ASTRO-JET

JOURNAL OF THE REACTION RESEARCH SOCIETY

Number 15 November, 1946

George James, President of the Reaction Research Society, holding Slim Jim, a parachute-test rocket, which rose 1200 feet at a press show, October 31, 1946.

TABLE OF CONTENTS

The Reaction Research Society Announces its first PROGRESS REPORT, which will be issued March 12, 1947, the fourth anniversary of the Society.

This Report will cover all Society research from the date of the organization on March 12, 1943, to January 31, 1947.

The results of our nearly forty research reports will be given in great detail and illustrated with numerous charts, diagrams and photographs.

The Report will make an indispensable addition to the library of anyone interested in reaction propulsion.

Due to the large demand for this report, advance orders are now being accepted. The price is $2.00 and purchasers will be billed upon issuance.

Please send orders to:
Secretary, Reaction Research Society,
3262 Castera Avenue,
Glendale 8, California

Members of the Society will receive the Report free.

As of January 1, 1947, Associate Memberships will be $3.00 per year, and Active Memberships will be $5.00.

Beginning with the January issue, ASTRO-JET will be issued four times yearly, and the subscription rate will be $1.50 per year.

THE HIGH ALTITUDE RESEARCH ROCKET

The ultimate goal of our present research program is, as with most rocket societies, the high altitude research rocket.

However, the Reaction Research Society's approach to this goal is quite different from that of many other rocket societies.

The Reaction Research Society intends to approach its research goal systematically, by carefully exploring all fields that are even remotely related to the high altitude research rocket.

Naturally, the field most directly related to the altitude rocket is the liquid fuel propulsive system. Realizing the inherent weight of the bi-fuel system, the Society is conducting research into the lighter weight solid-liquid, and mono-propellant systems.

Another field directly connected with the high altitude research rocket is that of launching devices. The Society does not believe that the research rocket necessarily has to be an expendable device. At the present time, several members are conducting research into various types of landing devices. To raise the device to a suitable height for accurate testing, solid fuel micrograin rockets are being used.

The solid-fuel rocket is another phase of rocket research that should be thoroughly explored before embarking on the testing and development of the altitude rocket. Because of the inherent low cost and easy handling characteristics of solid fuel rockets, all of the body designs, instruments, landing devices and guiding systems of the liquid fuel rocket can be tested at a lower cost than would be the case if the units were tested with liquid fuel rockets.

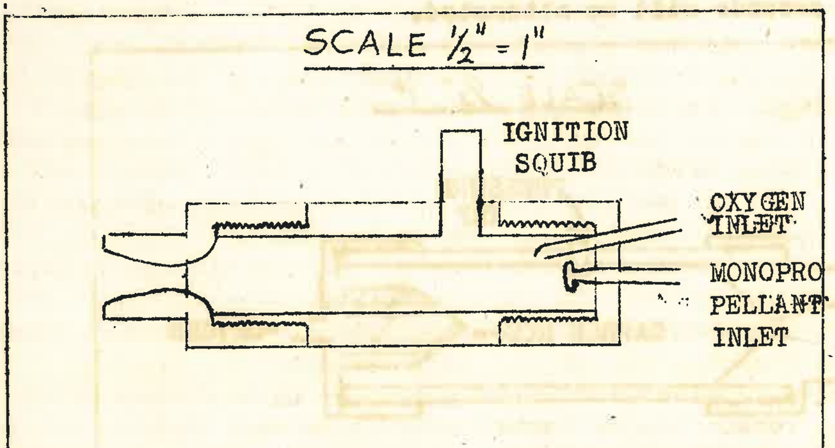
When the time comes for the actual designing and construction of the high altitude rocket, the task will be greatly simplified because of the data which will result from our research system.

G. J.

MONOPROPELLANT ROCKET ENGINE RESEARCH

On September 18, 1946, George James developed the Reaction Research Society's first monopropellant. Subsequent research has resulted in a monopropellant listed as R39-Ex5 in the research report files. This particular monopropellant is a light blue liquid at normal temperatures but decomposes with explosive violence at elevated temperatures.

Because of this characteristic, probably the liquid will only be able to be used in uncooled motors. The high cost of the fluid, at the present, will limit research to very small engines. At Present the planned ignition procedure will be as follows: The pyrotechnic squid in the side of the engine will be ignited electrically, the oxygen will be turned on, and the monopropellant valve will be opened. After combustion starts the oxygen will be turned off. Below is sketched a monopropellant test motor now under construction.

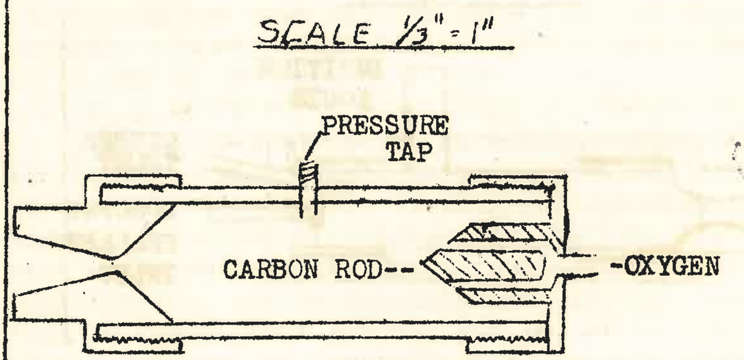


MONOPROPELLANT TEST MOTOR

S. D. MAYALL

SOLID-LIQUID ROCKET ENGINE RESEARCH

As pointed out in Astro-Jet No. 14, the Reaction Research Society has acquired the untested CRS solid-liquid engine No. 5. After many modifications this engine is at last ready to test. These modifications have consisted of replacing the cracked graphite nozzle with a solid copper nozzle, changing the oxygen flow which originally started perpendicular to the combustion chamber walls, and cutting holes in the carbon rod to increase burning area. Also a chamber pressure fitting has been tapped into the side. This first engine will be started in the conventional CRS manner--a welding rod will strike an arc on the carbon rod and maintain it long enough to cause the carbon to glow. When the carbon begins to glow the welding rod will be withdrawn and the oxygen turned on. Because of the uncooled nature of RRS solid-liquid engine no. 1 (sketched below) only short runs of less than ten seconds will be attempted.



Drawn by
S. D. MAYALL

OLD NEEDLENOSE, THE
SUPERSONIC TRAVELER

-Roland Bradley-

This article is reprinted from the August, 1946 issue of Boeing Magazine.

Frankly, we came down from Seattle to Wendover, Utah, in very high pitch. We were going to watch a GAPA launching--GAPA for Ground-to-air Pilotless Aircraft--a new type of air weapon being developed by Boeing for the Army Air Forces, designed for thrust by rocket motors to supersonic speeds. Until very recently this project has been classified "secret" by the Military, and very few persons had witnessed an actual launching.

We knew that the Boeing GAPA were intended automatically to seek out and destroy enemy high-speed, high-altitude aircraft, both piloted and pilotless, should hostile action necessitate; but we were looking forward to this GAPA launching mainly as a "preview" of what ultimately might be developed in the way of supersonic transports of the future, carrying people and cargo, not atomic warheads.

The firing range is located in the heart of the Great Salt Desert of Utah. In summer the desert is a most unpleasant place to be. But physical discomfort? The heat, the alkali dust and the blinding glare of the white salt flats? So what? We were privileged people, and we knew it.

Routine Work

Night before launching we were together in a hotel that stands directly athward the Utah-Havada line on the main highway out of Salt Lake City to San Francisco, discussing next morning's program. "We," at the time, were Capt. W. R. Wilson, project officer, Special Weapons Section, of the adjacent Wendover Army Air Base, and the following Boeing personnel: R. H. Nelson, former project engineer of the B-17 Flying Fortress wartime development, now

GAPA project coordinator; K. K. McDaniel, GAPA field test engineer; Waine Archer, a GAPA design engineer: P. T. Wendel, and A. E. Stege, engineers of McDaniel's staff; Vern Manion, photographer; and the writer.

"Now don't expect anything too spectacular when we launch "Old Needlenose" (pet name for the missile), Nelson was saying. "Launching these pilotless aircraft is just routine test work, and we have small missiles. Currently, we are measuring the magnitude of the large forces exerted by the rocket motors on the stability of the missiles."

At 5:45 in the morning, we rolled out of bed with no ceremony, had quick breakfast, and were met by several Air Base vehicles. We had the good luck to draw our companion of the previous evening, Captain Wilson. A former P-47 Pilot in the Pacific, this morning "Willie" was "piloting" a command car named Concrete Mixer Putsy-Putsy"--famed for her ability to crowd sixty mph with three out of six spark plugs missing.

In due course of time "Putsy" got us out to the firing range, somewhere in the middle of a 10,000-square-mile area set aside by the Army Air Forces for Special Weapons testing, and to a sign which read: "GAPA CITY--SLOW DOWN TO FIFTEEN MILES PER HOUR!"

"A gag," said Captain Wilson, giving "Putsy" the gun. We roared up to the "city's" six small shacks in a cloud of dust and piled out.

Directly before us, firmly embedded in concrete, was the launching tower, rising to a height of forty feet. Of steel construction, the tower is strongly stressed, and painted a brilliant yellow. "Old Needlenose," the GAPA, ten feet long and pencil slim, had already been hoisted in place, but McDaniel and Wendel were up in the tower, "arming" the rocket motors with remote control ignitor fuses.

HANDLE WITH CARE

McDaniel and Wendel were putting the finishing touches on the remote control firing equipment inserted in the rocket motors. Incidentally, they treated the ignitors will great respect.

A tall slim chap, naked to the waist and cordovan brown hurried over. It was "Smoky" Stover, in charge of the Boeing technicians, who assemble the missile-components, which are fabricated in Seattle and shipped down to Wendover for assembly.

"The cargo plane is in on the landing strip," he shouted, "they brought Col. McCauley and Jewett, and Nelson over from the base."

"TRACK" MEN

Col. H. K. McCauley is commanding officer of Wendover Army Air Base and the firing range was under his jurisdiction. R. H. Jewett is Boeing chief of preliminary design and under him the GAPA project is being developed. With Nelson, Jewett was here to check on project progress.

McDaniel was briefing the crews now. Engineers Wayne Archer and W. J. Hanson would man theodolite station No. 1 about two and a quarter miles northwest of the tower. A theodolite is an ingenious device which combines a surveyor's transit with recording apparatus with an automatic motion picture camera. The job of the theodolite crews was manually to "track" the missile from launching to landing so that a complete record of "Old Needlenose's" progress might be had for later study.

Clyde Eberstein and L. L. Lewis, both engineers, were assigned the theodolite station no. 2, one mile south of the tower, and two other engineers, A. E. Stege and E. W. Smith, drew station No. 3, about two miles northeast of the tower.

Manning the radar equipment, a mile and a half south of the tower, for manual and automatic tracking of the "bird," as "Old Needlenose" and his kind are also sometimes called, would be H. D. Finch, the Radar expert, Joe Yaeger and G. C. Shively, radar technicians, and in charge of Station No. 4, another automatic "tracker" six miles northeast of the tower, would be A. P. McCabe, Maurice Norton, and Edward Hale, technicians.

Col. McCauley, Capt. Wilson, Jewett and Nelson were to observe the launching from a ridge a mile and a half south, while Vern Manion and Bill Tribou, Boeing Photographers, were to take position on another ridge, 2000 feet to the west.

100 YEARS PROGRESS

McDaniel reviewed procedure....

"Launching will be at 2:00 p.m. It is now 1:15. All stations will report into the tower not later than 1:40. First warning siren will be sounded at 1:45. Five minutes before firing, time signals will be given every minute. Thirty seconds before launching the siren will again be sounded. Beginning at 1:59:30 five second cues will be given up to five seconds before zero hour. The last five seconds will be counted. At the call of "Fire!" "Old Needlenose" will be on his way."

The heat, the dust, the shimmering glare. The immense and empty wastes of the Great Salt Desert with its deceptive distant mountain ranges. Across this desert, exactly one hundred years ago, rolled the covered wagons of the ill-fated Donner party, first seekers of a new pass to the west. Traces of those wagons, which lumbered along at eight miles a day, are still visible. Now, above these historic trails, streak advanced aircraft like "Old Needlenose", pioneering new trails at supersonic speeds. Sometime in the future, because of tests like these being conducted here today, it may be possible to develop man-carrying vehichles capable of flashing around the globe in less time than was required for the Donner party to cover eight miles on this desert. Some time in the future, rocket-ship variants of "Old Needlenose" may flash outward into space--conquering the desolate wastes of interstellar flight.

WELL PROTECTED

Plumes of dust curled up in six directions as crew cars fanned out spokewise from the tower, bound for their station positions. We waited in the observation dugout for the call-in. The dugout, 300 feet from the tower, is an underground structure of heavily reinforced concrete thickly piled with sand. The quick-burning rocket propellant has been known to explode--with a force matching that of high explosive. It was good to know we were surrounded by concrete and sand.

The dugout is headquarters, the heart of the launching operation. Here McDaniel cued the crews. Here ~~Wendel~~ was to push the button that "touched off" the missle.

The moment we have traveled for, dreamed about, imagined, waited for--is here.

The stations are calling in now. Station No. 1 is ready. Radar calls in, standing by. Stations No. 2 and No. 3 and No. 4 report that all is in readiness.

First siren sounds: 1:45, fifteen minutes to go. Wendel gives the firing switches a final check. McDaniel, calm and efficient, chats informally with the crews, giving additional time checks. Tension is mounting, but no one lets on. The stations kid with McDaniel and he sends back as good as they give.

Five minutes to go. All stations are informed. We ask McDaniel for final instructions.

"Stay in the dugout," he says. "You can watch the initial blast through the observation window here. If everything goes okay, we'll dash out in a hurry and catch the ascent."

"Check," we say.

Heat waves swirl about the tower, causing it to seem to undulate. Old Needlenose is resting in the guide rails that will "aim" him, slim and deadly, on his way. Thirty seconds more and, a great finned rocket, he will flash upward at supersonic speed, sizzling through space.

There is nothing now but business in the voice of McDaniel as he ticks off the speeding seconds into the mike. "Twenty-five!"

There is nothing now but business in the attitude of Wendel as he rapidly throws the "Ready" switches in the fire control panel. "Twenty!"

At the Stations--theodolite and radar--the men get a "bead" on the tower, focusing their apparatus. "Fifteen."

A mile and a half south of the launching tower stand Col. McCauley, Capt. Wilson, Jewett and Nelson checking their watches. "Ten!"

High on a ridge, one mile to the west, Manion and Tribou, the photographers, look through their camera finders to locate the tower and hope that their trigger fingers are good. Time to snap a take-off picture--a split second! "Five!"

The last seconds creep and crawl.

"Three!"...

"Two!"...

"One!"...

"FIRE!"...

Wendel pushes the button.

Doomsday thunder, flame and smoke, a heart-stilling scream! Old Needlenose is off!

"A beaut! Come on!" yells McDaniel, as he rushes out. We follow.

ON THE BEAM

Elapsed time, now, mere seconds after take-off. Incredibly high in the sky, Old Needlenose is soaring, trailing a streamer of whitest smoke against the cloudless blue. Higher, higher, higher! Finally the rocket motors spend their charges. Old Needlenose is arcing now, points down, and hurtles wailing to the earth.

The Station operators track Old Needlenose through the air and to the ground. He hits! There is a pom-pom of dust. Although landing is several miles away, it is clearly visible. The stations will compute the place of the fall and, speeding over the desert, the crews will join at the spot to examine the remains.

How high did it go? How fast? How straight? These are some of the answers to be found. Old Needlenose's successors must go higher, faster and straighter. Testing is the only answer.

Standing here in the Great Salt Desert, after what we've just witnessed, it is easy to believe that practical commercial flight at supersonic speeds will surely come. Tomorrow?--perhaps not. Soon?--perhaps sooner than we think!

RRS PRESS SHOW

-Carroll Evans-

On October 31, 1946, the Reaction Research Society gave a demonstration for the press. Many representatives of news papers were there, and also some national magazines, including Model Airplane News and Science Illustrated.

The purpose of this demonstration was to get publicity. The Board of Directors of the Reaction Research Society reasons that properly presented publicity will allow us to increase our membership.

The first part of the program consisted of a short talk by George James, President of the Reaction Research Society, on the various types of rocket propulsion systems, on what the RRS is doing in each of the fields, and on what it plans to do.

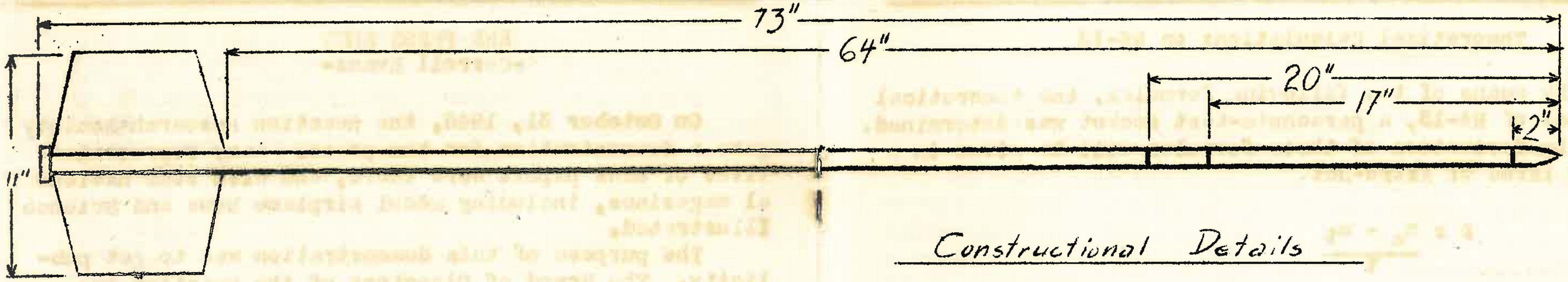
Accompanying the lecture were burning demonstrations of many types of Society-developed propellants. Among these were the following: A liquid monopropellant, a plastic propellant, a restricted burning type propellant, and micrograin propellant.

After the lecture and demonstrations, several rockets were fired at the testing ground. There were two large micrograin rockets. R6-14 was about three feet long and 1-5/8" in diameter, with a calculated thrust of 385 lbs. and firing time of .5 seconds. The other rocket, R6-13, was 1" in diameter, and 6 feet long. It has a calculated thrust of 170 lbs. and a firing time of .5 seconds. R6-13 rose to a height of 1200 feet, but the parachute failed to open. R6-14 blew its front section, because the aluminum tube melted around the screws. Although it was not successful, it added to our knowledge of what a good parachute-test rocket will have as design features.

Several smaller rockets were fired. Among these were a small micrograin rocket, a black powder rocket, and some model aircraft rockets.

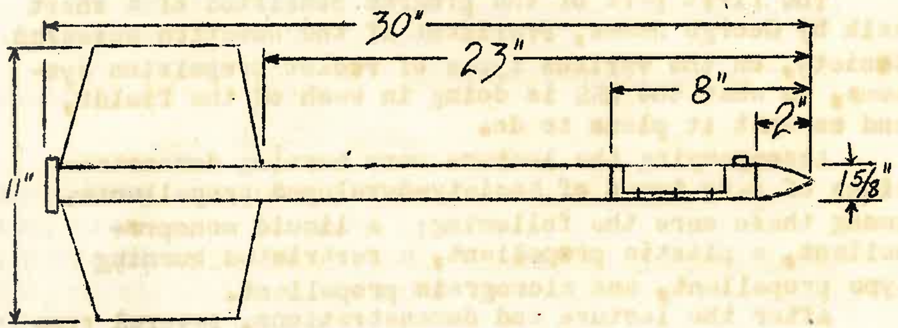
Of interest to model aircraftsmen were rocket-propelled model planes built by Dick Schonz. These planes flew excellently, demonstrating the possibilities of this phase of the Society's work.

SEE PAGE 22



Constructional Details

R6-13 The propellant chamber of this rocket is of 1" stainless steel tubing. The nozzle and connecting plug are of brass and the fins are of .04 aluminum. There are three fins. The parachute release is of the progressive burning type, actuated by the smoke flare.



R6-14 – Built of 1 5/8" aluminum tubing, this rocket has four fins of .08 aluminum. The nozzle and connecting plug are also of aluminum. The parachute is of the mechanically time variety. The time operates the parachute trap door at the highest point of trajectory.

	R6-13	R6-14
Total Weight	4 lb.	6 lb.
Propellant Wt.	1 lb.	3 lb.
Firing Time	.5 sec.	.5 sec.
Thrust	170 lbs.	325 lbs.

Theoretical Calculations on R6-13

By means of the following formulas, the theoretical altitude of R6-13, a parachute-test rocket was determined. The derivation of these formulas will be given in a future issue of Astro-Jet.

$$p = \frac{m_o - m_t}{t}$$

$$v = \frac{f}{p} \ln \frac{m_o}{m_t} - gt$$

$$s = \frac{f}{p^2} \left(m_o - m_t - m_t \ln \frac{m_o}{m_t} \right) - \frac{1}{2} g t^2$$

Where:

p = rate of decrease of mass

f = thrust in poundals (32F where F is in pounds)

m_o - original mass in pounds

m_t = mass at time t in seconds

t = time in seconds

v = velocity in ft/sec at time t

s = height in feet at time t

These specifications were taken for use in the formulas:

f = 85 lb average

m_o = 4 lb

m_t = 3 lb

$t = \frac{1}{2}$ sec

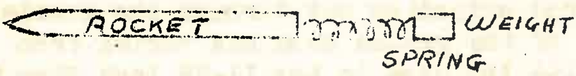
Continued on Page 22

California Institute of Technology
Lecture Series
"War Time Developments and their Peace Time Applications"

On the following pages are the summaries of two of the rocket lectures of the above series. Both of these lectures were accompanied by very good color movies. The first lecture was given by Dr. Lauritson, of the California Institute of Technology, on November 1, 1946 and was entitled:

ARTILLERY ROCKETS

"Because of wartime research, rocketry has progressed into an extensive branch of armament. Perhaps its main advantage is its versitility. It is versatile because of its lack of recoil. Rockets are propelled by the same force that gives recoil to a gun. A rocket may be compared to the device drawn below.



When the spring is released, the rocket and weight will be thrust apart with equal momentum. The small weight will go with a greater speed than the rocket, and may be compared to the exhaust gases. The following formula applies to the momentum.

$$MV = M'V'$$

Where M= Mass of ejected gases
M'=Mass of rocket
V= Velocity of gases
V'=Velocity of rocket

To illustrate this formula, an artillery rocket (5"HVAR) has 25 pounds of propellant, and weighs 125 pounds empty. The velocity of the ejected gases is 7000 ft/ sec.

$$MV = M'V'$$

$$V' = \frac{M}{M'} \cdot V$$

$$V' = \frac{25\ \text{lb}}{125\ \text{lb}} \cdot 7000\ \text{ft/sec.}$$

$$V' = 1400\ \text{ft/sec.}$$

Because rockets have such light launchers, they can be fitted to almost any kind of vehicle or sea going craft.

An artillery rocket has three main parts. These are the motor, with stabilizing fins, the payload, such as high explosive or smoke, and the fuse. The fuse may be of the dalayed action type, or of the "daisy-cutter" type which extends about four inches in front of the rocket, and explodes the warhead upon impact. Artillery rockets are powered by a double-base propellant called ballistite, which is composed of 40% Nitroglycerin, and 60% Nitrocellulose. These grains are extruded, much as with modern plastics.

An electric igniter is placed at the head of the rocket, with wires extending out through the nozzle.

The weight of the grains used has varied from 1/10 lb to the 144 lbs used in the 11.75 inch Tiny Tim.

On some types of rocket, the case for the payload can be lighter than in a projectile, since the rocket does not have the large starting acceleration of the artillery projectile.

In the Okinawa campaign, five inch spin stabilized rockets were used very successfully. Spin stabilized rockets have to be shorter than finned rockets, because, as they become longer, more rotational speed is required to keep them stable. The present rate of spin is already near to breaking the rocket by centrifugal force.

The 11.75 inch Tiny Tim has a total weight of 1200 pounds. There is a total weight of 144 pounds of powder, composed of four grains of powder of the type used in fove inch rockets. The wall is 3/8" thick. For a warhead it carries the equivalent of a 500 pound armor piercing bomb. The back plate has 24 separate nozzles, and one blow out plug in the center.

The artillery rocket project was started in May 1942, when it was found necessary to have assault rockets with a range of 1000 yds. These assault rockets, when mounted in racks, are fired electrically through the insulated tail fins. By this system, rockets leave the launching rack at 2/10 second intervals.

With a folding launching rack developed for paratroopers, a trained operator can keep eight rockets in the air at once. A 300 foot LCM can fire 400 rounds a minute, that is, 2000 in five minutes.

In tests conducted at San Clemente Island in 1942, 21 rockets with a seven pound charge each of FS (Chlorosulfuric acid) completely covered one side of a hill with a smoke screen.

At the Tarawa Campaign, a few ducks (amphibious jeeps) outfitted with 144 rounds each, the equivalent of several destroyers, were used with great success.

Rocket are much more stable and accurate when fired from an airplane because the fins are already stabilizing the rocket because of the plane's speed of about 700 ft/sec. Rockets fired from an airplane are as accurate as machine gun fire from the same plane. Rockets have more gravity drop than machine gun bullets, because of the longer time in flight.

The HVAR rocket has a velocity of 1400 ft/sec, with the addition of the plane's speed, the impact velocity is then equal to that of a five inch shell at 10,000 yards.

An F4U with eight five inch rockets is said by the rocket engineers to be the equivalent of one and one-half destroyers.

Many rockets can travel for 50 feet under the ground and then detonate under thinly protected floors. This can also be done under water, allowing a shot to fall 100 feet short of a submarine, and still sink it.

In the summer of 1943, the British, using inert heads on the rockets, scored 25% kills, and 25% probables out of 12 encounters with enemy subs. The United States had developed similar rockets by the end of 1943.

In order to find out how many rockets a plane could carry, a P-38 was fitted with fourteen five inch rockets. This was never used operationally. Radar was often used to find the range of the target.

After one week of training, the pilots are able to place one-half of the rockets in a circle 80 feet in diameter at a thousand yard range.

For travel under water, a sphere-ogive shape was found to have low drag and low lift, thus no deviation to one side of the target.

An A-26 can carry two 11.75 inch rockets in its bomb bay, in addition to the many rockets on the wings. This eliminates most of the 25 mph drag imposed by the rockets. External launching racks have a 3 mph drag effect.

An F6F can carry two 11.75 inch rockets. These are beneath the fuselage, and are dropped free before ignition. An F4U can carry two 11.75 inch rockets and eight 5 inch rockets."

* * *

The second in the series of lectures was presented on Friday, November 8, 1946, by Dr. Howard Seifert. The title of his lecture was:

HIGH ALTITUDE ROCKETS

"High altitude rockets have had a brief history. About the first attempt at this type of rocketry was made by Dr. Robert H. Goddard, starting his research in 1912. The maximum altitude reached by his rockets was about 7500 feet.

In Germany, Herman Oberth, in the years 1923-30, obtained a height of 3000 feet with VfR rockets.

The American Rocket Society, started in 1931, never had rockets go to an appreciable height.

The California Institute of Technology started work in 1936, with Dr. Frank J. Malina doing preliminary research calculations. The California Institute of Technology, Jet Propulsion Laboratory, GALCIT was started in 1940. A result of this work has been the WAC Corporal, a meteorological rocket, which has obtained a height of 230,000 feet, or about 44 miles. This was done in 1945."

On display in the lecture hall was a WAC Corporal, which had been fired. Although the parachute did not work, the rocket was not damaged much because it came down in a flat spin.

"In 1946 the United States Army shot a captured German V-2 to a height of 104 miles. This was done at White Sands, New Mexico.

Rockets are powered by the reaction of the exhaust gases. By Newton's Third Law of Motion, to every action there is an equal and opposite reaction."

Beginning at this point of the lecture, there were several interesting demonstrations . The first of these was a demonstration illustrating the rocket principle of reaction.

It consisted of a sling shot mounted on a small wheeled cart. The elastic was streached out, and tied with a string. When the string was burned with a match, the weight in the sling shot was thrown out. The cart moved forward several inches.

The next demonstration consisted of a small charge of compressed carbon dioxide. A small hole in one end was filled with solder. The charge was suspended on a rack, and allowed to rotate. The solder was melted with a gas torch. The charge rotated rather rapidly, due to the excape of the gas from the jet.

"Rocket motors need to be cooled by the fuel or the oxidizer, since the tremendous heat generated would soon melt the rocket motor.

Gasoline, coal, and other similar suels are too mild for use in rocket work. Rockets require more heat in a shorter time. Listed below are some of the more common fuels.

Oxidizer	Fuel
H_2O_2 90% (Hydrogen Peroxide)........	Alcohol
Liquid Oxygen.....................	Alcohol
Liquid Oxygen.....................	Liquid Hydrogen
Nitric Acid.......................	Aniline

Burning demonstrations were given with some of
(continued on page 23)

PUBLICATION REVIEWS

Recent Publications of the British Interplanetary Society

(A) The Bulletin of the British Interplanetary Society; No. 6, July 1946; No. 7, August, 1946; and No. 8, September 1946.

These bulletins have a more pleasing format than previous issues. Bulletin No. 6 deals with the various technical groups to be established and Society policies. Bulletins No. 7 and 8 have a very interesting series of experiments on pulse and ram jets which were performed by a member of the BIS.

(B) Journal of the British Interplanetary Society Volume 6, No. 2, September 1946.

This issue consists of a reprint of the same Galcit Report that the RRS reprinted as a seperate publication.

(C) The British Interplanetary Society, Annual Report and List of Members.

The contents of this publication are explained by the title.

NOTE:

The Reaction Research Society takes pleasure in announcing the beginning of a publication exchange with the British Interplanetary Society. Because of this exchange, starting with the November issue of the BIS Bulletin, all members of the RRS will receive all the publications of the BIS in addition to the publications of the Reaction Research Society.

Journal of the American Rocket Society--No. 66 and 67, June and September 1946.

The first half of this combined issue consists of the Galcit Report. The rest of the issue consists of numerous articles including: The Rating of Rocket Fuels; Atomic Hydrogen, the Fuel of the Future; and the Exponential Law of Motion.

Pacific Rockets, Journal of the Pacific Rocket Society, Volume 1, Number 2, September 1946.

This issue containes articles on Recent Progress, Aerodynamics in Rocket Design-Part 2, Preview of Coming Events, Atomic Energy, and Mojave Notes.

Rockets, Official Publication of the United States Rocket Society, Volume 1, Number 4 and 5, May and August 1946.

This issue is an improvement over previous issues in that it presents a slightly more serious approach to the problems of rocketry and space travel. Some of the articles contained are: Acid and Aniline as a Rocket Fuel, New World to Conquer, Interplanetary Archaeology, German Rocket Fuels, The Golden Moon, and the Philatelic Page.

Symposium on Jet Propulsion, Gas Turbines, and Rockets. Society of Automotive Engineers, Inc.
Special Publications Dept. SP22—$8.00 (to non-members of the SAE)

This collection consists of thirty very extensive papers on many phases of the above subject. Some of the papers of exceptional interest to rocketeers are the following:

1. German Rocket Aircraft and their Powerplants, by R.A. Cole.
2. Applications of Rocket Propulsion, by M. Summerfield.
3. The Rocket Powerplant, by M. J. Zucrow.

Continued from page 14:

By use of the formulas, these values were found:

$v = 372$ ft/sec at end of firing
$s = 103$ ft at end of firing

The coasting height was determined by the following formula:

$$h = \frac{v^2}{2g}$$

Where:

h = coasting height
v = velocity at end of firing
g = acceleration due to gravity

The coasting height was found to be 2162 feet. The total theoretical height was found to be 2265 feet. By deducting 30%* of the values to allow for air resistance, we obtain a total height of 1130 feet. The observed height was 1200 feet.

---

* See Astro-Jet Number 11 "Methods of Calculating Rocket Characteristics" by Richard Reiss.

*　*　*

Continued from page 11:

An AERO-SMOKE unit was demonstrated. This is an RRS-developed smoke producing charge, about 4" long. This unit is for model airplanes, and it produces a dense yellow cloud of smoke.

The small black powder charge rose to a height of about 600 feet, but it left its fins on the ground, because of the rapid initial acceleration.

The model aircraft rockets are scale models of the ones fired from Army and Navy fighter planes during the war. These rockets travel about 50 feet, leaving a smoke trail behind them. One of the main problems in the development of these rockets was to cut down the range of them sufficiently to make them practical for model aircraft use.

(Continued from page 19)

the above propellants. The first demonstration was to drop H_2O_2 90% on ordinary cotton. This demonstration did not work, either because the cotton was too clean or because the hydrogen peroxide had been diluted by moisture.

The next demonstration was to burn steel wool, first in air, then in a pure oxygen atmosphere furnished by dipping it into liquid oxygen. In air it barely burned, while in the pure oxygen it burned brightly and very quickly.

When [redacted] was dropped on fuming nitric acid, it immediately burst into a bright orange flame.

A small JATO on display could make 25pounds thrust for eight seconds. Other JATO's have made 200 pounds thrust for eight seconds.

"The Germans had a guided missile powered by rockets, which trailed two miles of wire behind it for control purposes. The Germans had developed a variety of rocket powered missiles. One of the most unique of these was called the Natter. It carried a pilot, and was launched from a vertical pole, and it ascended to the height of 40,000 feet in one minute. In the nose it carried a load of 20 large rockets. After the pilot fired the rockets, he descended from the rocket by parachute.

The WAC Corporal rocket goes up from 40 to 50 miles, and is useful for studying radiations. If rockets are ever used for travel between continents, we can probably travel from here to New York in one-half hour. To England it would take one hour.

Any rockets used for space travel will have to operate on the step principle, using a smaller rocket for the payload. With the step rocket principle, it would require a rocket weighing 100,000 pounds to get a 100 pound payload into outer space using liquid hydrogen and liquid oxygen as propellants.

Two interesting velocities are the orbital velocity of 5 miles/sec.and the escape velocity of 7 miles/second.

If atomic energy were used for space travel, as a rocket propellant, the heat of reaction would have to be used to expand water or a gas.

When the Germans first were shooting V-2's, they had an accuracy of 1 out of 3 hits in the target area. The target pattern was five by ten miles in size.

* * *

ERRATA

In Astro-Jet Number 14, September, 1946, the references given by Cedric Giles in his article, TESTING LANDING DEVICES BY KITE, were left out because of a last minute lack of space. Following are the references:

1. Garber, Paul E., Kites and Kite Flying, Boy Scouts of America Service Library, No. 3146, pp 53-4.
2. Shesta, John, Landing Gear Releases, Astronautics, No. 40, pp 3-7, 1938
3. Healy, Roy, Parachutes for Rockets, Astronautics, No. 41, pp 13-14, 1938.

REACTION RESEARCH SOCIETY

PURPOSE

The REACTION RESEARCH SOCIETY is a non-profit organization whose purpose it is to aid in the development of reaction propulsion and its applications and to promote interest in this new science. This purpose is carried out by maintaining an active research program, encouraging other experimentors, and promoting interest in reaction propulsion by the publication of ASTRO-JET, Journal of the Reaction Research Society.

MEMBERSHIP

At the present time there are two forms of membership in the REACTION RESEARCH SOCIETY, Active and Associate. Active membership is for those who can engage in the activities of the society. They may come to all society meetings, all society testings, receive all society publications published during their membership, and will be able to vote and hold office in the society. This form of membership is $3.00 per year. All applications for active membership must also submit a rocket model or by some other means show a genuine interest. Associate membership is for those who find it inconvenient to become active members. They have all the privileges of active members with the exception of holding office and voting. This form of membership is $2.00 per year. If you are interested in joining the society, please write to

SECRETARY, REACTION RESEARCH SOCIETY
3262 Castera Ave. Glendale 8, California

OFFICERS

ASTRO JET is the official publication of the REACTION RESEARCH SOCIETY, 3262 Castera Avenue, Glendele 8, California. It is published three times a year. Subscriptions are $1.00 per year. Statements and opinions expressed in ASTRO-JET do not necessarily reflect the views of the society