RRS NEWS

FOR THE ADVANCEMENT OF
ROCKETRY AND ASTRONAUTICS

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RRS NEWS

A magazine of comment on the amateur field today.

RRS NEWS NO. 101 ISSUE ONE, 1966

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MANAGING EDITOR

Don Girard

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FROM THE EDITOR

I suppose really that the purpose of a magazine ought to be defined somewhere at some time, but today we pass. What we have in the pages of 101 is a story of the enthusiasm of a group of people, a discussion of the amateur's right in rocketry, even a few subtle digs at the stuffiness of the scientist.

Interwoven we might have included some technical explanations and some experimental results, but then by honest intent we might very well not have.

A youth who is excited enough by the smoking and belching of fire to build his own belcher is excited by thought of any sort, and it is our belief (in this age of disbelief) that a technical journal should well be a thoughtful journal.

But enough of our bare-soul statement; we share with you some of our thought and our own feeling of the rocket field people we know:

"How in hell, Schreiner, are...the 4 a.m.ness broken only by intermittent flashes as pick met rock...twenty-four hours behind schedule, the crew...colder than...want to go to Roswell...who's got a beer belly...tracking reports altitude... where's the damn...it worked, son of a Dr. Robert Hutchins Goddard and Willy Ley all rolled into a silver size ten Cheerios package, it worked...the stars are tremendous...my lady, your hand is very warm."

It is a good thing, and one we are proud to bring you.

We have found it difficult to present the NEWS in this complex format four times a year, and with your kind permission will publish special reports using this journal as a rostrum. We have invited a number of young men and women to write and edit and publish, some completely outside the science field, and we hope that their originality and verve will further this magazine on a course 'til now vaguely defined. Be considerate of them.

Project
LIVE FIRE

By Don Girard, Secretary,
Reaction Research Society

Project Live Fire!, conceived in October, languished in November, sweated over during December, feared throughout January, and cursed for February, came to be at March 27, 1966.

The event, a public firing involving more than two hundred fifty people, was the highpoint of community relations activity for the Society. That weekend, over twenty rockets were fired, some of an experimental nature that Saturday, the others for show Sunday.

Driven by a need for money, we contemplated a choice between another mail flight (oh, no) or a public firing (a what?). We even considered doing both simultaneously, being greedier than most. Rational enlightenment won out, though, when they chose my idea.

I suppose the first thing we did was to procrastinate. But wiser heads did not have their way long. A committee of five worked out the initial blueprint, a masterpiece six pages in length. Preparatory work was divided into a number of areas: safety, legality, and financial; advertising; hardware; facilities; personnel and logistics; and ground support equipment, filming, and power.

The Society performed excellently in all of these areas, and to spoil the story a bit, ended with a spirited and renewed group far beyond expectation. May we use this journal, then, to record what has to be considered the growth of the RRS into a mature and full Society.


THE
REACTION
RESEARCH
SOCIETY
presents
PROJECT
LIVE FIRE!
March 27, 1966
PUBLIC SHOW:
spectacular live firing
of amateur rockets.
FOR INFORMATION WRITE:
REACTION RESEARCH SOCIETY
BOX 1101 GLENDALE, CALIF.
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We were to put on a show, and a show implied a spruced up Test Area. The Mojave Test Area, our forty acre site near the town of Garlock, was in fair shape, but needed work.

The spectators' trench, about sixty feet in length, was hardly adequate to accomodate more than fifty people, and needed repair at that. In a four-weekend effort, the ditch digging crew, the chain saw gang, the pole-wrassling team, and the sandwich makers of the RRS lengthened the trench to one hundred sixty feet, about a four foot depth, and provided telephone pole overhead protection for a hundred feet of trench.

Coincidentally, the trench stopped five feet short of the outhouse. It was probably the longest and widest leach line ever dug at the MTA.

Work continued. There had been a motorcycle rally in the area about a mile from our compound, and some six hundred people had left some six hundred six-packs over six acres of ground. It looked pretty sick. It took four people four hours, but we worked forthrightly, and soon the ground looked positively forlorn. We dug a hole four by four, deposited the sick-packs, sicced our arson specialist onto the trash pile, and watched gleefully.

It isn't often you can make a forge out of a six.

And in the wake of this punishment, the RRS assembled several launchers, cleaned up the compound area, fixed some minor breaks in the compound fence, painted part of the quonset, installed a metal shelf the length of the blockhouse, cleared an acre of brush for a parking area, installed two more outhouses, and turned our thoughts to advertising.

Which will lead us directly to the next phase of Project Live Fire! Prior to the public firing, the Society had received exactly zero amounts of public notice, and had little idea in what direction to move.

But on February 6, a high school girl fired her first experimental rocket at the RRS's test site south of Garlock and achieved singular success. Monica Brown of Culver City, a student at St. Bernard High, developed her rocket as a chemistry experiment and joined the Society so that she could continue her interest in rocket science. The performance of that rocket is written up in another section of this issue, but we mention it here as it occasioned the first good press coverage for the Society prior to the March 27th event.

Roberta Starry, proprietor of Roberta's Mineral and Gem Shop in downtown Garlock, wrote up Monica's efforts for the Bakersfield and Mojave regions, and prepared the editor of the Bakersfield Californian for a series of feature articles on Project Live Fire! Mrs. Starry also published her work in the Home section of the Long Beach Press Telegram.

And then on February 20, the RRS made its television debut with the Louis Lomax Interview show the guilty party. May we lift a page from the notebook of Joe Buttner, RRS witness, to describe ourselves:

"One of the highlights of the RRS season was an invitation of KTTV-Los Angeles to an exposition of the RRS on the Lou Lomax program on February 20.

John Mariano was chief spokesman with supporting officiates Don Girard and Dennis Shusterman. The RRS had to take its place beside the high priest of the Zor-Astor sect of India and a trick golfer who has long been a PGA outcast.

So, considering the variety showmanship of the program, the RRS presentation was made in good taste with all three representatives dealing with the esoterics of rocketry in a popular fashion which has proven over the years to be a good method of general communication.

Among the items displayed were R. Butterfield's 4-inch solid propellant static test motor, the RRS number two hydrogen peroxide project assembly, a colorful 8-inch photographic flight test model and a number of payload and part innards from previous rockets.

Mariano captitalized upon this opportunity to publicize the upcoming Project Live Fire! by doing a doubletake of a "whip the hanky from vest" routine with all the event particulars listed on the handkerchief. I suspect it had its effect. As this report is going to print, the memory of the success of Project Live Fire! still lingers. Good show!"

These two breakthroughs led to a number of other items. The Lomax program brought an offer from a free lance writer and photographer to prepare an article for sale to Argosy magazine. A YMCA director invited the RRS to lecture at a club meeting. The mail response was quite good, and generated four new members.

On another level, the Society sent out press releases to 130 newspapers and agencies, almost convinced KTTV to handle the event as part of their television news coverage, almost interested Life magazine, did interest a writer-photographer from Mechanix Illustrated, and did receive radio support from Ray Greene and station KLAC.

We should also mention the artistic contributions of some very talented young women to the publicity efforts. Miss Roseanne Dymond, of RRS cartoon notoriety, masterminded, drew, prepared, and silk-screened the poster design appearing as the frontispiece of this issue. And Miss Margery Hills handled the artwork for the flyers, or information sheets, so very valuable in broadcasting Project LF.

The RRS in the meantime entered the Gardena Hobby Show, partly since the clubhouse (rather, Society Headquarters) is in Gardena, and partly as a dry run for the big hobby show for all of Los Angeles. George Dosa, who handled the arrangements for the RRS, prepared two display cases and a background montage that received a quite favorable comment from the Gardena Community Center officials.

Launch fever took over. Numerous inquiries, attracted by the poster and flyers, came in. A science teacher in Tehachapi, California, re-mimeographed the press release, and distributed it to the community. Friends and long lost enemies responded. All that was left to do now was to build a few rockets and. . . .

Rockets. Three weeks before Project Live Fire! there was exactly one rocket built.

But somehow March 27th came on the appointed day, and we were forced to consider the day itself. From the very start, we saw that there were three very important elements for our spectacular. (1) Communications had to be perfect, and accomodate a general usage public address system. (2) The RRS had to appear very much in control of the event. (3) The rockets had to look good beforehand, but did not have to be scientific miracles.

(1) Communications were perfect. Unbelievable, as a matter of fact. Bob Schreiner set up communications center at the observors' trench, ran a dual system of private phone lines and the public address network to tracking, blockhouse, and roadblock to use some five thousand feet of wire.

(2) The RRS appeared very much in control of the event. Interestingly enough, no one person fully understood what was happening. (We say this tongue-in-cheek, but it came very close to being true. The event was so thought out that each position was filled with little confusion. We had chanced upon the very unusual in amateur rocket firings: we were following a routine.)

(3) The rockets were not scientific miracles. (So how many bakers have you known who've had cake crumbs on their faces?)

Her Hobby: Rockets

By KATIE HUMMES
St. Bernard High School

Junior Monica Brown of St. Bernard High School has a hobby which is kind of unique and distinctive: She constructs and launches rockets in the Mojave Desert.

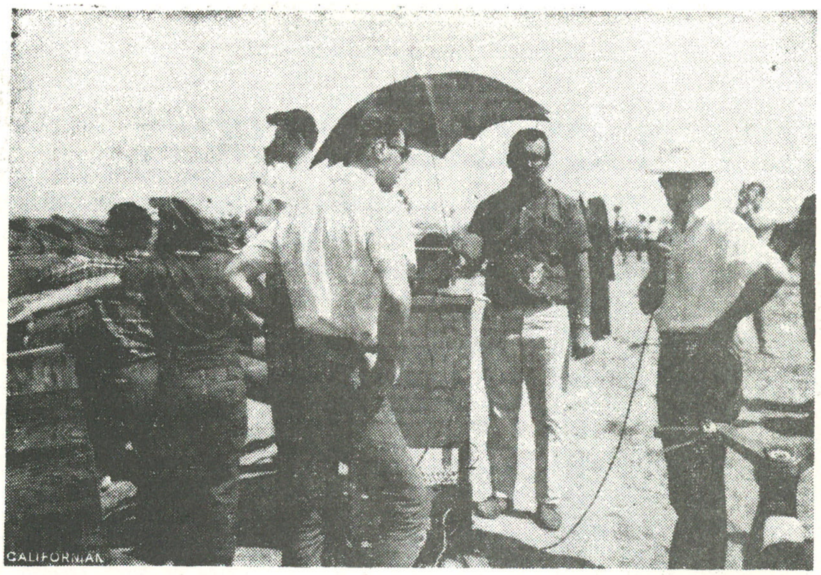
Her latest "launch" sets a new record for altitude. The rocket christened "Blood, Sweat and Fears." soared 8110 feet and exceeded the speed of sound.

As are most of her rockets, it was propelled by the gases released through the combination of zinc dust and sulphur.

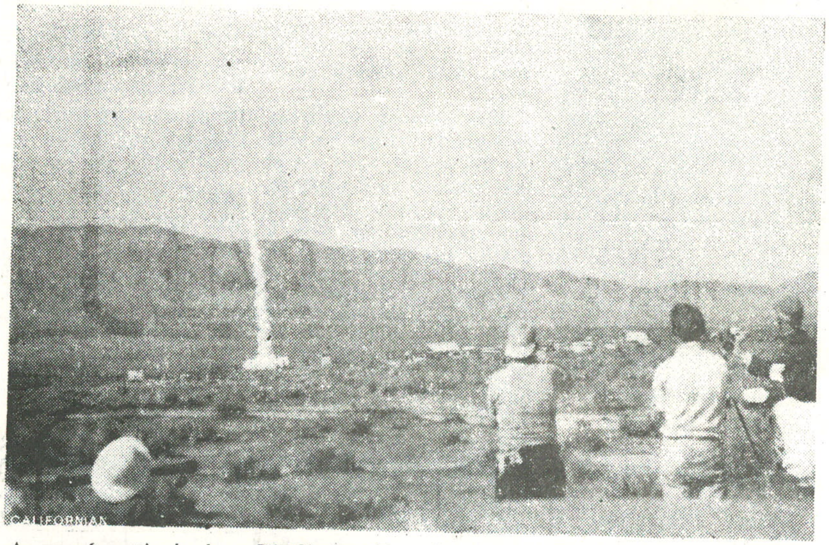
Launching the rocket was part of a project for her chemistry class. The second part of the project was data-reduction, or obtaining as much information as possible about the rocket's performance. With the aid of an eight-millimeter movie camera, it was possible to determine the rocket's velocity, acceleration, thrust and burnout time.

Monica became interested in rocketry about three months ago through a fellow student who is president of the Chaminade Rocket Club. She joined the Reaction Research Society, one of the oldest and most respected rocket societies on the Pacific Coast, and she admits that building and launching these rockets would be impossible without the help of the society.

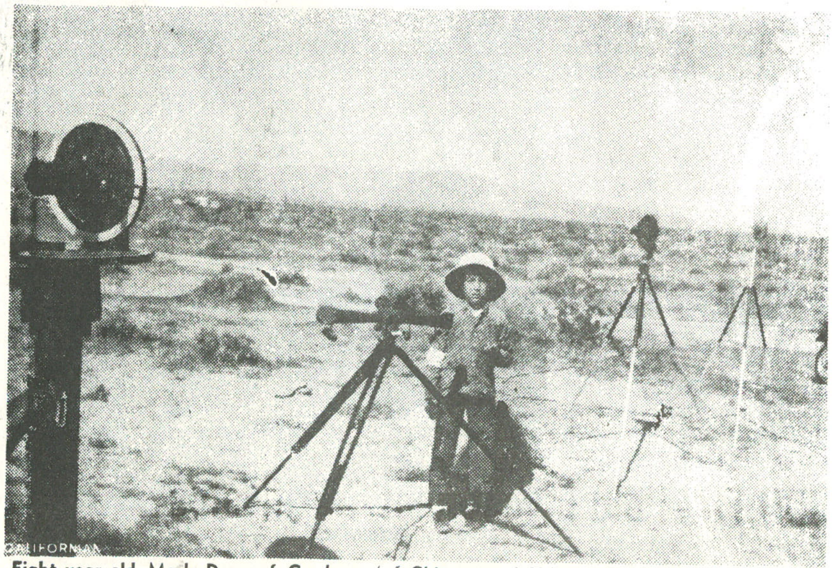
This high school student does have an unusual hobby, but she has made several contributions to her study of rockets and the progress of science. What else is there to learn?



From left are three key men in Sunday public rocket show near Garlock—Don Girard, Loyola University student, rocket-builder and assistant pyrotechnician; Bob Schreiner, Santa Monica City College, in charge of countdown and commentary; Richard Butterfield, president of of Reaction Research Society, pyrotechnical operator for firings.



As seen from the bunkers, Bill Claybaugh's rocket awed the crowd. He is a junior high student. Chaminade Prep School was elated.



Eight-year-old Mark Dosa of Gardena (of Chinese and Hungarian descent) was chief-timer at one of tracking stations and caught time on two rockets missed by others. His father has been a Reaction Research Society member seven years.

Rocketers Stage Desert Spectacular

By ROBERT STARRY
California News Service

GARLOCK — Sunday's first public rocket-firing, sponsored by the Reaction Research Society, was a spectacular show seldom seen in the Mojave desert of eastern Kern County. Cars poured into the area all morning far in advance of the noon firing. The space back of the bunkers looked like a tent and camper city.

Hundreds viewed the launching of 14 rockets. Cars waited at the road block as the first group of rockets sailed skyward. Ther about 200 persons crowded into the protective bunker and trench area while others drove out to tracking stations where an address system kept them informed of the activity between launchings. Many watched from cars.

Richard Butterfield, president of the Reaction Research Society, said they were not able to get an accurate count as spectators arrived early before the road station was in operation, but an estimated 300 cars passed through the gate. Cars from Long Beach, Inglewood, Covina and Hollywood were noted.

Student groups were much in evidence as science teachers had brought the launching date to the attention of their classes. Jim Thorpe, Tehachapi teacher, sent notices home and encouraged parents to attend the exhibit.

Monica Brown, a junior high school student, fired a rocket which reached 8,500 feet.

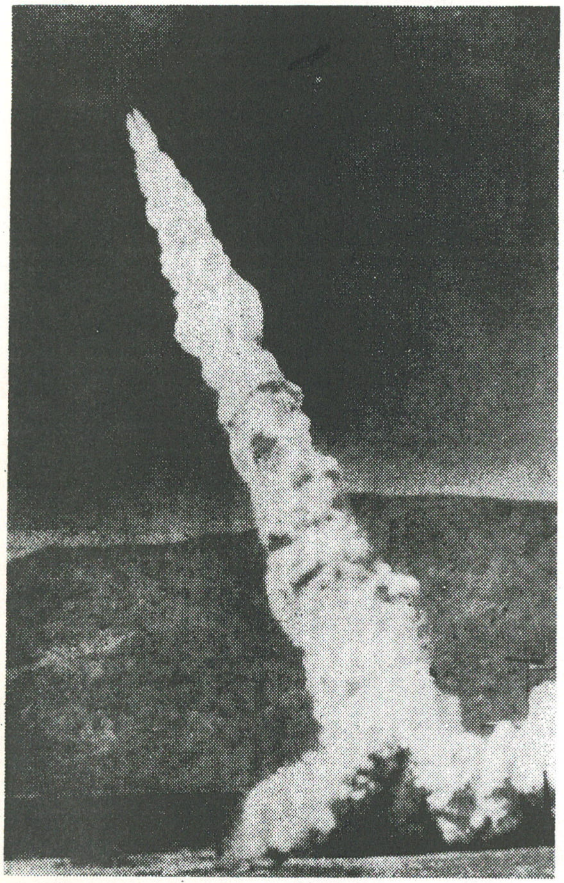
Science students found much to look for while waiting for the next launch. Lizards, turtles, insects and flowers were a "nature" contrast to the rockets. One boy, for example, examined a large turtle and tried to talk it into sticking out its head out—and five minutes later he was gasping as a rocket reached thousands of feet, and taking off on a run to see the parts that landed after the "all clear."

Project "Live Fire" not only had successful rockets launched, but as one woman said:

"I understand what goes on at Cape Kennedy now. These were a size that I could see and the young fellow on the mike made it so easy even I got an insight into the workings. No wonder every one is becoming fascinated by rockets.

WANT TO GO TO A LAUNCHING?

Countdown in the Desert



Money, hopes and hard work culminate in the sky-reaching takeoff of a rocket like this.

By ROBERTA M. STARRY

THERE is something tense and exciting about a rocket countdown. The stillness, the watching and the waiting—then fire! And the rocket soars from the launch rack. That is the moment of fulfillment for the rocket builder!

Uncounted millions have shared in this excitement from afar, watching America's space probes on television screens.

Next Sunday a rocket firing is scheduled in the Mojave Desert, open to the public, and a chance to get a closeup view.

ABOUT A DOZEN missiles will be launched by a band of amateur rocketeers who long for the suspense of involvement in the countdown and are willing to pay for the thrill of watching their "baby" streak skyward.

Richard Butterfield of Long Beach knows that special feeling, having built many rockets that have soared into the distance on A-OK flights. Employed by IT&T, Butterfield spends every moment off the job in building experimental rockets.

The satisfaction gained from developing rockets he passes on to science students and youthful engineers through encouraging and supervising their efforts in rocketry.

As pyrotechnical operator and secretary of the Reaction Research Society, Butterfield is responsible for the coordinating and arming of the experimental rockets at the Society's test site at the Mojave. He explained that this organization has much to offer those interested, as within the membership qualified persons give technical guidance, help in manual skills and assistance at the firing which protects against injury to person and property.

REACTION Research Society is a civilian research organization for the purpose of furthering the use of rockets for nonmilitary purposes. The members finance all their own experiments as well as volunteer labor toward the maintenance of the desert test site 30 miles east of Mojave.

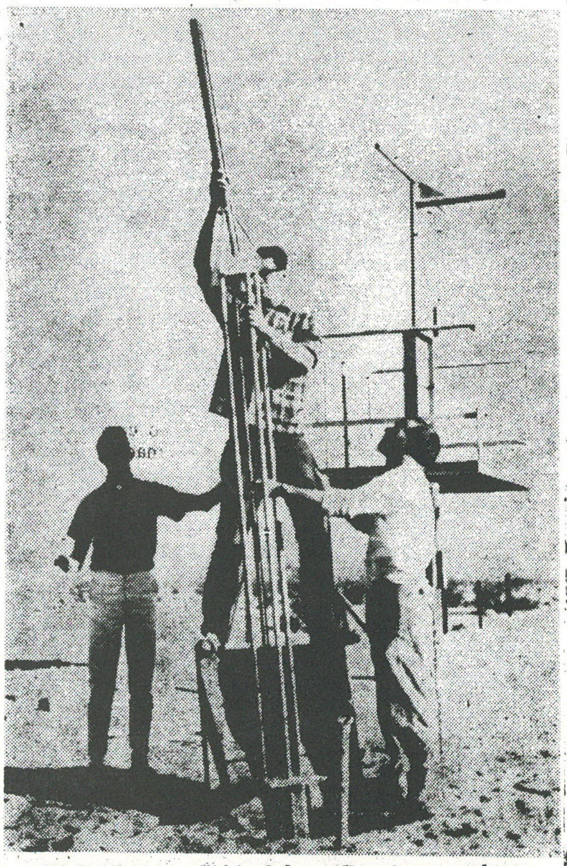
Butterfield, encouraged and frequently assisted by his wife Maryann and two small sons, builds rockets, experiments with new materials, drives from Long Beach to the test site to work with aspiring rocketeers.

With seeming inexhaustable energy, he and his wife dig the drifting sand out of the bunkers, haul supplies, gather up what members are available for work parties and continuously repair and replace equipment damaged by vandals.

Rockets fired at the desert site have carried pay loads which eject at peak altitude and land at a designated area via parachute. Experiments are aimed at developing small rockets that will travel some distance and have controlled landing.

Butterfield said that there have been discouraging failures of what seemed like good ideas but out of each failure has come progress toward usable vehicles.

FIVE ROCKETS, perfected at the Mojave site, were the ones used in carrying first-day covers and stamps commemorating Dr. Robert Goddard, "father of rocketry" in October 1964. Butterfield was the rocketeer who developed and supervised the setting up of the launch area in Roswell, N. M., and armed the rockets that carried the first-day covers so desired by Philatelic collectors.



Richard Butterfield of Long Beach supervises arming of rocket at Mojave Desert test site.

Like Dr. Goddard, Butterfield is convinced that mail via rocket is not only desirable but now feasible. In the experimental stage, is a rocket with a range of 500 miles; with its perfection mail will take on a new look. As an example, Butterfield would mail his letter in Long Beach at 1 p.m. and it would arrive in San Francisco at 1:10 p.m.

Special Delivery would take over and within 45 minutes from the Long Beach launch, the recipient would be reading his letter. Cost would be approximately $1 which would be a fast, economical service with more wordage possible for the money than any other kind of swift service available at this time.

THOUGH THE society is continually making tests and sending rockets aloft, only once each two to three years does it hold a public firing session.

Next Sunday, the Society will send a dozen missiles into the desert sky. They will climb one to two miles and land a mile from the firing sites. Safety shelters for several hundred spectators have been erected.

The test site is near Garloc, a ghost town in the Mojave Desert near the town of Randsburg. A donation of $1 (50 cents for children over 6 years) will be requested. Youth groups are welcomed.

Maps and attendant information regarding a front row seat at "Countdown to Zero" are available by mail from Butterfield, 3500 Wise Ave., Long Beach.

The darkness broke quickly as the sun rose. It made little difference. Sleep was for mortal men.

Saturday. The day before. Arg. We had established camp a hundred years or so ago, perhaps at 2 a. m. As I recall that morning, the MTA looked hung over.

Whistling while we worked, and laying a finger to the sides of our noses, soon enough some confusion came out of the chaos. Bob Schreiner began grumbling about the mile of wire he had to string, George Dosa mumbled about some tracking station or other, Rick Bennett muttered something, probably unrepeatable, and the rest murmured in a chorus of voices that venerable Gregorian chant, "Lord, save us."

The day before was to be a day of preparation, and would serve as a dry run for the Event. The Pacific Rocket Society and Chaminade High School had both requested to fire under RRS license, and Saturday was the chosen time. Two Goddard rockets rose quickly enough to 2500 feet, and four other Goddards were just as quickly reserved for Sunday. (We knew they weren't toys all along, Rick.) Bob Weinhardt followed by exploding a static model using potassium nitrate and sugar, and chose to cancel his second experiment. Chaminade placed last, successful in igniting three squibs, and in taking home three very intact rockets of sodium nitrate and polyester resin description.

Saturday night, we mixed a second, larger amount of fuel, set up the road signs, and in a completely unprecedented and very unpopular move, went to bed.

Again the sun rose. Ladies and gentlemen, keep together please. On your left you will notice a substantial brick structure, of reinforced concrete and steel; on your right, fourteen tall and elegant fire breathers; behind you, a long and sometimes crooked path at elevation minus three feet, carefully enhanced by General Telephone and Southern Pacific; and if you listen, soft music from KPOL brought to you by audiotape transmission.

What a day! What an absolutely thoughtful, entirely exciting, thoroughtly exhausting, undeniably professional day. There's an expression for it, I believe. The MTA rocked out, baby.

Bob Schreiner on communications, George Dosa at tracking. The yellow flag lowered; condition red established. Two hundred fifty crouching spectators, twenty-five finger crossing participants.

"X minus 60 seconds and counting. . . 50 seconds. . ." Then a spell breaker. Schreiner deadpanned, "Reminds me of the biblical story where the unjust stewart presented his case to his master and waited for his decision. The stewart could see the thoughts roll past his lord's eyes. Finally this good man turned to one of his attendants, pointed at the stewart and exclaimed impatiently, 'Fire the mother!' X minus 10 seconds and counting."

Somehow, the wrong rocket went off, but who cared at the moment. All of a very sudden the event became different than a fireworks show. "Tracking reports peak at 15 seconds, theoretical altitude at 3600 feet." Dosa was on the ball.

The day moved on: "The final rocket in the first battery is a two-inch vehicle with a titanium tetrachloride smoker in the nose section. Prior tests have shown the fiberglass construction to be adequate. . ." and so on.

Midway in the firing, Butterfield experienced a great deal of trouble igniting his four-inch, six-foot vehicle. It was an hour before it finally left the rack, and a full minute before the spectators believed the shrapnel from the explosion had finished raining. Mariano echoed the chorus in the next round, with a second-rate explosion, obviously a poor imitation of the master's touch.

Richard pointed out somewhat smugly to John that a proper explosion enabled twelve (12) or more people to use something other than their feet for bodily support, and not a paltry five. John apologized, and promised to do better.

But to Sacramento with convention. May we describe the feeling of most of that day in paraphrase of a talented master of verse, and hope that his repose be not disturbed too greatly.

Twas the day of the launching
And sweat lay on brows;
Not a rocket was ready.
There emerged some great vows.

The road had been marked
By a plywood V-2,
In hopes that the customers
Would be paying their due.

And Dennis in his armband and Bob in his hat
Had just settled down for a long winter's spat.

When over the airwaves
We received such a sound,
We turned off our transistors
To listen to this clown.

"Away to the bunkers, you must I insist."
His voice was so demanding we could not resist.

The rockets, on fins, so tall to the eye;
One could not question as to their why.
When, what should wandering minds assess
But a team of notoriety called the RRS.

With a squat old captain, uppity and die-hard,
He introduced himself simply. "You may call me
Ri-chard."

More rapid than Schreiner his profanity flew,
And he pleaded and prodded, and pushed on anew.
"Now, Bennett! When, Dennis? Up, Schreiner!
                No breakfast for you.
On Dosa! No, Parker! Oh, Claybaugh!
                Volkswagen's for glue."

To the end of the firing cable,
To the last inch of wire.
We fought for our team,
For the right to make fire.

But enough of our pride,
There was a show to put on.
A moment later (perhaps an hour)
To the microphone walked Don.

His shirt quite white, his jeans freshly laundered;
"Welcome to Group Therapy Camp I," he pondered.

"Remain under cover,
We ask quiet when it lands;
Failure to be safe
Could be a trip worse than these sands."

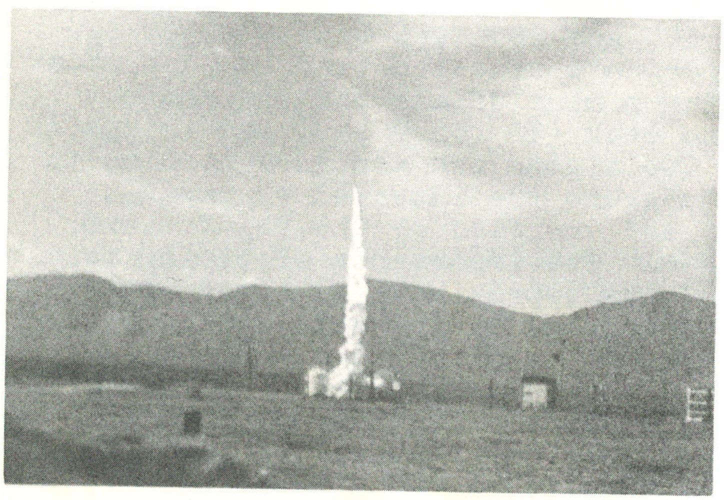
On a tail of sulphur, with zinc in its gut,
A monster emerged from the confines of its hut.
Racing and yelling, it exceeded its sound,
It reached out for glory, a freedom new found.
A pinnacle was reached; it paused and overturned.
Smile my friend. What lay ahead was yet to be
                learned.

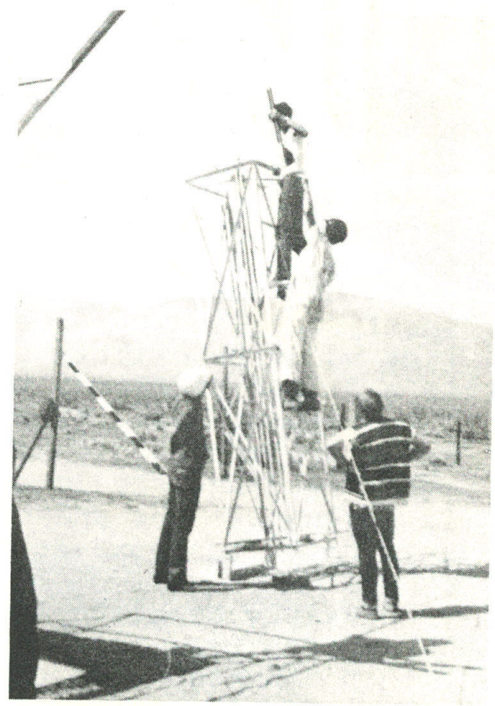
Death is a sport that few have enjoyed.
The rocket died. But wait! A package. Deployed?
By the grace of some cloth, and the phenomenon of
                air,
A bundle, very small, fell triumphantly to its lair.

A mob rushed out, a team stayed behind.
The mob that came back to show off its find
Found twenty-five men on the run,
A half-year's project just begun.


PROJECT
LIVE FIRE
10 MILES

From out of the woodwork emerged a rocket,





and scared hell out of the mice.

DATA REDUCTION ON
PROJECT LIVE FIRE

By George Dosa,
Reaction Research Society

Rarely does a data reduction team have the opportunity to gather data on such a unique group of rockets as were sponsored by the RRS as in their recent Project Live Fire. There were two or three rockets of each type for comparison of a single type, basic types for type comparison, and a few unique styles for comparison to the more or less 'standards.' More data was gathered during this project than has been accumulated in a long time; however, as in the past, certain pieces of information which could have been obtained were overlooked. The information and data reduction still yield a fascinating story.

The basic data used was timing and burnout phase motion picture photography. A team of five, using timing deviced and high speed photography took time to peak and to impact on most rockets and photographed the displacement every 48th and 64th of each second. From the information gathered it was possible to know the time to peak, time to impact, approximate elevation, displacement, velocity and acceleration.

The blast off of typical micrograin is fast and furious with the burnouts occuring between 100 and 200 feet within about 0.2 to 0.3 seconds. The average person's reaction time is also about 0.2 to 0.3 seconds and stopwatch timing of the burning phase would be impractical; timing to peak (10 to 20 sec) and impact is quite feasible. Accordingly, two timers are assigned to time to peak and two are appointed to measure the interval to impact. All data is logged immediately and verified by the chief timer before the stopwatches are reset. The importance of timing is that it is the only evidence of the approximate altitude without a tracking device. Even with tracking, timing will still be used to verify altitude and impact.

The known time to peak and to impact can also be used to verify each other. Without drag, or in a vacuum, the total flight time would be exactly twice the time to peak. However, since it is a little difficult to remove all the air on the rocket range, the ratio of total time to peak time is about 2.25 to 1. If the known two readings do not fall close to this ratio, one or the other readings should be suspect. A summary of Live Fire times is given near the end of this article. And now it is time to move on to the next subject.

Fairly complete information on twelve rockets is available. There were two, 2-inch diameter by 2-feet long RRS Betas, three 1-inch diameter by 3 feet long Goddard types, five 2-inch by 4 feet, a 2½-inch and a 3-inch by 4 feet type, and a 3-inch by 4 feet vehicle. The 2's, 2½, and 3 inch Beta types behaved much as they have done in the past. Take off was generally smooth and fast with generally increasing acceleration to a point presumed to be fuel exhaustion with a typical tail-off due to residual gases. The short, 2-foot rockets showed that they had not reached their full potential before burnout. The other Betas behaved with surprisingly consistent performance. Some of the displacement curves could be superimposed on one another with very minor variations, an indication that packing was quite consistent.

The 3-inch diameter rocket had a very good displacement curve and an amazingly even acceleration curve indicating uniform thrust. It and three other Betas managed to exceed Mach I. The Goddard types were smaller rockets, of aluminum tubing, without nozzles, and with a loosely packed fuel. These rockets exhibited a surprisingly long burning time. All had over one second of burning time (vs. 0.1 to 0.3 seconds for the Betas) and burnout did not occur until an elevation of 200 feet had been exceeded. However, the velocity was just enough to keep the vehicle going and the acceleration was very low. This was a special test of the Goddards and their behavior is entirely different when using the usual capsulated fuel.

The most interesting data comes from motion pictures of the burning phase, taken at 48 to 64 frames per second. When these pictures were analyzed, a complete displacement vs. time graph was plotted from the data. With the camera at 48 frames per second a displacement picture is taken every 0.0208 seconds. This data is refined and manipulated to yield velocity and acceleration curves. A data summary of Project Live Fire is included in this article.

A general review of the film also shows various other interesting phenomenon. Slow starts, erratic burning changes in flight paths, and chuffing are some of the variations that can be seen in the films.

TIME TO PEAK AND TO IMPACT: A STATISTICAL VIEW

Since it was generally known that the time to impact is slightly more than twice the time to peak, and since a small sampling of data was available from Project Live Fire, a tabulation is shown here of those rockets which were timed both to peak and to impact.

Total time (impact) - time to peak = 2^+; in particular, #5 - 1.95; #6 - 2.00, 2.03; #9 - 2.27, 2.95; #10 - 2.72, 2.66; #13 - 4.16; and #16 - 2.28.

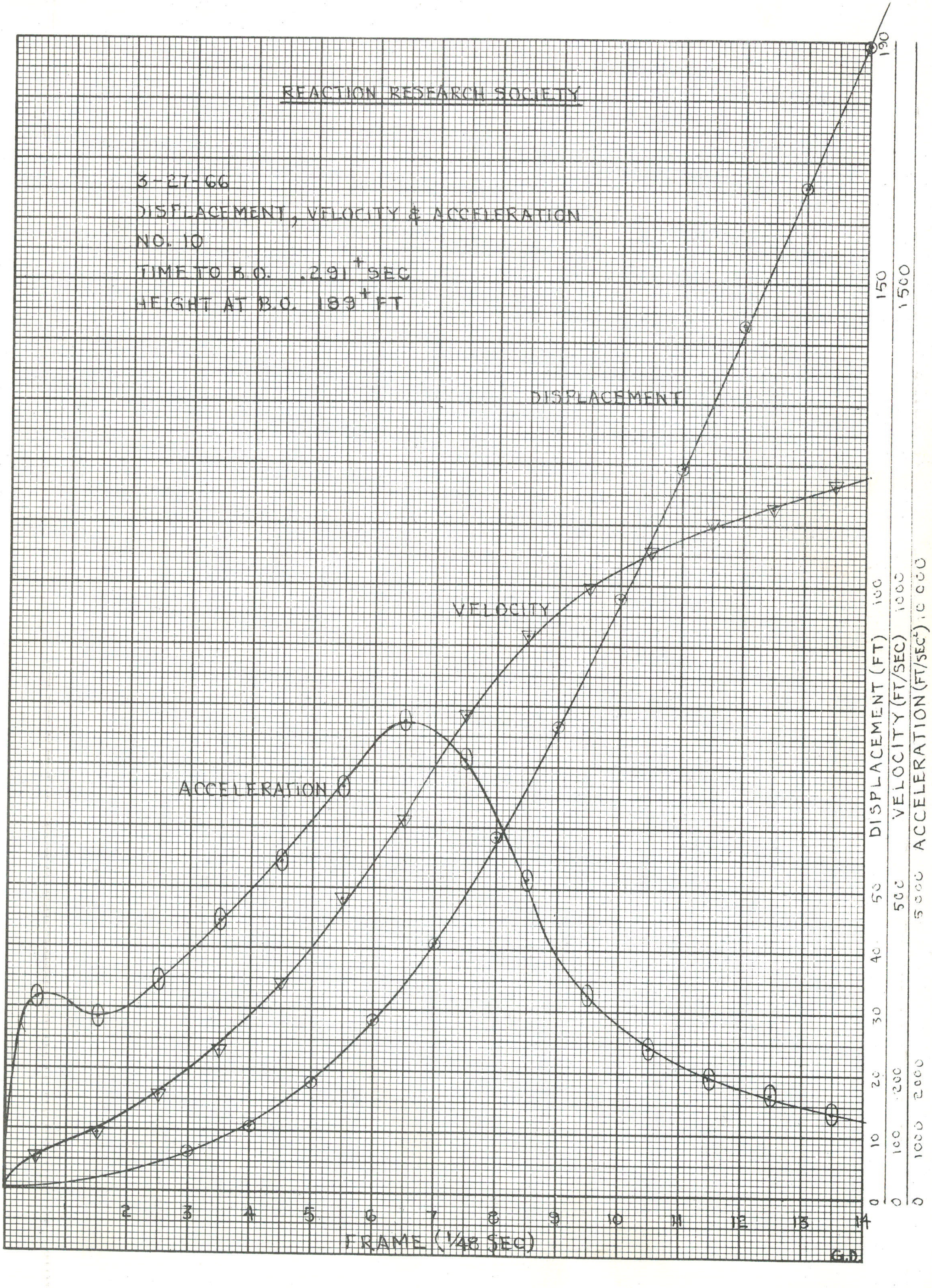
The expected results are shown by rockets #9 and #16 and possibly #10. The ratio 2.00 can only be achieved in a vacuum. Therefore rocket data on #5 is inaccurate and #6 suspect.

Previous data, in the Drag report, showed a ratio of approximately 2.25:1.00.

DATA SUMMARY
PROJECT "LIVE FIRE"

5-9-66 G.D.

SHOT NO.	TIME TO B.O.	HEIGHT AT B.O.	MAX. VEL.	MAX. ACC.	TIMES TO PEAK	TIMES TO IMPACT	HEIGHT BASED ON TIME	RANGE	COMMENTS
1	.083"	43.7'	795	17,550 ?	8.4	-	1,136	-	
2	.187	178.3	1,096	26,442	16.5 19.9 11.4	-	4,121	3320	
3	1.123$^+$	202.6$^+$	340	1,106	2.7 ?	15.0 11.1	~ 700	-	GODDARD TYPE OUT OF FRAME
4	.370	183.8	1,262	7,644	25.0 ?	-	10,062 ?	-	MACH 1$^+$
5	1.331$^+$	204$^+$	264 ?	889	16.68 12.0	23.4 13.92 ?	3,338	-	GODDARD TYPE OUT OF FRAME
6	.208	98.8	1,154	13,460	23.34 23.00	-	8,700	-	MACH 1$^+$
7	1.560$^+$	209$^+$	236$^+$	~1158	-	17.92, 18.7 16.8, 16.8	-	-	GODDARD TYPE OUT OF FRAME
8	.125	52.4	770	13,462	9.0 11.2	-	1,600	-	SLOW START: .27 SEC IN RACK
9	.208	141.0	1,120	9,375	15.6 15.6 12.0	35.4	3,918	-	MACH 0.97
10	.312$^+$	190$^+$	1,180	7,740	19.5	53.0 51.9	6,185	3460	MACH 1$^+$
13	-	-	-	-	10.0 ? 10.8 ?	45.0	1,740	-	
16	-	-	-	-	10.0 10.8 9.0	20.52	1,600	-	


REACTION RESEARCH SOCIETY
3-27-66
DISPLACEMENT, VELOCITY & ACCELERATION
NO. 10
TIME TO B.O. .291+ SEC
HEIGHT AT B.O. 189+ FT
DISPLACEMENT
VELOCITY
ACCELERATION
FRAME (1/48 SEC)
DISPLACEMENT (FT)
VELOCITY (FT/SEC)
ACCELERATION (FT/SEC²)
G.D.

POST FIRING REPORT:
DECEMBER 18, 1965

By Maryann Butterfield
Reaction Research Society

Sunday morning, December 18, dawned clear and crisp. The temperature was 18 F and every member of the crew worked hard trying to get someone else up to light the fire. Richard Butterfield finally braved the cold at 6 A.M., got up and lit the fire. A half hour later, it was a cozy 36 F (at least inside).

I fixed breakfast while Dennis Shusterman and Richard put the water back in the truck radiator. Before putting it back, however, they had to skim the ice off the top and throw it away. After waking Dennis Jackson, who was still in bed, we had breakfast, then started mixing propellant for the three rockets.

The propellant was 80% 320 mesh technical zinc dust and 20% Braun superfine sulfur. While we were preparing the propellant, two more carloads of rocketeers arrived: Don Girard, Monica Brown, Brother David Reeves, Bill Claybaugh, Joe Buttner, and Bob Schreiner.

With their help, the three rockets were prepared and some bunker digging took place (we had to work, for it was too cold to sit around). After lunch, we loaded the first rocket into the launching rack.

The rocket, a standard RRS Beta, was built by Dennis Jackson. It was two inches in diameter and 54 inches long. It used an expanded nozzle and was equipped with a micarta burst diaphragm. Upon ignition, the rocket sat in the rack and smoldered for about five seconds, then accelerated briefly, rising to an altitude of about 100 feet. The flight was unstable and the rocket fell 57 feet uprange of the blockhouse.

The second rocket was a Fort Sill Beta built by Richard Butterfield, two inches in diameter and 54 inches long. The firing system, nozzle, burst diaphragm, and launch tower were similar to that equipment used with the first rocket. The nose cone was built by George Dosa and modified by Dennis Shusterman to contain titanium tetrachloride ($TiCl_4$) which generates a dense white cloud upon exposure to air. For a description and diagram of a similar cone, see further on in this section. Upon ignition, the rocket rose to an altitude of 2400 feet, impacting at a range of 2600 feet. A beautiful white trail, ideal for visual tracking, was left behind the rocket, marking its trajectory.

The third rocket fired, built by Richard Butterfield, was four inches in diameter and 57 inches long. This rocket used a 1/16 inch micarta diaphragm 2 inches in diameter, just above the nozzle throat. As the rocket rose, one of its four fins caught on the launching rack and was mangled. This caused a pronounced wobble in the trajectory during the acceleration phase, and some tumbling during the unpowered phase of the flight. The rocket reached an altitude of 2000 feet and impacted a 1000 feet downrange.

After recovering the rockets, we loaded the truck and were ready to go at 2:30 P.M. As we were leaving, we noticed that there was still the ice from the morning on the ground. We turned on our heaters and headed home.

POST FIRING REPORT:
FEBRUARY 6, 1966

By Monica Brown,
Reaction Research Society

The white moist of the clouds clung to the dark hills; the contrast of light and dark resembled the familiar contrast of an oreo creme sandwich. The wind that threw pebbles at the quonset hut was powerless to clear the sky. It had rained during the night in the desert; it continued to rain in Los Angeles. The joys of rocketry were not so sharply etched in the minds of the members of the RRS who had driven out for a weekend of working and one rocket firing. The rocket slated for launch on this bleak Sunday was built by Monica Brown and the Society. The rocket was an RRS Beta, with a total length of 72 inches, and a motor diameter of 2 inches. The nosecone, of George Dosa origin, carried an experimental smoke tracer. The cavity of the nosecone was scheduled to be filled with $TiCl_4$, which would generate smoke during the flight.

The only pre-flight problem was the $TiCl_4$. The solution was supposed to be injected into the nosecone with a syringe, but the titanium tetrachloride jammed the inner chamber of the syringe. The firing crew finished loading the solution with a system of straws and a plastic bag.

The rocket was fired from the rack at 3:00 P.M. and quickly was lost in the clouds. Maryann Butterfield reported impact at 27 seconds, but 18 seconds later she and Mr. Dosa heard the whistling of the vehicle abruptly stop. The time was then recorded at 45 seconds. It is possible the first sound was a sonic boom created by the rocket.

The downed 'bird' was found in the desert nearly a mile from the launch rack. The distance was measured by Richard Butterfield and George Dosa, who patiently tramped from the rocket to the compound.

George Dosa had recorded the visible portion of the flight with a 8mm movie camera at the tracking station. Later analysis confirmed that the rocket had attained supersonic speed. The maximum altitude was estimated at 8000 feet.

Examination of the nosecone revealed that the $TiCl_4$ had corroded the interior of the fiberglass nosecone. Film analysis also revealed the erratic burning rate of the 80-20 zinc sulfur mixture. It is believed the cool air temperature aided the rocket flight.

Monica had attempted rocket building as a chemistry project and an entry in St. Bernard High School's science fair. A second part of the project was data reduction, patterned on George Dosa's techniques. The project received honorable mention in the physics division of the school fair.

Technical Reporting by George Dosa

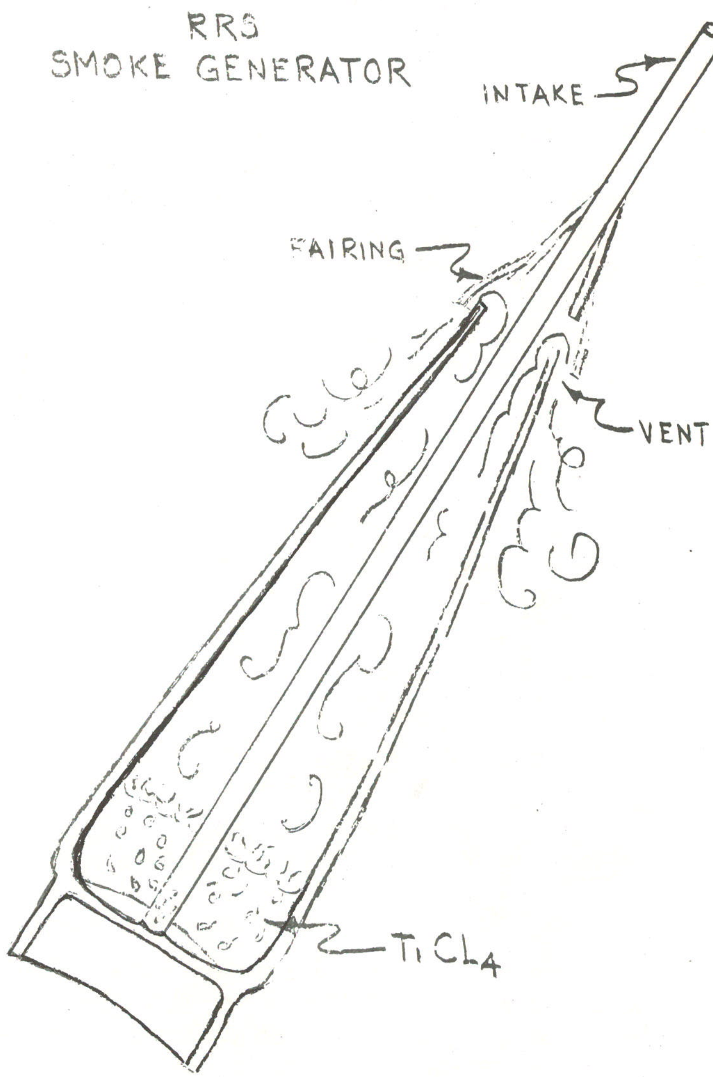
SMOKE GENERATOR TRACES
ENTIRE FLIGHT PATH

A fascinating new development in the Reaction Research Society is a self-contained nose cone smoke generator, now undergoing field trials at the Mojave Test Area. The smoke generator is designed to leave a thin, visible trail of smoke from burnout to impact.

At the present time, a goodly number of rockets are fired and lost forever; no time to peak, no time to impact, no azimuth or elevation, and sometimes no more rocket. This is great if one is going to claim that it went into orbit, but not very satisfying to the serious experimenter. There is a definite need to be able to see the critical points in a flight path. In photographing, timing, and tracking it is most desirable to determine burnout, peak, and impact.

The new, hollow fiberglass nosecones now being tested have their base sealed and an air inlet tube extending up from the base, out beyond the tip of the cone. The inlet tube has several small holes near the base and the nosecone has three larger holes about a quarter of the way back from the tip to exhaust the smoke. These larger holes are shrouded with small streamline fairings.

In operation, titanium tetrachloride is introduced into the nosecones through the inlet tube. During flight, air is taken in through the inlet tube and bubbles up through the liquid $TiCl_4$ to produce a dense white smoke which is forced out through the exhaust fairings.

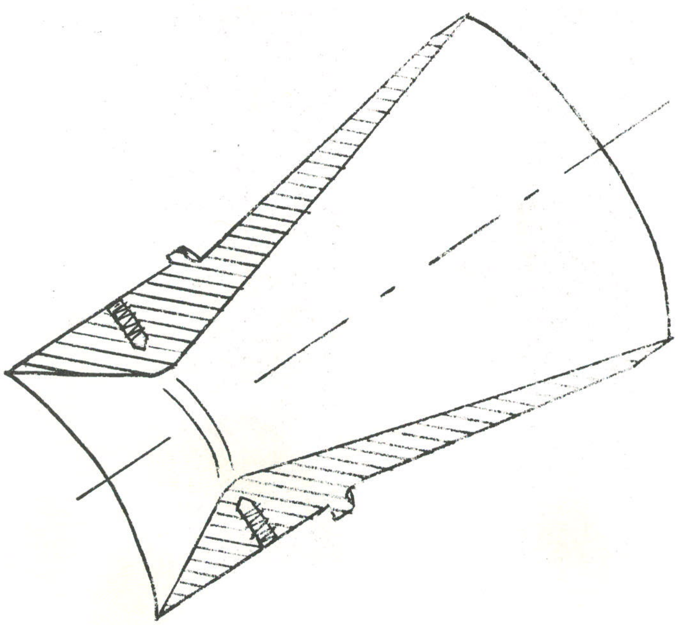


Thus far about eight or nine of the cones have been built and although there are some problem areas such as sealing and loading the liquid, the three or four that have been fired functioned quite well.

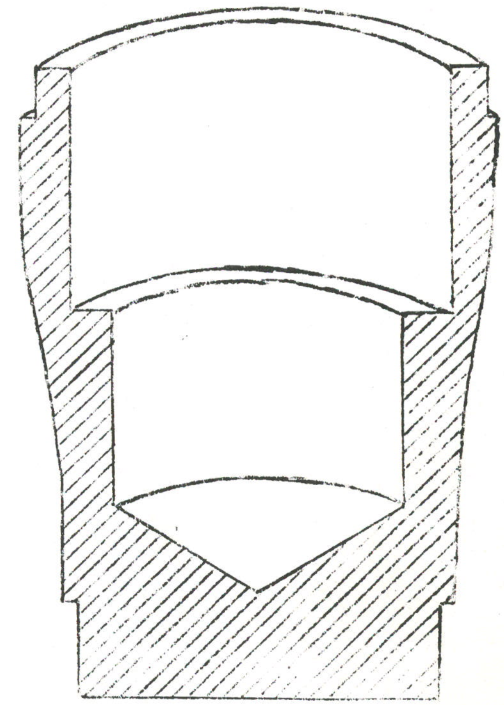
NOZZLE MODIFICATION AND ADAPTER FOR RRS TWO-INCH VEHICLE

The RRS has, over a considerable period of time, experienced very good results with the Beta-type nozzles. This nozzle, as adapted from Brinley's handbook, starts well, performs well, and can often be used for several firings before excessive erosion enlarges the throat. But even a good design can be improved.

In the process of evolving a more useful nozzle the design was changed to include a small collar, no larger than the O.D. of the motor, in order to prevent the motor tube from swallowing the nozzle on impact. Then this collar was shifted to the rear to allow the mounting screws to be in the thickest section of the nozzle (near the throat) so that the tapped holes would be sufficiently deep and that there would be adequate edge distance for the

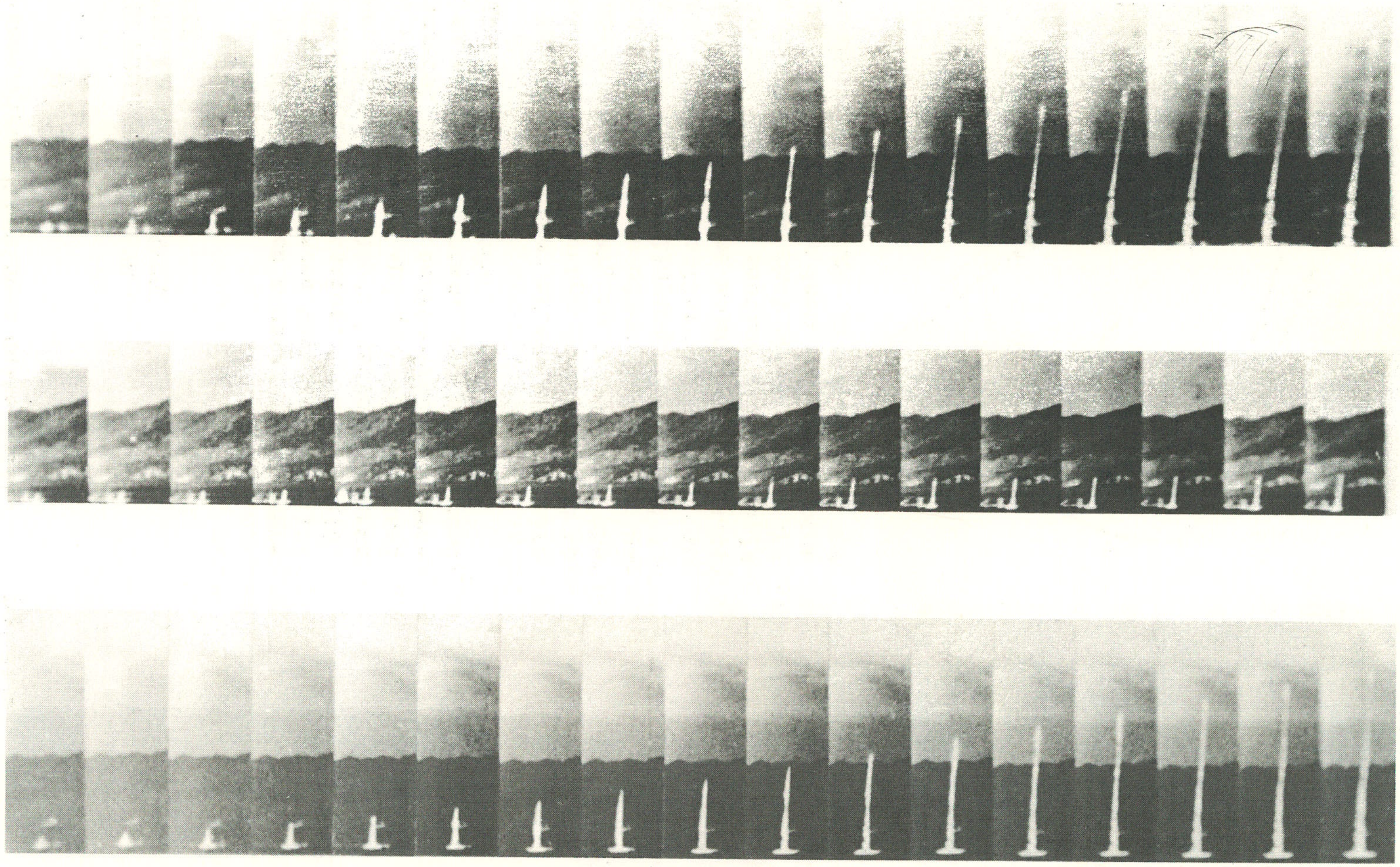


clearance holes in the motor tube. Then a small portion of the outer exit diameter was left untapered, to stiffen an otherwise sharp and thin exit diameter. This diameter, about a quarter of an inch long, was also useful in realigning the nozzle in a lathe for subsequent remachining and polishing.



However, one of the major problems with this nozzle was that the exit diameter was about a half inch larger than the rocket body and the rocket would not lie in the launcher with its axis parallel to the guide rails.. Attempts were made to add equalizing rings near the front of the missile, but these were never very satisfactory. The solution to this problem is being investigated with two alternate approaches.

One approach is to make a nose cone that bulges out in the middle with a maximum diameter equal to the nozzle exit diameter and a base equal to the motor tube diameter. Such a nose was produced by Richard Butterfield (now known as Butterfield's Turkhead Nosecone) and fired most successfully. Another, slightly more difficult approach is to use a standard $2\frac{1}{2}$-inch diameter nose cone, and a $2\frac{1}{2}$-inch to 2-inch adapter. With a section of $2\frac{1}{2}$-inch aluminum tube between the nosecone and adapter (useful as an instrument compartment) a very serviceable assembly is produced.



VISUAL DISPLACEMENT CURVE

A paste-up of 35mm exposures taken from a frame by frame projection of motion pictures. Mr. Finch Walker, of Long Beach, made this display in an attempt to capture the movement of Project Live Fire.

FEATURED ARTICLES

MR. DOSA, I PROTEST!

By Don Girard, Secretary
Reaction Research Society

"If only amateurs would get more data out of their testings!" Oh, the number of times have I shuddered at the thunderings of the man. "How high up did it go?" threatens Mr. Dosa. "Pretty high," respond I naively. "Pretty high!" I am sure the earth itself is shaking at this moment.

"Well, it went up pretty fast, and there was a lot of fire. It looked real good." "Oh." And there comes over him a dead silence. Even my squirmings leave him unimpressed.

Finally the gentle Atlas speaks. "I will teach you how."

And so seven thousand and ninety two calculations later, I am taught. There he stands, waving his now-available-at-four-dollars-a-copy booklet on Data Reduction and Drag, voraciously demanding, "Recite it again!"

So I do. Use a high speed motion picture camera set back a convenient distance, say one thousand feet, and record the burning phase of the rocket trajectory. Locate in the film some scale factor, say a post one hundred feet from the launcher. Plot distance versus time from the film.

"Very good."

I continue. Then find the smoothest curve joining these points. Use the corrected points in further calculations. Find the average between two points, divide that by the time interval between the points, and plot this against time. Average distance per time unit equals velocity. Smooth out the velocity curve, and prepare a third curve in like manner. This is your acceleration curve.

"Again, very good."

I stop. "But Mr. Dosa, it can take three people an hour and a half to develop good displacement, velocity, and acceleration curves if we have to crank out all the calculations.

"Crank."

But I am educated. I read the RRS NEWS #100 and learn about nomograms.

Pay attention, Mr. Dosa.

Nomography is only a part of the graphical calculus, which also includes analytic geometry and two-dimensional vector calculus. First, let us examine the alignment chart that Miss Beth Hooper introduced in NEWS #100 (Fig. 1, page 16). Two scales were constructed parallel to each other and of equal divisions, and a third scale (the answer scale) established equidistant from both of these.

Why equidistant? And why was this middle scale graduated differently from the other two?

To answer these questions, I'm afraid we'll need to know some theory behind alignment charts. So sit tall, gulp, and we'll try.

A rectilinear scale can be graduated evenly according to distance, or with respect to some function of that distance (the scaled divisions on a slide rule were determined with reference to a logarithmic function, for example). We can say that the position of a point on the rule is equal to some scale factor times the function, or

$$x = m \cdot f(u).$$

Now if we wish to add two numbers, and say one ranges between 0 and 100, and the other between 0 and 1,000, we can assign different scale factors to these ranges so that we can keep both scales of reasonable size. The center scale, showing the sum, has to be located in a particular way.

If for the first scale, $x_1 = m_1 \cdot f(u)$, and for the second, $x_2 = m_2 \cdot g(v)$, then

$$\frac{a}{b} = \frac{m_1}{m_2},$$

where a and b are the distances shown in Figure 1. The scale for the center is given by

$$m_3 = \frac{m_1 \cdot m_2}{m_1 + m_2}.$$

Proofs of these relations are omitted. We refer to the center scale as the projection pole, P.

Enough of the theory. We have introduced in designing a simple alignment chart the notion of scale factors (modulus), and a projection pole.

In Miss Hooper's example, the two scales had the same scale factor, implying that $m_1/m_2 = 1$, and therefore $a = b$. Also, $m_1 \cdot m_2/m_1 + m_2$ in this instance equals $\frac{1}{2}$, so there are twice as many divisions on the center scale.

It is not immediately obvious, but we may take these concepts and use them for calculus solutions. The velocity curve extracted from the distance curve is simply the first derivative of the distance function (or curve); the acceleration is the second derivative.

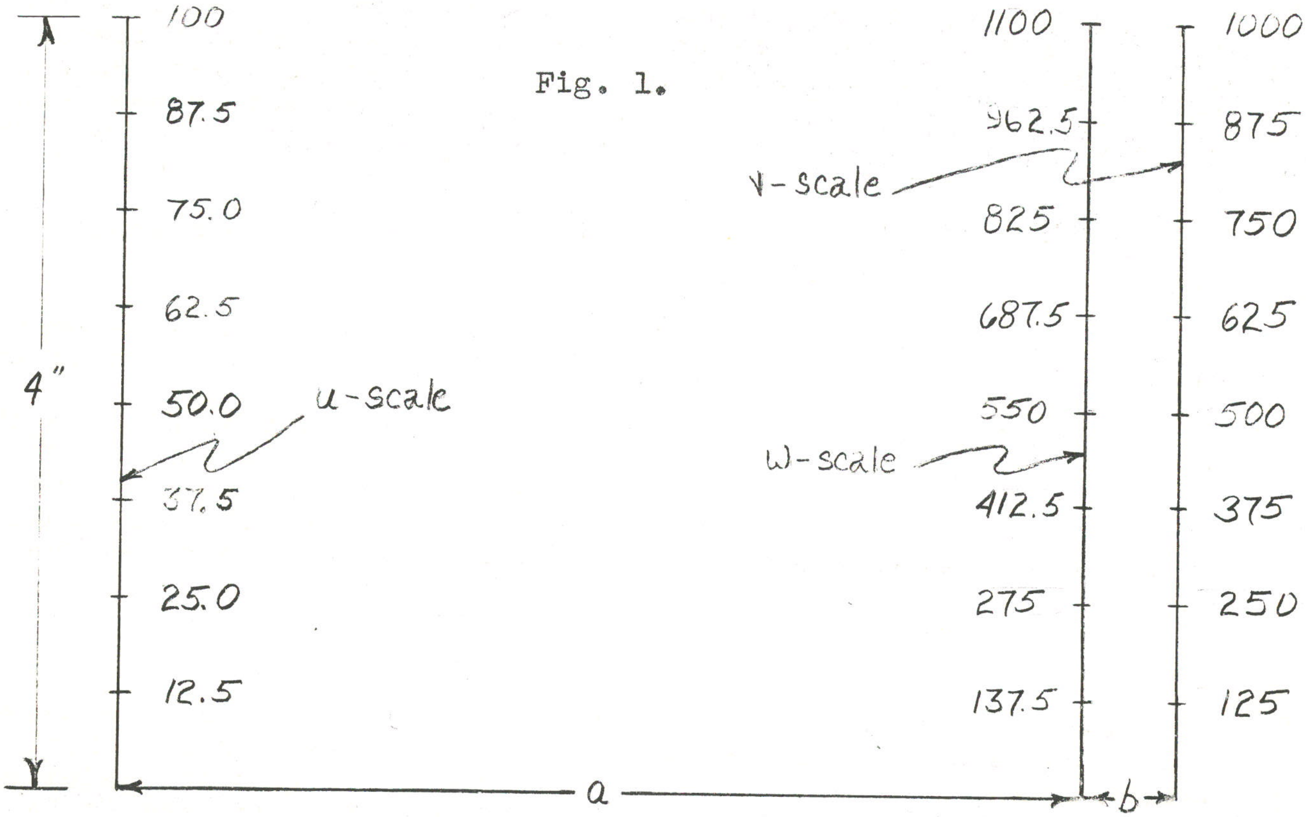


Fig. 1.

FOR THE FIRST SCALE:

$$X_1 = m_1 \cdot f(u)$$
$$4'' = m_1 \cdot 100$$
$$m_1 = .04\,''/\text{division}$$

FOR THE SECOND SCALE:

$$X_2 = m_2 \cdot g(v)$$
$$4'' = m_2 \cdot 1000$$
$$m_2 = .004\,''/\text{division}$$

FOR a & b:

$$\left.\begin{aligned} a + b &= 5.5'' \\ a/b &= m_1/m_2 = .04/.004 \end{aligned}\right\} \Rightarrow \begin{aligned} a &= 5'' \\ b &= .5'' \end{aligned}$$

FOR m_3:

$$m_3 = \frac{m_1 \cdot m_2}{m_1 + m_2} = \frac{(.04)(.004)}{(.04) + (.004)}$$
$$= .00363$$

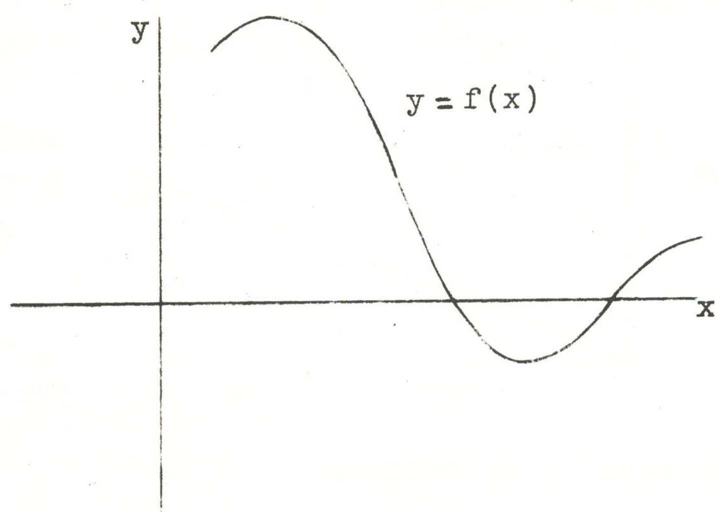
FOR $h(w)$

$$X_3 = m_3 \cdot h(w)$$
$$4'' = .00363 \cdot h(w)$$
$$h(w) = 1100$$

(For our purposes, we may explain a derivative to a curve as taking the slope of each and any point on the original curve, and plotting this value. A derivative curve will reflect a change in direction of the original curve. See the nomograph example for a visual relation of the derivative to the parent curve.)

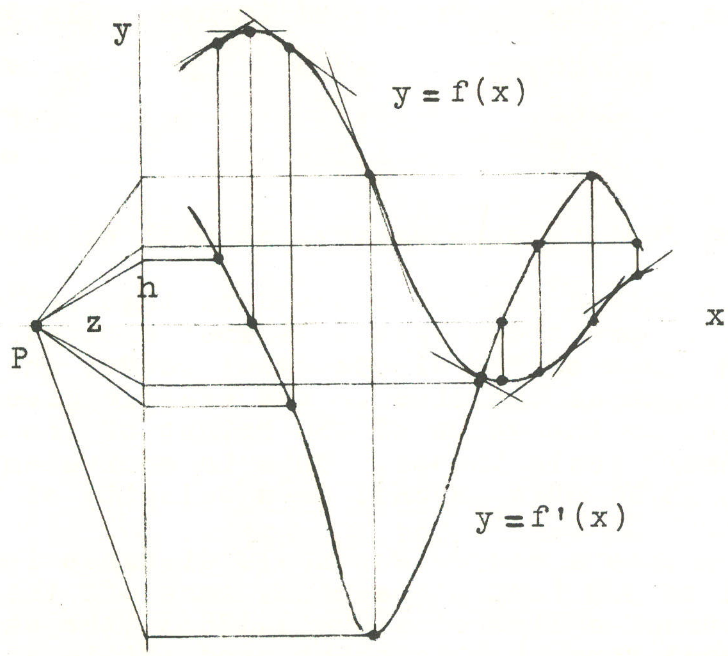
Fair enough. Let us take an arbitrary curve, say

Fig. 2.



We wish to take the derivative to this curve. If we construct the lines as shown, the derivative will look like:

Fig. 3.



What we have done is this: we have drawn a tangent line (representing the slope) to several of the points on the parent curve, and laid out an identically sloped line passing thru 'P'. (How 'P' is established will be explained in a moment.) The height of the derivative function is where this line crosses the y-axis. Then a smooth curve is drawn connecting the derivative points.

The scale of the derivative is determined by the distance 'z' that 'P' is from the y-axis. (You might note a similarity here between 'z' and the modulus factor, m, introduced earlier, and between 'P' and the projection pole of the alignment chart.) If we use data-reduction on a rocket power phase as an example, the method of choosing P might be easier to illustrate.

We are given the displacement curve for the first three frames of a 48 frame/second camera.

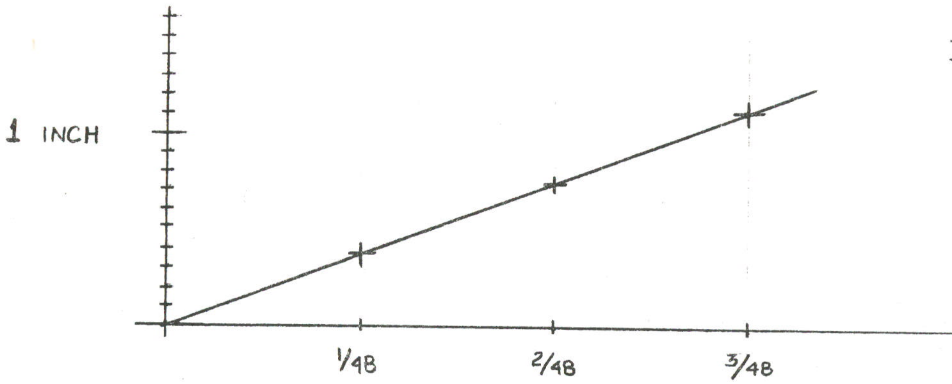


Fig. 4.

The tabulated data is as follows:

DISPLACEMENT DATA

Scale: 3.75" = 100'

Frame	Time	Projected Inches	In Feet
1	1/48	.375	*
2	2/48	.750	*
3	3/48	1.125	*

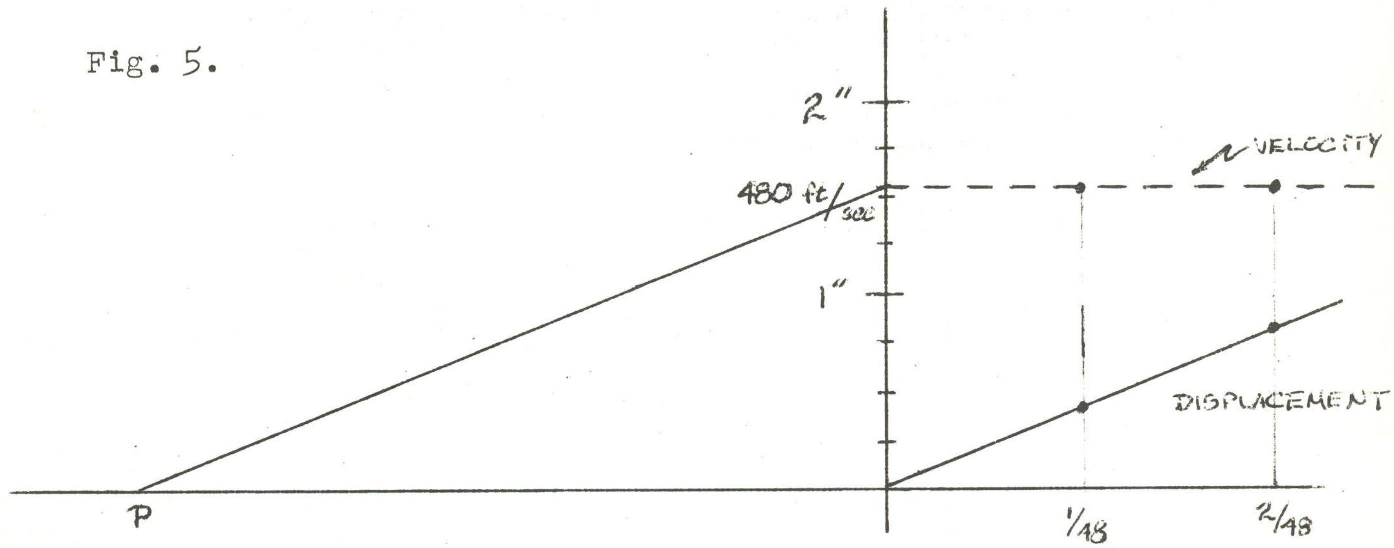
The conversion to feet is unnecessary, as will be shown.

It might be noticed that we chose data that would give a constant velocity. In practice, draw a line of arbitrary slope greater than the maximum slope of the displacement curve, and this will have the same significance as the line in the example given here. The slope of the line (or the value of the height of the derivative) is 1.125 scale inches/3 scale inches. This is equivalent to saying we rose 100 feet in 10/48 of a second, or a velocity of 480 feet/second.

Now simply choose a convenient scale distance for velocity, say 1 inch equal to 300 feet per second, mark off the height 480 feet per second, construct a line of slope 1.125/3 (the same slope as our displacement curve) through this point, and 'P' is established. Proceed with the differentiation, and read values of velocity directly. Figure 5 illustrates what we have done.

A few comments, however. In all probability, your first attempt at laying out a properly scaled curve will take about three hours (it took me seven), the second about a ½ hour (I didn't do a second one) and the third about 15 minutes (mine is to reason why, not to do and cry). But by a proper placement of the projection pole, the need to translate displacement in actual projected movie frame inches to displacement in feet is eliminated. It's important to master this technique.

Fig. 5.



The construction of the velocity curve takes but a few minutes, saving considerable time over numerically figuring "average" velocities between points and then plotting. We have found that as an aid to taking the tangent lines to points on a curve, a small mirror works very well. Hold the mirror perpendicular to the paper at a point where the tangent is desired, then rotate the mirror until its curve and reflection appear to form a smooth curve. The mirror will then be normal to the curve.

That's all. My protest is finished.

SUCK. SQUEEZE. POP. PHOOEY.

By Bob Schreiner
Reaction Research Society

Here is a do-it-yourself generator that is inexpensive to build, very portable, and delivers just about 350 watts of 110 volt 60 cycle AC, enough to run a $\frac{1}{4}$-inch drill motor, lights, a firing panel, or a tape machine.

The Society has used a generator built to this design for many of its minor firings, and for most of its work parties. It has served quite adequately, and should assist the amateur group that is continually hindered by the lack of power when on the field.

Essentially, it consists of an old lawn mower engine driving a modified six volt automobile generator to get 110 volts AC. Don't let the modifications put you off--it should take about three hours to make the conversions.

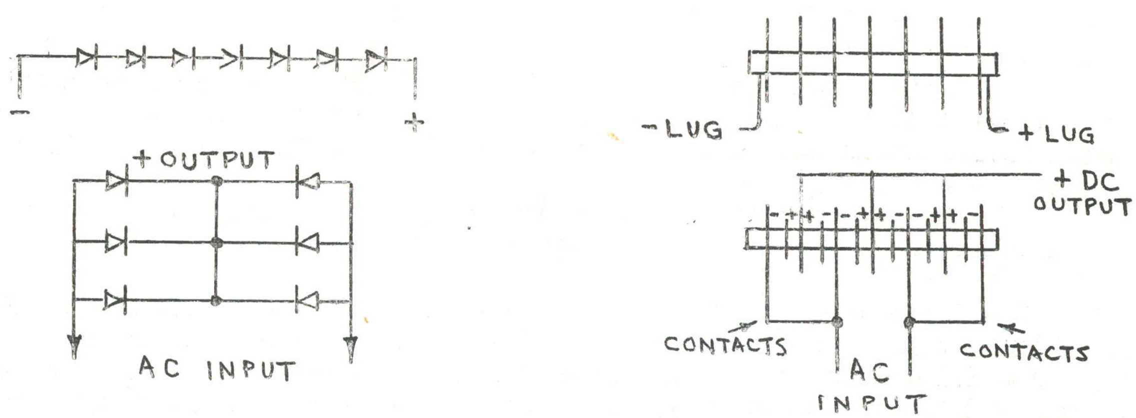
Used engines are available at nominal cost, as low as $15.00 for a two horsepower model. A 1/2 horse engine will suffice. The Society uses a Briggs & Stratton 4 cycle 1 HP engine with a governor. Make sure yours has a governor.

GENERATOR. The generator is a 6 volt, 35 ampere Delco or Auto-Lite automobile generator. Junk yards carry these for about $3.00, including mounting brackets.

The field is excited by means of a step-down transformer and a low voltage selenium rectifier. The transformer should have a 110 volt 60 cycle primary and 20 to 30 volt center tapped secondary, good for about 3 or 4 amperes. Transformers from old pin-ball machines, or some model train transformers have suitable windings. Various taps will prove to be very helpful when starting to adjust the compounding circuit for best voltage regulation.

The rectifier must deliver 8 volts or less of DC at about 1½ amps, and anything you can scrounge up that will do the job is fine. One way to get one for about two dollars is to take apart a standard 500 or 600 milli-amp TV selenium rectifier and rearrange the plates for low voltage operation. Figure 1 shows the initial and final arrangement of plates. The between-plate contacts can be cut from tin can metal, and the eyelet can be replaced with a long bolt to hold the stack together when finished.

Fig. 1.



GENERATOR CONVERSION. A good way to start is to give the thing a bath so you can handle it easier. Remove the brushes and take out the two long bolts that hold the front and back plates together. These have screwdriver slots and are located on the front plate. The armature comes out with the front plate. You don't have to disturb the pulley or the front bearing. Working with this armature:

(1) Use a heavy, well tinned and hot soldering iron to unsolder all of the connection to the commutator bars, and pull these out.

(2) Use a large screwdriver, or any suitable piece of metal, to remove the retainers from the slots to free the windings.

(3) Remove all of the armature windings and discard.

(4) To rewind, one pound of #20 Formex or Formvar wire will be required. Solder one end to the shaft just on the pulley side of the armature laminations. Make sure the joint is solid, then wrap and

tie the wire around the shaft to take off any mechanical strain. Before proceeding further, check the insulation of the slots. Make sure there are no exposed metal edges which could cut through the insulation of the wire, causing a short circuit.

(5) Rewind as shown in Figure 2. There are fourteen slots, so we have seven coils, all in parallel planes. Each coil has about 50 turns, more or less. (It is better to have more than less.) The only thing to remember is that all turns go in the same direction. Replace the retainers as each coil is completed.

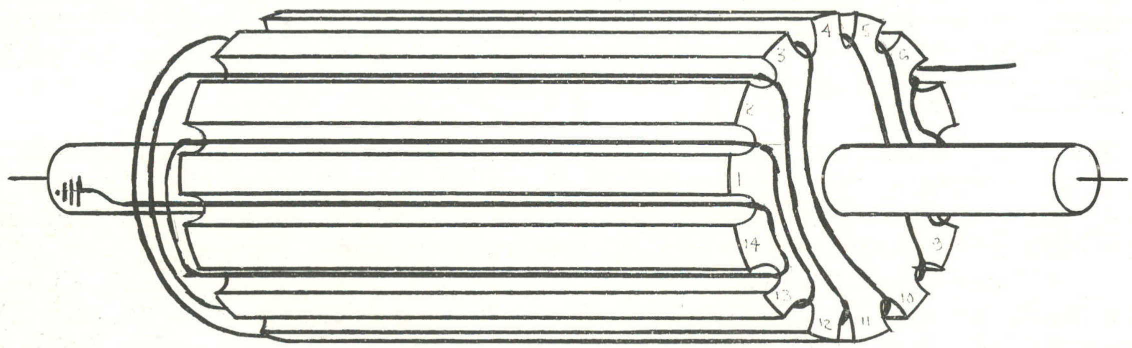


Fig. 2.

(6) Bring the end of the last coil out on the commutator end, and after scraping the insulation, wrap it around all of the commutator bard ends so as to short them out to form a slip ring. Solder the wire all around.

(7) Slap on some varnish or shellac to keep the wires from moving around, and the armature is completed.

Take a look at the field coils in the main part of the frame. Note that one wire goes to the "field" terminal (small screw terminal) and the other end is connected to the insulated brush holder. There is also a lead connecting this same brush holder to the "armature" terminal (large screw terminal). Remove this lead. Disconnect the field from the insulated brush holder also. Connect it to the "armature" terminal. You now have the field winding brought out through the two terminals on the side of the generator frame. Reassemble the generator.

Do not replace the grounded brush, since we are now using a slip ring, and this brush would short the output to ground.

The generated AC comes out at the uninsulated brush and the frame ground. When replacing the "hot" brush, include a large solder lug under the pigtail screw terminal for connecting the output lead. And that's all there is to the generator.

ASSEMBLY. The generator is built on a 2 inch by 10 inch wood base about two feet long, using carriage bolts for mounting components. Mount things solid, because the vibration will shake the parts loose in no time if you don't.

Wiring follows the mechanical construction. Stranded #12 rubber or vinyl covered wire is highly recommended. Tape together parallel running leads for mutual support, and fasten as often as practical.

TESTING AND ADJUSTING. The first thing to do is to get the engine running and adjust the generator speed to about 3600 rpm. Be sure you have adequate ventilation. Connect a 100 watt bulb to see if anything comes out at the start. Chances are it won't. While the engine is running, connect a 6 volt battery across the field terminals with the polarity corresponding to the rectifier output. If the lamp doesn't light immediately, it is due either to a burned-out bulb, incorrect wiring, shorted armature turn or turns, or an open field winding.

Assuming the bulb lit, disconnect the 6 volt battery. If the lamp goes out, try reversing the primary or secondary phasing of the transformer. Current flowing to the load should increase the field voltage output. The secondary tap should be adjusted to give the best voltage regulation characteristics. The absolute voltage level under load is adjusted by engine speed and R2. R1 affects the voltage with a small load (or no load) and also determines how well the generator builds up initially.

Next, take the lead off and watch the voltage. If the voltage soars, R1 is too small. The voltage should drop off to between 30 and 100 volts. A load of about 75 watts should bring the voltage to 115. If you expect to ever use less than 75 watts load, then another resistor across R1 (shown dotted on schematic in Figure 3) through a switch is suggested. This resistor would be adjusted to bring the no-load voltage up to 115.

For 60 cycles, the generator speed must be 3600 rpm. If the voltage output is low and can't be brought up otherwise, the speed could be raised until it comes up. The speed regulation of the engine is critical with respect to the voltage regulation characteristic. The better the speed regulation, the better the voltage regulation.

NOISE ELIMINATION. Noise can be eliminated by: (1) bonding all component frames electrically together with heavy wire; (2) bypassing the brush with a 0.01 microfarad disc ceramic capacitor; and (3) installing a resistor or shielded spark plug.

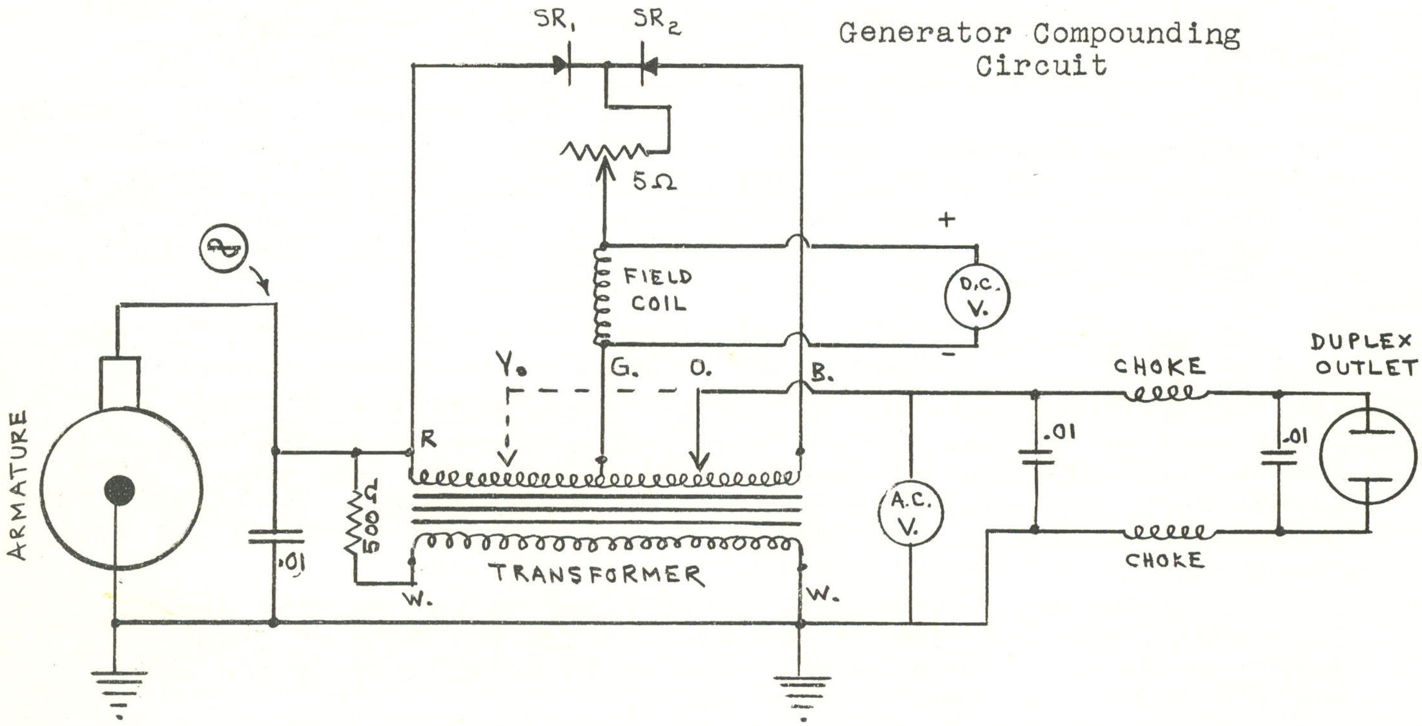
GENERAL. To get maximum power out of this generator, the engine pulley size should be adjusted so that the engine is operating at maximum efficiency at the speed the generator needs for proper regulation. About 4 inches is usual, but a little experimenting will be necessary.

Fuses are not necessary, because any overload causes the field excitation to limit armature current to a safe level. This is fortunate, for if you get a short while operating, all that is necessary is to clear the trouble and power resumes without having to replace fuses or restart the engine.

The unit is light enough for one person to handle. Five gallons of gas will power the station for over 15 hours.

Fig. 3.

Generator Compounding Circuit



SECTION 8

TO EACH BUT ONCE

In the early part of this year a very good friend died. Mr. Ralph Jilek, technical director of the Pacific Rocket Society, of Los Angeles, passed away after hepatitis set in following treatment of non-malignant tumors. He was a young man, and is survived only by his mother, Mrs. Lestie Jones.

His interests were varied; his associates termed him a "very personal fellow," and explain that "Ralph was simply Ralph," a tribute that in its own way stands very tall. Ralph was in active pursuit of a higher education, attending night school in geology, minerology, chemistry and mathematics. He worked as a warehouse clerk for a pharmaceutical house, and as an amateur for his Society for well over nine years.

His achievements came primarily in propellant work. He determined to his own satisfaction that micrograin worked best in the 82-18 mixture; he experimented with double base propellants; he conducted a broad range of investigation in the mechanical construction of grains.

His notes are incomplete, unfulfilled by an untimely death. The bulk of his chem lab was donated to the students of Chaminade High School. We hope that his death be saluted by the continuance of a fine tradition of study.

A COMPARISON OF SEMI-PACKED AND CAPSULATED ZINC-SULFUR

By Richard D. Bennett
Reaction Research Society;
Technical Advisor, Pacific
Rocket Society

It seems that most amateurs believe that almost any kind of rocket fuel, prepared in most any way, will work in just any piece of tubing. To demonstrate that this does not always work, the Pacific Rocket Society set about a test program to prove that a standard amateur rocket fuel, when prepared in different ways, would provide radically different performances in a common rocket body.

To conduct the necessary tests, micrograin fuel (zinc dust and sulfur) was chosen as the standard propellant. The rocket picked was the Goddard I.

The Goddard I rocket, named after the rocket pioneer Dr. Robert H. Goddard, is a Rocket Research Institute development. Devised as an amateur rocketeer training rocket in the 1957-1958 period, it has been a basic experimental tool ever since. Its attractiveness to this test program was its simplicity and its corresponding lack of cost. A simple and cheap rocket was mondatory as a large quantity of test vehicles would be needed.

Designed for the beginning amateur, the parts of the Goddard I rocket had to be simple and available at most neighborhood stores. It consists of a low quality of aluminum tubing, a wooden nose cone which also serves as the upper bulkhead, and three simple strap-on fins. It contains no nozzle to complicate its construction and therefore its cost remains below $1.50, including its micrograin propellant.

A Goddard I can obtain altitudes in excess of 1500 feet using a capsulated propellant for which it was originally designed. As an amateur training rocket, it consistently flew above one thousand feet and occasionally flew above 2500 feet on special test missions. There have been nearly a thousand static and flight tests of this rocket using the capsulated zinc dust-sulfur propellant in an 85-15 mixture with a reliability record above 99%.

Since the Goddard I had been designed for capsulated fuel and had flown very successfully, we became interested in determining what a different method of packing would do to its performance. Eleven rockets were constructed and fired on two occasions, Project Live Fire and the May 29th firing.

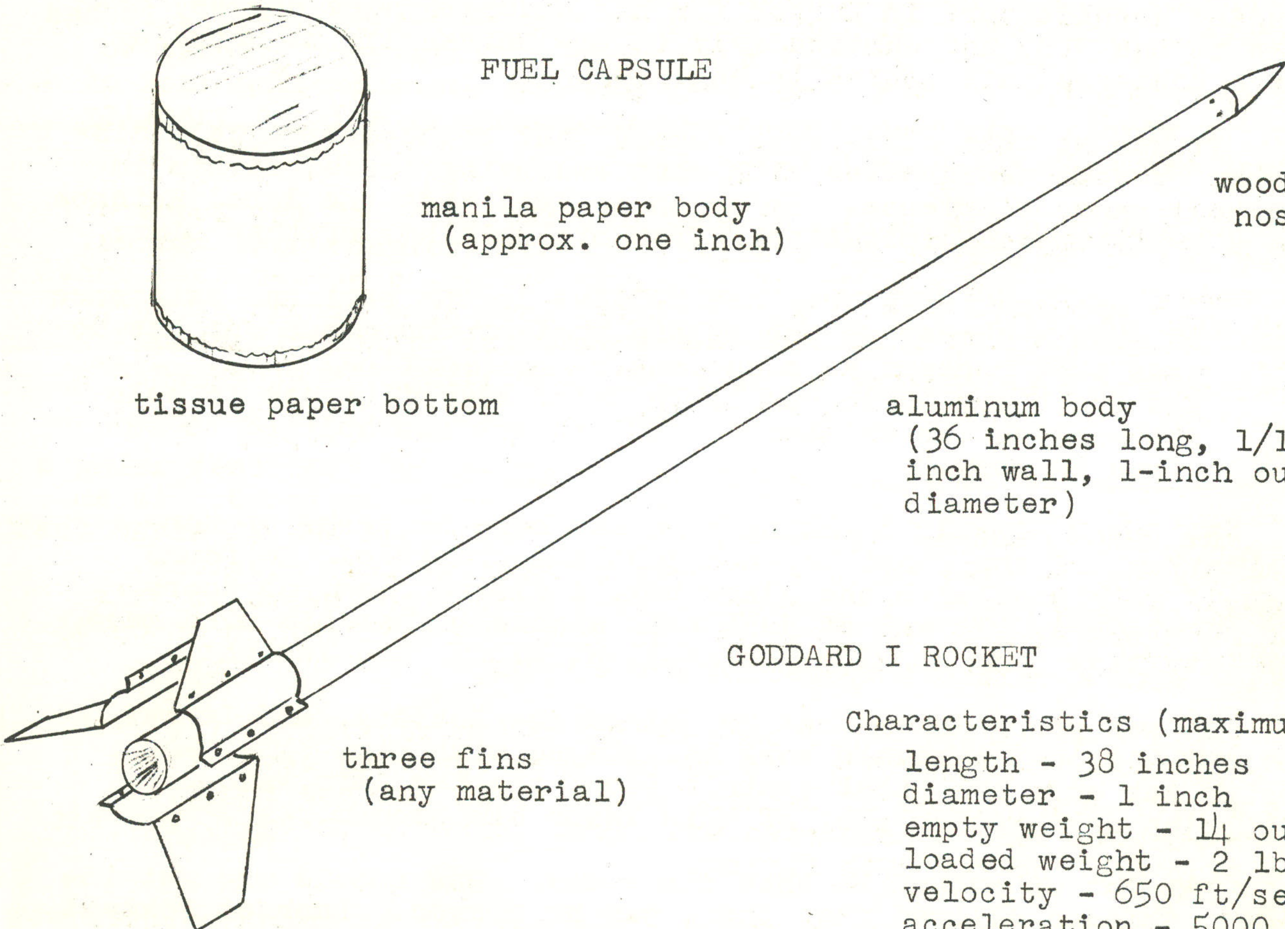
Using a number of fixed and movable cameras at known points, we were able to record the rockets' movement in the powered portion of flight. Since we used the same identical launch rack, fixed at the same angles of azimuth and altitude, there would be little discrepancy in the resulting computations. All rockets were fired at similar times during the days at temperatures of 85°F to 95°F.

The micrograin fuel used in all rockets came from the same source. On both firing occasions, five flight vehicles used an 85-15 fuel ratio and two an 80-20 ratio. Those vehicles launched during Project Live Fire were semi-packed, and those at the May 29th firing were capsulated packed. Each capsule weighed the same as the next, providing an equal density of propellant throughout the rocket.

The effects (if any) would show in the films of the different flights, indicating that densities modify the burning characteristics. Preliminary analysis indicates that there were many inconsistencies in the burning of the non-capsulated rockets.

On the May 29th firing, there were seven Goddard I launches with a total of four rockets. Three of the rockets flown were recovered in such good shape that they were used again. All rockets reached an altitude of between 1700 feet and 2300 feet. There were no burn-throughs, and in spite of the 30 to 40 mph gusty winds, all rockets with the exception of one Goddard landed inside a 150 foot radius of each other.

FUEL CAPSULE



GODDARD I ROCKET

Characteristics (maximum):

length - 38 inches
diameter - 1 inch
empty weight - 14 ounces
loaded weight - 2 lbs, 6 oz.
velocity - 650 ft/sec
acceleration - 5000 ft/sec^2
altitude - 3500 feet

The rockets flown at Project Live Fire were all filled with the semi-packed zinc dust-sulfur fuel. Their burning times varied from 2.3 seconds to 3.5 seconds, and their altitudes reflect the variances, ranging from 250 feet to 2575 feet. All seven rockets burned through with multiples of holes in the tail sections.

The tests were highly successful in that there is now some firm data on micrograin performance in at least a small spectrum of amateur rocketry. The time since the last firing has not been long enough and all the data is not in. Therefore, there will be a complete and refined report in a subsequent issue of the NEWS.

THE AUTHOR OF THE Y-4,
RRS STANDARD EXPERIMENTAL
ROCKET

We allow you a major privilege. But we must warn you that knowledge once obtained can return to haunt the inquisitive. If you wish, you may read on.

The RRS standard experimental rocket, known to its friends as the Y-4, is the invention of a very peculiar type of man. He studied architecture in Europe for his undergraduate degree, then came to the U.S. and particularly to the University at Berkeley for a post-graduate course in engineering.

It was at this cloistered campus that he became vaguely disturbed by some wrongnesses with what was being tossed at him in the holy name of Science. He began to feel that the label Science was a self-imposed limitation. From his writings of that time:

> "The mathematician does not believe in the rational existence of such a number as the square root of the minus one but he uses that concept as a successful mathematical tool. Time and Space are analogous tools which all of us use to help rationalize our existence. But we are not obliged to believe in them."

He found himself thinking more and more in terms of non-limitation, of the possible, not just the probable. He found himself intrigued with the black box, a closed room, no doors and no windows. It was at just such a moment that his mind made the intuitive jump linking perspective, humor, and insight.

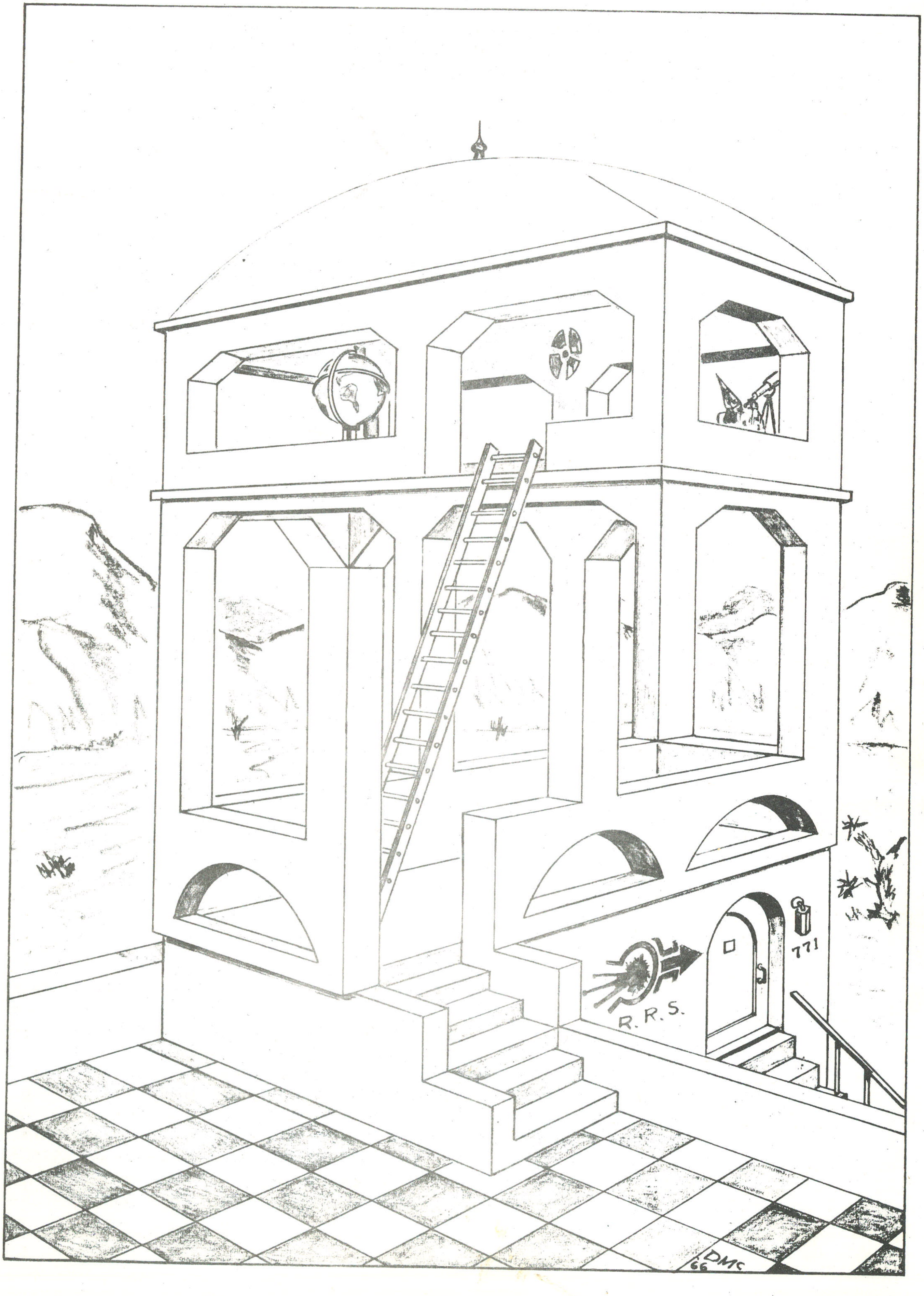
It was years later that he joined the Society, and it was obvious his post graduate work had stayed with him. The Y-4 design was only his first contribution; the far left, mid-Victorian observation post of this issue his second.

But let us return to that black box. How should one get inside? Science allowed that there was no answer. Emerson Foxtail (for that was his name) argued that if the inside were the outside, and he were outside, he would be inside. It doesn't require an excellent student of culture to realize that this was the beginning of the Moebius style of architecture.

His mid-Victorian palace is carefully designed to permit one to use a ladder to go from the inside of the first floor to the second without cutting a hole in the black box, or in this instance the ceiling.

Foxtail remains noncommittal about the number 771, refusing to reveal whether it is the street address, year of construction, or number of visitors. The Society has found the structure to be of great benefit to tracking, though it makes Dosa's tracking chair somewhat plebian by comparison.

Foxtail has served as advisor to other societies, perhaps the most notable that of the armies of Alexander the Great. It would seem that the soldiers were terribly disgruntled with the inequities while standing watch. There was constant complaint that one man had been standing watch longer than the previous. There was no easy way to mark time, since a sundial tended to run down during the later part of the night. Alexander commissioned Foxtail to find some method of determining when a period of time had elapsed, and so it was that not even a month later Foxtail presented his warlord with a chemical that would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stain a rag black in exactly two hours.

That very much is the origin of the two hours on and four hours off for watch, traditional even to our time. At any rate, the invention became a favorite of the soldiers, and they christianed it Alexander's rag time band.

THE LOCAL SCENE

Excerpts from the minutes of the 1966 RRS meetings:

The Society is on call for a work party over the Memorial Day weekend, May 28, 29, 30. Major project for the weekend is a down-range road. . . . The Pacific Rocket Society is holding a firing that weekend with RRS President Richard Butterfield acting pyro-technician. . . . Joe Armstrong volunteered to head parachute eject design team.

Lathe donated to Society by Herschel Rabitz. . . . Society has submitted proposal to Fire Marshal in application of a liquid pyro-operator's license.

Data Reduction and Drag, a paper by Mr. George Dosa of the Reaction Research Society, is now available in Xerox form. The paper is 50 pages, and sells for $4.00. It is planned that the paper be multilithed in about a year's time, and will then sell for less. In order to allow interested amateur's early opportunity to use the information, the society has made these arrangements.

We thank here many people for many things: Chuck Hebbon of Armco Manufacturing for a field generator; Roseanne Dymond and Margery Hills for artwork; Chuck Hills for the loan of a tractor; Herschel Rabitz for the donation of a lathe; Charles Stirling for serving as company photographer; Jess Vargas for emergency machining; Roberta Starry for publicity efforts; General Telephone for overhead bunker protection; the Pacific Rocket Society for the loan of a fuel mixer and generator; Finch Walker for his visual displacement layout; Darwin McMillen for the Y-4 cartoon; Pete Guerin of Star Space Systems for reproducing the Live Fire poster; and Emerson Foxtail for his benevolence.

LETTERS

The following article is an excerpt from an editorial appearing in the January-February 1966 Theoretical Review:

Within the group of known amateur rocketeers there lies great potential. If just a third of (or even a fourth) the some 1800 known amateurs in this country could be organized into an effective and functional national organization, a successful amateur satellite project could be realized. As it stands, amateur rocketry on the whole has not yet "come of age". This is evidenced by the failures of groups such as ASTRA and IAAS and others to gain any real following. But perhaps the whole blame should not be placed wholly upon the individual amateur. In view of all of the new groups which spring into existence each year intent on launching amateur satellites and banding all amateurs together into one unified club -- and the resultant rather childish and senseless squabbling and bickering which goes on between these groups--it is very easy to see how the amateur could get confused, bewildered and disillusioned.

An entirely new approach to the problem is clearly needed. Always in the past brand new groups have been formed each time the "national organization" idea has been suggested. And each of these new groups has invariably been either more or less "glory seeking" in their aims and their goals. None of them has formed to advance amateur space technology as a whole and none of them have been purely bipartisan organizations. Even if one of them is successful (which is highly unlikely) it won't do much for amateurs as a whole. The persons who organize these groups don't seem to really grasp the true meaning and deadly seriousness of the business they are getting so deeply, and wrongly, involved in. In the end, even though they don't intend to, they hurt the amateur more than they help him. A respectable name and reputation for the serious student rocketeer is never going to be established until a thoroughly responsible and dedicated collective amateur effort is rallied. This effort need not take the form of another bureaucracy-stifled brand new organization. No, such an organization would only succeed in complicating matters further. What is needed are intelligent, experienced, amateurs to act as "go-betweens" or mediators between the various different amateur rocketry groups. These mediators could foster better and fuller understanding among rocketeers and promote co-operative, collective efforts by them. Eventually such efforts by persevering, neutral amateur mediators could lead to a successful amatuer satellite program and an "amateur's co-operative" movement. To start, the going would be rough and slow, the rewards few and small; but such efforts could very well mark the beginning of a new era in amateur rocketry experimentation. Maybe then we could finally prove to ourselves and our fellow rocketeers--not to mention our government--that we have at last come of age and are worthy of their support and respect.

Only time will tell whether or not our efforts will be in vain. Will amateur rocketry rise to national prominence or sink silently into oblivion?

Erich Aggen, Jr.
Liberty, Missouri

Dear Erich,

As for national organizations, hold on! You're talking about teen-agers who want that hot-shot chance at glory, and not about adults who are happy to have a radio league fight their court battles for them.

There is a need for the beginner to stumble into the recognized field of rocketry, but I don't think amateur rocketry is, at this time, ready for a national organization.

What should take place is this: a continued effort in journalism. **Amateur** rocketry needs a mouthpiece, not a committee. Keep writing, and then, consider a national organization.

To illustrate. The RRS is appearing on the Lo is Lomax TV interview program February 15. The RRS is conducting a public launch that is attracting city-wide attention. The RRS has appeared in national magazines, including Popular Mechanics and Mechanix Illustrated. Now when someone is exposed to any of these, and writes to us as an interested party, what does amateur rocketry offer him?

A committee? Be serious. Words, tradition, a journalistic background, **reading** material for his experiment, and now how to build a Titan III. Feed him something interesting, not a newsletter.

Let him feel comradeship, let him feel the existence of an established order, and then maybe your teenager will join in a national program.

Don Girard
Los Angeles, Calif.

Dear Don:

Re: the future of the RRS. I suppose

my personal feelings are that I'd like to see the RRS grow in size and stature and become mature. But I would still like to see it as a sort of haven for those people who would normally end up as "basement bombers". I feel that these kids (and adults) have as much to offer as any engineer or Ph.D. It just takes time and encouragement. Especially encouragement. There are plenty of people who would tackle serious, difficult projects if they were just given a chance. I disagree vehemently with those who assert that study alone is enough. It's simply not true. While it is true that a theoretical foundation is absolutely necessary for a complete understanding of a given problem, it always turns out that live experiments are needed to bring a machine or process or whatever to a state of acceptable reliability. Not only that, but it turns out that an experiment will lead to a considerable short-cut to the desired information. As if this weren't enough reason for experimentation, it so happens that there are certain physical, thermodynamic, etc. quantities that are indeterminate by theoretical means! In short, one must experiment if one wishes to determine this particular information.

So, I think the RRS should accept all of the help it can get. But it should retain its identity and authority. It should pursue knowledge on its own also, and not be content for others to do its thinking. Original thinking is vital and necessary. Progress was never the result of imitation or "cook-book" thinking. The RRS should remain a club wherein all members are able to conduct scientific investigation. It should continue to provide encouragement to all seriously interested members, yet it should not be necessary to be a "mother hen" to yokels looking for temporary, meaningless diversion. It should encourage the joining of interested professionals, but should not allow these professionals (or anyone else) to wrest control from the legally consituted administration (and ruin so to speak our "amateur standing") or to divert the Society from its main goal: the creation of a club which would allow non-professionals and professionals alike to legally conduct experiments in rocketry which they might not normally be able to conduct; a club which would allow amateurs to exercise their right to pursue the hobby of their choice under reasonable conditions of safety. Thus, we should remain autonomous. But let's try to get as much professional assistance as possible without having to surrender our corporate soul. Have I explained well enough or are there some points you wish clarified? Just remember that preservation of our self respect and desire to work will not be accomplished if we let someone else run our business for us. If we don't care enough about the society to run it ourselves, we might just as well junk it. And you know we won't do that.

Well, that's about it for now.

Larry Teebken
Chicago, Illinois

Dear Don,

The astroscientists of the future (the amateurs of today) are going to have to be more, much more, than merely scientists with only mathematical equations and voluminous amounts of technical data floating around in their brains. They're also going to have to be humanitarians and 'total' thinkers, leaving no area to chance. They're going to have to be philosophers, logicians, et al. That's the reason the amateurs of today must be taught how to think and to form opinions on all things and on all subjects. To just teach them how to build ultra-sophisticated rockets and the payloads to go in them is not enough; they must in addition know how to use their new knowledge, and use it well. The things they are learning now will still be in their minds ten, twenty, thirty years hence and might very well have great bearing on the way they will think and act in times to come. The world of the future is going to be a risky place to live in, there isn't going to be much room for careless errors and mistakes.

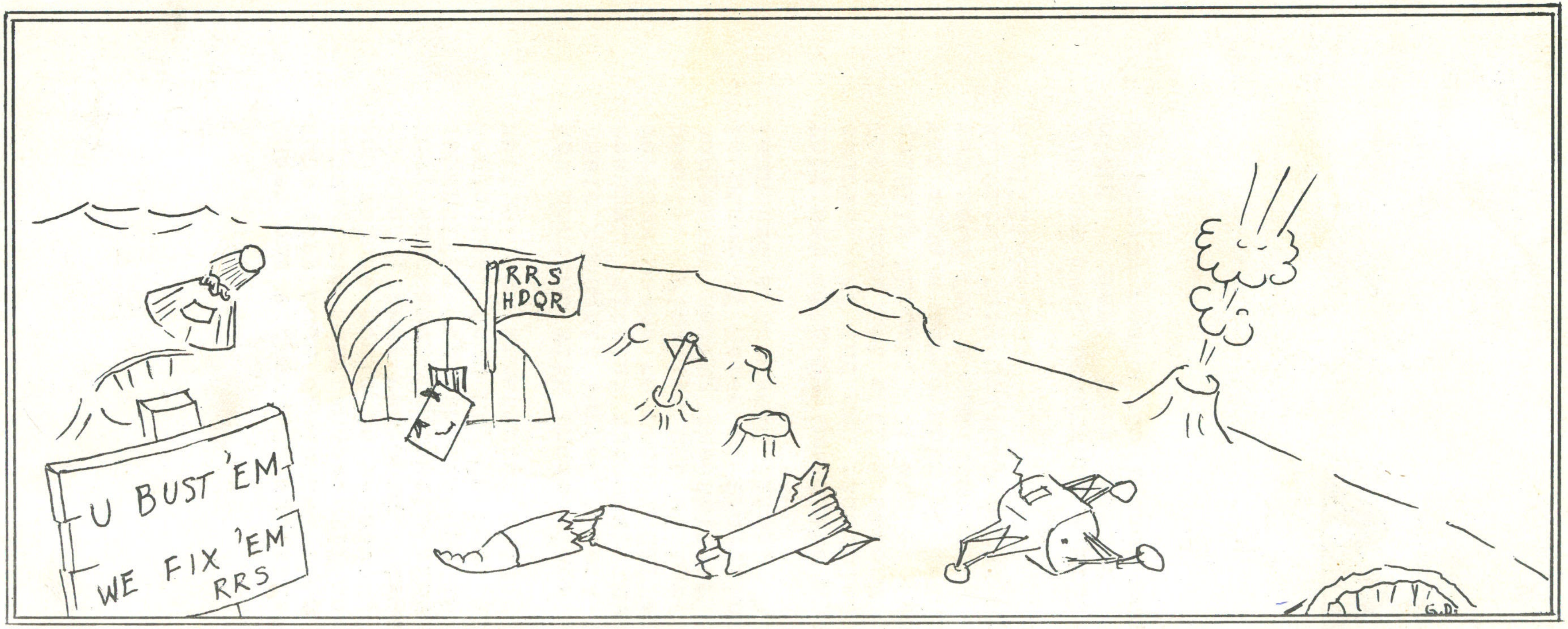
Erich Aggen, Jr.
Liberty, Missouri

There was a group of scientists recently who were very much concerned with the measure of intangible substances. If heat, and pressure, and volume could be measured, why not the emotions, they reasoned. It was soon that they were spending their time developing scientific ways to measure love, hate, fear, prejudice, thought, dreams, stress, and the rest of the immaterial universe.

Not content with these minor achievements, their thoughts turned toward the measure of beauty. Without success, they considered various means to record different levels of beauty. Finally, one of the brighter men suggested naming the unit of beauty the helen, in honor of Helen of Troy, the face that launched a thousand ships.

This met with an immediate approval, of course, and the men redoubled their efforts. Their work met with a second obstacle very quickly though. It was apparent that a helen was such a large unit of beauty that there was need for a smaller unit. Being men of science, they quickly named this smaller unit a milli-helen.

But how much beauty is a milli-helen, you might wonder. Very simple. It's that amount of beauty needed to launch one ship.



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