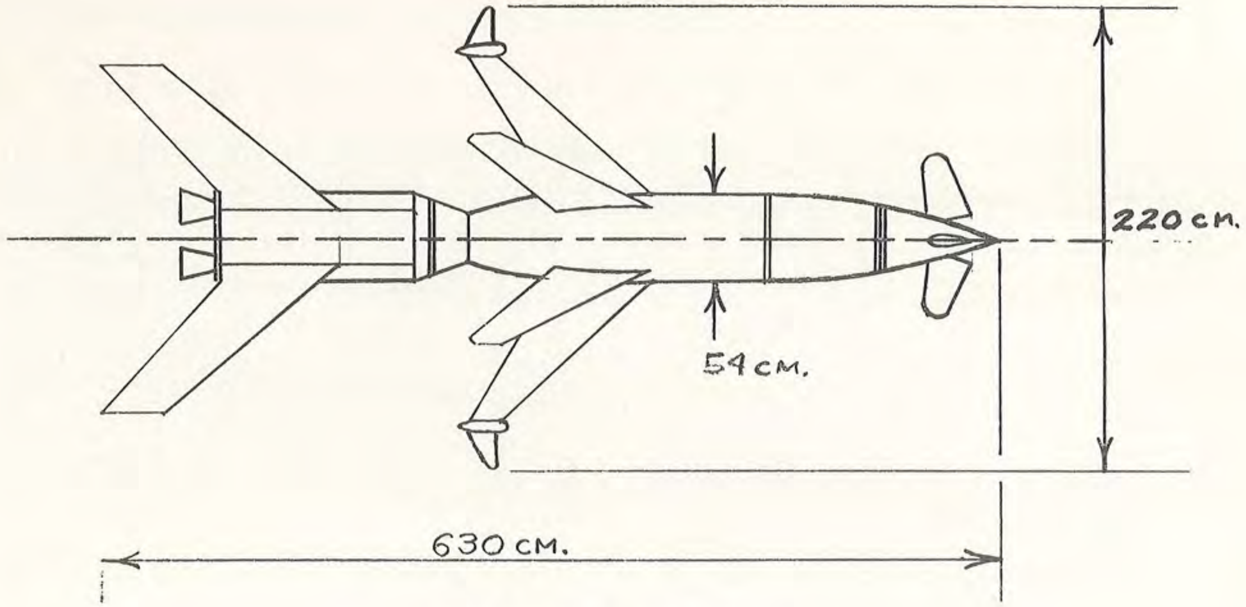
(a) If given a relatively short period of time, Germany would have succeeded in bringing into the war an effective counter measure against aerial bombers. She would have produced infinitely superior assault weapons through intensive exploitation of the science of guided missiles.

(b) From the standpoint of future warfare, the work of the Peenemunde and associated groups without question ranked among the most important being done in Germany on any subject. Although the apparent results of this organization have been extensively covered by investigators, determination of the groups' ultimate goal remains an assumption based on the trend of their developments. Undoubtedly they expected to produce weapons from the A series with which they could accurately hit any area on the face of the earth. It is equally obvious that with the V-2 they were not only working out in advance the aerodynamic and control problems of such weapons, but that in the present weapon they had a proven vehicle ready to receive whatever radically new explosive and propulsive substance they expected to become available. It is inconceivable that the V-2 was considered by the German scientists to be an end in itself, nor that with all its complexities it was developed at the cost of billions of dollars and manufactured in great quantity with highest priority merely to deposit 750 kilograms of ordinary explosive on British territory.

With the relaxation to a practical degree of the impenetrable screen that has surrounded the investigation of German atomic disintegration research, some of the hitherto inexplicables of their guided missile program are now subject to an analysis from which reasonable answers can be derived. It is now obvious that the Germans realized and have accepted for years the fact that a controlled missile is the natural vehicle with which to transport atomic explosive. At last, the reasoning behind the design specifications which provided for very small warheads and the invariable orders to terminate missile projects upon completion of development are no longer mysteries or absurdities.

(c) There existed in Germany no guided missile project which would warrant exact duplication with the expectation of using it as a practical weapon by the Allies. However, the knowledge we can gain from intensive study of their progress is infinite. Therefore, serious consideration should be given to the practicability of producing a limited number of representative German types to be used in a development and operational educational program conceived to bring the Allies abreast of the field.

(d) **If in any country the development of the weapons with which to fight a future war is, as it has been in the past, dependent only on the impetus of the war for support, that country when attacked will not survive the first operation!**



RHEINTOCHTER 1

Ground-to-air Missile Supersonic

Developed by: Dr. Hennies

Manufactured by: Rheinmetall-Borsig

Status: Experimental units built: NOT KNOWN
Experimental units tested: 88
Exp. units tested at: Leba, Pomerania
Production contract: None.

Method of launching: Adjustable launching ramp

Auxiliary launching propulsion unit:
Type: Solid rocket
Make: Rheinmetall-Borsig
Total impulse: 45,000 Kg. Sec.
Duration of thrust: 0.6 sec.
Thrust: 75,000 Kg.
Weight of unit: 650 Kg.

Launching attitude: At an angle.

Launching mechanism:
Length of guide: 6.0 meters
Aiming range: 360°

Velocity, maximum: Mach 1.12
Launching: 20 meters/sec
End of propulsion burning: 360 meters/sec

Propulsion unit:
Make: Rheinmetall-Borsig
Manufactured by: Rheinmetall-Borsig
Type unit: Solid rocket
Burning time: 10 sec.
Weight: 220 Kg.
Total impulse: 40,000 Kg. Sec.
Fuel type: Diglycoldinitrate
Fuel capacity: 220 Kg.
Thrust: 4000 Kg.

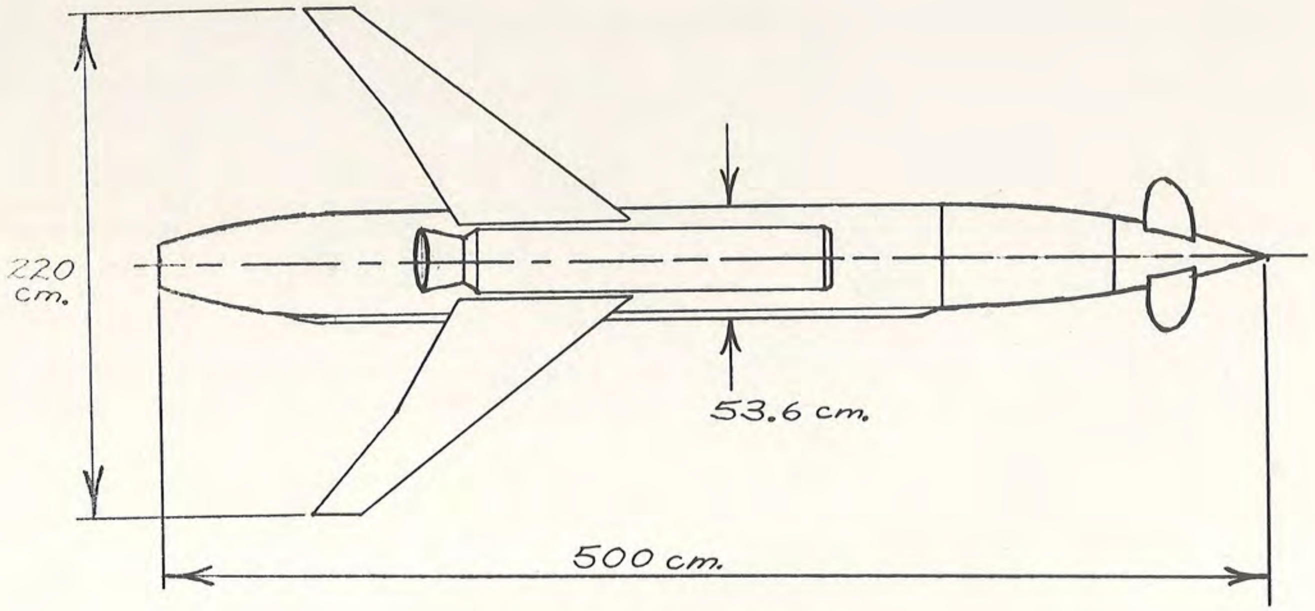
Missile dimensions:
Weight, total: 1750 Kg.
Weight, empty: 760 Kg.
Weight, warhead: 150 Kg.
Weight, explosive: 100-150 Kg.
Length: 630 Cm.
Span: 220 Cm.
Diameter: 54 Cm.

Control: Type in use: Radio and radar tracking
Code name: Elsas
Manufactured by: Telefunken & Strassfurt Rundfunk

Fuse: Type: Proximity
Code name: Marabu or Kugelblitz

Operating range: 12 Km.

Operating altitude: 6 Km.



RHEINTOCHTER 3

Ground-to-air Missile Supersonic

Developed by: Dr. Hennies

Manufactured by: Rheinmetall-Borsig

Status: Experimental units built: Approx. 260
- Experimental units tested: 40 tested as of 2 Sept 1944
- Exp. Units tested at: Leba, Pomerania
- Production contract: yes
- Contract quantity: Contemplated 1000 per month

Method of launching: Adjustable launching ramp.

Auxiliary launching propulsion unit:
- Type: Two soild rockets
- Make: Rheinmetall-Borsig
- Manufactured by: Rheinmetall-Borsig
- Total impulse: 25,000 Kg. Sec.
- Duration of thrust: 0.9 sec
- Thrust: 28,000 Kg.
- Weight of unit: 440 Kg.

Launching attitude: At an angle

Launching mechanism:
- Length of guide: 6.0 meters
- Aiming range: 360°

Velocity, maximum: Mach 1.28
- Launching: 20 meters/sec
- End of propulsion burning: 410 meters/sec

Propulsion Unit:
- Make: Conrad
- Manufactured by: Rheinmetall-Borsig
- Type unit: Liquid rocket
- Burning time: 45 sec.
- Weight: 100 Kg.
- Total impulse: 80,000 Kg. Sec.
- Fuel type: Visol and acid
- Fuel capacity: 424 Kg.
- Thrust: 1780 Kg.

Missile dimensions:
- Weight, total: 1570 Kg.
- Weight, empty: 525 Kg.
- Warhead: Not Known
- Weight, explosive: 160 Kg.
- Length: 500 Cm.
- Span: 220 Cm.
- Diameter: 53.6 Cm.

Control: Type in use: Radio and radar tracking
- Code name: Elsas
- Manufactured by: Telefunken & Strassfurt Rundfunk
- Proposed types: Decimeter
- Code name: Brabant
- Status: Development

Homing: Type in use: none
- Type proposed: Infra-red
- Code name: Gluhwormchen
- Manufacturer: Rheinmetall-Borsig

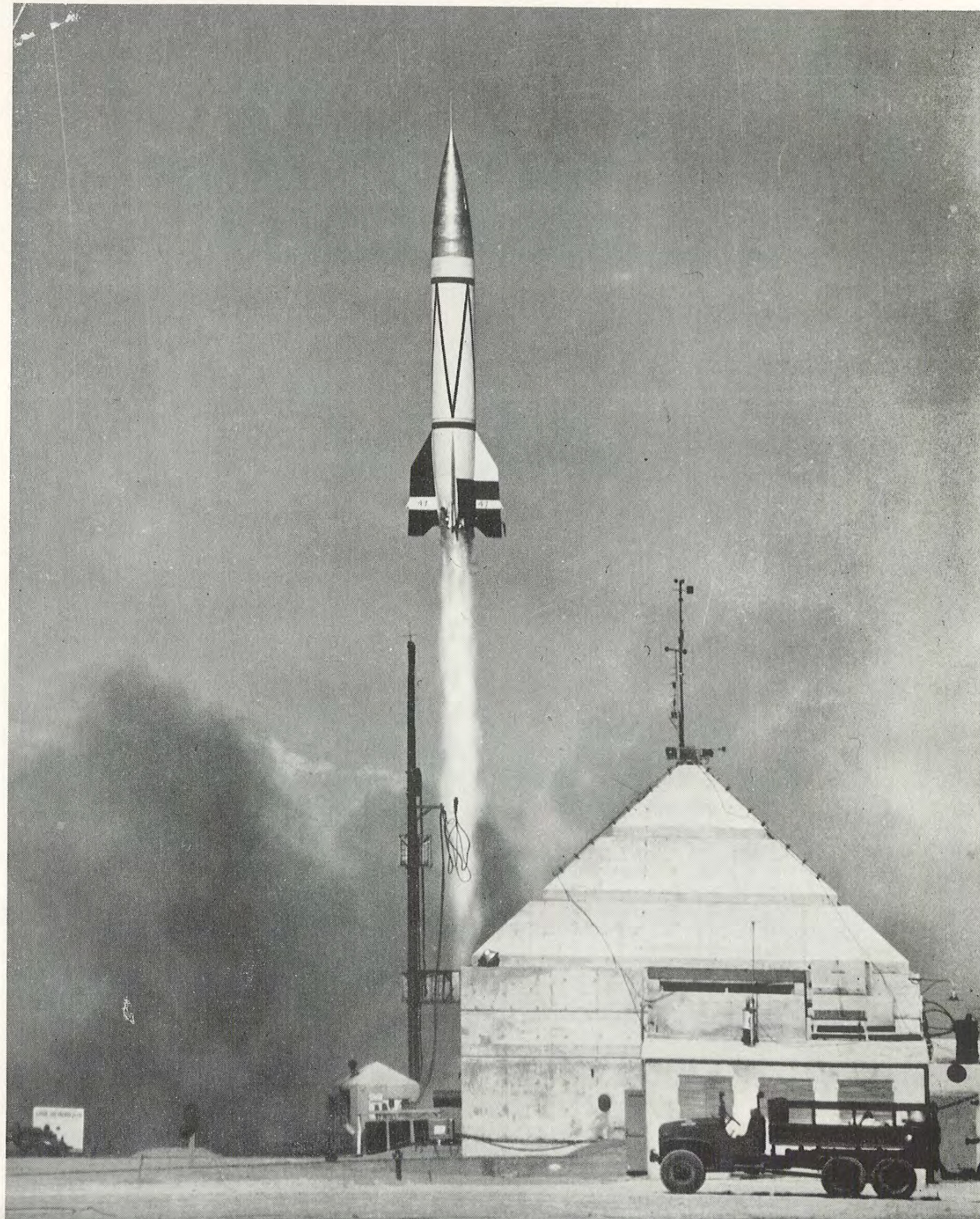
Fuse: Type: Proximity
- Code names: Marabu or Kugelblitz

Operating range: 15 Km.

Operating altitude: 8 Km.

converted warhorse . . .

A V-2 carries scientific instruments aloft at WSPG. (U. S. Army photo)



THE DESERT NAVY

by

C. I. RICKETTS

The story of the Army at White Sands Proving Ground and of the Air Force at Holloman and at Alamogordo bombing range has more than once been told and told well. How the Navy came to be at White Sands is less often heard. In this article Mr. Ricketts, who has seen much of this history himself, tells somethings of the beginnings and growth of the Naval Facility at White Sands.

U. S. Navy Firing Area W.S.P.G. (U. S. Navy photo)

This year White Sands Proving Ground celebrates its 10th Anniversary. In the Tularosa Basin to the east of the Organs, a group of several thousand people, most of whom work for the Army, has good reason to celebrate. To the east of the White Sands, a group of several thousand people, mostly working for the Air Force, also has good reason to celebrate. In addition to these thousands, there is a group about 300-strong which has equal reason to celebrate; this last group works for the Navy.

The Navy contingent at White Sands is small but not unnoticeable. In the Armed Forces Day parade held annually in Las Cruces, there are comparatively few Navy men marching but in their white uniforms they stand out. Similarly, there are comparatively few Navy missiles fired here at the Proving Ground, but like Viking 12 soaring more than 158 miles into the air they do not go unnoticed.

How much reason does the Navy have to join in the Anniversary celebration? How long have they been here, and how did they come to be here? Before the Navy could arrive in large numbers, they had to have a place to stay. The first arrival, therefore, was an Officer in Charge of Construction, a member of the Civil Engineer Corps. This officer, CDR J. A. Coddington, was given the responsibility of handling the planning and the negotiations which finally resulted in a contract to put up approximately 80 buildings at the Proving Ground for the Navy. The Navy apparently received its money's worth for its million dollar contract since the Quonset huts are still a prominent feature of the landscape.

As a result of CDR Coddington's planning, started at the beginning of 1946, the construction on the buildings began on the 15 of July, and all buildings were completed before a year had passed. In those days quonsets were used for laboratories, hangers, offices, shops and residences for the Navy. Quonsets are still used for all these purposes, but more than half of them are now occupied by the Army, although ownership is still retained by the Navy at the Proving Ground.

So we have facilities established for the Navy at White Sands. Why? The first contingent of personnel to arrive here for participation in missile work for the Navy was comprised of a group of 5 enlisted Marines followed in short order by two Marine Officers and a pair of civilians. Eighty buildings constructed at the cost of $1,000,000 were not required to house this group of 9 people since they arrived long before the buildings were constructed. Apparently they liked what they had found, since three are still at the Proving Ground, R. T. Malloy, R. T. Fuqua, and Mike Krivanich; although none of them, of course, are still working on their original project. They came here to contribute to Navy support of the V-2 firings at White Sands. The Naval Research Laboratory was given the task of instrumenting some of the early V-2 flights, and this group arrived for the instrumentation of a V-2 warhead.

Malloy at present is a civilian who works for Bendix Mishawaka on a Navy missile. Fuqua is a civilian employee of the U. S. Naval Ordnance Missile Test Facility here. Krivanich no longer works for the Navy. His allegiance has been switched to the Flight Determination Laboratory, then to WSSCA.

The first Naval Unit to be permanently established here, forming the original nucleus of the present Naval Establishment, had arrived by September of 1946 and was firmly settled here by the end of that year.

This settlement was badly surprised about the beginning of 1947 when a severe wind storm—more severe than the usual 70 and 80 knot winds encountered in this area—blew down from Organ Pass and did considerable damage to the Navy's buildings. Although the winds approached 100 knots in velocity, no one, fortunately, was hurt. Having weathered this blow, the Navy decided to become a permanent fixture here.

Eight years ago the seasonal sand storms, the winter's cold, and the summer's heat were major concerns for the personnel at the Facility—then called a unit. Now, with modern buildings such as the Desert Ship supplementing the older quonsets, and with adequate sand protection and air conditioning, working conditions are far more satisfactory.

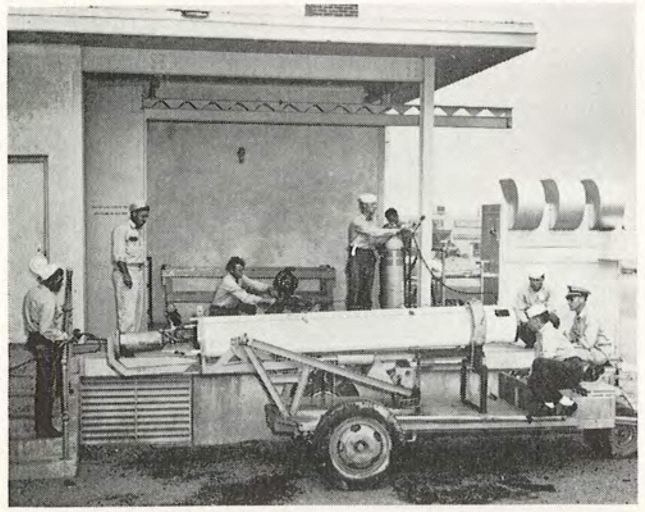
The nine years that have elapsed since the first arrival of the Navy—or what is almost the same thing, of the Marine Corps — have resulted in enormous changes. In those days all housing was highly temporary; even the quonsets had not been built. Now, seventy-six units of Naval housing present a jungle of television antennas staring toward Roswell in the east with smaller UHF antennas gazing down into the desert. Grass and garages, air coolers and hedges, all point up the difference from the "good old days". Looking from the elaborate and comfortable Naval Headquarters Building past a clump of the old quonsets, the 100-man Navy E. M. Barracks and the Navy Bachelor Officers Quarters are visible. Behind the Headquarters Building, the Proving Grounds' Machine Shop, manned by Navy, sits alongside a double missile hangar. Ten miles out in the desert, far beyond the Navy Supply Building and the Navy's warehouses donated to them by the Army, lies the Navy Technical Area. The old Navy Blockhouse with its twenty-seven-foot-thick roof faces the Aerobee launching tower. This blockhouse grew a new wing in 1952 far thinner-skinned than the original structure, but still providing adequate protection to personnel watching Viking firings. This section of the Blockhouse looks out on a 50,000 pound static test stand and twin launching pads which are serviced by tremendous gantry crane with 3 power-operated working bridges and an Otis elevator. Beyond this lies the deckhouse, an eleborate launching installation which leads to the Desert Ship, the LLS-1. All this progress and change indicates that the Navy is at White Sands Proving Ground to stay. At the Holloman end of the Proving Ground, however, things are different. The Navy drone squadron which for more than two years has occupied one of the Air Forces' hangars is at last leaving, taking their F6F drones with them. And with their departure, the Navy Liaison Officer will be the only representative of the Navy at Holloman.

But be careful; when you see a missile in the air at White Sands Proving Ground don't assume it's an army missile; when you see one flying near Holloman, don't assume it's an Air Force missile; look again. The Navy's missiles cover pretty wide territory. • • •

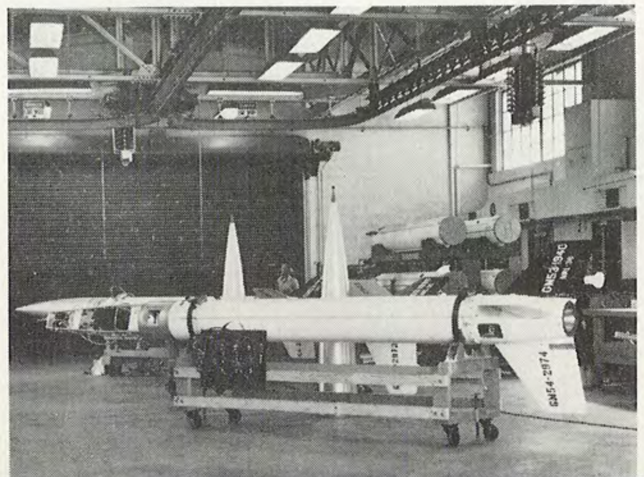
Aerobee in Pictures

The History of a Rocket Firing

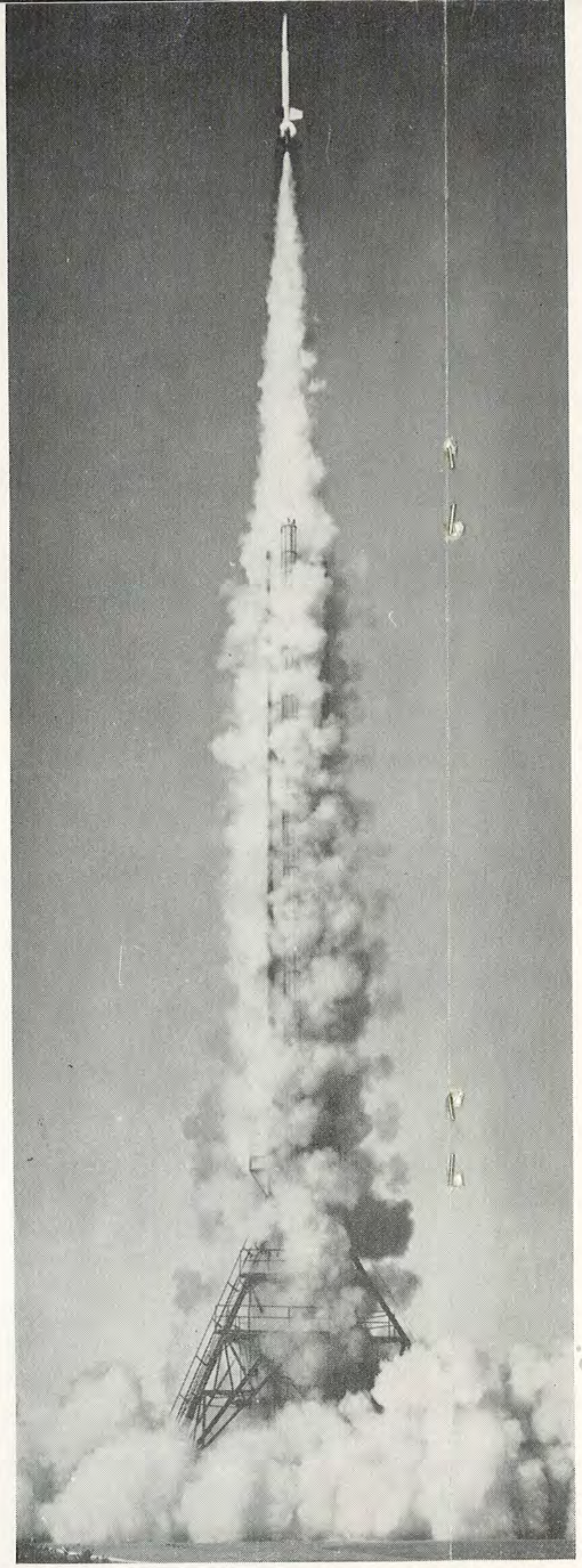
(U. S. Navy Photographs)



1.



2.

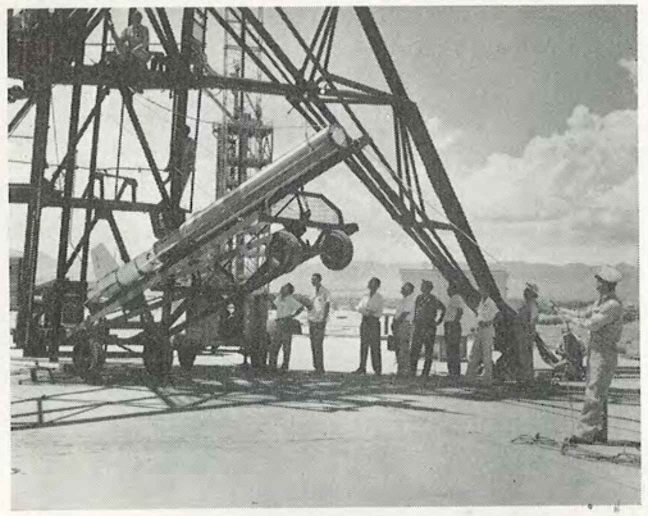


6.

1. Hydrostatic check of propellant tanks for strength and leaks.

2. Hangar check of instrumentation on NRL Aerobees 34, 35, and 36.

3. Transporting the rocket body from Aerobee laboratory in Navy Headquarters area to launching tower in Navy Technical Area 10 miles to the east.



4. Erecting rocket in launching tower.

5. Fuelling operations Note men in protective suits.

6. Flight firing. Note sustaining motor flames below rocket tail. Smoke trail is from booster. Both rocket and booster ignite at about the same time.

7. Impact. Note rocket body section in background and nose instrumentation section in foreground.

7.

SIMULATION

Three members of the Flight Simulation Branch are shown above programming and checking output on the ERA 1103 digital computer "UNIVAC." This general purpose computer can be used to simulate missile flights.

by

M. KEENAN

Introduction

CURRENT missile design relies more and more on various simulation techniques. In a recent article, M. Norman[1] described some basic techniques involved in electronic analogue simulation of a simple mechanical system. At this time I would like to discuss briefly certain general principles involved in simulation.

There are two basic types of simulation problems: a) simulation of an isolated system; and b) the replacement within an operating system of similes of some of the components. Although the basic techniques are the same, the approaches to these problems are quite different.

System Simulation

Let us consider the first aspect: simulation of a complete system. In this case, the inputs, outputs, and all intermediate steps are simulated. Figure 1 shows how such a simile represents the actual system. In the problems generally encountered, the relations are such that we may write

$$\mathbf{u}/\mathbf{v} = \mathbf{g}(\mathbf{p})$$

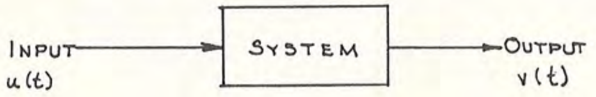
where $\mathbf{p} = \mathbf{d}/\mathbf{dt}$. Similarly

$$\mathbf{u}'/\mathbf{v}' = \mathbf{g}'(\mathbf{p}').$$

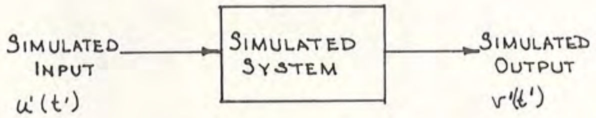
We say that the simile is adequate if the following conditions are met:

$$\mathbf{u}' = \mathbf{k}_1\mathbf{u}$$
$$\mathbf{v}' = \mathbf{k}_2\mathbf{v}$$
$$\mathbf{t}' = \mathbf{k}_3\mathbf{t}$$

where the various $\mathbf{k}_i$ are proportionality constants between the original variables and their similes. For example: if the system being considered were a servo, **u** and **v** might represent the input and output shaft positions; if we were using an electronic analogue, $\mathbf{k}_1$ and and $\mathbf{k}_2$ would have units of volts/radian; $\mathbf{k}_3$ accounts for any change in the time scale, ie, the relationship between "computer time (**t'**)" and "real time (**t**)."



a. ORIGINAL SYSTEM: v= f(u,t)



b. SIMULATED SYSTEM: v'=f'(u' t')

FIGURE 1. COMPLETE SYSTEM SIMULATION

The actual simulation may be accomplished in several ways. If the function g(p) is known, then a set-up which has a response of **g'(p)** may be used. Often, however, g(p) is unknown and is part of the information desired, or **g(p)** may be too complex for ready representation. In such cases each component of the system may be represented individually so that we have **g'(p')** built up from its "parts."

Component Simulation

In those cases where it is desired to simulate a component of a system, where the other components are to be present and operating, the problem is quite different, and generally more difficult. Figure 2 shows such a simulation problem. The difference and difficulty lie in the fact that we cannot choose convenient variables **u'**, **v'**, and **t'**, but must remain constrained to use the variables as they appear in the remainder of the system. That is to say: the input must be the same as the output of the previous stage and the output must be the same as the input to the following component. Such a limitation on the freedom of choice of variables often presents problems which are insurmountable with the techniques currently available.

(a). ORIGINAL SYSTEM: v = f(u,t)

(b) SYSTEM WITH SIMULATED COMPONENT: v = f(u,t)

FIGURE 2 COMPONENT SIMULATION

In those cases where a practicable solution is achievable, it is often necessary to perform a simulation by means of one type of technique and use converters at the two ends of the simile to convert the input and output data to the necessary forms. Figure 3 represents such a situation.

Examples

Any utilization of simulation techniques is designed to answer some question or group of questions. For instance, it may be desired to design an hydraulic servo which will position a given shaft assembly in accordance with some function of the position of an input shaft. What is the optimum design for such a servo?

(next page, please)

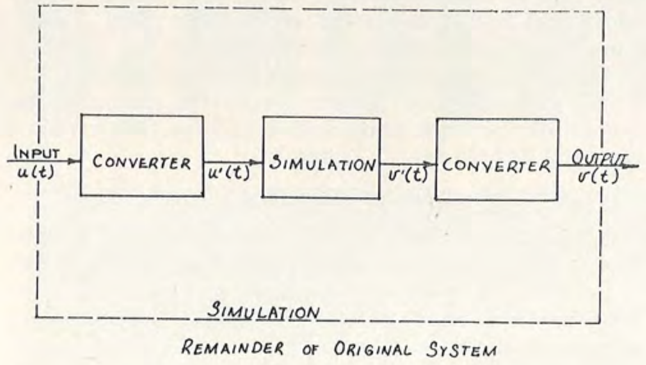


FIGURE 3 COMPONENT SIMULATION WITH CONVERSION STAGES

Since it is an exceedingly difficult task to vary components in an hydraulic system, we will simulate the servo with an electro-mechanical servo. Once the design problem is solved, we can translate our results form electro-mechanical terms to hydraulic terms. Figure 4 represents such a simulation problem. The techniques used in constructing the electro-mechanical servo may vary widely, making maximum use of various electronic techniques which are available. Notice in the figure that the input has been simulated as well as the servo itself. Since we have assumed that the response is a function of the input, such a measure can simplify the simile design vastly.

If the response characteristics of the load were known, then the whole system could be simulated. Generally this will result in a tremendous simplification of the problem. The complete system could be represented on a single electronic analogue computer, permitting convenient analysis of the problem.

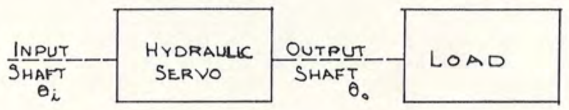
Of course, limitations are placed on the parameters in the simile. These correspond to practical limits involved in the manufacture of the hydraulic components. A valve vane with a mass of 10^6 grams is quite impractical (at least in missile work), as would be one with a moment of inertia of 10^{-3} ounce-inches. It might even be desirable to limit the parameters to certain discrete values corresponding to available commercial components. Even in such a case, the testing can be performed at a fraction of the material cost and labor involved in testing of actual hydraulic equipment.

Conclusion

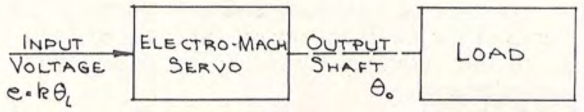
A great many engineering problems can be solved by means of simulation techniques, which can indicate solutions with ease and speed. These problems are by no means limited to mechanical, electronic, or hydraulic machinery. Nor are they limited, as might be indicated by my choice of examples, to systems with a single input and output. Such techniques are used extensively in the solution of design and evaluation problems in anti-aircraft fire control systems, missile guidance systems, even propulsion systems.

The Electro-Mechanical Laboratories at White Sands Proving Ground has established two simulation laboratories, Digital Simulation and Analogue Simulation, which are constantly working on the simulation of problems encountered in the design and testing of guided missile systems.

Note:—[1]Norman, M: "Analogue Computer Methods"; **"Missile Away!"**, 11:4, Winter 1954-55, p 22 ff.



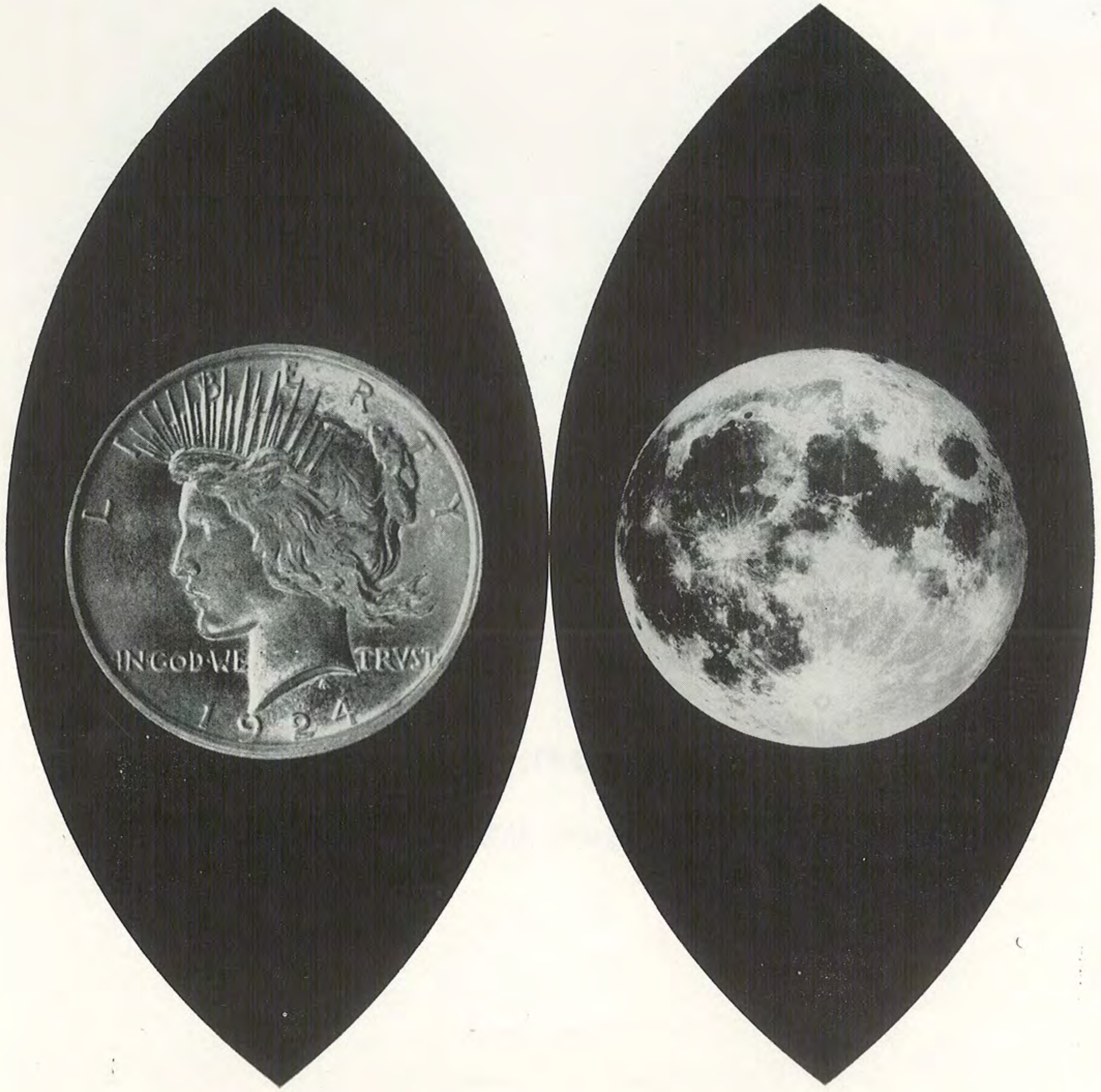
(a) HYDRAULIC SYSTEM: $\frac{\theta_o}{\theta_i} = g(p)$

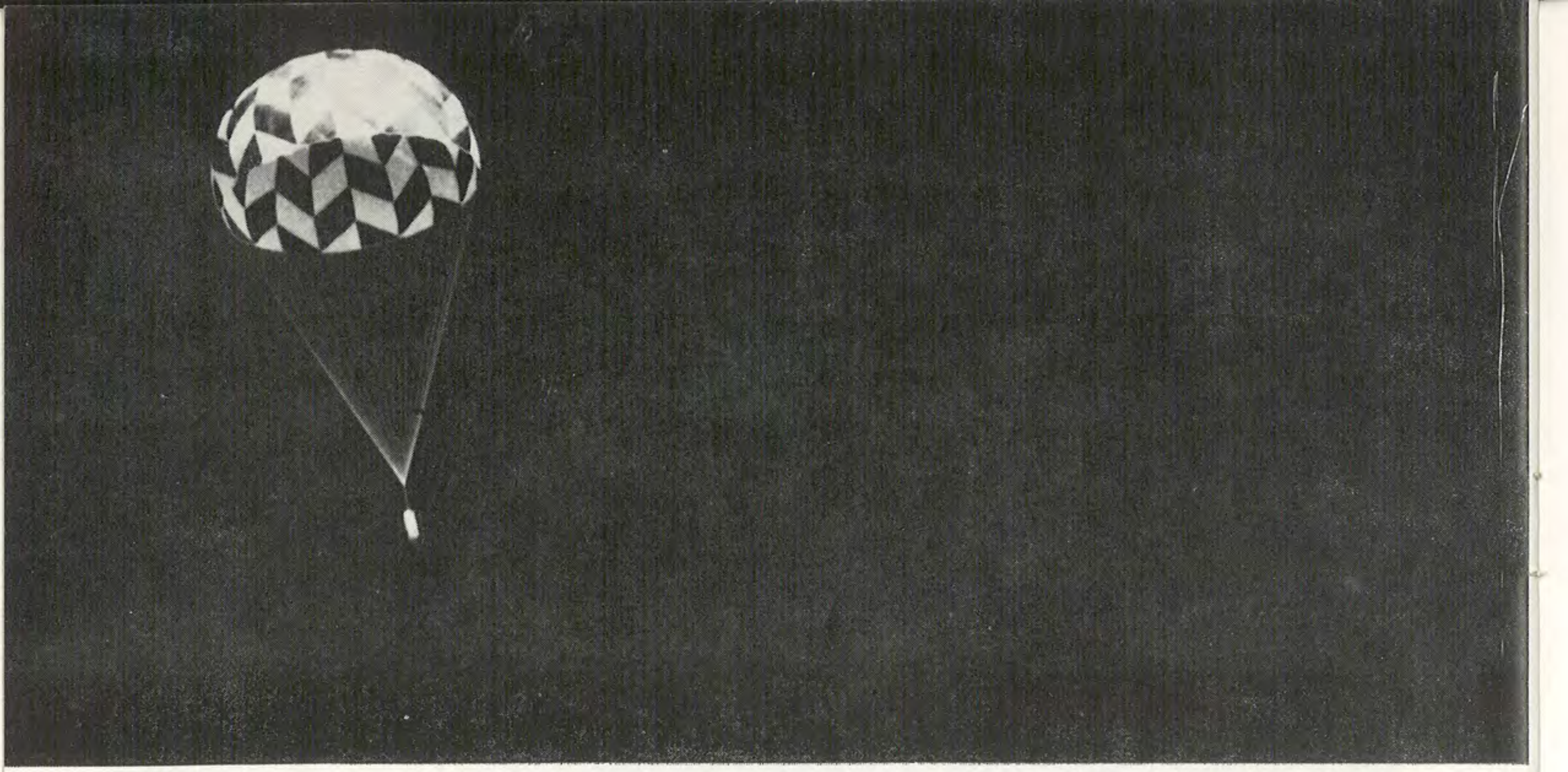


(b) ELECTRO-MECHANICAL SIMULATION: $\frac{\theta}{e} = \frac{1}{k} g(p)$

FIGURE 4: SIMULATION IN A SERVO DESIGN PROBLEM

"Hey, I forgot my disintegratin' pistol!"





The Application of Parachutes for Missile Recovery Systems

by

Reinhard Krause

Holloman Air Development Center

Performance diagrams for parachutes. Does the opening shock increase with altitude? Multiple stage recovery systems for high speed recovery. Two basic methods to accomplish recovery at high altitudes.

RECOVERY systems are used in research programs or during the test phase of missiles to recover valuable parts at the end of a test flight. Generally they are used only as auxiliary devices in missiles and are therefore often considered to be items of minor importance. The loss of valuable equipment, however, in cases where no recovery systems were used or where failures of the system occured, leads to a more thorough consideration of recovery requirements, especially as increasing performance requirements (higher weights, speeds, and altitudes) create new problems.

The purpose of a recovery system is to bring a body down to the ground from a certain altitude and initial velocity with such a low speed as to avoid major damage. The most important components of recovery systems in use today are parachutes, because they provide very high drag-weight and drag-bulk ratios.

Many factors worthy of consideration which apply to parachutes can only be mentioned. The characteristics of different parachute types, such as drag and stability, are of great importance. Among these types are solid flat, extended skirt or ringslot chutes used as final stage chutes and ribbon and guide surface chutes used as drag chutes. The conditions affecting reliable opening of parachutes and the squidding above a certain "critical opening speed" are of interest. It is, however, beyond the scope of this article to treat these questions.

It is not the intent of this paper to present the present state of the art, but to show some applications of parachutes for Missile Recovery Systems. A number of interesting problems are involved in the design of recovery systems, which are unknown to the layman as well as to most engineers working in other technical fields. Latest research results and test data can, of course, be published only to a limited extent.

1. SINGLE STAGE AND MULTIPLE STAGE SYSTEMS

Recovery systems which used only one parachute (or several parachutes parallel, deployed at the same time) to decelerate a body to the final rate of descent are called single or one stage systems. The final rate of descent at ground impact determines the size of a specific type parachute required for a given weight. The drag surface or drag area required for the parachute results from the equation:

$$C_D S = \frac{2W}{\rho V_e^2} \; [\text{sq. ft}] \quad (1)$$

where C_D is the drag coefficient of the parachute
S the area of the parachute in sq ft
W the weight of the load in lb
p the density of air in slugs/ft^3 and
v_e the equilibrium speed in ft/sec (rate of descent).

Equation (1) shows that at a higher allowable rate of descent the size of the parachute required can be reduced considerably, which means less weight and volume for the parachute. The allowance rate of descent depends on the sensitivity of the equipment to be recovered. Normally the rate of descent required for missile recovery is in the order of 20 to 25 ft/sec. Special means, if applicable, such as use of air bags or of a penetration spike can be applied to reduce the impact shock. Using such means, it may be possible to increase the rate of descent up to about 50 ft/sec.

The maximum speed at which a parachute can be opened is usually determined by the strength of the parachute construction. At high speeds, volume and weight requirements increase considerably. The maximum speed for a certain type chute can also be limited by allowable forces acting on the structure of the recovered body and by the allowable G-load for the recovered equipment. One stage systems are, therefore, normally used only at low initial speeds (in the order of M 0.3).

At higher initial speeds two (or more) parachutes are used in series. The first stage chute will then be a small chute of heavy construction, usually called a "drag chute". The drag chute will decelerate the body to a speed that is lower than the maximum allowable speed of the final stage chute. The the drag chute will be released and the final stage chute deployed. This large final stage chute can be of light construction which is essential for low bulk and weight requirements.

SPEED VS. ALTITUDE DIAGRAM FOR PARACHUTES

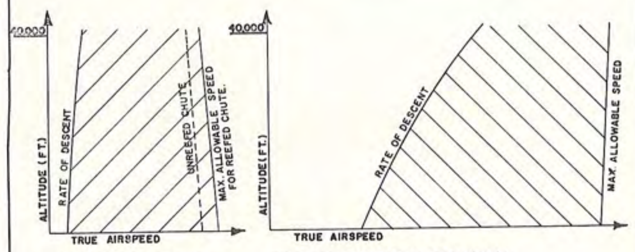


FIG. 1 DIAGRAM FOR A FINAL STAGE CHUTE.

FIG. 2 DIAGRAM FOR A DRAG CHUTE.

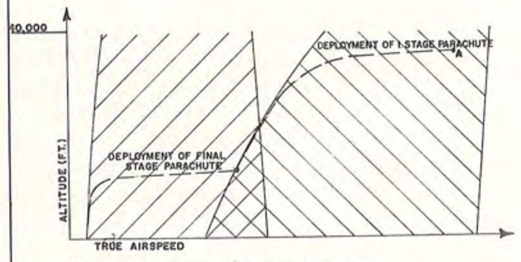


FIG. 3 DIAGRAM FOR A TWO STAGE SYSTEM.

Each parachute used in a recovery system will cover a certain speed range which changes with the altitude. It is therefore useful to determine the performance of each chute and to plot its speed range in a diagram.

Figure 1 shows this type of diagram for a final stage chute. In this diagram only deployment speeds which

(next page, please)

are higher than the equilibrium speed, or rate of descent, are considered. Of course, the parachute can also be opened at lower speeds as is done for recovery of loads from balloons. The rate of descent, as shown in Figure 1, will be higher at higher altitudes because of the decreasing density. The maximum allowable speed may decrease at higher altitudes for final stage chutes. This speed limit is determined by the maximum force during the opening process of the parachute, which is usually called "opening shock". The strength of the parachute must then be higher than the opening shock (safety factor).

Figure 2 shows a diagram for a drag chute. The main difference between this type of chute and final stage chutes can be expressed by using the factor W/C_DS, called here the "surface loading" of the parachute. The following typical example may show the order of surface loading for different chutes. Let the rate of descent of a final stage chute be 25 ft/sec at sea level. The surface loading will then be 0.75 lb/sq ft. For the drag chute, used as a first stage, a rate of descent of 250 ft/sec at sea level may be required. Then the drag surface of this chute has to be only 1% of that of the final stage chute as can be seen from equation (1), resulting in a surface loading of 75 lb/sq ft. The high surface loading of drag chutes is the main reason for the different characteristics of drag chutes during the opening process, compared with final stage chutes. The upper speed limit in the diagram is therefore different from that for a final stage chute.

Figure 3 shows the diagram of a two stage system. The overlap of the speed ranges of both chutes indicates at a glance the importance of a low deployment altitude for the final stage chute, which can be attained by activating the chute ejection with a barometric switch. Low deployment altitude will also result in less drift. If a drag chute is opened at point A, which is determined by a certain initial speed at a corresponding altitude, the body will be decelerated along the dotted line. The slope of this line is, of course, subject to the initial dive angle of the body. Although the final rate of descent of the drag chute will not be reached completely, after several seconds a speed is attained which is not much higher than the equilibrium speed. If the recovery is initiated in an emergency case at a lower altitude than that altitude for which the aneroid switch was set, the main chute deployment must not be activated. The drag chute must first be opened for such a time period as to decelerate the body from the maximum allowable speed of the drag chute to the maximum allowable speed of the final stage chute. This time delay required must be determined accurately and guaranteed by installation of a timer.

In order to find the upper speed limit, the opening shock of a parachute must be determined. A number of factors influence the opening behavior and will be discussed in the following chapter, considering only subsonic speeds. Readers who do not want to go into these details may continue with Chapter 3.

2. OPENING SHOCK VS ALTITUDE

One might expect the decreasing density to cause decrease of opening forces at higher altitudes. It has been found, however, in a great number of tests that the opening shock is greater at higher altitudes. This experience has been accepted so widely that it is frequently generalized as a characteristic common to all types of parachutes.

The question as to how the opening shock varies with altitude will be discussed, assuming the same initial TRUE AIR SPEED (TAS) for various altitudes throughout this chapter. Only in the last paragraph conditions for the same initial indicated airspeed (IAS) are discussed. Comparisons will be made for chutes with

a. High surface loading (in the order of 75 lb/ft^2)
b. Low surface loading (in the order of 0.75 lb/ft^2)

In order to simplify the problem, a number of other parameters of influence (porosity, shape, etc.) will not be considered and secondary effects, such as acceleration of the surrounding air (influence of virtual mass), will be neglected.

OPENING FORCES OF CHUTES OF DIFFERENT SURFACELOADING AT DIFFERENT ALTITUDES BUT AT THE SAME TRUE AIRSPEED.

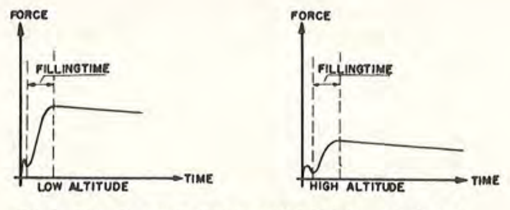


FIG.4. CHUTES WITH HIGH SURFACELOADING. (dragchutes)

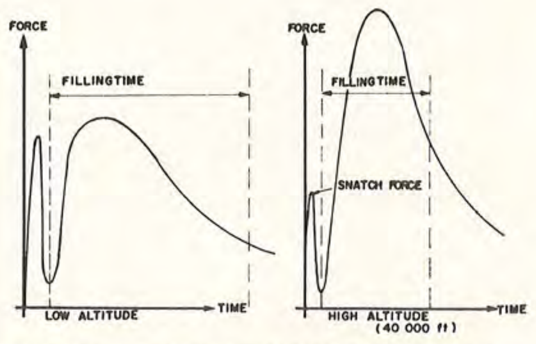


FIG.5. CHUTES WITH LOW SURFACELOADING (final stage chutes)

At initiation of recovery, the bag, into which a parachute is normally packed, may be pulled out by a small pilot chute. Due to the drag of the bag and pilot chute, the bag is decelerated. As the distance between bag and load increases, the suspension lines of the parachute are pulled out of the bag. After the lines have been fully stretched, the drag surface of the parachute comes out of the bag and is stretched. This portion of the procedure from the moment the bag leaves its compartment until full "line stretch" is called "deployment" of the parachute. Bags which are designed in such a way as to assure full line stretch before inflation of the parachute can occur, are called "full deployment bags."

At line stretch, parachute and load will attain the same speed. The acceleration of the parachute mass at this moment causes a force which is called "snatch force".

Inflation of the parachute begins after line stretch. The maximum drag occuring during inflation of the parachute is called "opening shock". The application of full deployment bags avoids the possibility of snatch force and opening shock occuring at the same time. The time period from line stretch to full inflation of the parachute is called "filling time".

For parachutes with high surface loading, the speed will be reduced only slightly during the opening process. For an infinitely great load, the speed would not be reduced at all and the maximum drag F would occur at full opening.

$$F = (C_D S)_o \frac{\rho}{2} V_s^2 \quad [\text{lb.}] \quad (2)$$

where $(C_DS)_o$ is the drag surface of the fully inflated parachute in sq ft and v_s the initial true air speed at line stretch in ft/sec. The filling time would then have no influence on the opening shock. For a finite load, but a high surface loading, the influence of different filling times at different altitudes may normally be neglected also. The opening shock of drag chutes can therefore be calculated in this simple way with the exception that a factor is introduced which allows for consideration of different types of parachutes and for secondary effects. The force may then be up to 50% higher than would result from equation (2). The fact that in many cases the maximum diameter of the parachute exceeds the normal open size, due to load peaks and the elasticity of the material, is normally neglected.

Figure 4 shows force vs time diagrams for parachutes with high surface loading, at sea level and high altitudes. Snatch force as well as opening shock are lower at high altitude deployment due to lower density.

The characteristics of this group of parachutes have been investigated extensively at an altitude range between sea level and 40,000 ft.

At high altitude deployment (40,000 ft) the speed will be reduced more during the filling process, than in the case of drag chutes. The dynamic pressure at the end of the filling process is, therefore, reduced to such an extent that the force drops off at the end of the filling process, which leaves the peak force occuring during the filling process as plotted in Fig. 5.

If a parachute is deployed at sea level, the reduction of speed begins very early in the filling process, when the drag surface is still small. This is due to the higher air density. As the drag surface increases, the dynamic pressure is continuously reduced. The force at each moment can be obtained by multiplying together the instantaneous values of drag surface C_DS and dynamic pressure $p/2.v^2$. The maximum force obtained can then be smaller, compared with high altitude inflation and takes place earlier in the filling process.

This is especially true for solid cloth parachutes,

(next page, please)

where the porosity effect contributes to the same tendency. The effective cloth porosity is higher at low altitudes (Ref. 7), therefore, the outflow of air through the porous cloth is greater, resulting in a longer filling time and lower forces.

The filling time is, however, also longer at low altitudes for parachutes with high geometric porosity where the effect of cloth porosity is of little importance. This will be explained later.

If we compare, for example, the condition of 50% inflation of a parachute at 40,000 ft and at sea level, the main factor of influence would be just the dynamic pressure $p/2v^2$. The influence of the density would cause a force which is 4.0 times higher at sea level if the speeds would be equal. Assuming that the speed at low altitude inflation at this moment would be 0.4 of the speed at high altitude, the dynamic pressure would be 0.16 of that at 40,000 ft. The force at sea level would then be 4.0 x 0.16=0.64 or 64% of that at 40,000 ft altitude.

In order to calculate force vs time during the opening process, certain assumptions must be made as to the increase of drag surface vs filling time. A simple assumption is that the projected surface increases linearly with time.

At very high altitudes (in the order of 60,000 ft and above), the influence of decreasing density is obviously greater than the influence of speed reduction during the filling process and then the opening shock will decrease even for parachutes with low surface loading. This leads to the question, "Would not the opening shock disappear at a certain altitude?". Considering the following, it is possible to draw a useful conclusion as to the order of magnitude of the altitude where the opening shock does not exceed the weight of the load:

Let the trajectory be vertical. Then the rate of descent v_e, the "equilibrium speed" of the fully opened chute with the load can be determined for each altitude. v_e will increase at high altitudes due to the lower density. At a certain altitude, v_e will be equal to the initial speed v_s, which was assumed to be constant for all altitudes. If the parachute is opened at this altitude, the body will not be decelerated. The force between parachute and load will therefore be equal to the weight of the load, if deceleration due to the increasing density during the descent is neglected.

As an example, a final stage parachute with a rate of descent v_e=25 ft/sec at sea level may be opened at different altitudes at a constant true air speed of v_s= 300 ft/sec. The equilibrium speed at any altitude will be such that the dynamic pressure is constant:

$$\frac{\rho_{SL}}{2} V_{e_{SL}}^{2} = \frac{\rho_h}{2} V_{e_h}^{2} \quad (3)$$

where SL denotes values at sea level and h values at the altitude h. The altitude at which v_eh equals v_s can be determined from the density ratio ph/psl. This ratio is obtained by solving equation (3) for:

$$\frac{\rho_h}{\rho_{SL}} = \left(\frac{V_{e_{SL}}}{V_{e_h}}\right)^2 = \left(\frac{25}{300}\right)^2 = 0.00695$$

which corresponds to an altitude of approximately 110,000 ft. This is, for this specific example, the altitude at which the force to be expected is only in the order of the weight of the load. If we go back to a horizontal trajectory at parachute deployment, the force to be expected should be even lower. As we are not interested here in an exact determination of this altitude, we may neglect other parameters. The virtual mass e.g. will probably not be of geat influence at a density ratio of 0.00695.

The type of force peak for low loaded parachutes as shown in Figure 5, suggests the application of special means to obtain a lower force over a longer time period. A device which is simpler than shock absorbers is very often used for such chutes. It is a reefing method by means of a line, which restricts the diameter at the skirt to a certain extent. After several seconds, the line is cut and the chute fully opens at reduced speed.

The observation that the filling time decreases with altitude is, at first glance, just as surprising as the fact that the opening shock increases with altitude. We have seen that the increase of opening shock was restricted to certain conditions (low surface loading, lower altitude range). This presents the question whether the variation of filling time with altitude might not be restricted to the same conditions.

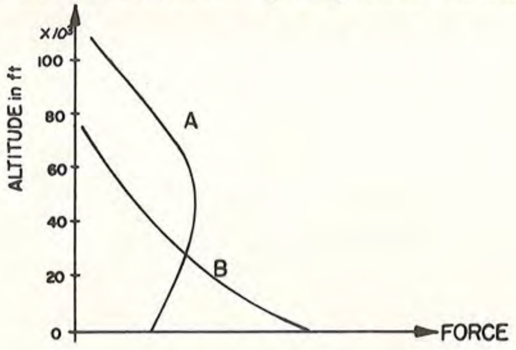


FIG.6. OPENING SHOCK vs ALTITUDE AT CONST. INITIAL TAS

A = LOW SURFACE LOADING
B = HIGH SURFACE LOADING

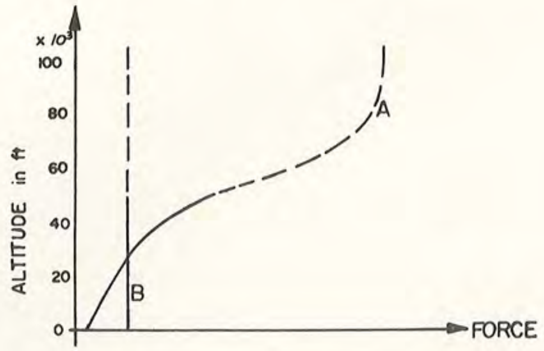


FIG.7. OPENING SHOCK vs. ALTITUDE AT CONSTANT INITIAL IAS.

An empirical formula is frequently applied to determine the filling time (Ref. 3):

$$t_f = \frac{8D}{V_s^{0,9}} - \frac{\rho}{\rho_{SL}} \quad (4)$$

where D is the diameter of the parachute in ft.

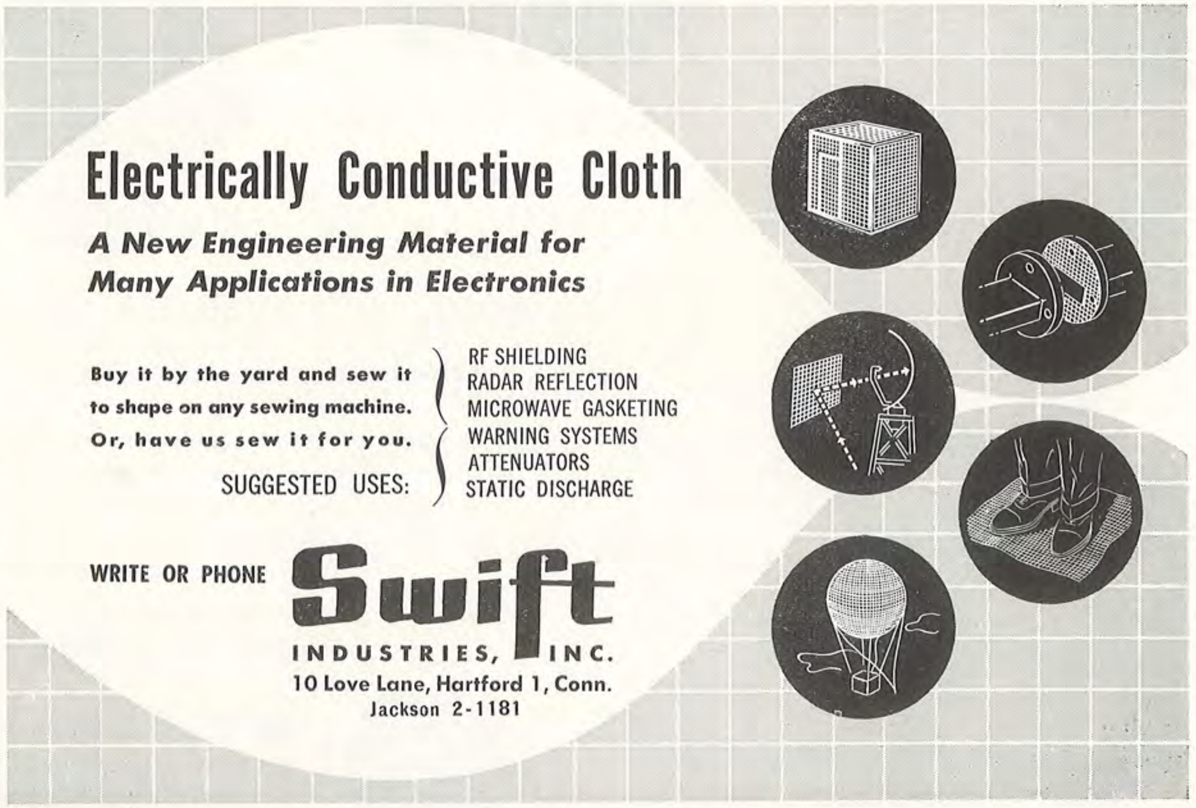
The usefulness of this formula has been proven by a great number of tests of conventional parachute types with low surface loading at altitudes up to 40,000 ft. For other conditions, however, this formula cannot be used to predict the filling time. Especially at very high altitudes, it cannot be expected that the filling time is reduced by the factor p/psl.

Assuming for a first approximation that the filling time would normally be constant at different altitudes (and constant initial TAS) but considering variations of speed during the filling process, it seems that the increase of filling time for the case of low loaded parachutes at low altitudes can be well explained as follows: The rate of opening is determined by the increase of volume, caused by the air inflow into the parachute (reduced by the outflow through the porous parachute). The rate of opening is then proportional to the speed (Ref. 11). A decrease of speed during the filling process, therefore, causes a decrease in the rate of opening, resulting in a longer filling time.

In Figure 6, the results of these considerations for constant TAS at various altitudes have been plotted. The results for the same Mach number at various altitudes will be similar. Arbitrary values for both chutes were selected for the force at sea level. The tendency of opening shock to decrease at higher altitudes is evident from curve B and the upper part of curve A. The lower part of curve A represents the range in which the opening shock increases with altitude or, in other words, decreases at lower altitudes. If this phenomenon is interpreted as an exception to the general behavior, mainly caused by the deceleration during the filling process at low altitudes, the varying slope of the curve is easily explained. Frequently, this lower part only has been considered, since the majority of parachute tests conducted in the past were tests with low loaded parachutes at altitudes up to 40,000 ft, such as jumps with personnel chutes, and low speed tests with single stage parachute systems—cargo drops, etc. This may explain why the characteristics of parachutes in this range have often been adopted as the general rule for parachute behavior.

Constant indicated air speed means constant dynamic pressure $p/2.v^2$. For drag chutes, equation (2) shows that no variation of shock forces with altitude is to be expected (see curve B, Figure 7). For parachutes with low surface loading, the opening forces will decrease more rapidly at lower altitudes since the difference in filling time at low and high altitudes (40,000 ft) is further increased due to higher true airspeeds at high altitudes.

(next page, please)



PARACHUTE SYSTEMS

In Fig. 7 again arbitrary values for the opening shock at sea level were selected. For practical conditions (surface loadings between 0.5 and 500 lb/sy ft) only the lower part of the curves is of interest because at high altitudes constant dynamic pressure is connected with high supersonic speeds. The upper part of the curves has only been plotted to show their characteristics.

The curves in Fig. 6 and 7 may actually look different if other parameters and secondary effects, as mentioned at the beginning of this chapter, would be properly considered. The purpose of these considerations, however, was only to contribute to a better understanding of the physical conditions during parachute inflation at different altitudes. For this purpose, Fig. 6 and 7 may be a good illustration.

3. RECOVERY FROM HIGH SPEEDS

Since some problems of recovery at very high altitudes are different from those at lower altitudes, only altitudes up to about 60,000 feet are considered in this chapter, although recovery from several hundred thousand feet will normally also be a high speed recovery.

At speeds which exceed the maximum allowable speed for a final stage chute, an additional drag chute can be used. At high initial speeds, such as supersonic speeds, the opening shock of this drag chute may be of such an order that the forces or the decelerations occurring do not allow deployment of a drag chute of the size required for sufficient overlap of the speed ranges of drag chute and final stage chute. Then it may be necessary to use another drag chute of smaller size as a first stage. This means, of course, a complication of the whole system.

Data which can be used for the design of drag chutes for transonic and supersonic speeds are being continuously collected. Shape and stability of such drag chutes may be different from those used at subsonic speeds and high loads may require new materials and a different construction. The determination of drag forces is in principle the same as at subsonic speeds, but requires knowledge of the actual inflated diameter and of the variation of c_D vs M.

The problem of aerodynamic heating may also become critical at higher Mach numbers. Materials more heat resistant than nylon, which is used today for all parachutes for missile recovery, may extend the speed limit in the future. However, nylon chutes can still be used at supersonic speeds due to the fact that the body will be decelerated to subsonic speeds within a very short time period.

The higher the initial speed, the more effectively a body can be decelerated without using a parachute, thus avoiding a complicated multiple stage parachute system. If the initial velocity is considerably higher than the terminal velocity of the free falling body, the body will be decelerated and the maximum speed for deployment of the first stage chute will be reduced.

In some cases it may be possible to reduce the terminal velocity of the free falling body by using air brakes or by making the body unstable. If it is planned to recover only the most valuable parts of a missile, separation of these parts from the remaining portion will ordinarily induce an unstable motion. Special care is, of course, required for the detailed design of recovery systems for unstably falling bodies, to consider such a location of the parachutes and such a deployment sequence as to avoid entanglement of the body or other parts with the deploying chute. After full deployment, rotation of the body around the longitudinal axis may cause twisting of the suspension lines and collapsing of the inflating parachute. This can be avoided by installation of a swivel.

This phase of deceleration without use of a parachute may be considered as a first phase of the recovery sequence as its application may be used to simplify the whole system. If weight and volume considerations do not allow the application of a recovery system using drag chutes with all pertinent deployment and release mechanisms, only this method might make recovery possible and it may, under certain conditions, be preferable to take a certain risk of failure due to the uncontrolled motion than not to recover at all. The application of this phase requires, of course, a certain minimum altitude above the ground to allow complete operation of all phases of the recovery sequence.

Figure 8 shows a family of speed vs time curves for horizontal motion. It can be used to determine the deceleration of bodies at high speeds due to their own drag in order to find the time period required to reduce the speed to a certain value. Weight, drag surface and altitude are considered by the parameter $\frac{W}{C_DS} \cdot \frac{P_0}{P}$. This graph can only be used for short time periods. For longer time periods, the angle of the trajectory and the altitude will change too much. This could be considered by using the same type of chart for several constant dive angles and considering large changes of the angle by using the next chart, while changes in altitude can be considered by changing the parameter in steps.

The greatest inaccuracy will be induced by the assumption of the drag coefficient in this speed range, as c_D varies considerably at transonic and supersonic speeds. If the body falls stably, data will be available to plot c_D vs M and to assume then a constant average c_D value in the speed range concerned. For an unstable motion the assumption of an average c_D value for the spinning body may be difficult and no general rule can be given. If the time delay for the deceleration phase, which results from the lowest c_D value expected, is not critical due to too low altitude for recovery, this value should be used.

The curves, Figure 8, can also be used to determine the deceleration of bodies with a drag chute in the speed range plotted. As the opening time of small drag chutes at high speeds is in the order of less than a tenth of a second, this opening process of the chute may be neglected. The drag surface of the body must then be

(next page, please)

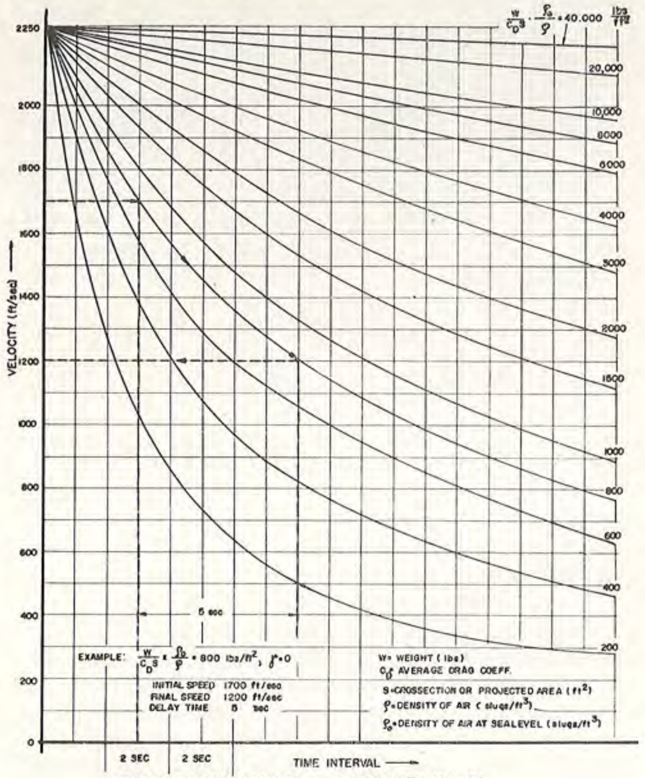


FIGURE 8: DECELERATIONCURVES $\gamma = 0$ (HORIZONTAL MOTION).

substituted for by the drag surface of the parachute.

Efforts to further simplify the recovery system have, in some cases, led to a solution where the missile is "pulled up" until the speed is reduced so much that the final stage chute can be opened. This method works only as long as full control of the missile is guaranteed. One great advantage, namely the possibility of saving the missile under severe conditions, even if other components fail, is then lost.

4. RECOVERY FROM HIGH ALTITUDES

Figures 1 through 3 have only been plotted up to an altitude of 40,000 ft because parachutes are currently used in this range. But parachutes can also be used at higher altitudes up to about 250,000 ft. However, at altitudes above 100,000 ft, certain speed limitations increasingly restrict the application of parachutes. In this chapter only vertical free fall of the body to be recovered will be considered. Recovery from very high altitudes is in any case related to high speeds, because at low air density the drag of a body or even of an inflated parachute may be considerably smaller than the weight of the body. Therefore, the body will be accelerating to to a higher speed. Normally the trajectory of a free falling body can be assumed until an altitude is reached where the drag exceeds 5% of the weight.

The speed vs altitude diagram for high altitudes (Fig. 9) shows a speed range in which the parachute must not only be deployed, but also remain after parachute inflation. The influence of free molecule flow (slip flow region) has been neglected.

The lower speed limit is determined by the minimum dynamic pressure required to obtain reliable inflation of a parachute. This pressue is assumed to be between 0.03 and 0.07 lb/ft² (Ref. 9). If the parachute is deployed at a speed below this limit, uncontrolled movement of parachute and load can cause entanglement and malfunction of the chute. Even above this speed limit the parachute is not always able to stabilize the system, due to the small drag. At high altitudes the minimum speed increases so appreciably that the speeds reached do not allow a reliable application of parachutes above 300,000 ft. Probably there are still other unknown factors which are of influence on the inflation of parachutes at supersonic speeds and very low densities. Photographs of Aerobee and V-2 firings showed that some parachutes did not inflate, although the dynamic pressure was higher than the minimum value. Other chutes showed violent vibrations while changing shape at high frequency after inflation (aeroelastic effects).

The upper speed limit is determined by the loss of strength of the parachute due to the influence of high temperatures on parachute materials (aerodynamic heating). Nylon may be used up to temperatures in the order of 300° F. This effect of the temperature on the material is a function of time. At higher temperatures the strength will be reduced considerably. At approximately 480°F, nylon melts. More heat resistant materials will allow a certain extension of allowable speed range. There are not sufficient data for calculations or sufficient test results available to determine the upper speed limit exactly. Therefore, the plotted line should be considered as an estimated limit. However, calculations of temperatures of parachutes and test results of Aerobee firings have been used (Ref. 9 and 10). These Aerobee tests are not quite conclusive, as there is little information about the inflation of the parachutes during these tests. At least some of the parachutes which failed due to overheating, were not fully opened. The emission of heat back into the air was therefore much smaller compared to a fully inflated parachute because of the smaller radiating surface.

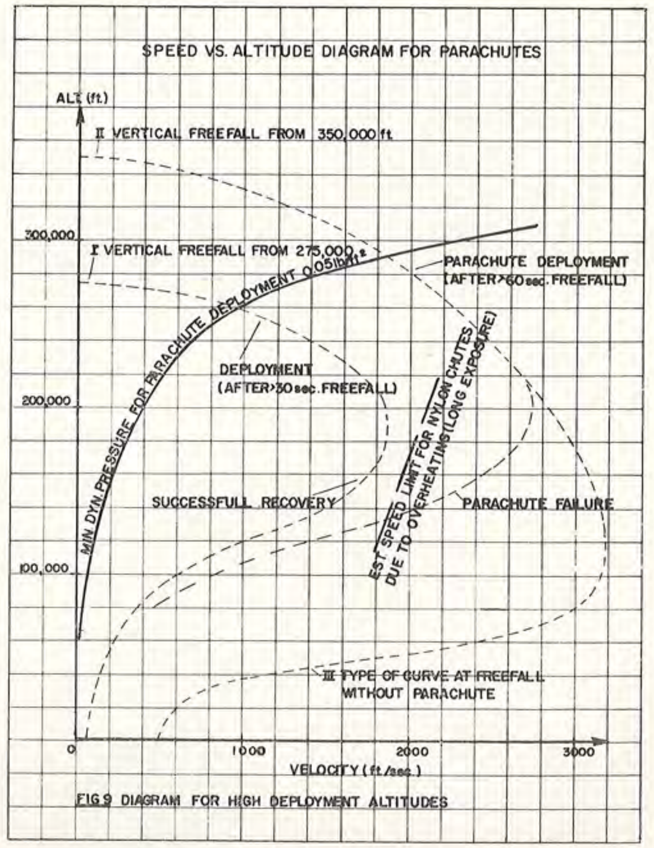


FIG 9 DIAGRAM FOR HIGH DEPLOYMENT ALTITUDES

Also, the exposure time has not been considered in Fig. 9 for determining the upper speed limit. Depending on the surface loading and the density, the exposure time will vary considerably. The factor for which part of the trajectory the parachute is exposed to is important. In the examples plotted, the parachute is already open when the body approaches the maximum speed. To designate this type of exposure, the curve plotted in Fig. 9 is called a limit for "long exposure". In fact it should be possible to substitute this curve by a family of curves for different lengths of exposure.

There is another type of exposure: deployment at low altitudes and high speeds, where the parachute is opened at the maximum speed and only exposed during the more rapid deceleration phase, as mentioned in Chapter 3. This type of exposure allows higher maximum speeds, if other conditions are the same.

Fig. 9 can be used by plotting on the diagram speed vs altitude for the body to be recovered. Trajectories for bodies which fall vertically from 275,000 and 350,000 ft respectively have been plotted in Fig. 9. Their shape is characteristic for all high altitude free fall trajectories.

Curve I represents the trajectory of a body falling from 275,000 ft, which may be considered as the peak altitude of a rocket. The parachute may be opened if the speed has increased to at least 1,000 ft/sec. The speed, however, will further increase with the fully opened parachute due to the low density, but is reduced again at lower altitudes within the safe speed limit.

Curve II represents the trajectory of a body falling from 350,000 ft. The parachute may be opened if the speed is in the order of 2,000 ft/sec. The maximum speed attained with the fully opened parachute is in the order of 2,800 ft/sec (about M 2.3) and exceeds the allowable limit. The parachute will fail due to overheating conditions. The maximum speed of the body depends on the size of the parachute. If for body II a larger chute were used, it might be possible to decelerate the body in the safe speed range, but a large chute (low surface loading) means a low rate of descent and a long descent time (drift), which is undesirable.

If a parachute with a drag surface of 100 sq ft is opened at a dynamic pressure of 0.1 lb/sq ft, the force will only be 10 lb. There is no opening shock, as was to be expected according to the considerations in Chapter 2. A parachute of light construction may therefore be used. The largest force will occur during deceleration at lower altitudes.

Another method of recovery from high altitudes has been suggested and a great number of successful tests have been conducted. In this method, the body is falling free to low altitudes without a parachute. The trajectory will be of the type of Curve III, Figure 9. The final rate of descent may be in the order of 300 to 1,500 ft/sec, mainly depending on the surface loading, the shape and the stability of the body. This rapid deceleration from a speed of several thousand ft/sec is caused by re-entry into the denser atmosphere. A drag chute could not do a better job. If the parachute deployment is initiated by a barometric switch at an altitude as low as possible for complete operation of the recovery system the conditions for recovery are no more severe than for normal recovery at low altitudes. A two-stage, or even a one-stage recovery system may normally be used. This is a very rapid recovery method compared with high altitude deployment.

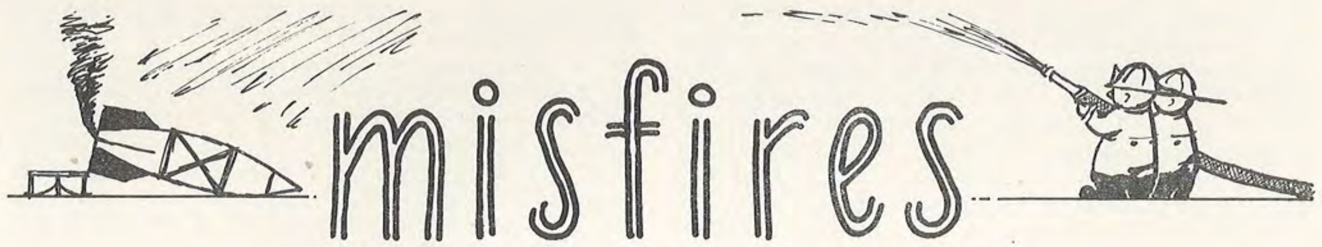
Another advantage of this method is that the limits for the peak altitude are much higher than those plotted in Fig. 9. The aerodynamic heating, however, for parts of the body or for the parachute inside the compartment, and the maximum allowable deceleration (G-load) for the equipment, due to the drag of the body itself, will set limits for the peak altitude.

5. CONCLUSION

The explanations made may give an idea of the various possibilities of the application of parachutes. This field is still in full development and much research is being done in order to extend weight and speed limits and to collect data for the design of recovery systems for the high performance requirements of future missiles. Many interesting problems concerning aerodynamics, properties of textile materials and the rather complex characteristics of parachutes are still to be solved. For present requirements, however, data are available for the design of reliable recovery systems if installation of the system is already considered in the first design phase of a missile and tests of components are conducted prior to the installation of the recovery system in the missile.

REFERENCES

1. E. Pflang, "Determination of the Deceleration Forces During the Opening of Cargo Parachutes", ZWB/FB/1706 RV92—AT1 26111, 1942.
2. W. D. Brown, "Parachutes", Sir Isaac Pitman and Son Ltd., London, 1951.
3. Wright Air Development Center, USAF, Parachute Handbook, AT1 No. 35532, Revised 1 March 1951.
4. F. J. Stimmler and R. S. Ross, Goodyear Aircraft Corporation, "Drop Tests of 6000 Sq. In. Model Parachutes", Vol. VIII Summary Report, AF Technical Report 5867, May 1954.
5. T. F. Johns, "Parachute Design", Royal Aircraft Establishment, Technical Note No. ARM 365.
6. H. G. Heinrich, "Parachutes, Guide Surface", MC REXE-672-25F, 10 February 1948.
7. H. G. Heinrich, "Experimental Parameters in Parachute Opening Theory."
8. T. W. Knackle, "Design, Use and Construction of FIST Type Parachutes", Memor. Rep. MC REXE-672-19LL, 30 January 1948.
9. T. W. Knackle, "High Altitude Parachute Recovery", A Reprint from Physics and Medicine of the Upper Atmosphere.
10. M. C. Green, "Investigation of Recovery Parachute Failures on Aerobee", HAFB Rep. No. 3, 8 February 1951.
11. Foote and Sherberg, "Dynamics of the Opening Parachute", WADC/The Ohio State University, 1952.
12. Cook Research Laboratories, "Recovery Systems for Missiles and Target Aircraft", Interm Progress Reports PR 3-1 through PR3-30.
13. J. C. McGrath, "Symposium of Parachute Textiles", WADC Technical Report 54-4g.
14. Radioplane Company, "A Study to Establish Parachute Research and Development Program", WADC Technical Report No. 53-78.
15. E. R. G. Eckert, Calculation of the temperature which a parachute canopy attains at high altitude, Headquarters AMC Technical Report No. F-TR-2123 ND, 1946.



The Night of The Kill

by

CPL. ROYMOND

The skies were grey that autumn day
And the status light stood on white;
And the launcher crew with naught to do
Lay sleeping with all their might.
The boys on the hill, as all men will,
Were sawing logs in the tent.
With a little buzz, that's all there was,
Into yellow alert it went.
Four men side by side hit the door in a stride,
And in a minute the missile lay white.
They went to their posts like scurrying ghosts;
The men didn't utter a sigh.
Without even a shrug, they threw in the slug
And pointed its nose at the sky.
The radars were manned, the skies quickly scanned,
That tell-tale blip to be seen.
They worked in haste, not a minute to waste,
For they wanted the hit to be clean.
Then with a roar that shook every door
The missile took off in its flight.
You'd better suppose that with death in its nose
It's motive was clear for that night.
To relieve all the tension, but needless to mention,
The plotting board showed a clear hit.
So back to the tent the radar men went,
And the launcher crew back to the pit.
The stories were told of that night so bold,
How the missile went off with a roar,
But their eyes couldn't reach 'way down to the beach
Where a seagull lay dead on the shore.

SURE-FIRE DIALOGUE FOR SPACE TRAVEL MOVIES

(Just plug it into any old plot)

You're Dr. Warner? Well, uh . . . I never expected that a Ph. D and rocket expert would be a good-looking . . . ah, I mean, an attractive woman!

It's absolutely essential that we get some drug to help those pilots when they get beyond the earth's gravity.

So Jake's sick . . . Waddaya mean, I've got to run the radar? I don't know nothin' about it!

Take it easy, Joe. Nothing to worry about. Just like riding a subway train back in Brooklyn.

Take **her** along? Captain, a woman on a space ship is bad luck! Besides . . .

It's a man from the Congressional Committee! He's got a subpoena for us! Quick, into the ship! We'll have to take off immediately!

It's a stowaway! Must have sneaked aboard.

Sometimes I think space wasn't meant for conquest by man . . . If the Bible is right . . .

Captain, we've got a leak in the nitric acid tank.

All hands strap down! There's a meteor coming!

That uncontrolled blast has thrown us off course. That's not the Moon ahead. It's Mars.

Dr. Warner . . . uh, Joyce, if we get out of this alive and back to earth . . .

So **that's** what happened to the Martians? We've got to get home and tell them it can happen to us!

So we have to throw out another 110 pounds! You can't force Joyce to stay! I'm going aground. Take off without me!

We made it! So help me, the biggest rocket I want to see after this is the Fourth of July kind!

New Years' Resolutions of a Rocketeer

I hereby solemnly swear (as I do quite occasionally) to abide by the following resolutions for the coming year:

1. I will not use 110 V. A. C. on a 28 V. D. C. electrical system.
2. I will not actuate the water flood valves while people are on the launching pad.
3. I will not lose the key to the firing panel three minutes before firing.
4. I will not forget to order propellants before attempting to fire.
5. I will make sure there is enough film and paper in the recorders before making a test.
6. I will not check booster squibb continuity with a standard VOM meter.
7. I will not spit in the hydrogen peroxide.
8. I will not call the range controller with a request to reschedule while the missile is burning on the lancher.

ENGINEERING TYPES

— by Wagoner —

Rare Birds of the American Southwest

Compiled by

R. K. AUDOBURNE

DESERT EAGLE (liquidis primerus)

Field Marks: There was considerable variation in size within the species, but the bird seldom reached a nose-to-tail length greater than 15 feet. Generally, a clear metallic covering with possibly a small distinctive mark on an individual bird. Tail fins tended to be rather long and narrow, not extending far beyond the body diameter. The body was long and slender having a length-to-diameter ratio in the neighborhood of 10.

Similar Species: Many contemporary birds — the European Man-O-War or Veetoo, the Fie Kingbird, the Nye Keybird, and the Square-Tailed Swift, to name a few — are nearly direct descendants of the Desert Eagle. During its era of existence, the only similar species was a distant relative in central Europe most frequently observed around the Raketenflugplatz in Berlin.

Range: Originated in Massachusetts, but was driven out of the area due to the fear that it might be dangerous. Migration to New Mexico was complete, and, after about 1929-1930, was seen only in the area around Roswell.

Comments: In Massachusetts, sightings were reported by quite a large number of individuals, but after the migration to New Mexico it was seen by only a few highly reliable birdwatchers such as Charles Lindbergh and Charles Mansur who were privileged to be in the area. Even though the observers of this bird were few, the flights around Roswell were quite frequent. During its time, the Desert Eagle was without a competitor, being able to fly higher and under better control than any prior or contemporary species. The bird is now extinct, but well preserved specimens have been ceremoniously placed on display in the Smithsonian Institute and in a special reconstruction of its nest in Roswell, New Mexico.

Other Names: Massachusetts Menace, Goddard's Growler, Roswell Redtail.

post shoot conference

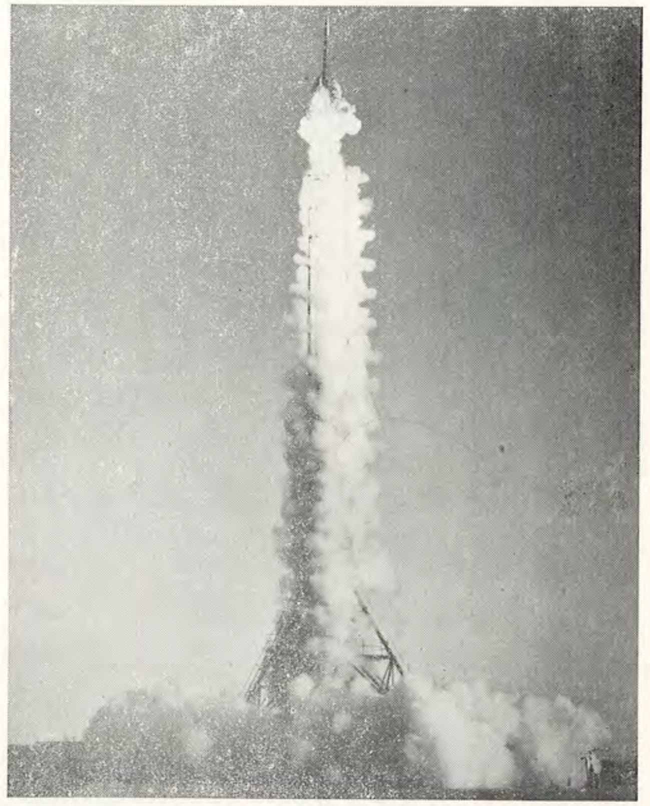
THE 25th Anniversary Issue of "Jet Propulsion," the ARS Journal, was certainly something to save, and the editorial staff of that esteemed "big brother" publication is certainly worthy of kudos for a fine job of publishing which will remain as a wonderful source of material and inspiration as we enter into the 2nd quarter-century of the ARS.

Also coming into the spotlight for cheers is the Southern California Section. According to the reports of our spy net (widely distributed in that area and very reliable!), they really outdid themselves, giving the NM-WT Section a great goal to meet the next time we have a Semi-annual Meeting down here.

Operation Bacchus has finally come to light. The Project Officer has authorized us to release the details of the project in order that people can get ready for it. For the past year, the NM-WT Section has been quietly planning to show the world in general that rocket people can have fun too. On March 3, 1956, the Navy BOQ at White Sands will be the scene of the biggest and best "space ball" thrown anywhere at any time. Plans are now in effect to decorate the entire lobby and dining room as a spaceport passenger terminal and the wardroom of a spaceliner, complete with sound effects, scenery, and large punch bowls containing various types of "rocket fuel". Costumes pertaining to rocketry and/or space travel of the past, present, or future will be the dress of the evening, unless members prefer to come in standard formal attire. Price will be $5.00 per couple, and admission will be limited to members of the ARS and their guests. Prizes will be awarded for the best costumes, and a dance band will be playing loudly (this is supposed to be a centrifuged space ship so there will be gravity available!). Better start making your plans now! Help will be available from the special Operation Bacchus Costume Aid Group, so don't put off coming because you can't think of a costume.

And if you haven't guessed it by now, Bacchus is the ancient Roman god of wine and revelry . . .

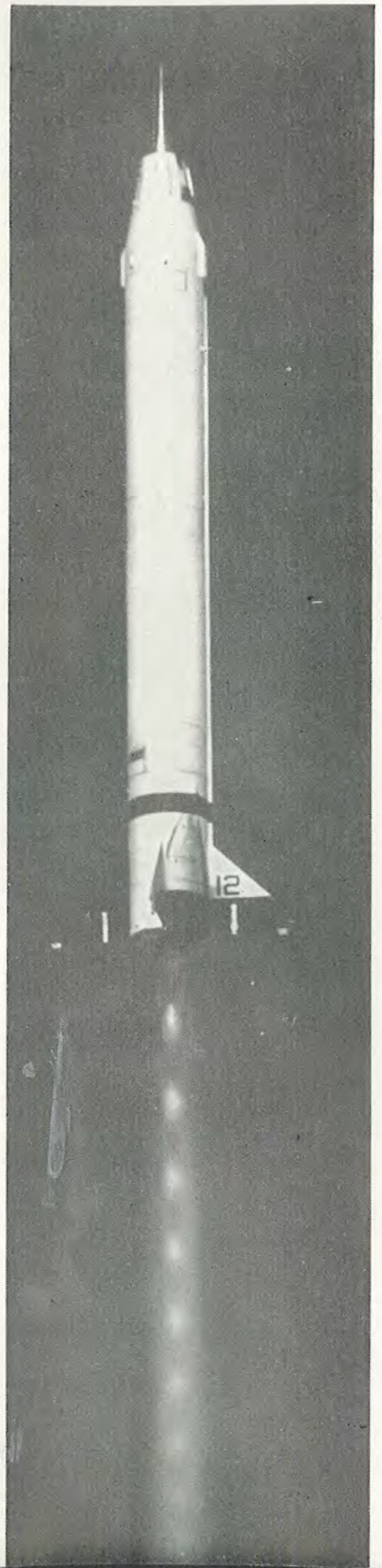
By the time you read this, the 1955 Section officers will be enjoying a well-earned rest from their strenuous duties, and the new 1956 officers will be getting down to the grind. We may not be the biggest Section in the ARS, but there is no reason why we can't continue to be the best . . . and the officers of the Section are the ones which lead the way. Let's remember the fine leadership shown by our past officers, and continue to show the rest of the Society how to operate! (The last said in jest, of course!)



(U. S. Navy Photograph)

Boy, you should have heard **the Post-Shoot Conference** on this Aerobee!

"Beyond the satellite, the future can be only dimly perceived. One thing can be said. As long as men have the curiosity and the courage, the exploration of space will continue to at least the farthest reaches of the solar system."—Milton W. Rosen, The Viking Rocket Story, **page 235.**



Coming from the Rocket Capital of the World at White Sands Proving Ground, "Missile Away!" is proud to publish the works of the men who are foremost in their fields, the men who have been in the forefront of American rocket development.

Those of us with the New Mexico-West Texas Section of the American Rocket Society chose the above quotation from Milton Rosen as the representation of our feelings about the ultimate use of the rocket, the new prime mover.

The rocket alone is not our goal; nor is the conquest of space. Already, rocket-powered guided missiles stand ready to defend our cities. Rocket-assists are being used on commercial airliners.

Advances in propellant chemistry, combustion, instrumentation, and servomechanisms are already being felt by the man in the street as derivaties of the devices of rocketry find their uses in the everyday world.

"Missile Away!", far from being written for the select few of rocketry, is our contribution. Within its pages has appeared—and will appear—the heartbeat of rocketry, the hard-won history, the humor, the thoughts, and the story of the men who are living the audacious dream of Goddard, Oberth, Winkler, Wyld, and all men who have looked at the stars and wondered.

The success of this magazine's philosophy is evidenced by the fact that few back issues are available. But the future ones can be yours if you are not already receiving "Missile Away!"

TO: MISSILE AWAY!
Subscription Dept.
P.O. Box 1242
Las Cruces, N. M.

Please begin subscription with issue circled:

Spring Summer Fall Winter

Name ______________________

____

Street ______________________

City & State ______________________

Occupation ______________________

SUBSCRIPTION RATE—$1.00 per year


RMI