MODEL ROCKETRY

The Journal of Miniature Astronautics

May 1969

50¢

TRANSMITTER
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PITTSBURGH CONVENTION

SCALE ASP

THE INFINITE LOOP
ODDBALL DESIGN

FRA-JYLE SPORT ROCKET

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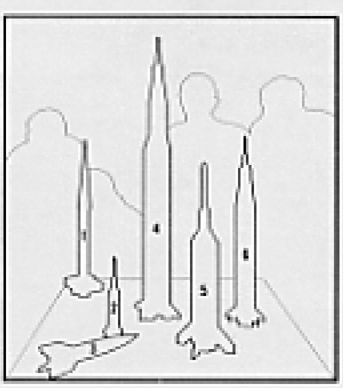

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engines not included in kits.

Take a close look at the model rockets pictured above. They're fine examples of the new, top-quality kits now available from Centuri Engineering Company. These accurately scaled historical models incorporate ultra-lightweight materials and new simplified construction techniques. Specially molded and formed parts duplicate the exact details needed to win those scale contests and science fairs. They look terrific . . . and fly great too!! All of these and many, many more are included in the world's largest model rocket supply catalog that's just been published. One hundred exciting colorful pages for just a quarter – and we'll refund the quarter on your first order too! Send for your copy today – right now – hurry!!

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Model Rocketry

Volume I, No. 6
May 1969

Cover Photo

This month's cover shows the loading of the launch rack during the scale altitude event during NARAM-10, at Wallops Station, in August 1968. An article on model rocket altitude design begins on page 27. (Photo by Stine.)

From the Editor

With the competition season once again in full swing, we have the opportunity to observe our NAR rules in operation. Orderly contests are possible only because there is a standardized set of governing rules. However, we also see such things as altitude rocket being disqualified because it goes *out of sight*, and ten-minute boost-glider flight due, not to construction techniques, but to helpful thermals.

In particular, the boost-glider rules are sorely in need of revision. To win under the present rules requires a great deal more *luck* than it does *skill*. You must, of course, construct a boost-glider capable of flight. But the real test is whether you happen to hit a thermal and perhaps set a new B/G time duration record. A revision of the rules to provide a consistent measure of B/G performance is necessary to encourage an advance in the state of the art. Under the present rules, each competitor is permitted two B/G flights. His best time out of the two flights is entered. Two possible revisions are suggested. A system similar to that used by the model aircrafters looks most promising. Each B/G catagory would be assigned a *max*. In the first round, any contestant whose B/G did not remain aloft for the maximum time assigned for that catagory would be eliminated. All other contestants would fly again in the second round. Those not remaining aloft for the *max* would be eliminated. This procedure would continue until only one contestant remained.

(Continued on page 39.)

Features

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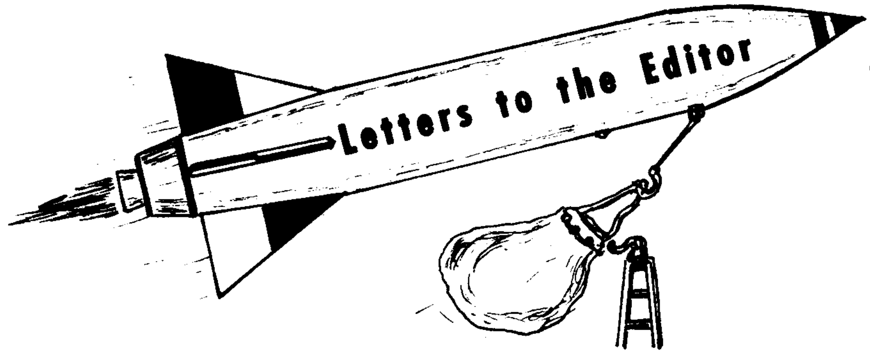


Southwest Conference

In response to your plea for model rocketry organizations to organize meets and workshops for their area I would like to announce that the ARC-Polaris Rocket Club is sponsoring the 1st Annual Southwestern Model Rocketry Conference on July 27, 28, and 29, 1969. This conference will be held on the campus of Eastern New Mexico University where all participants will stay and have their meals through the school cafeteria.

A variety of events have been planned including a display from the Manned Spacecraft Center, displays from Centuri Engineering and Estes Industries, plus other displays from various laboratories accross the state. Also Mr. Bill Gantz, Assistant Manager of the NASA test facilities at the White Sands Missile Range, will attend and present a talk on the national space program which will be at a maximum of activity at that time with the manned lunar landing of Apollo 11.

During the three days of the conference there will be several discussion groups on the applications of math, physics, and computer programming to model rocketry. As a matter of fact, a series of computer programs analyzing the flight of a model rocket will be run on the University's IBM 360 Model 40K computer to show not only the operation of a computer of this size, but also show what happens to a model rocket during its flight.

And finally there will be competition in twelve categories with the winners of each receiving a trophy award and the second place receiving a cretificate of achievement. On hand to watch the competition will be Colonel Larsen, Director of Education Programs for Centuri Engineering company, who will also talk about the recent research and developments made in model rocketry.

We are hoping that these events we have planned will be of interest to model rocketeers not only in our area of the nation, but in other areas as well. So we invite those interested to write and receive more information concerning this conference and the activities it involves.

James P. Miller
ARC Polaris Rocket Club
Portales, New Mexico

Too Technical

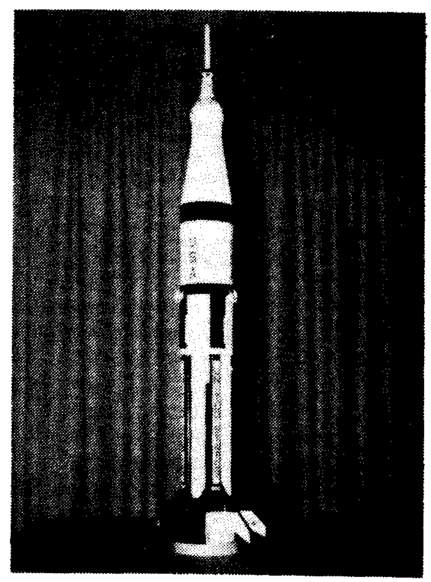
I am writing to you to air my grievances with your magazine. Since I have purchased several issues of **Model Rocketry** and read them it seems to me that you are always hopping on the technical end of the hobby of model rockets.

I will start by saying that I am 35 years old. My son is 10 years old and he and I are in this hobby together for the pleasure and fun that comes from it.

Most hobbyists are building models for the enjoyment that they derive from them to forget the tensions of everything that goes on in this mad, mad world of ours.

As for myself I have been building models of some sort or the other since I was 9 years old and think it is one of the things that keeps growing youngsters off of the streets and out of trouble.

I think your magazine is going to help model rocketry to go a long way as a hobby but please don't fill it all up with technical data so complicated that it will make youngsters lose interest before they get started in a hobby with much enjoyment in it.



Enclosed is a picture of my latest creature, an Estes Saturn 1-B which was just completed but as yet not flown.

Donald Orr
Norfolk, Virginia

COMPLAINTS

I enjoy your new magazine very much. I think articles from people like Mr. Joel S. Davis should be kept out of the magazine. People like this give the whole hobby a black eye, especially since a lot of us are striving to have fireworks ordinances changed and, looking for launch areas. I'm a 32 year old rocketeer and enjoy everything a 12-18 year old rocketeer might. Let's keep the hobby sane, and we will *keep the hobby*.

E. Blaise, Jr., NAR 13595
New Orleans, La.

Praise

I would like to thank you for coming out with such an excellent magazine. It's good to read a 100% model rocketry magazine and not to have to thumb around some other magazine to find the NAR newsletter, buried beneath tons of model airplane articles and advertisements. I say, get the Model Rocketeer away from the planes and into **Model Rocketry** magazine.

Bennett Kobb, NAR 12987
Houston, Texas

We believe that the hobby/sport of model rocketry has advanced to the point that we model rocketeers deserve a magazine of our own. To date, reader response has confirmed our belief.

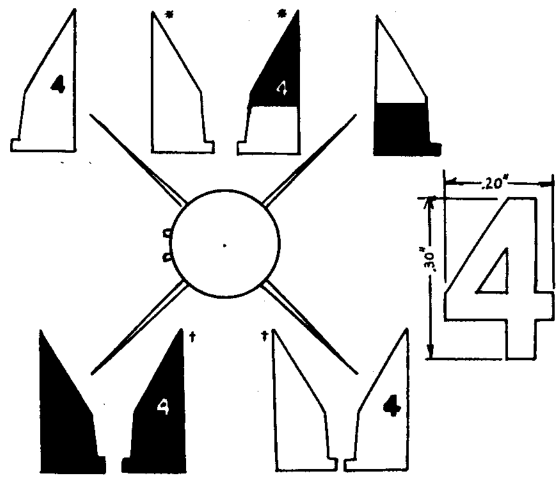
I am writing about the fine quality magazine you are engaged in. I like every part of it, particularly the new column by Mr. G. Harry Stine.

I would like to see an article on the organization of a rocket club, and how to join the NAR. Mr. Charles Ledbettter, my Matrix Algebra teacher, and I are currently engaged in forming a rocket club at my school, Northwest Classen High.

Don McCracken
Oklahoma City, Oklahoma

I would like to express my sincere compliments to you for providing the many serious modelers with a fantastic magazine. The technical articles are outstanding and the complete magazine is something marvelous.

SP/4 C. David Eagle
173rd Airborne Brigade
APO San Francisco



Viking Data Omitted

Please print the color scheme for the Viking IV rocket, which appeared in the January issue. A lot of us modelers are wondering what slipped. (By the way, the Bomarc B plans were excellent.)

Please *continue* the excellent technical series, including all applicable math. Some of us do "dig" calculus.

Gary W. Schwede, NAR 7834
Las Vegas, New Mexico

We regret that the fin painting pattern was omitted from the scale plans contained in the January issue of **Model Rocketry**. *The fin paint scheme is reproduced below. All black areas below, as well as the black stripes on the rocket body in the original plans, are black.*

VIKING 4 COLOR SCHEME

The basic color of the Viking 4 is white. The tip of the nose was silver to approximately one foot back of the tip; a black stripe about six inches wide was painted around the body, starting approximately ten feet from the tip of the nose cone. It appears that this stripe was painted at the nose section separation point at station 120. There is another stripe approximately twelve inches wide located around nine inches in front of the fins (lower edge of band). The fins had the numeral 4 on one side, and located 39" up from the base of the fin. The lower edge of the numeral appears to be about even with the "corner" in the fin. The fins are colored as shown in the sketch.

*The two bulges on the side of the body tube are the conduits that were the support point for the launching rail, and also contained the wiring and such that had to run the length of the rocket. The coloring on the fins is a composite. It appears that all the Vikings had the same basic fin coloring, so photos of Viking 7 were used to get the coloring for the fins indicated by *; photos of Viking 4 for those indicated by †; and the others are guesses. The dimensions and positions of the black bands and such are taken from the photographs, and are only very approximate measurements.*

Model Rocketry

I am overjoyed that there is finally a model rocket magazine for rocketeers only. Your magazine is just what the model rocket world wanted. In other publications, rocketeers had to be satisfied with a few paragraphs on page fourty. But, in your magazine, there are 32 pages devoted entirely to model rocketry. Hallilujah, and keep up the good work.

Craig Hartley
Austin, Texas

Movie Camera Rocket

I have finished reading the February issue of **Model Rocketry** and thought it was very good. In reference to the article *Model Rocket Carries Movie Camera*, our rocket club is building a rocket to carry a Kodak M12 camera. Power will be 2 Class F engines, and the camera will be carried in the payload section.

Cody Hinman
Las Vegas, Nevada

Technical Articles

On the question of easy/difficult technical articles, we are in favor of the thorough coverage you are giving– those who don't want to bother with the advanced math can skip it. We are a father-son team including a degree in Physics and a fourth-grader, and we *both* enjoy **Model Rocketry**.

Roy O'Brien
Bernardsville, New Jersey

NAR Membership

I would like to know how to join the NAR.

Tommy Wilson
Fort Worth, Texas

You can get information from the NAR national office at 1239 Vermont Avenue, N.W., Washington D.C.

Painting Modrocs

Allow me to congratulate you for publishing your **Model Rocketry** magazine, a magazine that has long been needed in this field. With the advent of your magazine, rocketeers have a forum in which they can express their ideas, opinions, and dreams– the result of such increased communication can only be progress for the entire field of model rocketry.

While reading your March 1969 issue, I came upon an item I want to comment on, "How to Finish Model Rockets" by Thomas Milkie. In that article Mr. Milkie says, "Silver rockets are indistinguishable both in the air and on the ground." It has been my experience that silver rockets can be seen for great distances if care is taken to assure that the rocket has a *shiny* silver finish. This can be done by doing several things. First, do not put masking tape over silver as this will dull the finish when the tape is removed. Also, be sure *not* to apply clear paint over the silver, since clear paint dulls the shine of silver paint. This means that silver should be the last color that you apply to your bird. I have also found that one of the best paint schemes is the one known as the Harlequin pattern, in which one side of the rocket is painted a very dark color, such as black, and the other side is painted a very light color, such as white or silver. (See figure below):

When the rocket rotates in flight, you will see the alternating dark and light sides of the rocket. That will make the rocket appear to pulsate which in turn makes it easier to track the rocket.

Warren James
St. Louis, Missouri

SOLICITATION OF MATERIAL

In order to broaden and diversify its coverage of the hobby, MODEL ROCKETRY is soliciting written material from the qualified modeling public. Articles of a technical nature, research reports, articles on constructing and flying sport and competition models, scale projects, and material relating to full-scale spaceflight will be considered for publication under the following terms:

1. Authors will be paid for material accepted for publication at the rate of two dollars ($2.00) per column inch, based on a column of eight-point type thirteen picas wide, for text, six dollars fifty cents ($6.50) for drawings, and two dollars ($2.00) for photographs accompanying text. Payment will be made at the time of publication.
2. Material submitted must be typewritten, double-spaced, on 8½ by 11 inch paper with reasonable margins. Drawings must be done in India ink and must be neat and legible. We cannot assume responsibility for material lost or damaged in processing; however our staff will exercise care in the handling of all submitted material. An author may have his manuscript returned after use by including a stamped, self-addressed envelope with his material.
3. Our staff reserves the right to edit material in order to improve grammar and composition. Payment for material will be based on the edited copy as it appears in print. Authors will be given full credit for published material. MODEL ROCKETRY will hold copyright on all material accepted for publication.

Those wishing to submit material should send it to:

Editor

Model Rocketry Magazine

P.O. Box 214

Boston, Mass., 02123

Building an Inexpensive
Model Rocket Transmitter

by Richard Q. Fox

This article is the first in a series on the construction and use of an inexpensive model rocket transmitter and its associated sensors.

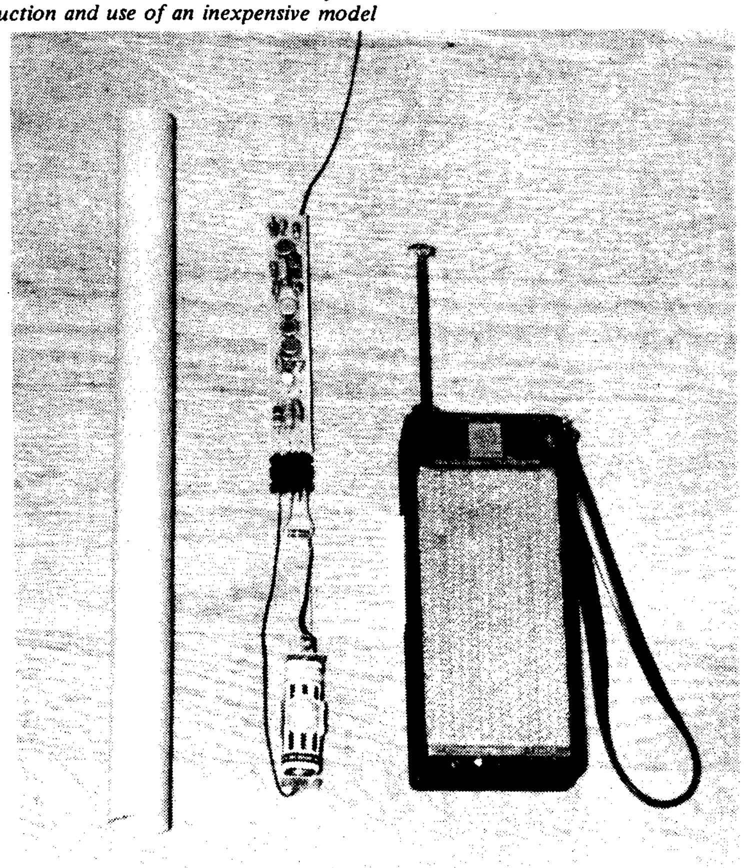


Figure showing xmitter, tone module, body tube and walkie-talkie receiver.

Part 1: The Basic Transmitter

Have you ever considered instrumenting your rocket with a telemetry transmitter that can tell you how fast your rocket is going, or how rapidly it is spinning, or how cold the atmosphere is at 1500 feet, or even where the rocket has landed, once it has flown out of sight! For about $10, you can build the transmitter described in this series of articles, and open up a whole new experience in model rocketry.

Two and one-half years of careful research and development have lead to the optimization of the design of this model rocket transmitter. The transmitter, which weighs less than two ounces, has a 100 milliwatt output on the 27 mc. citizens Band, and may be legally operated without any license. It has a range of over ½ mile, and can send back, among other things, the location of the rocket, the spin rate, the acceleration, velocity, and altitude, and the temperature of the air surrounding the rocket.

The only ground support equipment needed is a quality walkie-talkie for receiving the transmitted signals, a battery operated tape recorder, and some inexpensive calibration equipment which will be described in future articles.

Construction

This project is intended for those rocketeers who have previous experience assembling electronic circuits. It is not designed for assembly by the rank beginner.

The remainder of this first article of the series is devoted to the construction of the basic transmitter and a plug-in accessory which allows the transmission of a steady tone beacon from the rocket.

The key factors to be considered in the construction of the transmitter are mechanical strength, size, and neatness. The transmitter should be built up on perforated board, so that it can withstand the high accelerations that it will undergo in flight. The parts lay-out should follow the pictorials exactly, and the wiring should be done as carefully as possible. The transistor leads should be heat sunk with a pair of pliers when they are soldered into the circuit.

The crystal should not be soldered into the circuit. Instead, connecting wires should be carefully wrapped around the crystal pins.

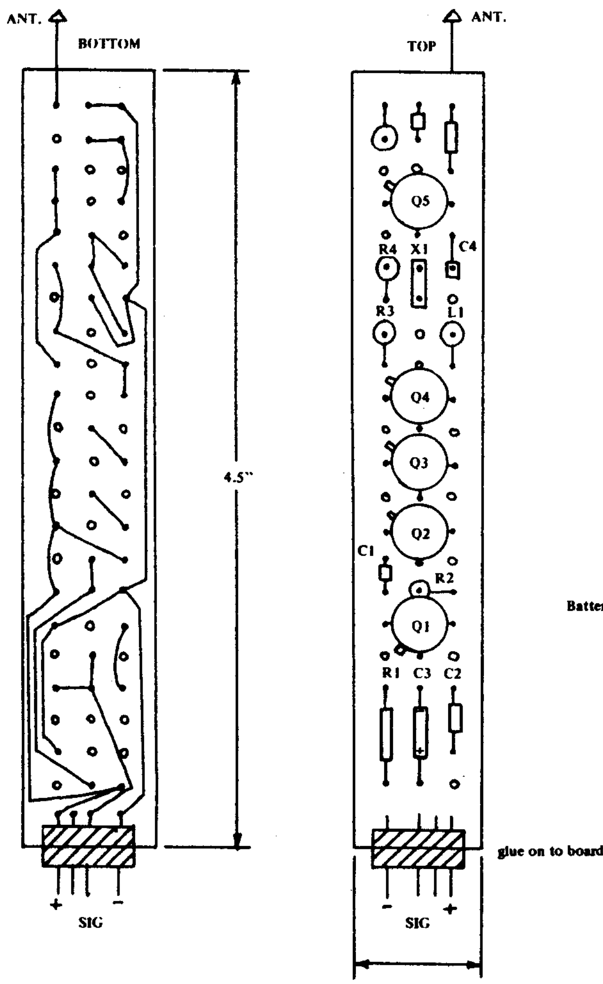
Initial Testing

To test out the assembled transmitter, first make sure that all wiring is complete, correct, and electrically sound. Check that the crystal is on the same frequency as the receiver, and that it is making good contact with the wires wrapped around its pins. Lay the transmitter down on a wooden table and stretch the antenna out to its full length. Place the battery in the battery holder observing that the polarity is correct. Plug the beacon tone module (the battery-resistor-black plug unit) into the transmitter board. Turn on the Citizens Band receiver and listen for the tone. The receiver and transmitter must be on the same frequency. Keep your body away from the transmitter. The electrical properties of your body and any nearby metal will affect the operation of the tranmitter.

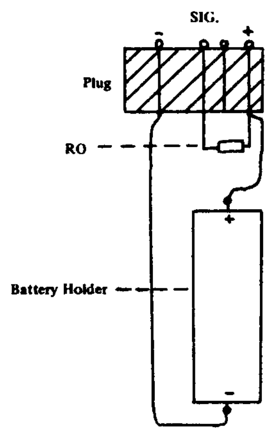
Flight Operation

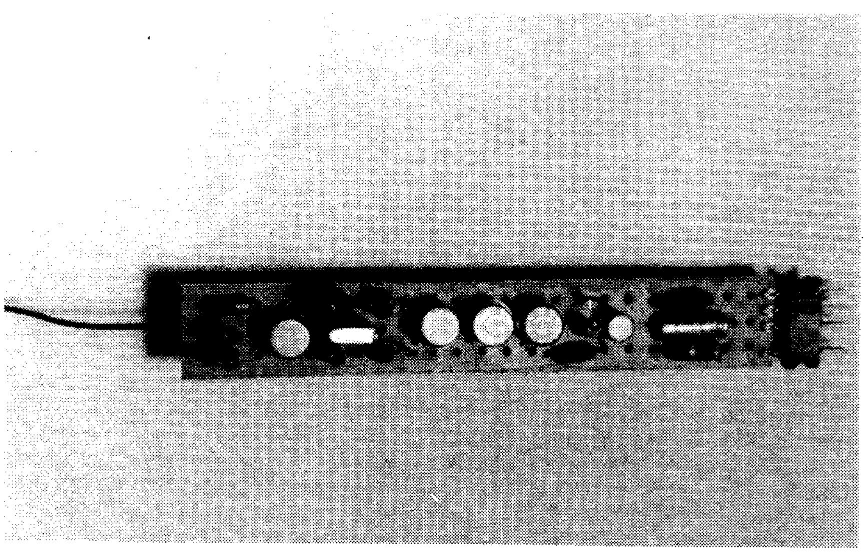
For best results, power the rocket that will carry the transmitter with three C6-5's, one Enerjet-8, or one D1.12-0 staged with a D1.12-6. When you are ready to launch, slide the transmitter circuit board into the payload section of the rocket. A 12" length of Estes BT-50 or Centuri ST-8 is ideal. The battery should be placed in the nose of the payload compartment, and the antenna should trail out the tail of the payload section. This arrangement will cut down on damage to the transmitter in the event of a faulty rocket flight. Once the transmitter is operating properly inside the payload of the rocket, tape the nose cone onto the top of the payload compartment, so that the transmitter will not fall out during recovery. Proceed with the launching of the rocket,

WIRING DIAGRAM



Beacon Tone Generator Plug-in Module





Sketch of wiring diagram (above) and assembled transmitter (bottom).

and recover the payload as quickly as possible. Remove the nose cone and remove the battery from its holder. The battery will run down very quickly if it is allowed to run for periods of more than a few minutes. Although these first flights of the transmitter do not send back any information on the rocket, they do allow transmitter performance to be tested.

Trouble-shooting a Faulty Transmitter
No Signal Received

1. Check that the battery is plugged in properly.

2. Check that the battery is putting out full voltage under load.

3. Check that the receiver is operational and on the same frequency as the transmitter.

4. Look for loose, broken, or shorted wires.

5. Using the voltages indicated on the schematic as a guide, check the operating voltages of the transmitter with a good volt-ohm meter.

6. Place a crystal earphone from the collector to the emitter of Q1. If no tone is heard, the trouble is in the oscillator.

7. Place the earphone from the collector to the emitter of Q4. If a louder tone is not heard, the trouble is in the amplifier-modulator.

8. If the amplifier-modulator is working, but the receiver does not pick up a signal, shorten the antenna.

9. If the transmitter works only when you hold the battery, lengthen the antenna.

Weak Signal Received

1. Check that the antenna is straight, and far away from metal, the ground, and your body.

2. Check that the battery puts out proper voltage under load.

3. Check that the transmitter and receiver are on the same frequency.

4. Get a better receiver.

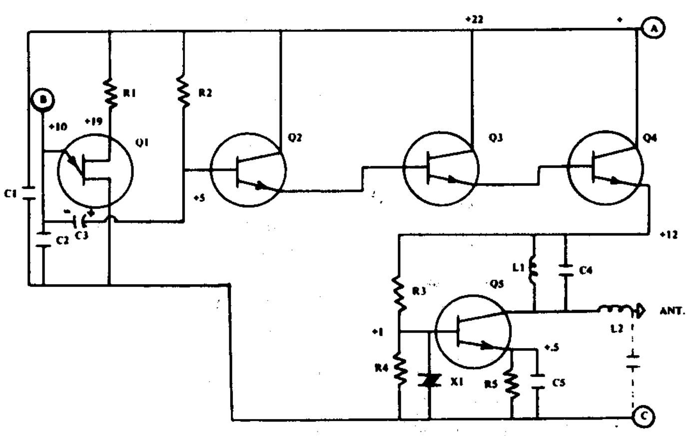
Signal Received on the Ground, but Not in flight

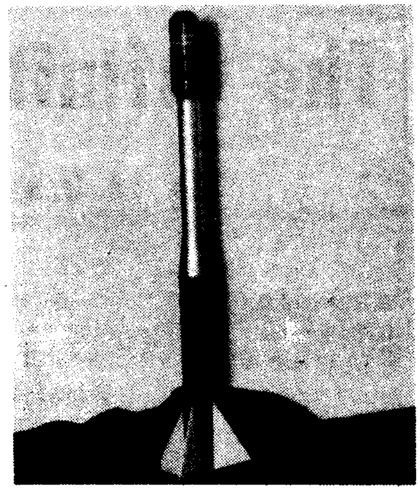
1. Clean and reform the battery holder.

2. Get a better receiver.

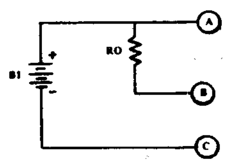
Next month, we will describe the construction of a temperature sensing module

27 M.C. MODEL ROCKET TRANSMITTER




Energet powered vehicle carrying CAMROC and XMTR.

Beacon Tone Generator Plug-in Module



which will enable the transmitter to send back data on the temperature of the atmosphere. (It is about 10 degrees colder 1500 feet up.) In addition, we will describe the construction of a device for converting the tone signals sent from the transmitter into numerical data.

In future months, we will discuss the construction of a spin rate transducer and accelerometer.

The extra capacitor (dotted lines) can be used to eliminate the ground plane wire. Its value should be on the order of 3 pf.

How It Works

Unijunction transistor Q1 oscillates at a frequency determined by the combination of capacitor C2 and resistor R_0. The output of the unijunction transistor is capacitively coupled to the three transistor Darlington current amplifier Q2, Q3, Q4. This amplifier serves as a modulator for the transmitter by switching the transmitter on and off at the audio frequency determined by Q1. The R F transmitter is a modified Coulpitts oscillator, using L1 C4 as an R.F choke, and inductance L2 as a load to allow the use of a small antenna.

Model Rocket Transmitter

Parts List

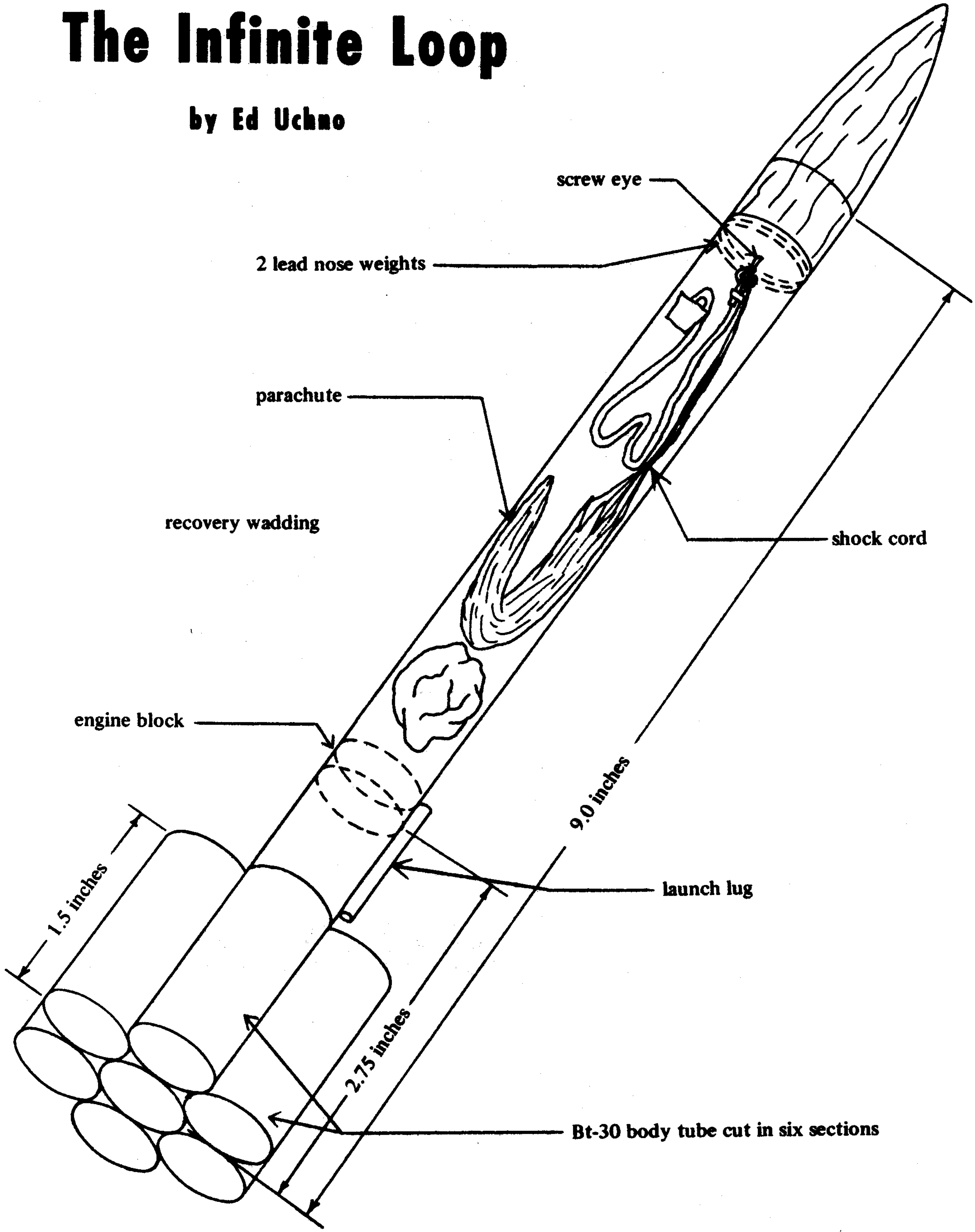
R_0	100,000 ohms	L1	27 uh R.F. Choke, Miller no. 70F275Ai
R1	220 ohms	L2	10 uh R.F. Choke, Miller no. 70F105Ai
R2	5,000,000 ohms		
R3	5,000 ohms	Q1	2N2646 unijunction transistor
R4	500 ohms	Q2, Q3, Q4	2N697
R5	50 ohms	Q5	40080 RCA House Transistor
		Plug	Ultra-Miniature R/C Connector, Lafayette no. 99H9091
All resistors ¼ watt		X1	27 m.c. crystal: Lafayette no. 42H0907C
		B1	22½ volt battery: Burgess no. Y15
C1	.01 mfds		
C2	.02 mfds	Battery Holder	Lafayette no. 34H5005
C3	6 mfds, electrolytic		
C4	2 pfds	Antenna	6'0" thin hook-up wire
C5	75 pfds		

All capacitors rated 25 V. or more

All parts, except those identified with Lafayette numbers, are available from Burstein-Applebee, Kansas City, Missouri.

The Infinite Loop

by Ed Uchno



Hey, gang! You say you're tired of the same old, worn-out model rocket styles? You say that if you see one more fin pattern, you'll do something desperate, like giving up rockets for model planes? Has finishing (fill, sand, fill, sand...) your 3/16 balsa got you down? Don't give up hope! Your salvation is here! Infinite Loop lives!

Infinite Loop is the ultimate in ring-tail model rocket design. It's all hoop and no fin. The advantages of this type of design are obvious. First of all, as I mentioned above, there's no fin pattern to worry about. This eliminates one of the longest and most tedious steps in model rocket construction– the cutting, sanding, and finishing of the fins. It also dispenses with the problem of fin placement. You needn't worry about equal spacing or proper alignment of the fins. By some obscure geometrical law, which I won't go into here, six objects of the same diameter fit perfectly around a seventh object of the same diameter. Presto! Perfect placement! (If you don't believe me, try it with seven coins of the same denomination.)

The unique design is another factor in Infinite Loop's favor. It will look good in just about any paint scheme you can dream up. The orignal Infinite Loop, by the way, has a black body and orange nose cone and tail assembly.

As you've probably suspected, this design just can't be that good; there's got to be a catch. Well, there is. It is necessary to add two lead weights to the nose cone in order to stabilize the rocket. Lengthening the body tube would, of course, get rid of one and possibly even both of these wights. I prefer, however, to sacrifice performance for a more pleasing overall appearance. Infinite Loop is a sport rocket. *not* a performance rocket.

Assembly of Infinite Loop is, as I mentioned before, a very simple procedure. First, glue the engine block into its proper position with a dummy or spent engine. Paint the body tube and set it aside to dry. Take the second tube and cut it carefully into six 1 1/2 inch pieces. Sand down the unfinished edges until smooth. Paint these tail assembly pieces and set them aside to dry. Sand down the nose cone, cover with clear dope, sand again, cover with sanding sealer, and sand again. Cover with sealer and sand until the nose cone is satisfactorily smooth. Paint the nose cone and set it aside to dry.

Next, take each tail assembly section and glue it into place at the base of the body tube. To insure a good, solid bond, scrape the paint off the portions of the pieces that make contact with each other. *Important*: When glueing in additional tail assembly sections, do *not* press the sections to assure a good connection. This may cause the sections to warp slightly and then they will not fit perfectly around the body tube.

Attach a launch lug to the body tube, making sure that the launch lug is directly above the gap between two tail assembly sections and the body tube.

Screw the screw eye into the center of the nose cone; then remove it, add two lead weights, put a drop of glue in the hole and screw the eye back into place. Assemble the recovery system as shown in the parachute kit instructions. Attach the shroud lines to the screw eye. Loop one end of the shock cord through the screw eye and fasten it with a tape strip.

Attach the other end of the shock cord to the body tube by cutting out a small (1/2 by 1 1/2 inches) piece of paper. Glue the end of the cord to 1/3 of the paper, fold over the paper, glue, fold over the paper, and glue again. Then glue this paper to the inside of the body tube.

Stuff some fireproof wadding into the front end of the tube, roll up the parachute carefully and place it on top of the wadding. Put the nose cone in place, and put an engine in the tail end of the body tube. You're ready to go!

The infinite Loop can take any Estes engine, up to a C. For the initial trial flights, a 1/4A or 1/2A is suggested.

Parts list:

Nose cone	Estes 651-BNC-3OE
Body tube	Estes 651-BT-30
Tail Assembly	Estes 651-BT-30
Nose cone weights	Estes 651-NCW-1
Launch Lug	Estes 651-LL-2A
Parachute, tape strips, and shroud lines	Estes 651-PK-12
Shock cord	Estes 671-SC-1
Screw eye	Estes 651-SE-2
Recovery wadding	Estes 651-RP-1A
Engine block	Estes 651-EB-30A

q & a

How hot would an estes C-65 engine get to be and how far would it travel at this temperature?

David Clarkson Perkins, I
Bethlehem, Pennsylvania

We were intrigued by your question concerning the temperature of Estes Rocket engines and have initiated a program to take some data on the time history of the temperature of the outer surface of the engine casing. As this will take some time, however, I thought I would go ahead and give you my initial guesses now.

Most model rocket engines (the Estes C-65 among them) use a propellant that is fundamentally black powder containing a propietary binder. The temperature of combustion of this propellant (and, therefore, the temperature of the *inside* of the casing during the operation of the rocket) is on the order of 2000 to 2200 degrees Fahrenheit. The thick paper of the casing, however, serves as an insulating material so that the outer surface of the engine does not become anywhere near this hot. Within one to two seconds after ignition, the temperature of the outside of the engine should reach a temperature on the order of 140 to 150 degrees F., after which the engine, propellant exhausted, begins to cool off slowly again. By the time the rocket lands (30 seconds to a minute or so after launch, on the average) the engine casing is only slightly warm to the touch– perhaps 120 degrees F. I would say that you could assume that the rocket will travel to its full height at parachute ejection while the casing temperature of its engine stays about 140 degrees F. The body tube, of course, provides additional insulation, so it is unlikely that the outside temperature of the rocket body itself ever rises above 120 degrees Fahrenheit.

Is there any way to prevent masking tape from tearing when it gets cold? Whenever we launch in the winter it becomes impossible to wrap engines with tape

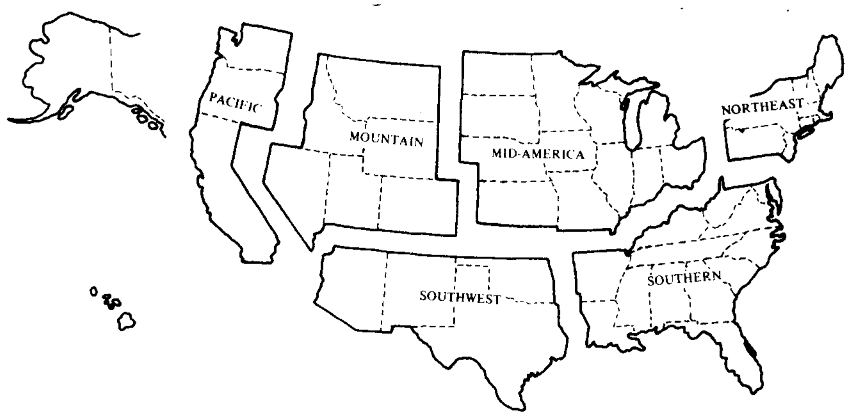
Herb Calahan
Great Neck, New York

Masking tape rips and shreds when the temperature gets close to 40 degrees. Even cellophane tape cannot be removed from its roll at low temperatures. The best material to use is freezer tape, available in most hardware stores for use in packages to be put in freezers. It looks like masking tape. If you can't get any of this your best bet is to wrap all of your engines to fit your rockets before going outside.

Any questions submitted to this column and accompanied by a self-addressed, stamped envelope will be personally answered. Questions of general interest will also be answered through this column. All questions should be submitted to:

Q and A
Model Rocketry Magazine
Box 214
Boston, Mass. 02123

NAR Section Activities Reorganized



In a new effort to place an emphasis on section activities and to encourage NAR members to join existing sections or form new sections in areas where sections do not already exist, NAR Director of Section Activities Robert Atwood announced the appointment of Division Managers to assist in the solution of regional problems. The country has been divided into six divisions, the Northeast, Southern, Mid-America, Southwest, Mountain, and Pacific—and a Division Manager of NAR Section Activities will be named for each region.

Division Mangers have already been selected for four of these regions. In the Northeast Division, Jay Apt, 40 Woodland Road, Pittsburgh, Pa. 15232; in the Southern Division, Richard Sipes, 5427 85th Ave. (Apt.101), Lanham, Md. 20801; in the Mid-America Division, Manning Butterworth, 2245 Sheridan Road, (Room 222), Evanston, Ill. 60201, and in the Pacific Division, Dean Boles, c/o Recreation Department, City of West Covina, California, have been named Division Managers. Managers for the other two divisions will be named soon.

As the NAR grows, it is anticipated that Department Heads for each state will be selected, and finally Urban Area Chiefs for the major population areas will be appointed.

NAR Rules Against Valkyrie-II

The Standards and Testing Committee of the National Association of Rocketry has announced that the Valkyrie-II rocket produced by Vashon Industries does not conform to the NAR Safety Code (Rule 2) and to the US Model Sporting Code, 1967 Edition (Rule 3.6). In addition, it does not conform to the FAI Sporting Code (Section 4b, Paragraph 2.6). This is because the Valkyrie uses an aluminium tube for a body.

NAR members who operate the Valkyrie-II in flight are subject to revocation of all membership rights for violation of the Safety Code. In addition, NAR insurance for individual members or clubs is void with respect to operation of the Valkyrie-II rocket.

News Notes

Estes Industries Holds Open House

Over 3,200 visitors saw the new facilities of Estes Industries, Penrose, Colorado, on Sunday afternoon, March 2, during "open house" festivities. Despite snowy weather, large crowds visited the facilities of the world's largest model rocket manufacturing plant.

Visitors were guided along a tour through the firm's modern office area, shown a brief film on the various functions of the company, and given a tour of the plant. The tour included the assembly, packaging, and mailing areas. Mid-way in the tour, a demonstration launching was held on the field behind the plant. The National Aeronautics and Space Administration provided a display on Apollo 8.

The company got its start in Denver under the leadership of Vernon Estes. In 1961, the company moved to an 80-acre site in Penrose, and the four employees worked in two buildings. Since that time, the firm has grown to include more than 220 employees working in 20 buildings.

The open house was arranged to allow visitors to see the new 24,000 square foot corporation office and mail order building recently completed on the Penrose site.

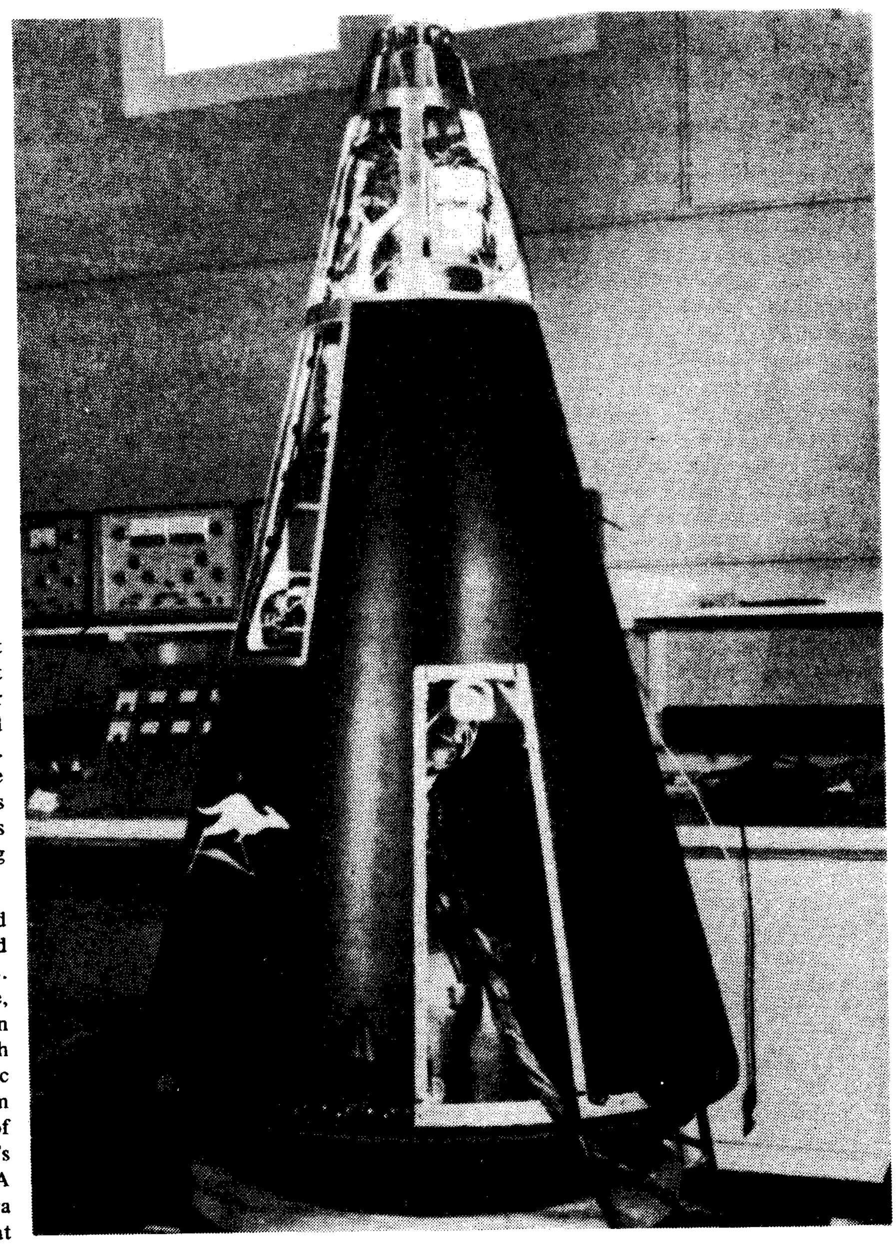
Stine Presents Saturn to New Caanan YMCA

G. Harry Stine (right), Section Chairman of the New Canaan, Connecticut YMCA Space Pioneers Section of the NAR, presents an exact 1/144 scale model of the Saturn 5 Apollo moon rocket to Philip C. Rose, general secretary of the New Canaan Community YMCA, in appreciation of the YMCA's support of the Section, which was organized in 1965 and now includes more than 30 teenage and adult members.

WRESAT

The First Australian Satellite

In November, 1967 a modified Redstone booster vehicle was employed in the launching of the first Austrialian satellite from the Woomera Rocket Range in South Austrialia. The satellite, called WRESAT (Weapons Research Establishment Satellite), was launched in continuation of the University of Adelaide upper atmosphere research project which had previously relied only on sounding rockets.



Project WRESAT is a good example of international cooperation in space research. The actual satellite was developed in Austrialia. The launching vehicle and the vehicle preparation team were provided by the United States Department of Defense. The launch operations were supported by the United Kingdom through its association with the activities at the Woomera launching range. In addition, the global traciing network of the National Aeronautics and Space Administration provided communications with the satellite.

The Weapons Research Establishment has for many years been carrying out extensive measurements in the upper atmosphere using Australian developed sounding rockets and scientific payloads. This work has been conducted in close association with the Department of Physics of the University of Adelaide and is primarily concerned with extending climatological studies.

The opportunity of extending and supplementing this work was presented when, after mutual assessment by W.R.E. and the U.S. Department of Defense, arrangements were made for the provision of a SPARTA (modified Redstone) launch vehicle to orbit a small Austrialian scientific satellite. Project SPARTA was a program phenomena associated with the re-entry of objects at high velocity into the earth's atmosphere. During 1967 several SPARTA vehicles were launched from the Woomera range. Design work on WRESAT began at the University of Adelaide early in 1967.

The primary object of the Project was to take advantage of this opportunity to supplement and extend the range of scientific data at present being obtained by existing Austrialian and other research programmes on upper atmosphere physics. Secondary objectives included assistance to the U.S. in the provision of further data of relevance to her own programs and the development of techniques pertinent to satellite launching trials in the ELDO,*Black Arrow** and other possible future programmes at the Woomera Range.

A further advantage in conducting a project of this kind accrues from the development and stimulation of the wide range of scientific and technological disciplines necessary for participation in satellite programs and which have wide application to defense science and general national technological progress. In meeting the requirements of the project, particularly those of time-scale, many parts of a complex organization have been usefull exercised.

The work already done by W.R.E. in the study of the effects of the upper atmosphere on climatology has attracted world wide interest. A detailed understanding of the mechanism of the heat balance between the solar and terrestial radiation within the atmosphere is vital in the study of climatology and this may, eventually, allow more accurate and extensive meteorological forcasting to be undertaken. An understanding of the whole atmosphere and the solar-terrestial relationship are prerequesites for the long term forecasting and perhaps eventual control of weather. Southern Hemisphere regions differ markedly from those of the Northern Hemisphere – firstly in the relationship of land mass to ocean areas and secondly in the attitudes to the solar flux. Australia is in a geographically favourable position to explore the effects of these differences.

The WRESAT experiment has been designed to provide information on the solar radiation flux in wavelengths which have a direct influence upon the temperature structure at heights above 30 Km (19 miles), and will assist in the determination of the composition of the upper atmosphere above the homopause at approximately 100 km (62 miles). Direct measurement of the solar flux will provide data on solar activity.

In order to gain a better understanding of the relationship between the outer and inner layers of the atmosphere it is necessary to know the specific inputs from solar radiation. The thermal energy interchange between the outer and inner layers is influenced greatly by the presence and distribution of molecular oxygen and ozone and since these constituents affect the absorption of ultra-violet radiations measurements at ultra-violet wavelengths are essential inputs to a greater understanding of the physical processes taking place.

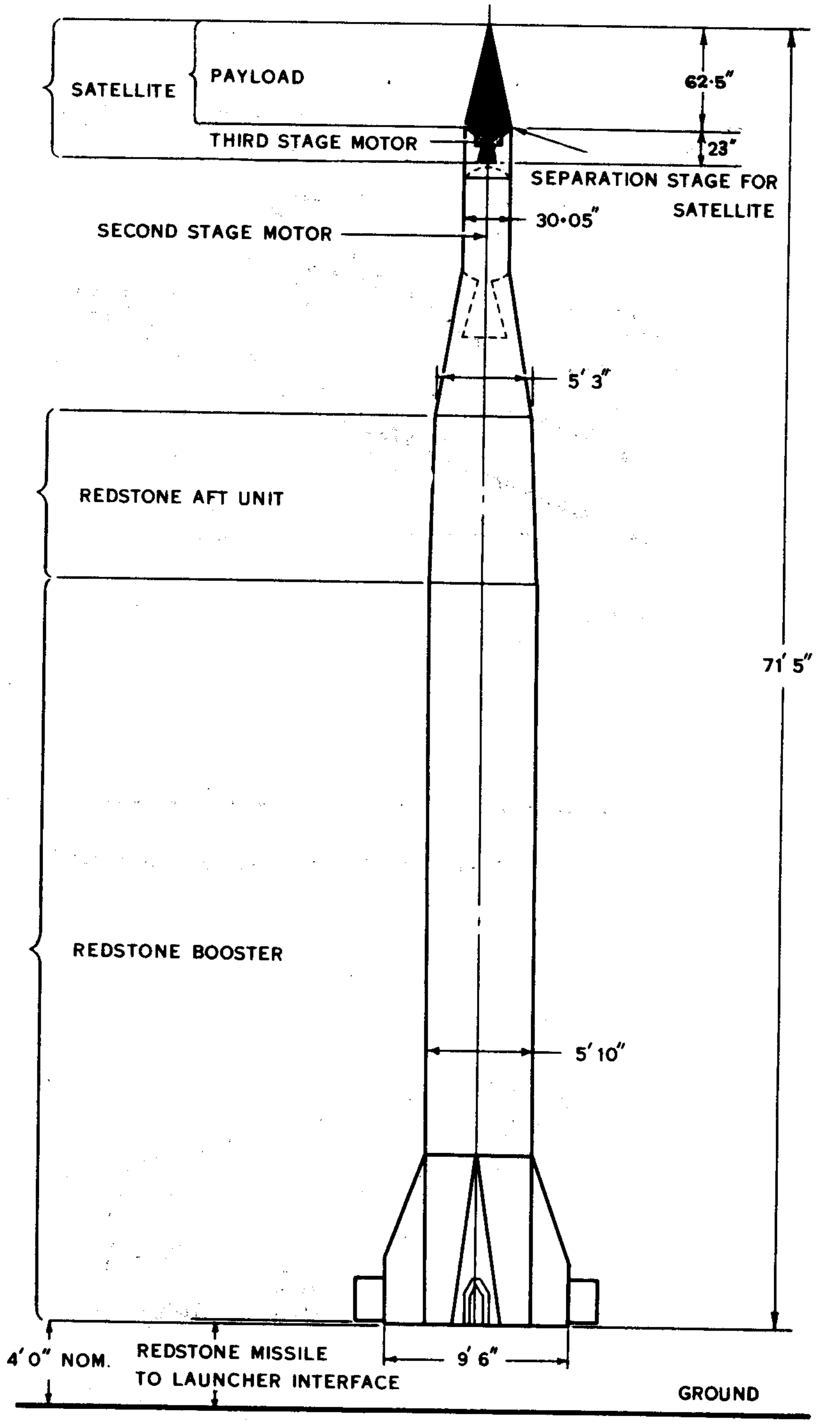


FIGURE 1. SPARTA MISSILE WITH WRESAT

The conical satellite including the experiment and instrumentation weighs about 100 lb and has a base diameter of about 30 inches and a height of about 5 feet. The third stage solid propellant motor was not jettisoned after burn-out but was allowed to go into orbit attached to the satellite cone, since no performance or operational penalties are involved and less

*ELDO is the Europena project designed to launch medium weight satellites early in the 1970's. **The Black Arrow is a British satellite launching vehicle in the early development phase.

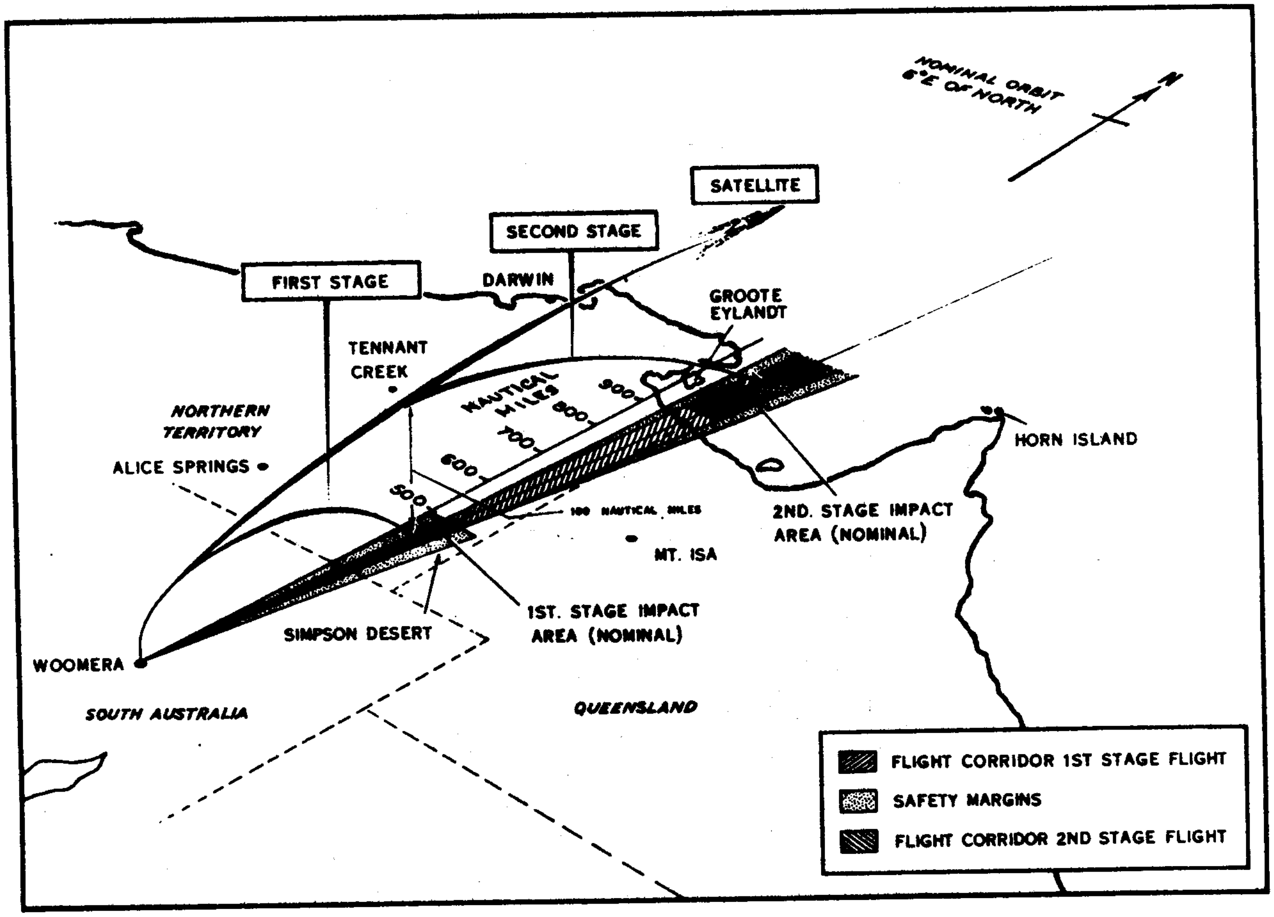


FIGURE 2. 1st. & 2nd. STAGES IMPACT AREAS

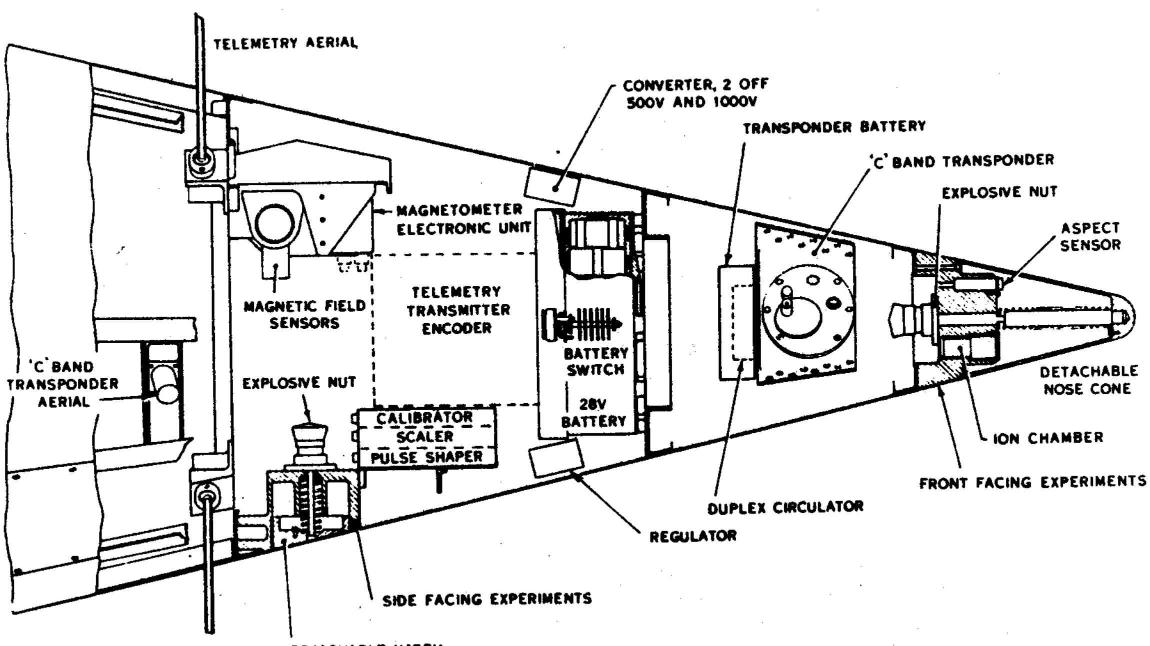


FIGURE 4. WRESAT INSTRUMENTATION LAYOUT

mechanical complication is introduced into the design. The total weight of the orbiting body is approximately 160 lb.

The satellite cone is made of light alloy frames and skin, and all instrumentation units are thermally isolated from the main flight structure. The external surfaces of the cone are treated with a special high temperature black paint in order to achieve a satisfactory temperature within the cone during the orbit phase and yet withstand the aerodynamic heating effects encountered during launching. The inside of the cone is painted white in order to assist in obtaining temperature equilibrium of the internal equipment.

Comprehensive environmental testing of the satellite structure and equipment was undertaken before launching. This included static and dynamic loading, vibration testing, impact loading and testing at elevated temperatures. In addition the complete satellite was tested in a vacuum chamber of the University of Adelaide at a pressure of 10^{-5} mm Hg while being cycled in temperature between +50°C and -15°C over a period of about one week. Since the final stages of the launch vehicle and the satellite are spin stabilized during orbital insertion it was necessary to dynamically balance the satellite to very fine limits.

The standard SPARTA launch vehicle, incorporating certain structural changes to accommodate the new payload, and was used. The vehicle first stage is a refurbished Redstone missile modified to accept two solid propellant upper stages. The complete vehicle is about 70 feet high, 6 feet in diameter and weighs approximately 57,000 lb at launch. The Redstone motor provided a thrust of about 75,000 lb and burn for 122 seconds. Certain modifications have been made to the upper stages of the launching vehicle in order to allow for the different trajectory requirements and aerodynamic heating effects arising in the case of the WRESAT launch.

The launch was made from the existing SPARTA launching site at Woomera. The inertial guidance system in the vehicle was reprogrammed to ensure that the trajectory obtained would allow acceptable first and second stage impact areas to be chosen consistent with a satisfactory orbital geometry and flight safety requirements. Unlike American orbital boosters, the SPARTA first stage was allowed to impact on land (see figure 2).

It was intended that, by constraining first stage impact to occur within the existing proclaimed areas of the Simpson Desert and the second stage impact in the Gulf of Carpentaria, a nearly polar elliptical orbit would be obtained. An apogee height of 700 n.m. and a perigee height of 100 n.m. for a satellite weight of about 100 lb (excluding the burnt third stage motor which will not be jettisoned) was expected. Under these circumstances a satellite life time of about 40 days was expected, although battery power limitations were expected to give the satellite a useful transmitting life of only about 10 days.

After burnout of the first stage booster, the second and third stage motors and the satellite separated from the first stage and coasted to a height of about 100 n.m. During this time, the inertial guidance unit, attached to the aft end of the configuration, caused the vehicle to be pitched into an approximately horizontal position. The complete vehicle was then spun by spin rockets up to a maximum roll rate of about 2½ rev/s before ignition of the second stage motor. After burnout, the second stage was discarded and the third stage ignited inserting the satellite into orbit with a tangential velocity of about 26,000 ft/s at a height of about 100 n.m., a latitude of near 27°S and an azimuth angle of about 6° East of North from the launch point.

The satellite, including the burnt third stage motor, entered orbit with a spin rate about the cone axis of about 2½ rev/s; the attitude of this axis will be about 27° to the earth's rotational axis. In the case of a rigid symmetrical body not acted on by external forces or moments, this attitude would be maintained but due to structural and balance misalignments, lack of infinite rigidity and other factors, the axis of spin will eventually nutate and finally the motion will assume that of a flat spin about the axis of maximum inertia. This axis will be parallel to the original spin axis on insertion into orbit.

As the sensors have a 80° total angle of view and as it is necessary that they see the sun, it is mandatory that sensor orientation and final plane of cone rotation must be positioned so that the sun may be observed at all times when the satellite is in sunlight. In order to achieve this requirement, the satellite was to be encouraged to tumble by fitting "wobblers" which are energy dissipation devices released soon after orbit has been established. It is expected that the transfer of the motion from the original to the final rotational mode should occur within the duration of one or two orbits.

Orbital measurements and predictions as well as the telemetered data were provided by the NASA Global Satellite Tracking and Data Acquisition Network (STADAN). The telemetry data tapes were sent to W.R.E. for final data reduction. In addition there are many other centres throughout the world with facilities for receiving satellite data at the frequency of 136.350 MHz; these centres were invited to receive data from WRESAT and forward it to W.R.E.

Reader Design Page

The HAWK 7 is a very radical looking rocket, being tall and slender, yet it flies very well. It is able to carry a thermometer, if the nose cone is hollowed out a little.

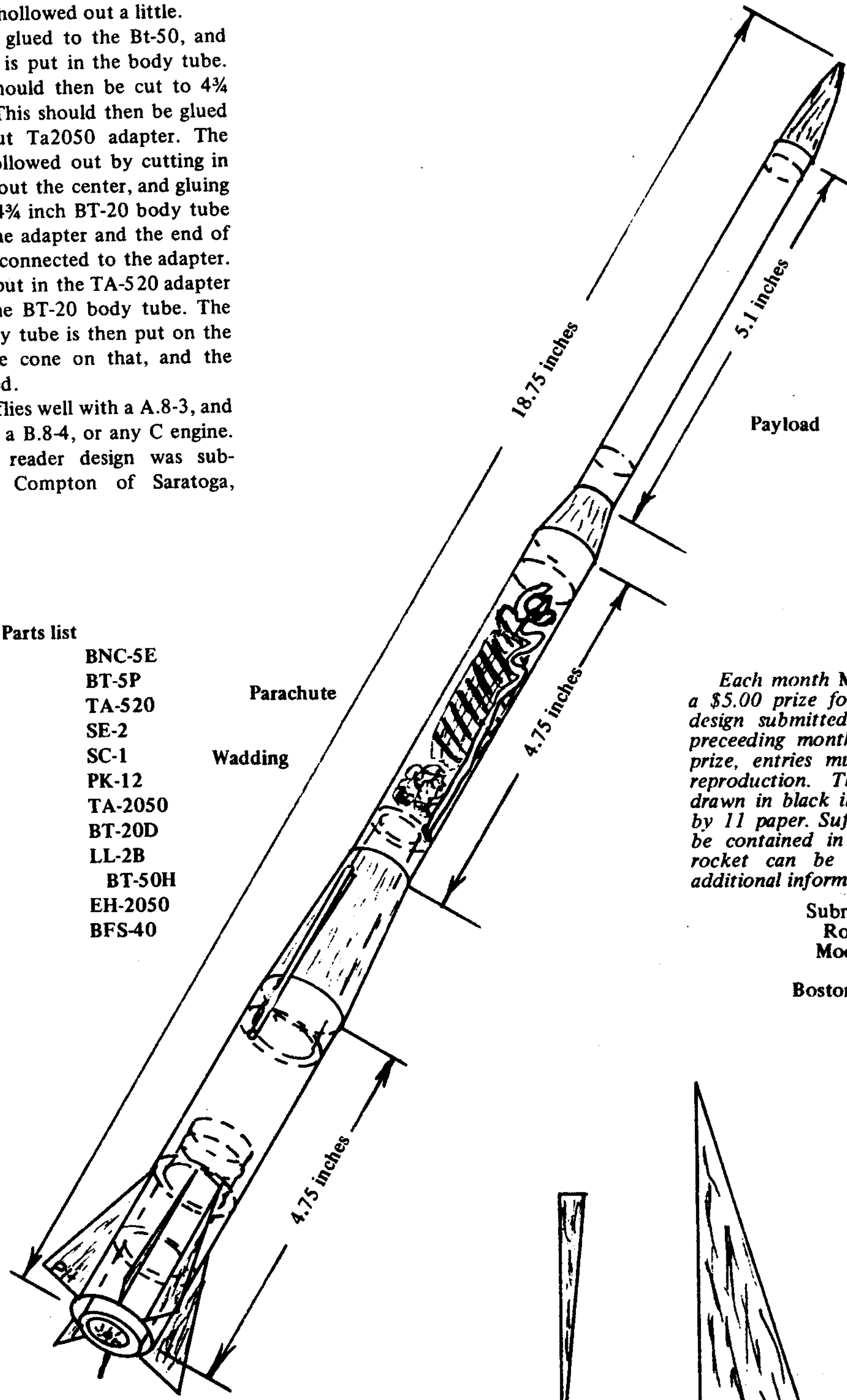
6 fins are first glued to the Bt-50, and the engine mount is put in the body tube. The body tube should then be cut to 4¾ inches in length. This should then be glued to a hollowed out Ta2050 adapter. The adapter can be hollowed out by cutting in half, and gouging out the center, and gluing together later. A 4¾ inch BT-20 body tube is connected to the adapter and the end of the shock cord is connected to the adapter. The screw eye is put in the TA-520 adapter and inserted in the BT-20 body tube. The 5.1 inch Bt-5 body tube is then put on the adapter, and nose cone on that, and the HAWK 7 is finished.

The HAWK 7 flies well with a A.8-3, and will surely handle a B.8-4, or any C engine.

This month's reader design was submitted by Dan Compton of Saratoga, California.

Parts list

ESTES	BNC-5E
ESTES	BT-5P
ESTES	TA-520
ESTES	SE-2
ESTES	SC-1
ESTES	PK-12
ESTES	TA-2050
ESTES	BT-20D
ESTES	LL-2B
ESTES	BT-50H
ESTES	EH-2050
ESTES	BFS-40

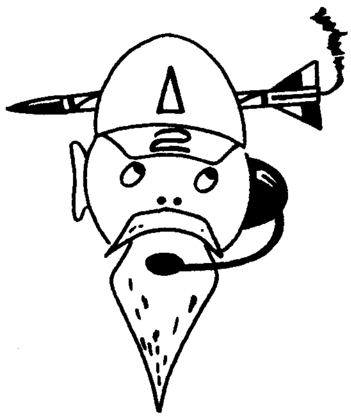


Each month **Model Rocketry** *will award a $5.00 prize for the best original rocket design submitted by a reader during the preceeding month. To be eligible for this prize, entries must be suitable for offset reproduction. They should be carefully drawn in black ink on a single sheet of 8½ by 11 paper. Sufficient information should be contained in the drawing so that the rocket can be constructed without any additional information.*

Submit entries to:
Rocket Design
Model Rocketry
Box 214
Boston, Mass., 02123

Launch lug stand-off (glue to adapter)

Full size fin pattern (make 6)



The Old Rocketeer

by G. Harry Stine NAR#2

Positive Ignition:

The Care and feeding of Rechargable Wet Cells

If you're still having trouble with dead batteries ("flat cells" as our British friends would say) so that your countdown sounds rather stupid– don't just do something, stand there! Granted, most commercially-available electrical ignition systems will do the job for the beginner if he happens to get nice, fresh photoflash batteries, and if the temperature outside isn't lower than 40 degrees Fahrenheit when he tries to ignite his bird. Still, the time comes when a modrocknut gets a wee mite tired of worrying about batteries and associated misfires. So what does he do?

He can and usually does pick up a Hot Shot dry cell...and continues to sweat with his electrical problem.

Wise modrocs manage to fix themselves up with wet cells, or lead-acid batteries such as those used in automobiles. But these are usually monsters with enough juice to launch 56,835 models without recharging... and they are somewhat heavy for most 97-pound weaklings to cart around.

I found the answer.

We have a lot to learn from the radio-controlled model aeroplane fliers who also have an electrical power source problem when they are out in the middle of that field twiddling knobs and trying to keep that $500 creation from pranging into a tree. The batteries that have been developed for R/C modelling can solve many of our own electrical ignition problems.

What, basically, *is* the problem anyway? Simply this: model rocket motor igniters are deliberately designed to require *beaucoup* amperes of electrical current to get the show on the road. This is to prevent accidental ignition if somebody in the launch area happens to run a comb through his hair and generates a spark...or to prevent the East Podunk Taxi Corporation from firing the igniter by radio-frequency pick-up whenever their two-way radio comes on the air with instructions for Car 82 to go pick up Aunt Nellie. There *are* igniters on the market–the FSI electric match, for instance–that will fire with milliamperes of current and about 1.5 volts, but they are expensive and very tricky to use (take the indicator light out of your firing panel, or these jewels will fire when you insert the safety key!). So the hefty, super-safe, hot-nichrome-wire model rocket igniter has probably saved a number of burned fingers. But such hot-wire igniters are pure, unadulterated hell on most batteries.

A nichrome-wire model rocket igniter is a direct short across the battery and the firing system.

Ordinary flashlight cells of the dry type (technically known as LeClanche Cells) are totally ruined by one such treatment.

Photoflash batteries are designed to take such direct short circuits, but they are basically souped-up LeClanche cells. They'll cut the mustard for about 50 shots if you're lucky, and have a very good firing system.

Hot Shots, lantern batteries, and other large batteries are usually LeClanche cells, too, but they are bigger and will withstand more current drain. I have had Hot Shots last for nearly 2 years, but other people have not been so lucky.

Alkaline Energizers are basically a new form of battery made for heavy current drains, and I have used both Mallory Dura-cells and Everyready Energizers with some success.

The absolute ultimate in small, "D" cell sized power sources are sintered-plate nickle-cadmium rechargeable batteries. These little bombs will throw a direct short-circuit current of 50 amperes for 90 seconds.

Ten of them in series is equivalent to a car battery, and I have used such a set-up in emergencies to start my car on a cold morning when my car battery was dead. But, like all the batteries mentioned to date except the LeClanche cells, nickle-cadmium batteries are expensive– like, about $5.00 for *one* D cell! Mine lasted for about 500 rechargings, then died a horrible death whilst I wept over their carcasses. Fifty bucks shot!

A 12-volt automobile battery is a wet cell, otherwise known as a lead- acid battery. Even the cheapest one will last for years, but they are expensive and very, very heavy. The one I bought in 1962 finally sulphated a few months ago because I had forgotten to keep it fully charged over a winter's season of non-flying.

Lead-acid cells are *the* answer if you really want positve ignition with lots of juice at a reasonable cost...and if you don't mind carrying 60 pounds of lead around. However, our big problem has been solved, because I stumbled upon some little bitty lead-acid cells made especially for radio-controlled models.

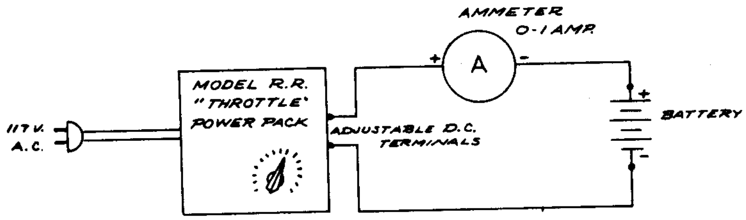
Irv and Nat Polk at Aristo-Craft Distinctive Miniatures, 314 Fifth Avenue, New York, NY 1001, are importing from Japan their nifty little No. 64 Rechargeable Wet Cell Battery. It's 3 5/8 inches long, 1 3/4 inches wide, and 2 3/4 inches over the filling caps. Weight ready to go is 1.55 *ounces*. It puts out an honest 6 volts with 4 ampere-hour capacity.

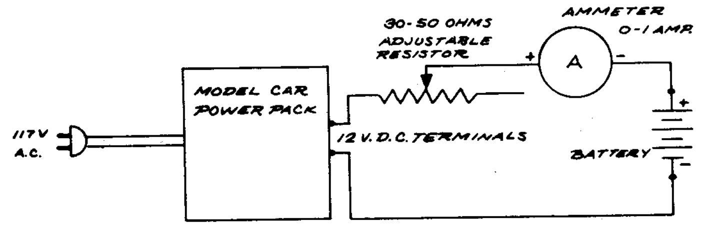
This is the modern version of the venerable Willard NT-6 miniature wet cell of World War II surplus fame.

I obtained a couple of Aristo-Craft No. 64 wet cells from Irv Polk expressly for evaluation for this magazine.

The battery comes dry, which means that you must fill it up with sulphuric acid. This is no job for a fumble-fingers. Battery acid may be obtained anywhere that dry-charged automobile batteries are sold. Just tell them you want about half a pint of battery acid. And don't spill it. In fact, if you're a student, get your science teacher to help you out. You will need a very fine eye-dropper to fill each of the three cells of the battery. Fill each cell with battery acid to the top of the label on the side so that the plates of the cell are well covered. Wash off any acid that has spilled. Remember, that stuff can burn the blazes out of you, so treat it with great respect!

Once all three cells of the Aristo-Craft No. 64 battery are filled with acid, you're ready to charge it up. You can get a charger from Aristo-Craft for $7.95, *but*...if you have an HO or N-Gauge model railroad or a slot racing set, you already have a battery charger and don't know it. The DC power pack. This converts the 117-volt alternating current that comes out of the household





wall socket to 12-18 volts of direct current for running model trains or model cars. It can also be used to charge wet cell lead-acid batteries with little extra trouble or expense.

Regardless of whether you have an adjustable "throttle pack" for an HO train or a slot-racing power pack, you will need an ammeter. You will use this to measure the charging current. The Aristo-Craft No. 64 requires charging for 12 hours at 0.4 amperes– no more. Therefore, you should obtain an ammeter capable of reading direct current from zero to one ampere. You won't use all of the meter scale, but ammeters normally come in 0-1 amp range. Such an ammeter can be obtained from a radio supply store, perhaps the local hobby store if the dealer goes in big for R/C stuff, or from a mail-order radio supply house such as Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

If you want to order your ammeter from Allied, you can get a cheapie Eico Model NF-2C for $1.90 (Allied stock no. 68 U 972) or a somewhat better one, the Eico Model RF-2-1/4C for $2.30 (Allied stock no. 68 U 025).

If you use a model railroad throttle pack with its adjustable throttle, you will need nothing more than the ammeter, some wire, and perhaps some alligator clips to hook things up with. Wire the circuit as shown. Watch polarity! You can burn out a meter or ruin a battery in short order if you don't. If, when you finally turn the switch on to give it the "smoke test," the meter needle tries to go off the scale to the left, or below the zero meter reading, you're hooked up backwards– so flip the "direction" switch on the throttle pack in the opposite direction; this swaps plus and minus coming out of the "adjustable 12-volts" terminals of the throttle pack.

Turn the throttle up until the ammeter reads 0.4 amperes. Note the starting time of the charge. Check every hour or so to adjust the amperage.

If you use a model car power pack, you will have to have an adjustable resistor (or "reostat") so that you can adjust the current coming out of the power pack. In other words, you'll need something to take the place of the throttle in the model train throttle pack. This requires an adjustable resistor of 30 to 50 ohms resistance. According to my calculations, a 30-ohm resistor with a power rating of 5-watts should do the trick. Suitable adjustable resistors (otherwise called "pots" in electronic parlance) include: IRC-CTS 4-watt 30-ohm wire-wound control (Allied stock no. 30 U 216 C) for $1.32; or the Mallory Type VW-30 30-ohm 5-watt wire-wound control (Allied stock no. 28 U 097) going for $1.38. Hook up as shown with the sliding contact of the reostat being indicated by the arrow of the adjustable resistor symbol on the drawing.

I ran some tests with the Aristo-Craft No. 64 rechargeable wet cell battery. Into a load of 2 ohms resistance, the little battery slammed 2.5 amperes of current at 5 volts for 75 minutes before it went flat and wanted to be recharged again.

It will easily throw 5 amperes through a 1-ohm load. And, it will do it again...and again...and again.

It vaporizes an Estes igniter as well as a Centuri Sure-Shot ignitor. Like POW! Just like a big auto battery.

It's as good as any $7 Hot Shot or $25 worth of nickel-cadmium cells. And it goes for only $5.00.

Two of these No. 64's in series will give you 12 volts, if you feel you really need the juice.

A few important tips to be carefully studied, remembered, and followed with the Aristo-Craft No. 64 wet cell battery if you want to have long-life and reliable juice from it are:

1. Take the little rubber caps off the filler holes on top of the cells when charging. When being charged, the battery generates hydrogen gas which bubbles up through the acid and *must* be vented to keep the rubber caps from blowing off, and to keep the cell from exploding due to internal gas pressure. Replace the rubber caps after charging to prevent acid from spilling out of the filler holes.

2. Because the battery does produce hydrogen gas as a part of the charging process, don't smoke around charging batteries, and also make sure there is air circulation in the room.

3. When the liquid level gets low in any cell, bring it up to the proper level again by adding only *distilled water*. Do not use water out of the faucet. Chlorinated city water or tap water will ruin a battery in a short period of time. Use *only* distilled water for filling a lead-acid battery of any type, including the one in your car if you want to beat the warranty on it!

4. Don't store the battery in a discharged condition. This causes the formation of lead sulphate in the cells, and lead sulphate is insoluble in battery acid. As a result, lead sulphate coats the plates...and you lose your battery. Keep it charged up. Touch up the charge with a couple of hours of 0.4 amps every month or so. If you wish, you can set your wet cell battery on "trickle charge" when you aren't using it. The normal trickle charge for a battery to keep it fully charged and de-sulphated is about 10 per cent of the recommended charge rate. In the case of the Aristo-Craft No. 64, the trickle charge rate would be 0.04 amperes or 40 milliamperes. The cells should not give off gas while on trickle charge. If they do, reduce the charging current until gassing stops.

It looks like the Aristo-Craft No. 64 rechargeable wet cell battery will be the answer to a modroc's prayers for fast, positive ignition. Furthermore, it's small enough and light enough to put in your field box! I have fabricated a box from plexiglass which will hold two of these batteries to give me 12 volts of positive zot power. Why plexiglass? Cheapest structural plastic I could get...and I wouldn't want a steel or aluminum case for a lead-acid battery...not when sulfuric acid attacks iron and aluminum!

See, it pays to snoop around and find out what other modelers are doing and what they've got that will solve our technical problems in model rocketry!

Technical Notes

George Caporaso

Technical Literature

In designing a model rocket one must have methods for computing the expected altitude, drag characteristics, and dynamic behavior of the vehicle under consideration. These methods, along with some supplementary information, can be obtained from many fine references, a few of which are discussed in this article.

There are many excellent methods available for computing the altitude of single or multistaged rockets. Two of these, which were formulated by Douglas J. Malewicki, appeared in technical reports offered by major model rocket companies. The Estes Industries **TR-10, Altitude Prediction Charts,** includes predicted performance graphs for single stage rockets using Estes' 1/4 A thru B type engines. It presents graphs of altitude vs. initial weight with the drag "form factor" as a parameter. Coasting times vs. initial weight for each engine are also given. An appendix is included which gives the derivation of the burning phase and coasting phase differential equations and their solutions. The same type of approach was also used in Centuri Engineering Co.'s **TIR-100, Model Rocket Altitude Performance** which included altitude vs. initial weight and coasting time vs. initial weight plots with the form factor as a parameter for single stage rockets using 1/4 A thru F type engines. Some data on rocket drag derived from wind tunnel tests is also presented in that report.

Other approximate methods and refinements of the Fehskens-Malewicki solutions are given in **Solutions of the Differential Equations of Ballistic Flight Paths for Model Rockets** by George Caporaso (available from M.I.T. Model Rocket Society, MIT Branch P.O., Box 110, Cambridge, Mass. 02139 for $1.50). The report gives detailed derivations of most altitude schemes and includes the derivation of the solutions for non-vertical trajectories.

Information on drag is even more plentiful than that on altitude performance. An excellent introduction to the nature of drag and to some basic concepts of aerodynamics is **Shape and Flow** by Ascher Shapiro. This little paperback book is an excellent primer for more advanced mathematical treatments and gives a good explanation of the boundary layer's importance in aerodynamic concepts.

For those who desire to delve into the mathematical intricacies of aerodynamics, two excellent books are suggested. They are **Fundamentals of Hydro- and Aeromechanics** and **Applied Hydro- and Aerodynamics** both by Prandtl and Tietjens, both in paperback, and available from Dover Publications, Inc. They cover such topics as Boundary Layer Theory, vortex motion, potential flow, compressibility, viscosity, drag, airfoil theory, experimental techniques and others.

Unfortunately, comparatively little work has been done specifically on model rocket drag characteristics. One fine exception is an apparently not well known paper by Prof. Jerry Gregorek at Ohio State University. Prof. Gregorek's report enables one to theoretically compute the drag coefficient of each component of a model rocket by utilizing some theoretical and some semi-empirical equations. The method appears to have a good basis but there was no experimental verification presented or suggested.

Semi-empirical methods for calculating drag on larger rockets may be found in most ballistics books. One particularly good example is **The Exterior Ballistics of Rockets** by Davis, Follin and Blitzer available from D. Van Nostrand Co. There is a section on drag characteristics, some of whose equations have appeared in **Calculating Drag Coefficients** by George Caporaso in the November 1968 issue of **Model Rocketry**.

Some older ideas on the nature of drag and some methods of computing them can be found in **Methods of Exterior Ballistics** by Forest Ray Moulton, available in paper back from Dover Publications, Inc.

The field of dynamic stability is treated in many references. **The Exterior Ballistics of Rockets** has a rather huge amount of material on spinning rockets, effects of thrust and fin mal-alignment, pitch, yaw, roll, aerodynamic restoring and damping forces and approximate methods of calculating radial and longitudinal moments of inertia as well as restoring and damping coefficients. Another treatment of dynamic behaviour of rockets covering similar topics can be found in **The Flight of Uncontrolled Rockets** by Gantmakher and Levin, available from Pergamon Press.

The dynamic characteristics of small projectiles are also covered in **Methods of Exterior Ballistics** under the topics of rotating projectiles, effects of damping on pitch-roll coupling, the trail and drift of projectiles and others. It also includes detailed sections on the theory of differential corrections for trajectory calculations and discusses the differential equations of motion for a non-oscillating and oscillating rocket as well as for a spinning rocket. Although it presents no closed form solutions, it presents the iterative procedures for solving all the equations so that the method is easily adaptable for digital computer use.

Undoubtedly the best source of information on the dynamic stability of model rockets is the collection of reports written by Gordon K. Mandell. The set consists of **The Linearized Rotational Dynamics of Spin Stabilized Projectiles,** a report delivered at the M.I.T. convention and the 5 part series *Fundamentals of Dynamic Stability* which has appeared in the first five issues of **Model Rocketry.** Mandell's reports cover the dynamic behaviour of non spinning rockets, inertial coupling for a spinning rocket, roll stabilization, computing corrective moment coefficents, damping moment coefficients, the longitudinal and radial moments of inertia, methods for measuring the moments of inertia and the aerodynamic coefficients and criteria for good dynamic stability.

As a general reference book for altitude prediction, computing aerodynamic characteristics (drag, corrective and damping moment coefficients) and computing dynamic stability, **The Exterior Ballistics of Rockets** is suggested. It happens to contain, among other things, the Fehskens-Malewicki altitude solutions and the coasting phase differential equations and solutions.

The two books by Prandtl and Tietjens contain a wealth of information on boundary layers and drag and the second book in the series, **Applied Hydro- and Aeromechanics** should prove especially useful to boost glider enthusiasts since it contains an elaborate section of wing theory.

Of course, a superior general reference book on static stability, basic analysis of rocket flight and drag is the **Handbook of Model Rocketry** by G. Harry Stine. It contains the Barrowman equations for computing static stability and is available in paper back or hard cover from Follett Publications.

The larger model rocket manufacturers offer many good technical reports on altitude prediction, static stability, and a host of practical details. Before you go off and try a three week derivation, take a look at the appropriate references and see if someone has already done the derivation for you. If so, you've saved quite a bit of time. If not, get your work published to save others some time.

The Pittsburgh Spring Convention

The 4th Annual Pittsburgh Spring Convention, hosted by the Steel City Section of the National Association of Rocketry, was a resounding success. The purpose of the convention, held March 28-30 at the Shadyside Academy near Pittsburgh, was to provide a forum for communication between rocketeers from all parts of the country. Over 200 rocketeers attended the sessions and participated in discussion groups and the launch. While this number was about the same as last year's attendance, due to space limitations, a larger group of rocketeers hailed from outside the immediate Pittsburgh area this year. Rocketeers from New York, New Jersey, Maryland, Washington D.C., West Virginia, Virginia, Minnesota, Ohio, and Massachusetts joined with those from Pennsylvania in discussions ranging from model rocket instrumentation to criterion for good scale substantion data.

The convention opened on Friday, March 28, with the keynote address delivered by Leroy Piester, President of the Centuri Engineering Company. Piester stressed the importance of model rocketeers acting responsibly to promote public acceptance of the hobby across the country. He warned that irresponsible acts by a few model rocketeers will make the legalization of the hobby more difficult in areas where such efforts are presently being undertaken.

Discussion groups met for the first time on Saturday morning and frequently during the remainder of the weekend. The scale group, led by Arnold Pittler, considered questions such as what constitutes good scale data and how the spiral winding on a body tube can be eliminated on a scale model. In the R&D group, Dick Fox presented plans for his new transmitter (which appears in this month's issue of **Model Rocketry**. He also discussed possible uses of the transmitter to relay micrometerological, acceleration, position, and other data from model rockets. A working model of the transmitter was demonstratedat the convention. Bob Atwood, NAR Trustee and new Director of NAR Section Activities, discussed the services provided for sections by the NAR. George Caporaso, in another R&D session, emphasized the need for experimental data to supplement the theories for model rocket altitude performance.

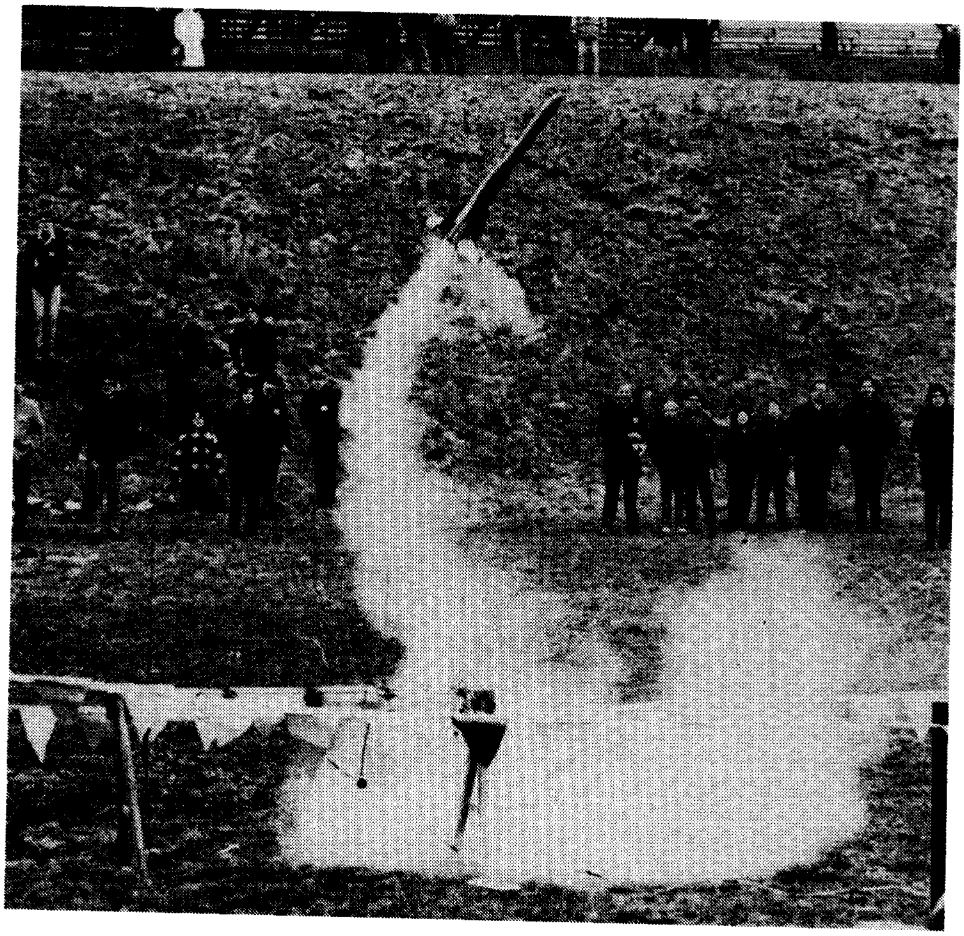
As the day went on, the weather worsened, and it looked for a time that last year's cancellation of the launch because of rain would be repeated. However, the weather held, and over 100 rockets were launched Saturday afternoon. Due to the sub-freezing temperature, difficulty was experienced with cluster ignition. Even though each rocket had been safety checked before the launching, there were some tense moments. An engine failure on a two engine F cluster caused it to go wild and fly horizontally before crashing.

The manufacturers took this opportunity to display several of their new birds. Vern Estes, President of Estes Industries, was first up with a sport rocket powered by one of his new D engines, which will be ready for sale in August. The black and yellow rocket climbed straight up into the clouds with the new engine. Leroy Piester flew two new models from Centuri. A scale Nike-Smoke with a plastic nose cone got off fine. However, his Saturn V was plagued by cluster ignition problems on the cold afternoon. One engine in the cluster failed to ignite and the rocket climbed to only about 100 feet before crashing. Three new altitude rockets were flown by Howard Kuhn of Competition Model Rockets. Their performance, using Class A engines, was spectacular.

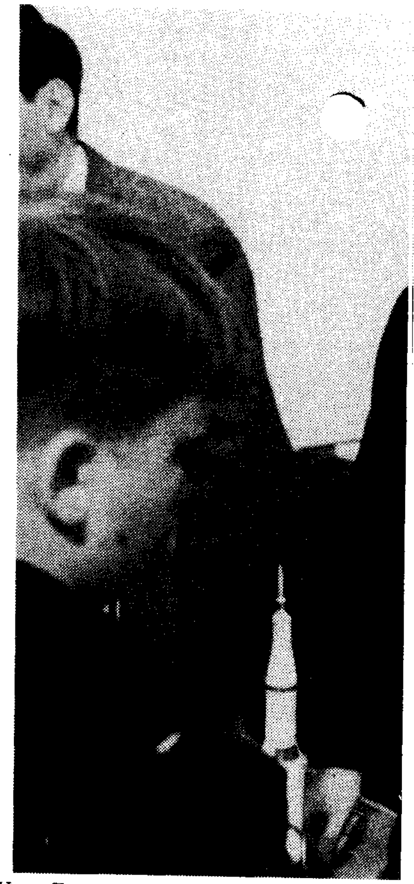
Following the launch, John Bannister of NASA's Goddard Space Flight Center gave a lecture on "Man in Space." He detailed the efforts which are necessary in order to provide an enviornment in space in which man can survive. He showed slides illustrating the physical training necessary to prepare astronauts for the high "g-force" experienced during a rocket flight. He also discussed the method of preparation of the special "freeze-dried" foods which are used on space flights, and brought along samples of the food for some of the rocketeers to taste.

On Saturday evening, the Leader Administrative Council of the NAR held a meeting of NAR members present at the convention to discuss member reaction to the services presently being offered by the NAR. LAC Chairman Jay Apt distributed an extensive questionaire on NAR activities to those present. Results of the questionaire will be used by LAC to formulate a report to the Trustees.

The convention concluded on Sunday with more discussion groups. At the close, participants were asked what type of activities they would like to see at future conventions. The expected request for more launch time in the future was heard from all around the room. Requests for more time for manufacturer demonstrations indicates the interest in new kits among the younger rocketeers. Convention Chairman Alan Stolzenberg, Steel City Section President Ben Davis, Finances Director Arnold Pittler, and the entire Convention Staff should be congratulated for a job well done.



Cluster rocket lifts off on an erratic flight as spectators watch during the Pittsburgh Convention launch.



Vern Estes describes new scale Mercury R
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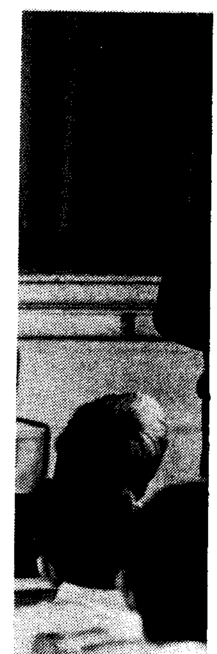
The Pittsburgl

Arnold Pittler leads the scale modeling discussion group. Among the topics discussed was how to eliminate body tube spirals and how to obtain good scale data.



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Vern Estes describes new scale Mercury Redstone model to interested onlookers during the manufacturers demonstration at Pi ırgh.

The Pittsburgh Convention

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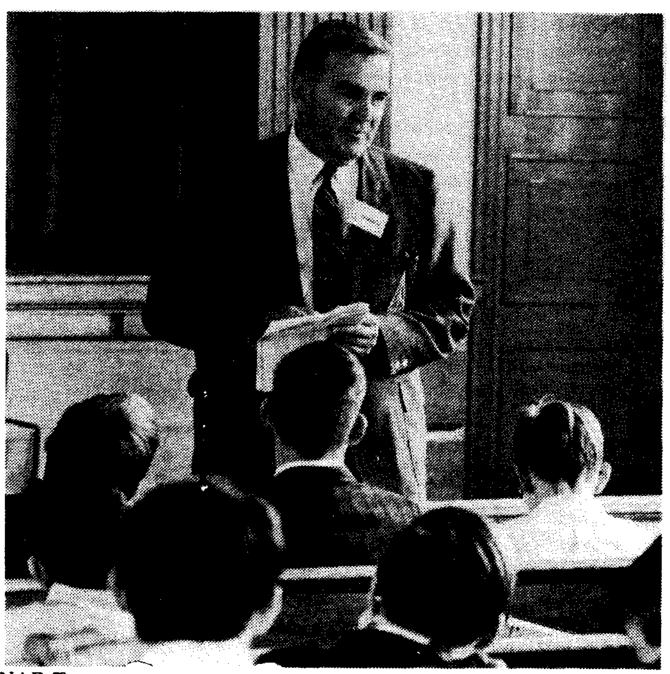

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Centuri scale model Satur
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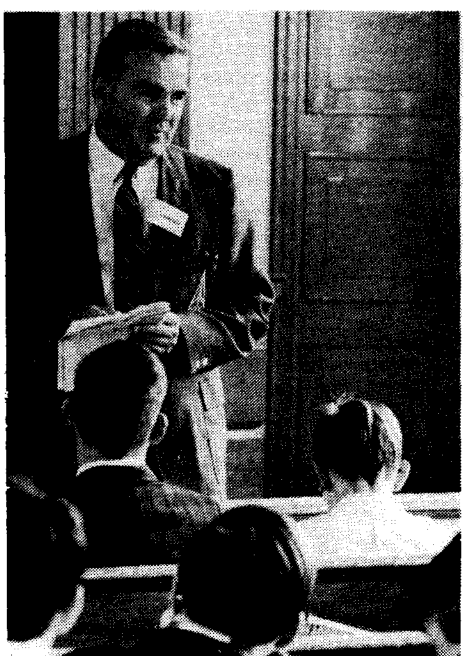

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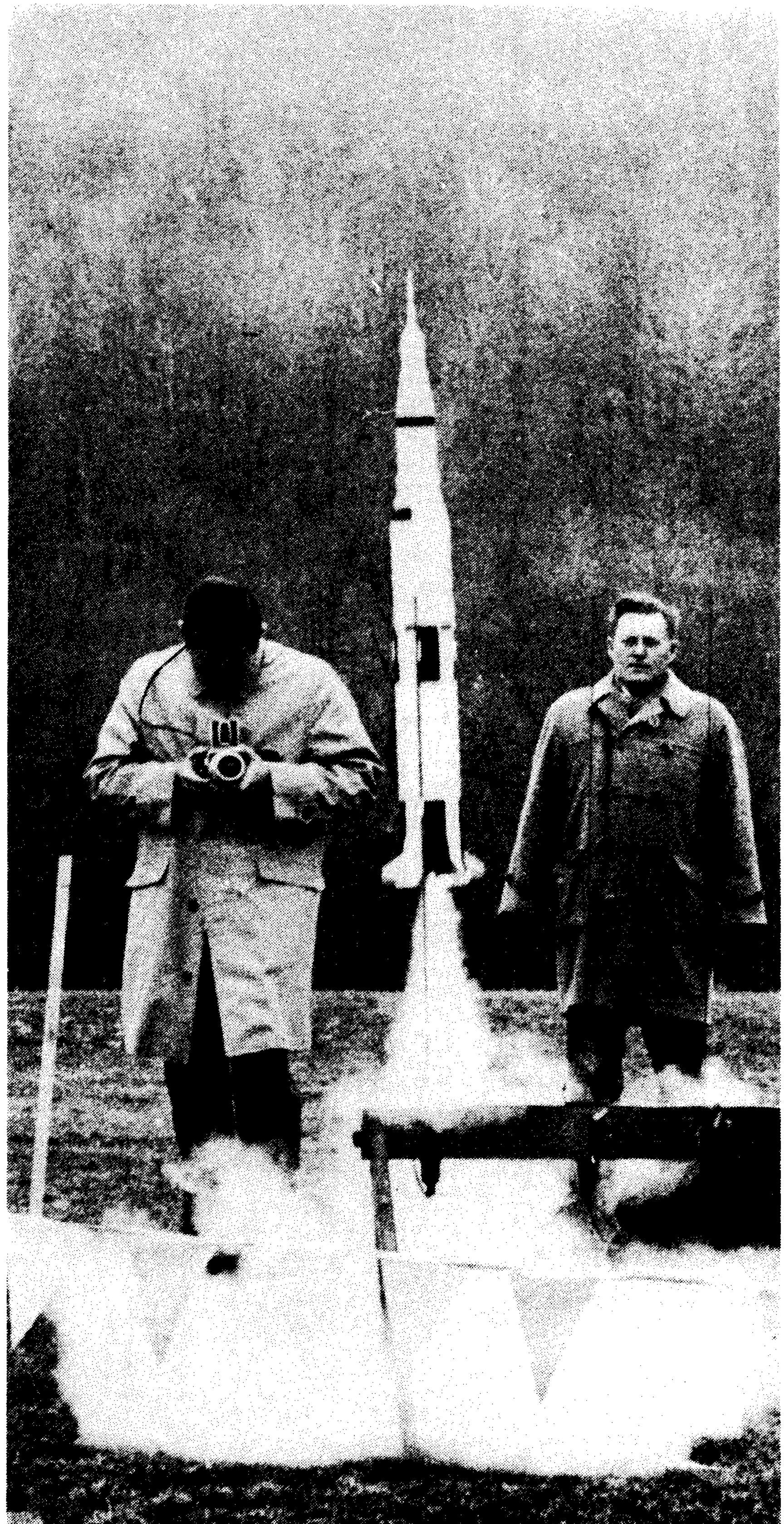


Photos by George Flynn

Centuri scale model Saturn-V lifts off at Pittsburgh. Leroy Piester (left), Centuri President, photographs the takeoff as Howard Kuhn (right) of Competition Model Rockets looks on. The demonstration launch allowed manufacturers to present their new products to the conventioneers.

Astroscale* Data:

The ASP Rocketsonde

Operation Redwing Configuration

by G. Harry Stine

**Astroscale data is drawn from the most accurate sources and meticulously checked for historical authenticity. Every effort is made to call out all data sources. Since Astroscale data is not official NAR plans or information, it may be used as the total scale substantiation data in NAR and FAI competition. Please DO NOT attempt to obtain original copies of photographs, drawings, and other data referenced herein because, in most cases, additional copies do not exist or are extremely difficult, if not impossible, to obtain. The reason this data is being published is to provide modellers with the information they need for constructing a good scale model.*

Astroscale is copyrighted by G. Harry Stine.

The ASP is a single-staged sounding rocket powered by a solid propellant rocket motor which was used by the US Navy for obtaining information from the clouds resulting from the detonation of nuclear devices. The ASP configuration discussed herein is that developed and flown in Operation Redwing at the Pacific Proving Grounds in 1956. When launched from sea level, the ASP is capable of transporting a 550 cubic-inch payload weighing 25 lbs. to an altitude of 200,000 feet. The vehicle is a free-ballistic, unguided, fin-stabilized rocket vehicle launched from a simple rail launcher. Propulsion is provided by an ASP-I solid-propellant rocket motor. Four fins are affixed to the aft end of the vehicle for stabilization purposes.

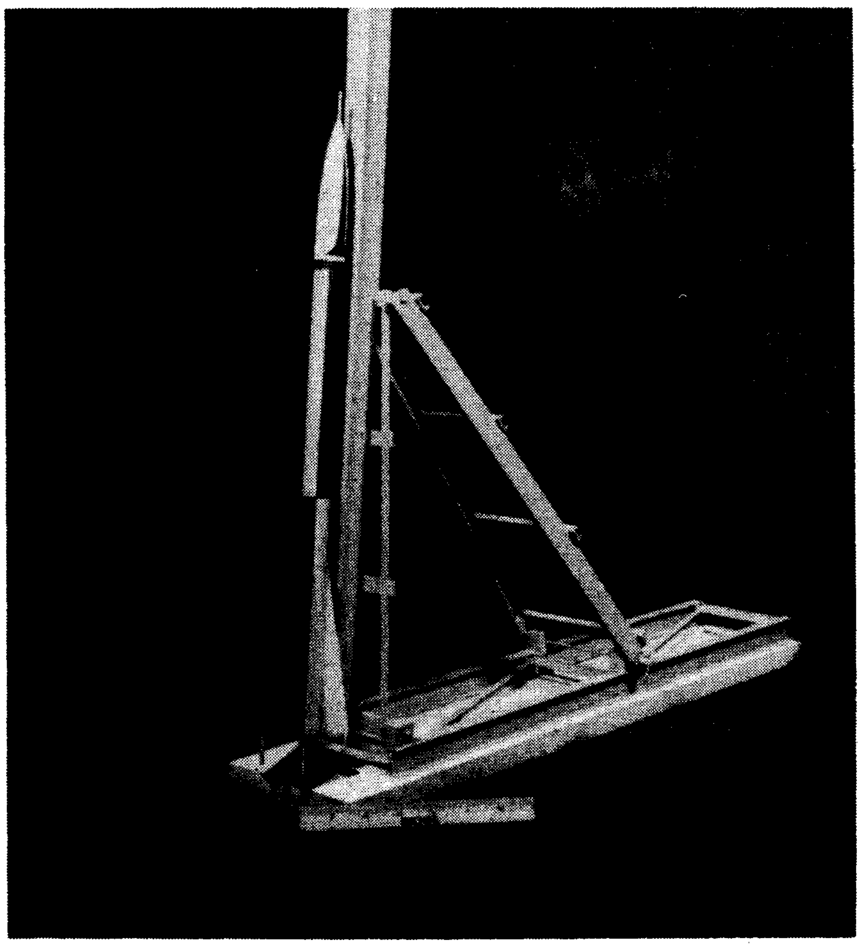


Photo by Stine

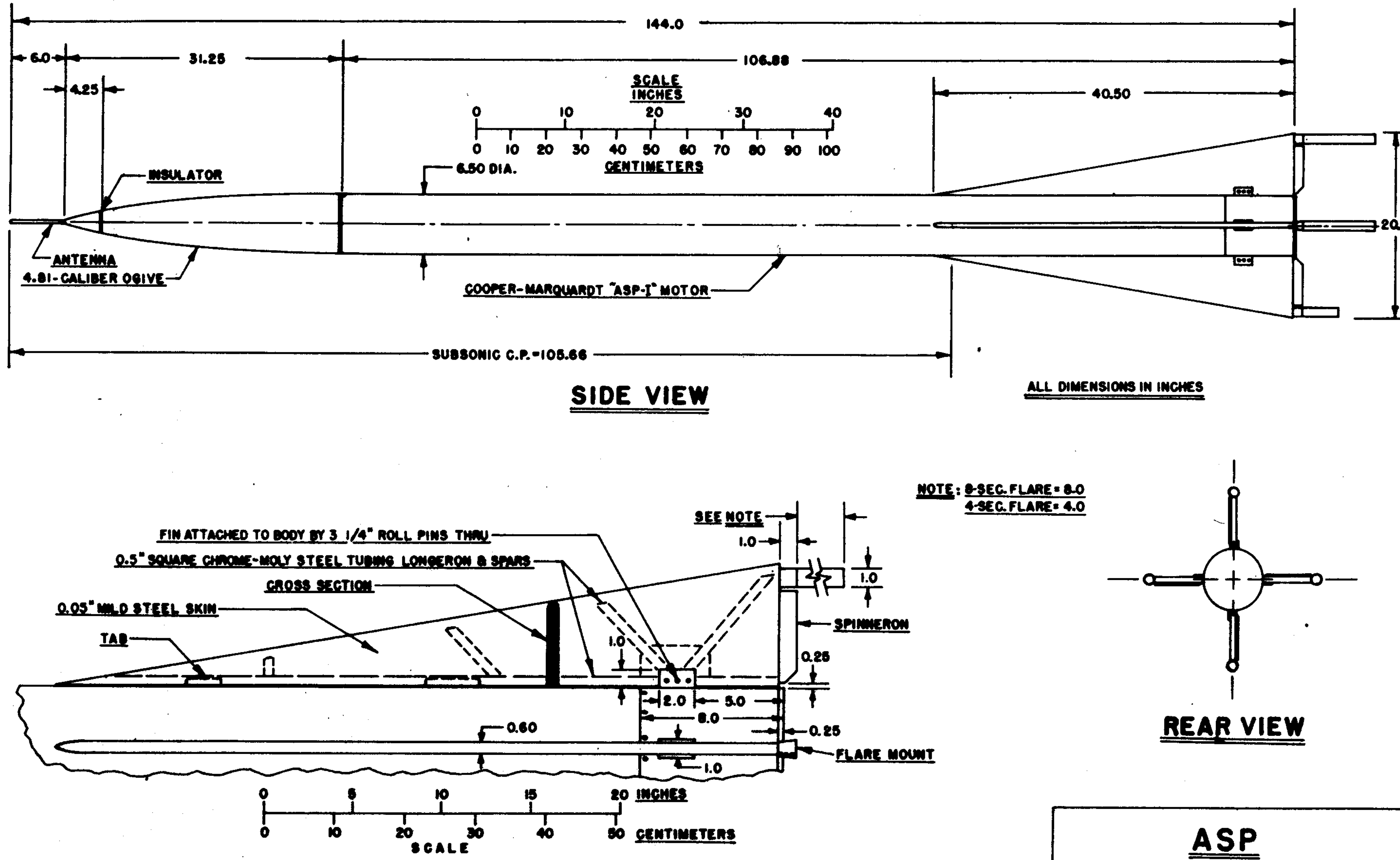
Stine's ASP-I model and launcher in scale of 1:7.16 was winner of NARAM-10 Space Systems, Senior Division.

The configuration of the ASP rocketsonde consists of three major assemblies: (a) the ogival payload section, (b) the cylindrical rocket motor casing which also forms the center portion of the vehicle airframe, and (c) the fin and after skirt assembly.

The ogival payload section consists of a spike nose antenna, with an insulator ring at its base, an ogive spun from mild steel, a thermal insulation blanket cemented to the inner ogive wall, and telemetering instrumentation. The base of the steel ogive is welded to a threaded ring which screws into the inside threads on the forward flange of the rocket motor casing. The telemetering equipment used in Operation Redwing consisted of radiation detectors modulating a single subcarrier of an FM-FM 217-mc-band-telemetry transmitter. The entire telemetry package was self-contained within the ogive. A 24-volt eternal impulse fed through two wires soldered to two glass-ceramic feed-throughs at the base of the ogive spinning actuated a Ledex stepping switch which simply turned on or turned off the internal power to the rocketborne equipment. The two soldered-on wires were torn off at launch by the motion of the vehicle.

The cylindrical rocket motor casing was fabricated of 4130 steel and heat- treated to 180,000-200,000 psi ultimate tensile strength. The nozzle was made of 1020 steel with a graphite throat insert. The propellant is an ammonium perchlorate- polysulfide rubber compound.

The four fins have a welded chrome-moly steel frame covered with a mild steel sheet skin which is flush-riveted to the frame. The fin base longeron is slotted at two points to receive two tabs welded to the rocket motor case for the purpose of stabilizing the fin. Each section of the motor casing, and the primary bending and torsion loads on the fin are transferred to the casing through these two tabs. The fin is affixed to



ASP

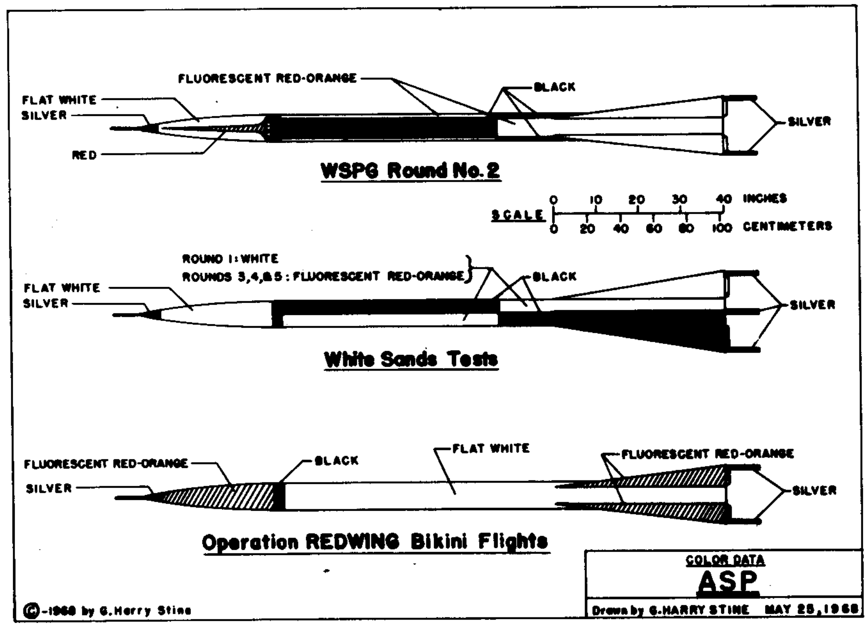
OPERATION REDWING CONFIGURATION

DRAWN BY G.HARRY STINE MARCH 14, 1968

the tabs in the field by three roll-pins which are driven in place to hold the fin to the rocket casing.

Development & Flight History

The ASP was designed, devloped, tested, and flown operationally by the Field Operations Group of Horning-Cooper, Inc. of Monrovia, California (later Cooper Development Corporation, then even later Cooper-Maquardt Corp., a division of Marquardt Corporation). In 1955, a survey of existing rocketsondes by the Lawrence Radiation Laboratories, Livermoore, California, showed that there was no available rocketsonde capable of economically penetrating the radioactive clouds resulting from nuclear detonations. Therefore, on July 8, 1955, Contract Number NObs72000 was let by the US Navy Bureau of Ships to Horning-Cooper Inc. for the development of a suitable rocketsonde.



Under this contract, 30 ASP-I rocket motors were static tested at Grand Central Rocket Company, Redlands, California in 1955. On December 1955, the first ASP vehicles were ready for flight testing. Four flight tests were made at the US Naval Air Missile Test Center, Point Mugu, California in December 1955 and January 1956, but the high performance of the ASP combined with the sea-level weather conditions of Point Mugu resulted in insufficient ballistic data for the determination of drag coefficient, a critical datum for flight trajectory prediction.

Therefore, arrangements were made to flight test ASP at the US Naval Ordnance Missile Test Facility, White Sands Proving Ground, New Mexico in order to take advantage of the excellent optical and electronic instrumentation and the high- visibility desert weather conditions there. Six ASP vehicles and a launcher arrived at USNOMTF at the end of January 1956, and the launcher was emplaced on the old Talos launch pad just to the east of the Aerobee launching tower in the WSPG Navy Launch Area. All ASPs tested at USNOMTF were launched due north with a launcher elevation of 30 degrees.

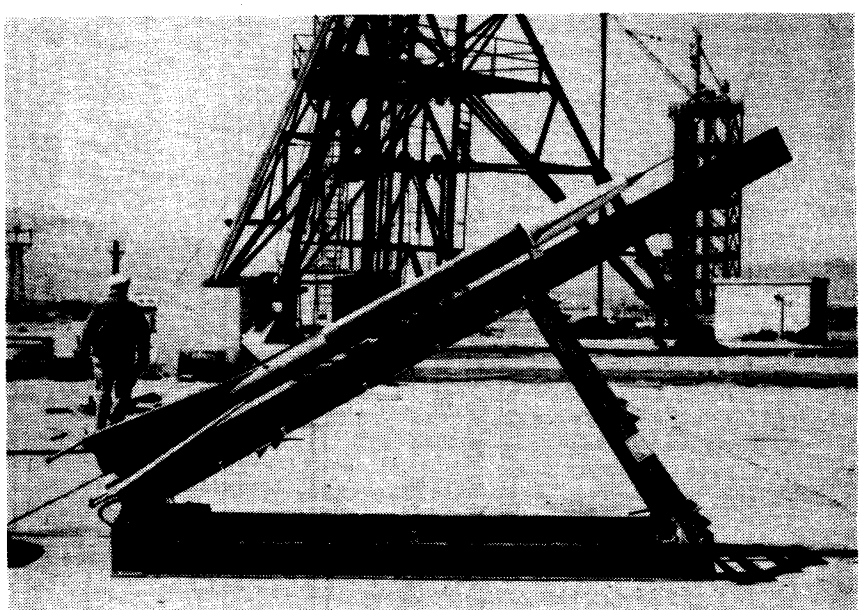
Personnel concerned with the USNOMTF firings from Horning-Cooper Inc. were: Charles M. Zimney, Chief Engineer; Donald W. Fite, Electronics Engineer; Austin G. "Tex" McLaughlin, Design Engineer; and Frederick Soltis, Electronics Technician. USNOMTF personnel involved included Captain J.C. Parham, Jr., Commanding Officer; CDR Thomas C. Buell, Operations Officer; Donald R. Green, Operations Engineer; G. Harry Stine, Project Engineer; CWO A. Douglas Weaver, Ordnance Division Chief; CWO C. C. Culp, Electronics Division Chief; and Albert G. Kniele, Photographic Division Chief.

The initial WSPG flight was made at 1400 hours, Friday, February 3, 1956 with CWO Weaver as firing officer. The round was painted black and white. Four 4-second tracking flares were mounted. Phototheodolite operators on the Askania cameras were unable to follow the round, but skin-track data was obtained from the C Station radars and from the TSP-10 doppler radar stationed 100 yards to the south of the launcher (the aft launch shoe hit the side of the TSP-10 trailer).

At the request of the range personnel, the remaining ASP vehicles were oversprayed with fluorescent red-orange paint with no attempt being made to mask-off the black portions of the vehicle; ogives were left flat white.

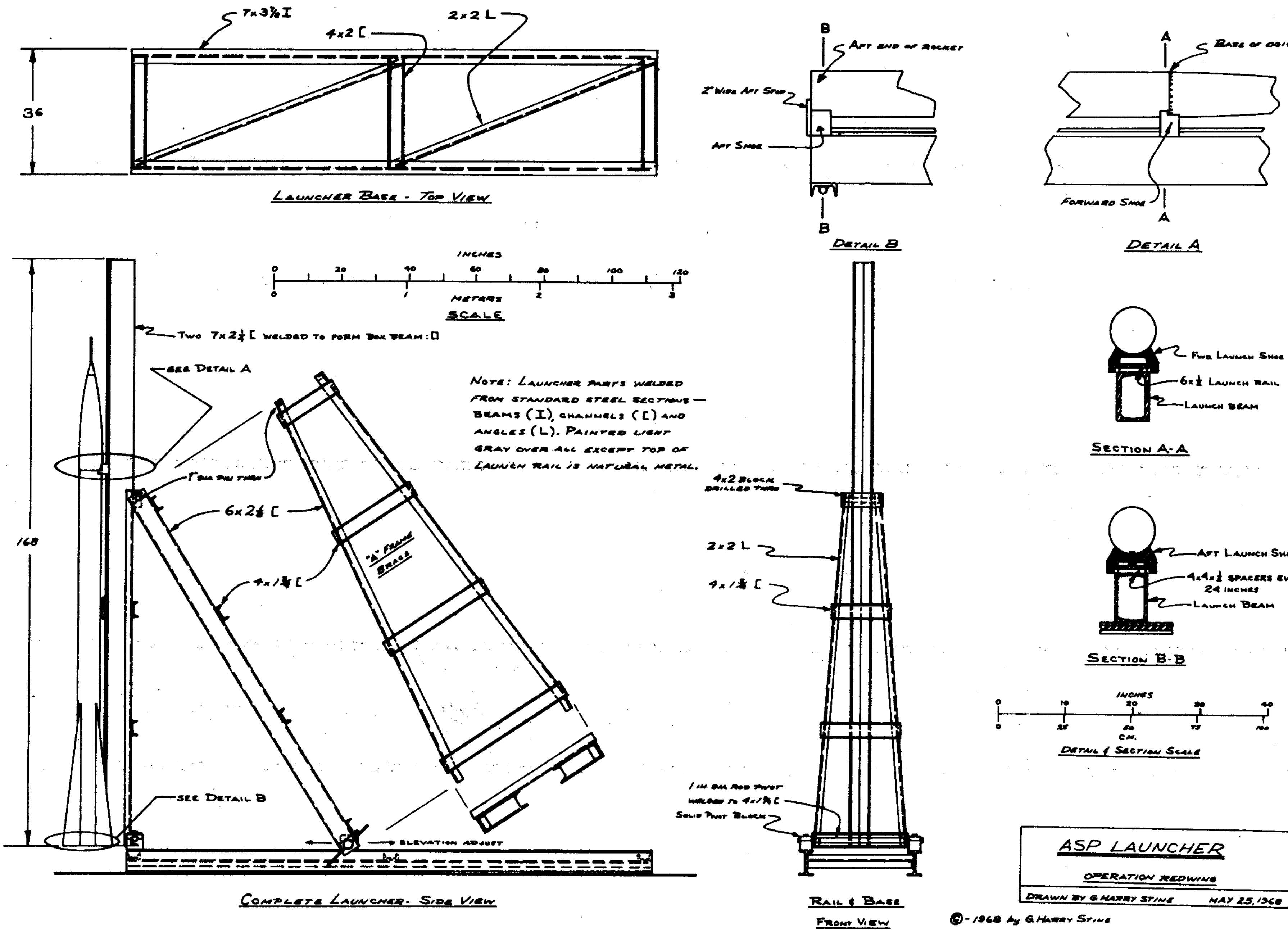
The next four flights were made at 30-minute intervals starting at 0900 hours on Tuesday, February 7, 1956. Firing officer for Round No. 2, the first of the day, was G. Harry Stine; firing officer for the remaining rounds was CWO Weaver. Two 4-second and two 8-second tracking flares were mounted on each round. C Station skin-track radar data and TSP-10 doppler radar data was obtained for each round, and Askania cinetheodolite operators managed to track one round for 4 seconds. One round was recovered. Enough data was obtained to determine drag coefficient.

During the period May 1965 to Jul 1956, operations were conducted on Bikin



U.S. Navy Photo

ASP, WSPG no. 2 on launcher February 7, 1956. Launcher has short front A-frame for 30-degree elevation launch.


7x3⅝ I
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36
Launcher Base - Top View
B
Apt end of rocket
2" Wide Aft Stop
Aft Shoe
B
Detail B
A
Base of ogive
Forward Shoe
A
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Inches
0 20 40 60 80 100 120
0 1 2 3
Meters
Scale
Two 7x2¼ [welded to form box beam: □
See Detail A
Note: Launcher parts welded from standard steel sections — Beams (I), channels ([) and angles (L). Painted light gray over all except top of launch rail is natural metal.
1" dia pin thru
6x2⅛ [
4x1⅜ [
"A" Frame Brace
168
See Detail B
Elevation adjust
Complete Launcher - Side View
Fwd Launch Shoe (Al.)
6x½ Launch rail
Launch beam
Section A-A
4x2 Block drilled thru
2x2 L
4x1⅜ [
Aft Launch Shoe (Al.)
4x4x½ spacers every 24 inches
Launch Beam
Section B-B
Inches
0 10 20 30 40
0 25 50 75 100
CM.
Detail & Section Scale
1 in. dia rod pivot welded to 4x1⅜ [
Solid Pivot Block
Rail & Base
Front View
ASP LAUNCHER
Operation Redwing
Drawn by G Harry Stine May 25, 1968
©-1968 by G.Harry Stine

Atoll of the Pacific Proving Grounds by the Horning-Cooper Inc. Field Operations Group in support of Operation Redwing. Twelve launchers were set up in two groups of six. In each 6-launcher group, launcher elevations were in 10 degree increments starting at 30 degrees up to 80 degrees. Following a nuclear detonation, 12 ASP rockets were fired in two salvoes of 6 rockets each. Data was telemetered to Horning- Cooper Inc. ground stations, and no attempt was made to recover the vehicles. 41 rounds were flown at Bikini.

The reliabilitity of the ASP in Operation Redwing was 100 per cent perfect. There were no failures in 30 static tests and 50 flight tests. All launchings were completed by July 21, 1956, a little over one year after signing of the contract.

Description of Operations

An ASP Operation Redwing vehicle was shipped as a completed ogive, a rocket motor, an igniter, and four fins. Preparation for firing involved assembling the four fins to the rocket motor casing by slipping each fin over the two tabs and between the two aft fittings, three roll pins being driven into the fittings and fin to hold each fin in place. The spinnerons on each fin were adjusted at the factory to provide the correct spin rate. The ogive was threaded onto the front of the motor case and the aft launch lug attached to the aft skirt of the motor case with a brass shear bolt.

The vehicle is placed on the launcher by at least four men or by a hoist. The rear shoe is engaged to the rear of the launch rail and the aft rail stop bolted in place to prevent the vehicle from sliding off the aft end of the launch rail. The forward launch shoes is attached by means of an aft-facing hook which engages a drilled hole in the forward flange of the rocket motor casing. The launching area is then cleared.

The telemetry umbilical wires are attached to the flush soldering feed- throughs at the underside of the base of the nose cone. Four tracking flares are screwed onto the fin mounts and wired-up. The igniter, a one-inch diameter cardboard tube filled with a pyrotechnic material and held in the center of the cored grain by two felt washers, is inserted through the nozzle until it is halfway up the grain core.

Shortly before launch, the ogive telemetry is turned on by means of a 24-volt impulse that steps the Ledex power switch inside the ogive. The round is fired by an electrical impulse to the igniter that also ignites the tracking flares. As the front launch shoe leaves the launch rail, the aft shoe strikes a steel stopper block welded to the launch rail. The brass shear bolt breaks, freeing the aft shoe from the vehicle (the aft shoe rebounds to the rear, shearing the aft stop from the launch rail and leaving the rail. At WSPG, the aft shoe bounced as far as 100 yards to the rear of the launcher site).

The vehicle accelerates during powered flight, follows a ballistic trajectory, and impacts with no attempt being made to recover the vehicle. While in flight, it telemeters its information to the ground.

U.S. Navy Photo

ASP WSPG Round no. 2 being placed on launcher February 7, 1956. Chief Warrant Officer A.D. Weaver is holding the rocket. Don Fite and A.G. McLaughlin are hooking up nose wires. Checking igniter circuit is CWO C.C. Clup and an unknown sailor.

Propulsion

The ASP-I rocket motor is a solid-propellant rocket motor using GCRC 201- C propellant, a solid propellant similar to JPL 131. Ammonium perchlorate is used as an oxidizer with polysulfide rubber as a fuel and binder. The motor burns for approximately 6.0 seconds, producing an average sea-level thrust of 5850 lbs. Total impulse is 31,000 lb.-seconds, and specific impulse is 211 lb.-seconds- per-lb. The thrust-time curve is that of a typical core-burner.

Performance

Burnout velocity: 5350 ft/sec (30-degree launch at sea level)

Peak altitude: 200,000 feet (25-lb. payload, sea level launch)

Data Sources

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Cox, Robert B., "ASP," **Sounding Rockets** (Newell), McGraw-Hill Book Co., New York, 1959, pp. 105-123.

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Staged vs Cluster Model Rocket Performance

by Peter Wysgalla

A problem that faces every serious model rocket experimenter, at one time or another, is when to use a clustered rocket or a staged rocket. This occurs most often when a rocketeer begins testing aerodynamic principles; new fin, nose cone, and rocket designs; and begins inserting payloads in his models. The questions asked concern themselves with: In which system is there greatest velocity? Maximum altitude? Limiting velocity? And so on.

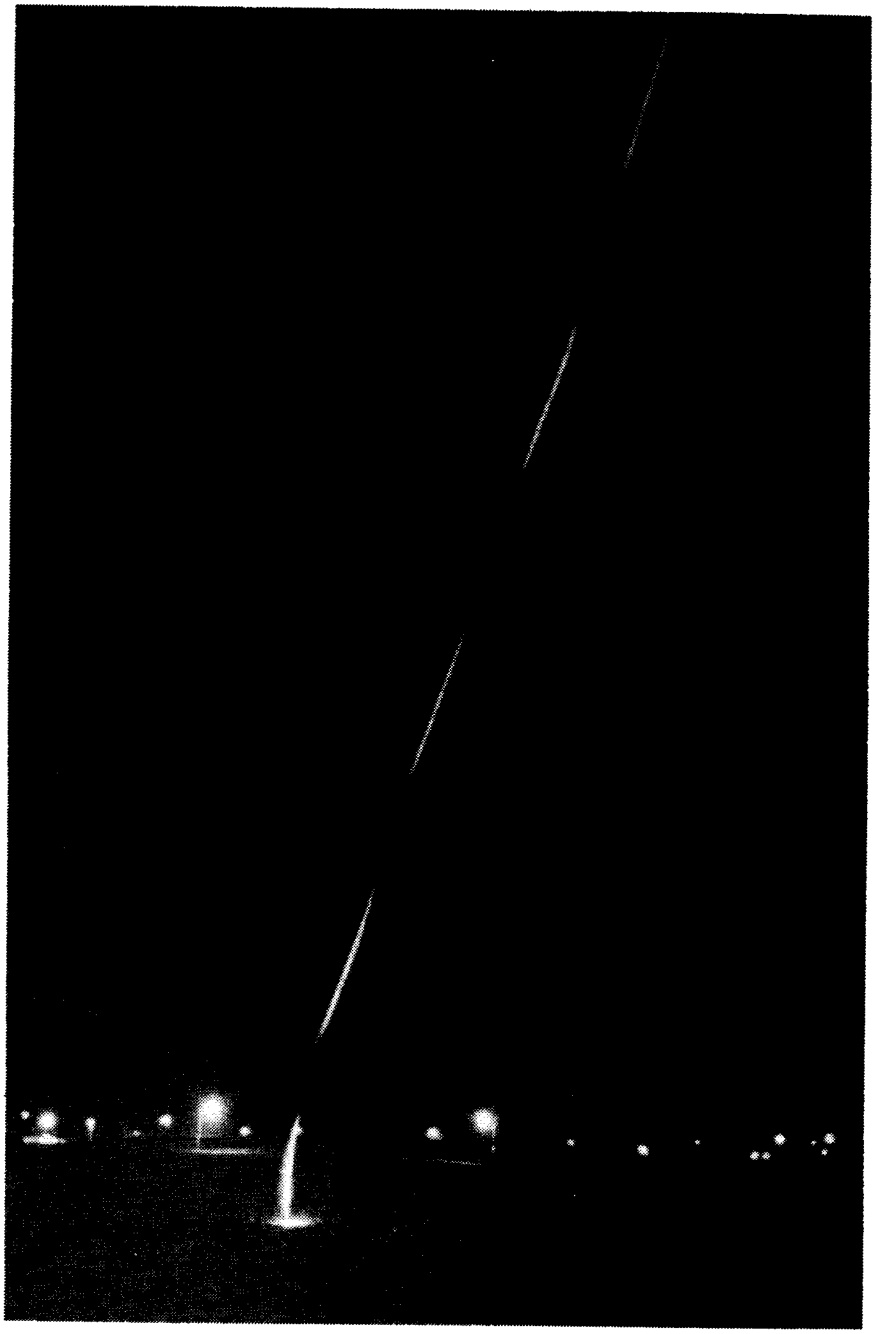
The difficulty a researcher faces in answering these questions is the huge number of combinations possible in how a rocket can be built. Parameters of a rocket such as: the number of stages, the number of engines in a cluster, the type of engine, the diameter of the body tube, affect the performance of a rocket, and should be varied from rocket to rocket, in order to make a thorough study of staged and clustered rockets.

Since building and flying rockets, with different variations in them, would be most desirable but impractical for a number of obvious reasons, an alternative was found.

With the help of a computer and a suitable program, it is possible to simulate the performance of any type of rocket. In writing the computer program, which is a set of logical steps for the computer to follow in executing the particular function required of it, two things were considered: the equations the computer would use, and the manner in which analysis of staged and clustered rockets would be carried out.

A recent source of reliable equations to calculate model rocket performance is Estes Industries' *Altitude Prediction Charts including Aerodynamic Drag*. The equations used in the computer program came from page fifteen and sixteen of the manual.

Since the actual procedure for the analysis of staged and clustered rockets was not immediately decided upon, the computer was programmed to calculate as much information about a certain rocket as was considered useful. For a cluster rocket, then, the ballistic coefficient during burning and coasting, burnout velocity, burnout altitude, coast distance, time of coasting and total flight time were calculated. For a two-stage rocket, the



An enlargement of a polaroid picture taken of rocket exhaust trail using the strobe.

velocity, altitude, and ballistic coefficient of the first stage were found, then, using this information, the velocity, ballistic coefficient for powered flight and coasting, altitude at burnout, final altitude, time for coasting and total flight time were calculated for the second stage.

Again, because of the huge number of variations possible in model rocket design, and the prohibitive cost of computer time at $.05 a second, I eventually used about a half hour of time– it was necessary to limit the parameters of the rockets. These were: that the cluster be of the two engine type, and be built of 1.637 inch diameter (BT-60) tubes, and that the staged rocket be of the two-stage type, and the engines in each stage be the same type.

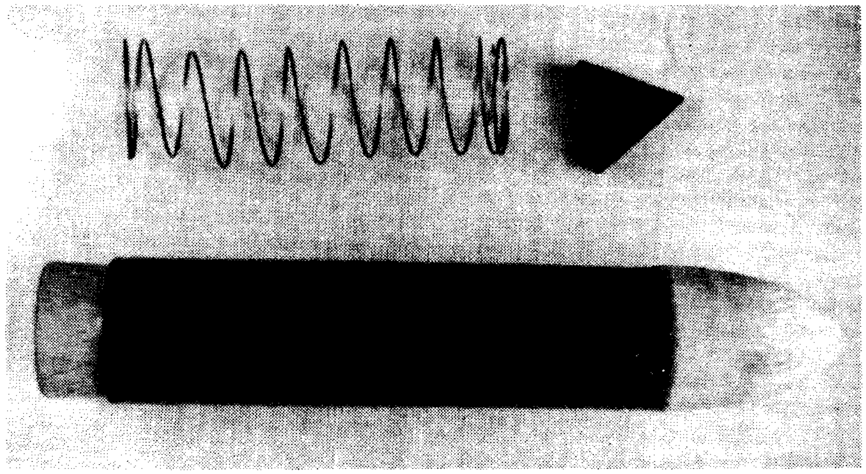
The output from the computer was checked with actual launchings of rockets. Before the rockets were launched, two things were needed: a method to measure velocity and altitude.

Three methods of velocity determination were tried. The first was using the accelerometer developed by Amrocs, which consists of a weight of known mass suspended on a spring and surrounded by a special type of wax paper, such that when the accelerometer was placed in a rocket, the weight would be pushed down by acceleration, and scratch against the wax paper. The length of the scratch would indicate maximum acceleration , and with this it would be possible to estimate a maximum velocity. However, for some peculiar reason or another, it was never possible to get consistent readings.

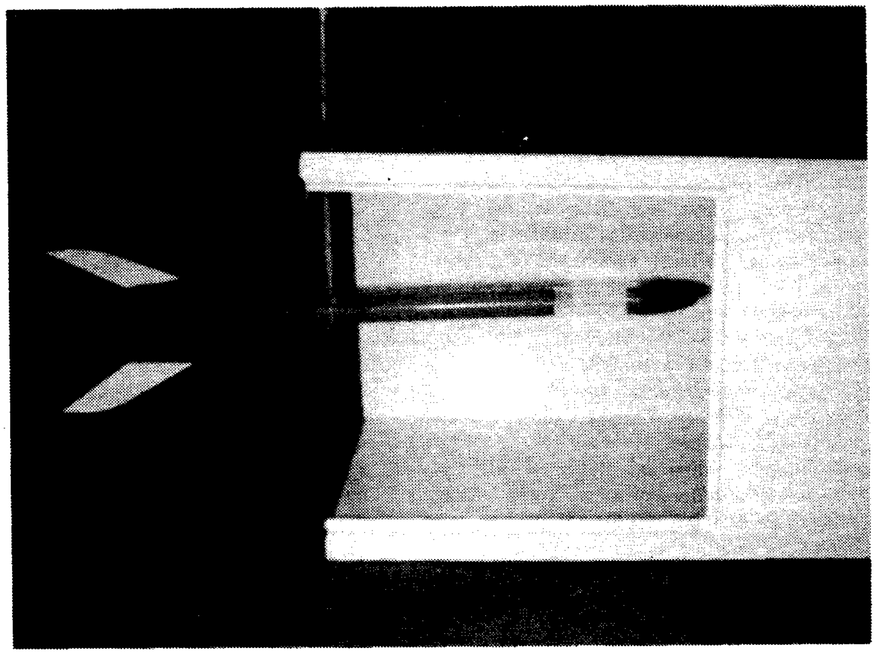
A second method of velocity measurement tried was to place an electronic flasher inside the rocket, then by launching at night, and photographing the trail, it would have been possible to determine the velocity at any point by measuring the length of the flashes on the film. However, the light was not recorded on film because it was overpowered by the much brighter light of the rocket exhaust.

The third method of velocity measurement was highly successful. This method consists of a stroboscope and a polaroid camera. The stroboscope is nothing more than a stiff disc of cardboard sixteen inches in diameter with seventeen spaces, 1.5 inches wide, evenly distributed about the circumference of the disc. The strobe is rotated at a speed of 36 revolutions per minute in front of the polaroid camera lens. When a rocket is launched at night, the strobe-camera combination would be aimed at the intended path of the rocket, and the rocket exhaust would be recorded on film as a broken line.* Each division of the rocket

* In order to assure that the rocket exhaust would be recorded, the polaroid was loaded with 3000 ASA film and, of course, left on a time exposure setting for the duration of the rocket flight.

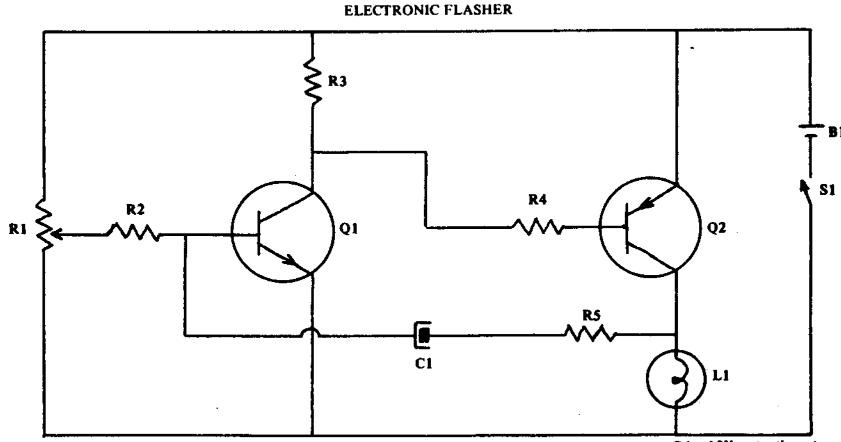


Enlarged photo of Amroc's accelerometer



Same rocket in which light flasher was placed being tested in a wind tunnel.

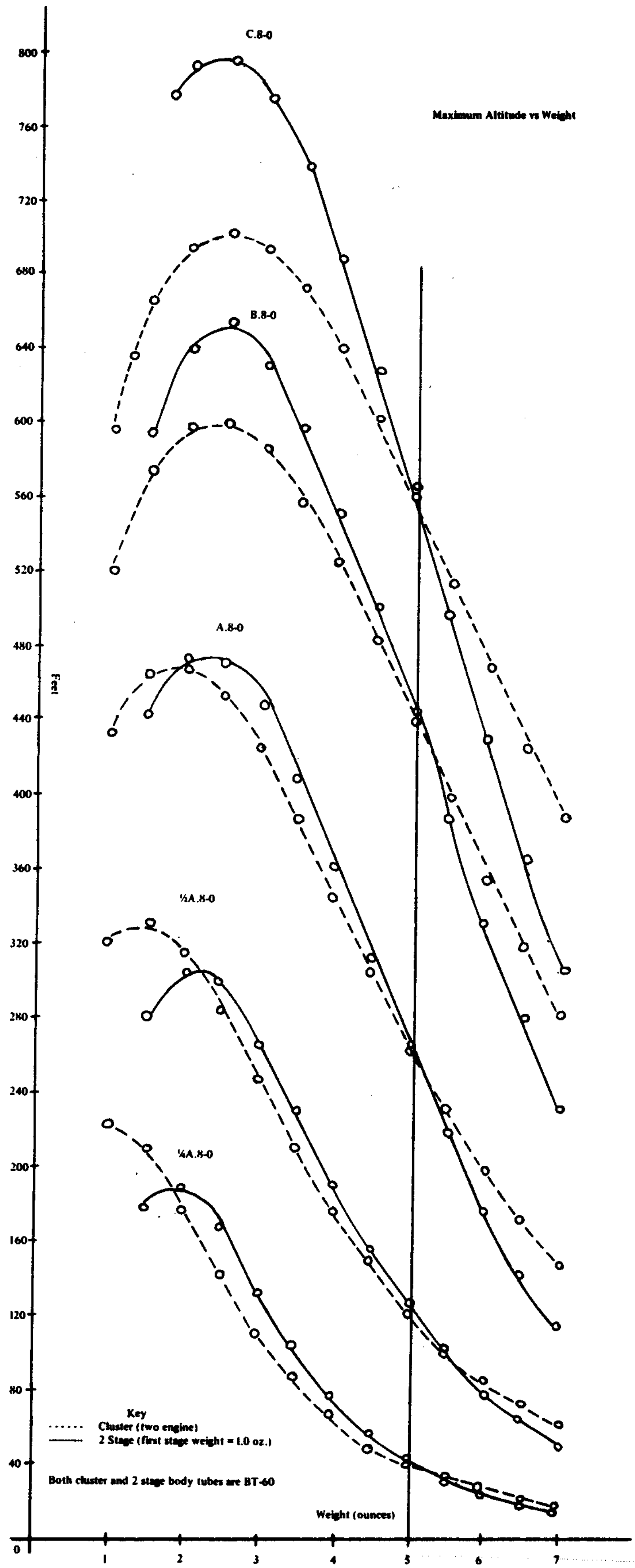
ELECTRONIC FLASHER



R1– 10K potentiometer
R2– 6.8K 1/2-watt resistor
R3– 1.5K 1/2-watt resistor
R4– 220-ohm 1/2-watt resistor
R5– 2.2K 1/2-watt resistor
B1– 3 volt battery
Q1– 2N170 transistor
Q2– 2N107 transistor
C1– 30-mfd 15-volt capacitor
Li– light bulb
Si– switch

This circuit is a modification of a standard light flasher circuit. First, the entire assembly was put on a printed circuit board 8" x 5". The original circuit called for the use of a heavy power transistor and potentiometer, a light weight 2N107 transistor and a potentiometer of the type used in transistor radio volume controls were substituted.

This circuit was designed to deliver a flash rate of one every 1.5 seconds, which was too slow for this application. This was solved by lowering the value of R5, thus obtaining a flash rate of two per second.



exhaust represents an interval of .05 seconds. Then, knowing the burnout altitude of the particular rocket, it is possible to determine the maximum velocity of the rocket.

Total altitude was measured by a device which was basically a protractor and a weighted string. The angle between the oserver and the top of the rocket's flight was measured, and using trigonometry, the total altitude was computed. Burnout altitude was measured by simply finding the scale of the photographs that were taken of the rocket exhaust trail (1 inch = 1 foot) and measuring the length of the trail.

Approximately thirty launchings of cluster and staged rockets with a voluminous amount of observed data confirmed the accuracy of the output from the computer. With the computer data, it was then possible to draw conclusions about the performance of staged with respect to clustered rockets.

Conclusions

As stated before, the two engine cluster rocket was built from 1.637 inch (BT-60) diameter body tubes. Generally, when a two-stage rocket is made of body tubes smaller than that of the cluster, and the engines in the two stage and cluster are identical, the performance of the two stage is greater then, with respect to total altitude and velocity, the cluster. Of course, there are exceptions, but the above generality will hold for the "average" model a rocketeer would build.

When both the two-stage rocket and the cluster rocket are constructed out of BT-60 body tubes, the cluster has slight advantages in performance. The criteria arrived at are:

The limiting velocity for the two stage rocket using series 1 engines (48 ounces of thrust or less) is 230 feet/second.

The limiting velocity for the cluster rocket using series 1 engines is 312 feet/second.

Generally the maximum velocity of the cluster is higher than the two-stage.

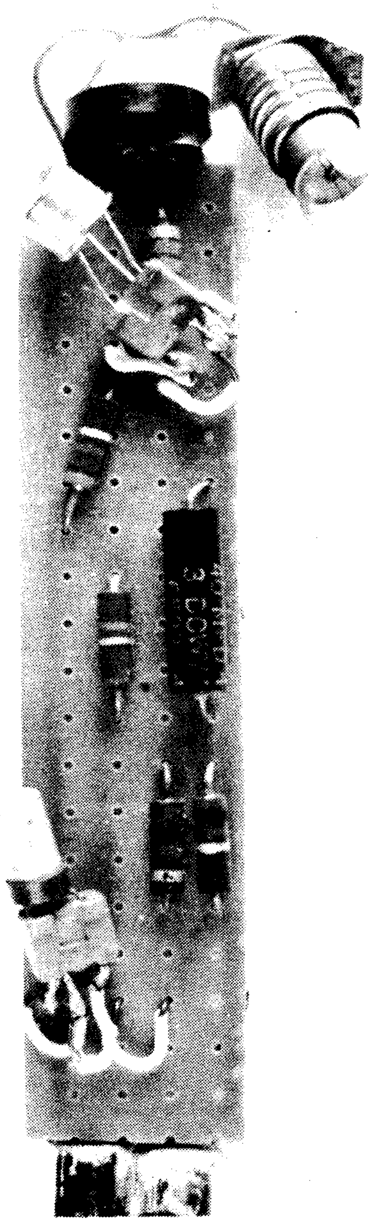
When the cluster has an initial weight of more than five ounces, it has a higher maximum altitude than a two-stage with the same initial weight.

However, when the cluster has an initial weight of less than five ounces, the two-stage has a higher maximum altitude with the same initial weight.

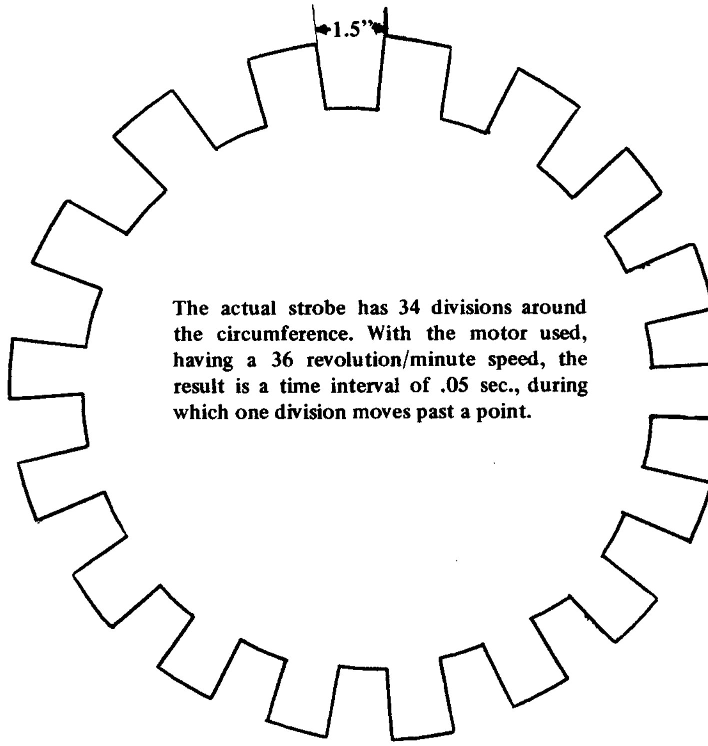
The altitude at burnout of the top stage of a two-stage rocket is greater than the altitude at burnout of the cluster.

The behavior of the strobe is governed by the formula:

$$D = \frac{60 \cdot W}{\pi \cdot R \cdot T}$$



Electronic light flasher, designed mostly by myself, which was used in an attempt to measure velocity of the rocket.



The actual strobe has 34 divisions around the circumference. With the motor used, having a 36 revolution/minute speed, the result is a time interval of .05 sec., during which one division moves past a point.

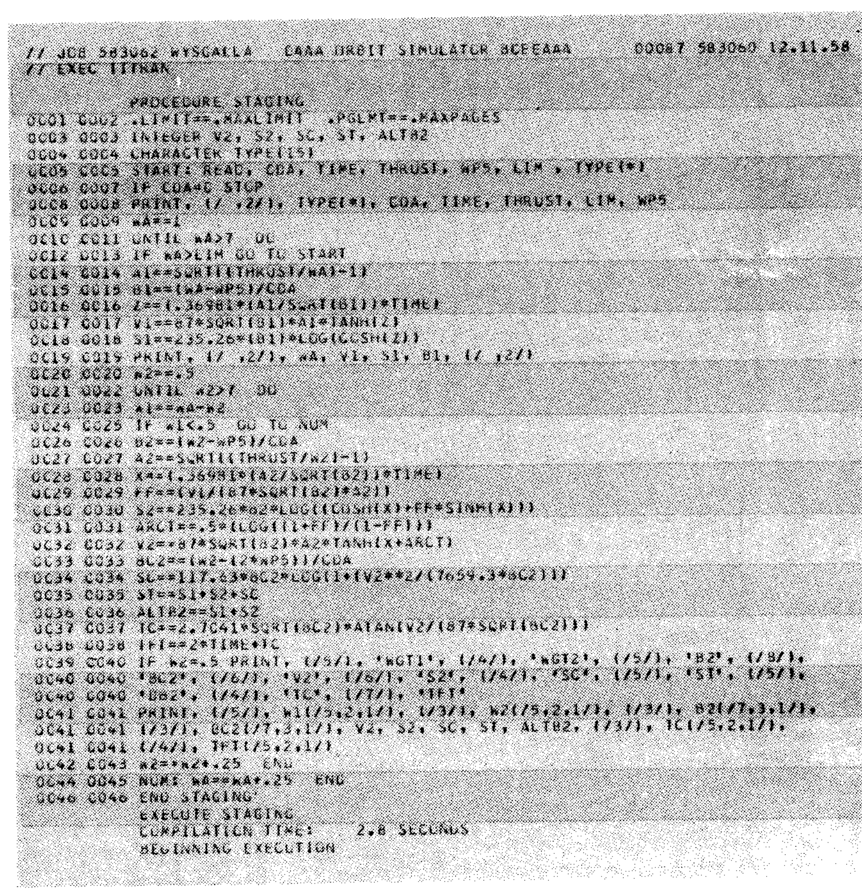
R= number of revolutions/minute of strobe

T= shortest time interval measurable

W= width of slots on strobe

D= diameter of strobe

The above formula was used to find the diameter of the strobe with T= .05 seconds, R= 36, W= 1.5 inches. Substituting these values in the formula gave a diameter of 16 inches. In use, a polaroid camera with 3000 ASA film, was placed behind the divisions in the strobe and pointed towards the rocket, resulting in a broken exhaust trail, as seen in the pictures.



```
// JOB 583062 WYSCALLA   CAAA ORBIT SIMULATOR BCEEAAA        00087 583060 12.11.58
// EXEC TITRAN

            PROCEDURE STAGING
0001 0002 .LIMIT==.MAXLIMIT   .PGLMT==.MAXPAGES
0003 0003 INTEGER V2, S2, SC, ST, ALTB2
0004 0004 CHARACTER TYPE(15)
0005 0005 START: READ, CDA, TIME, THRUST, WP5, LIM , TYPE(*)
0006 0007 IF CDA=0 STOP
0008 0008 PRINT, (/ ,2/), TYPE(*), CDA, TIME, THRUST, LIM, WP5
0009 0009 WA==1
0010 0011 UNTIL WA>7  DO
0012 0013 IF WA>LIM GO TO START
0014 0014 A1==SQRT((THRUST/WA)-1)
0015 0015 B1==(WA-WP5)/CDA
0016 0016 Z==(.36981*(A1/SQRT(B1))*TIME)
0017 0017 V1==87*SQRT(B1)*A1*TANH(Z)
0018 0018 S1==235.26*(B1)*LOG(COSH(Z))
0019 0019 PRINT, (/ ,2/), WA, V1, S1, B1, (/ ,2/)
0020 0020 W2==.5
0021 0022 UNTIL W2>7  DO
0023 0023 W1==WA-W2
0024 0025 IF W1<.5  GO TO NUM
0026 0026 B2==(W2-WP5)/CDA
0027 0027 A2==SQRT((THRUST/W2)-1)
0028 0028 X==(.36981*(A2/SQRT(B2))*TIME)
0029 0029 FF==(V1/(87*SQRT(B2)*A2))
0030 0030 S2==235.26*B2*LOG((COSH(X)+FF*SINH(X)))
0031 0031 ARCT==.5*(LOG((1+FF)/(1-FF)))
0032 0032 V2==87*SQRT(B2)*A2*TANH(X+ARCT)
0033 0033 BC2==(W2-(2*WP5))/CDA
0034 0034 SC==117.63*BC2*LOG(1+(V2**2/(7659.3*BC2)))
0035 0035 ST==S1+S2+SC
0036 0036 ALTB2==S1+S2
0037 0037 TC==2.7041*SQRT(BC2)*ATAN(V2/(87*SQRT(BC2)))
0038 0038 TFT==2*TIME+TC
0039 0040 IF W2=.5 PRINT, (/5/), 'WGT1', (/4/), 'WGT2', (/5/), 'B2', (/8/),
0040 0040 'BC2', (/6/), 'V2', (/6/), 'S2', (/4/), 'SC', (/5/), 'ST', (/5/),
0040 0040 'BB2', (/4/), 'TC', (/7/), 'TFT'
0041 0041 PRINT, (/5/), W1(/5,2,1/), (/3/), W2(/5,2,1/), (/3/), B2(/7,3,1/),
0041 0041 (/3/), BC2(/7,3,1/), V2, S2, SC, ST, ALTB2, (/3/), TC(/5,2,1/),
0041 0041 (/4/), TFT(/5,2,1/)
0042 0043 W2==W2+.25  END
0044 0045 NUM: WA==WA+.25  END
0046 0046 END STAGING
            EXECUTE STAGING
            COMPILATION TIME:     2.8 SECONDS
            BEGINNING EXECUTION
```

COMPUTER OUTPUT FOR PROGRAM ON THE SIMULATION OF STAGED ROCKETS FROM THE IBM 360 COMPUTER AT THE ILLINOIS INSTITUTE OF TECHNOLOGY

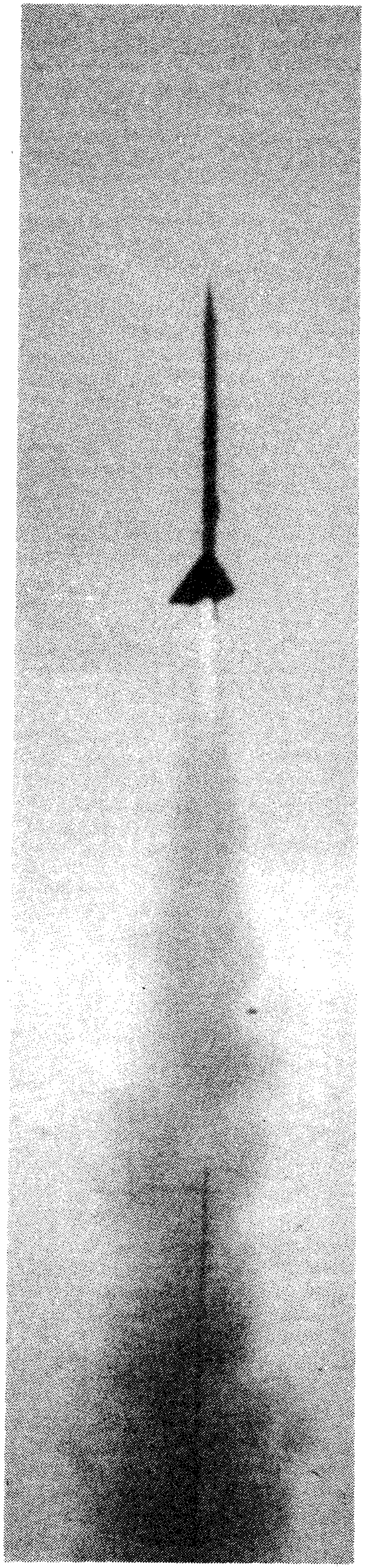
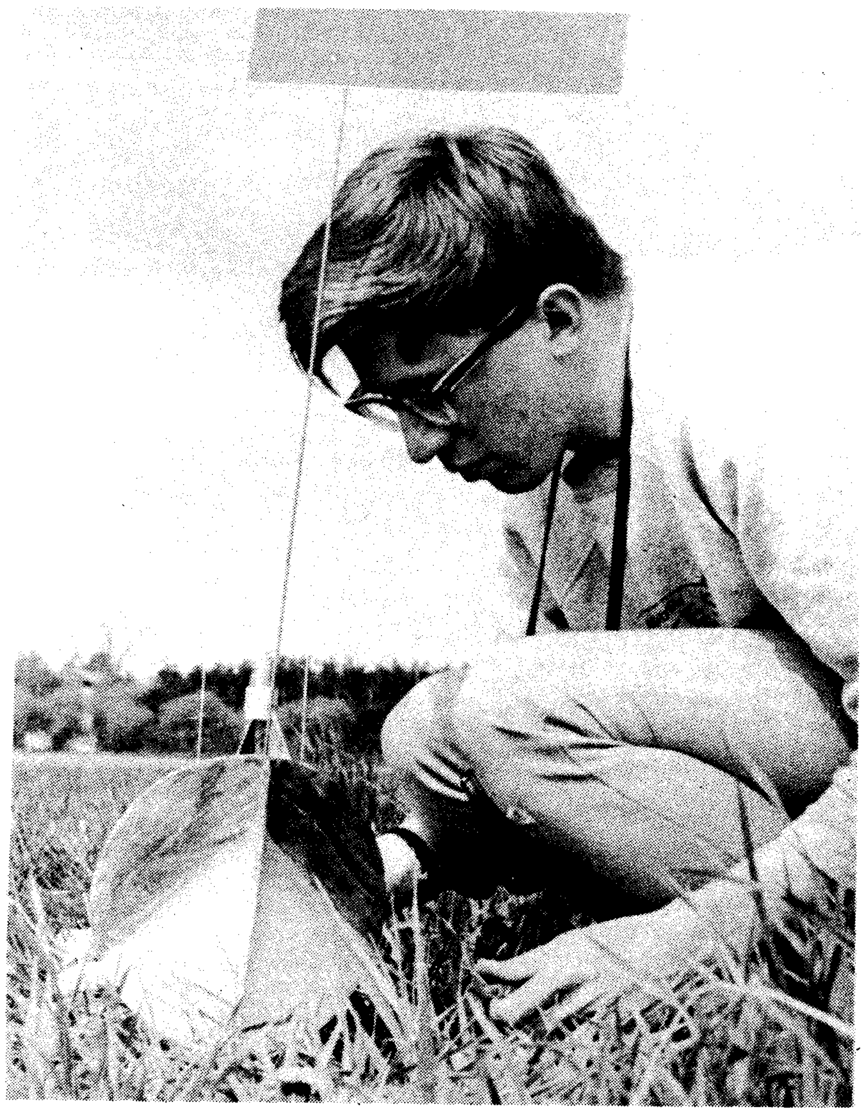


PHOTO GALLERY

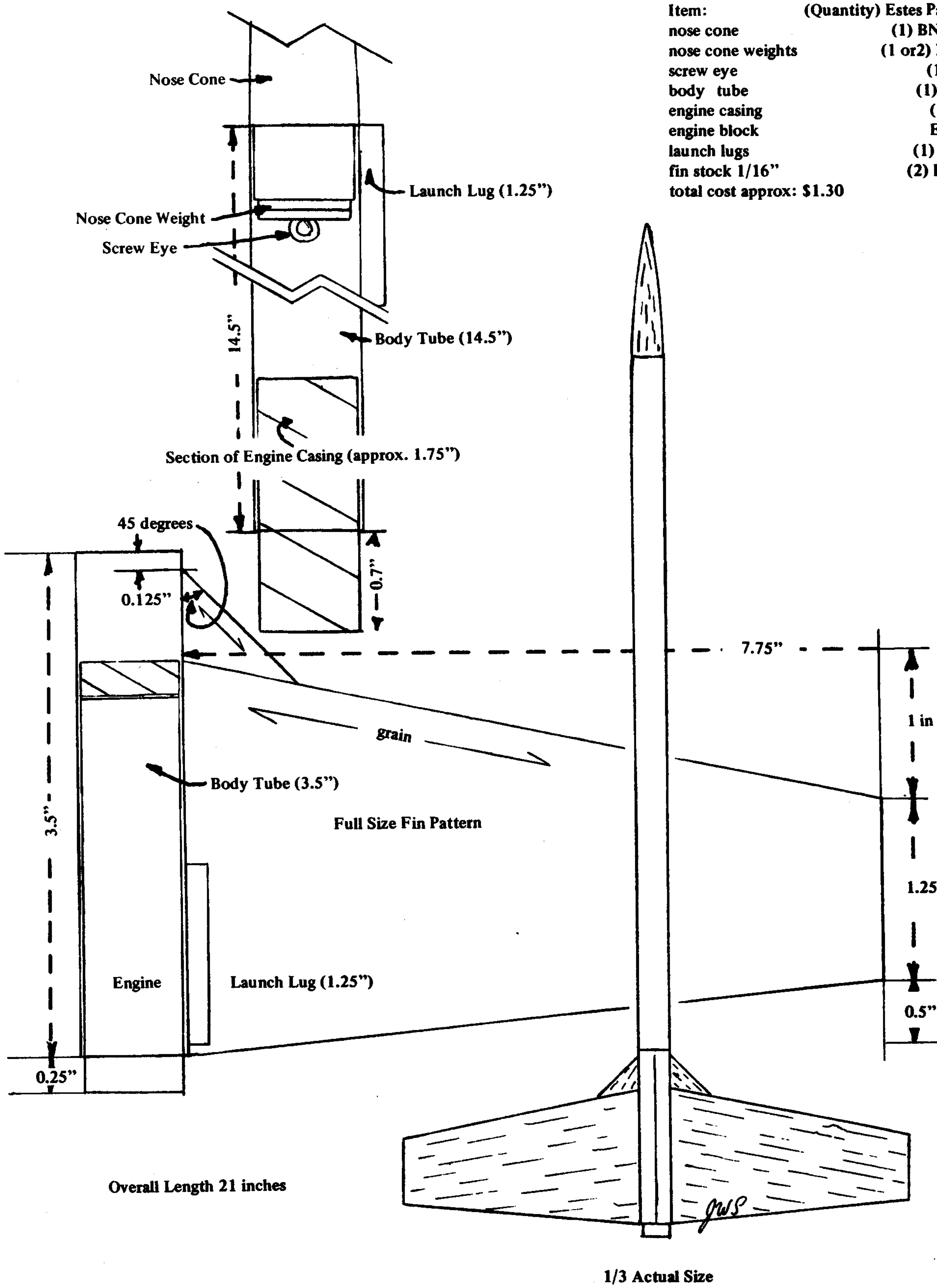
Readers are invited to submit photographs of their model rockets for publication on this page. Our staff will select those photographs having superior quality and composition for inclusion in the **Model Rocketry** *Photo Gallery. Send your photos to:*

Photo Gallery
Model Rocketry
Box 214
Boston, Mass. 02123



Parts for the Fra-jyle

Item:	(Quantity) Estes Part No.
nose cone	(1) BNC-20N
nose cone weights	(1 or2) NCW-1
screw eye	(1) SE-2
body tube	(1) BT-20
engine casing	(1)EC-1
engine block	EB-20A
launch lugs	(1) LL-2A
fin stock 1/16"	(2) BFS-20
total cost approx: $1.30	



The Fra-jyle

Sport Rocket

by John W. Starling

This is a protest rocket with a purpose. Its purpose is to sweep back the growing tide of distrust toward balsa wood fins. The only cases I have had where a fin actually breaks are: (1) (First and foremost) Little Jimmie examines the rocket, (2) Rover is looking for new taste sensations, and (3) The rocket plunges down through a tree. I have never witnessed a balsa fin break under acceleration or wind drag. However, I have seen many fluttering fins fill the air. These might prompt people to say that balsa fins tend to come apart. Close examination usually proves that either: (1) A 60-second glue joint has come apart, or (2) The fin has come off complete with fillet, taking with it the outer layers of the body tube!

There are two ways of approaching this problem. One is to reduce the torsional forces on the joint. This means to use thin lightweight fins of airfoil shape. They should be long and narrow, close against the body of the rocket. Most rockets are built in this manner. The other approach is to spread the forces out over as large an area as possible. This means you should either use wider fins (which is contrary to the first approach) *or* use extra wide fillets. Reinforcing material and fin fairings accomplish the same thing.

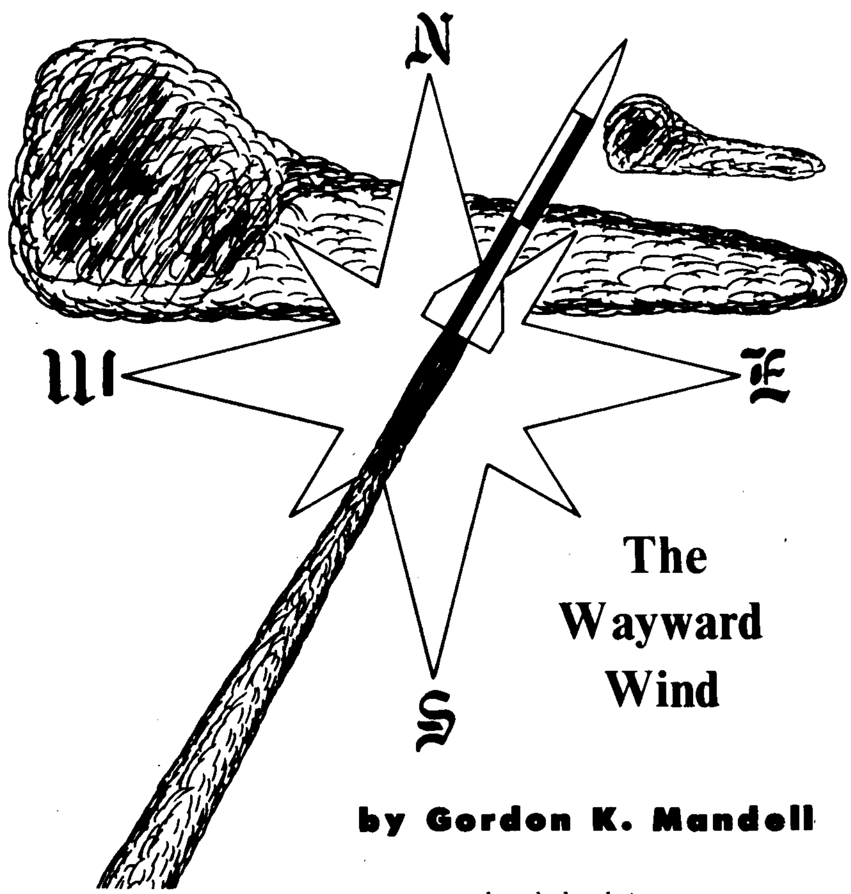
There is a common misconception that breakup type rockets must stream back to earth at tremendous speeds and hit the ground with tremendous force. Thus, this type of rocket in particular, usually has extra thick fins. The rest of the model is also very rugged and heavy. The Fra-jyle, on the other hand, is a break-up recovery rocket with "flimsy" fins. It is, therefore, light- weight and designed to drop back gently.

Construction

1. Cut the 18" body tube 3.5 inches from one end.
2. Install the engine block in the shorter body tube such that the engine will protrude ¼ inch.
3. Cut out 4 fins and 4 fairings. Watch the grain.
4. Hold the 4 fins together in a bundle and sand the edges against a piece of sand paper which is taped to a flat surface. Thus all fins will be identical and have straight edges. Repeat for the fairings.
5. Glue one fairing to each fin. Be sure that neither fin nor fairing is upside down.
6. Glue a two inch section of engine casing inside one end of the long body tube. It should protrude 0.7 inches. I used a thin walled case of the type that comes with kits for installing the engine block. I find stage couplers too short for this purpose.
7. Using a screw eye attach one nose cone weight (.12 oz.) to the nose cone. Use two weights, only if the engine casing above is the heavy standard type.
8. Glue the nose cone in the opposite end of the long tube.
9. When the fins are dry, hold them in a bundle and sand the *root* edges against a flat surface. Round all other edges with sandpaper.
10. Mark the small body tube for 4 fins and attach the fins in the usual manner. Note which end the engine block is in, before attaching fins. Use white glue.
11. Attach one launch lug against a fin. Use a section of launch rod when attaching the second lug.
12. *Apply Fillets!* This is best done by applying several thin coats of white glue. 4 or 5 coats should be plenty. Allow each coat to dry clear before applying the next. Be sure the fillets go all the way around the front of the fin. This is where the stress on the joint is the greatest. Don't be afraid that heavy fillets may spoil performance. In most cases fillets improve performance by reducing interference drag.
13. After sealing all balsa surfaces, apply a few light coats of dope or spray paint. Paint the *inside* of the lower section also. Aluminum paint is best though any enamel will do. The small section just ahead of the engine block should be especially well covered. This will help protect the body tube from the ejection charge as well as mechanical wear and tear.

Just sitting on the pad, this rocket may appear very clumsy due to its unusual proportions. However, it is quite graceful in flight. The forward section returns first. It wobbles slightly as it comes down on its side. The lower section soon follows. It comes down with the body tube parallel to the earth and the fins going around as though it were a paddle wheel! Recovery as gentle as with most parachute birds.

This model can be flown with any series I engine ½A6-2 or larger. An A5-2 may be best for the first flight. Don't fly it with B6 or C6 engines unless the fins are straight and the fillets and fairings are done *properly*. Otherwise *you* may learn that 60 second fin-body joints tend to come apart!



The Wayward Wind

by Gordon K. Mandell

The Closed-Breech Launcher

Regular readers of Model Rocketry will remember last month's exposition on the history, prospects, and present state of launch tower technology, in which I pointed to the great reduction in drag and consequent increase in performance associated with the absence of a launch lug as one of the chief reasons in favor of using towers in preference to rods as a means of providing launch guidance.

This month I'd like to discuss another possible method of eliminating the launch lug, one which results in a substantial increase in liftoff acceleration in the bargain. The device that accomplishes this remarkable feat is called the *closed-breech launcher.* Such launch systems have been employed with a considerable degree of success for many years by the Atlantic Research Corporation of Alexandria, Virginia. The ARCAS , Model Rocketry's scale subject last month, is but one example of the sounding systemsin ARC's inventory which use closed-breech launch. The National Aeronautics and Space Administration's Wallops Station has also been quite active in the closed- breech field in recent years. Wallops not only operates ARCAS facilities, but has been engaged under the HARP project in research to increase the accelerative capabilities of the closed-breech system to the point of developing what are literally *gun*-launched rockets.

The basic form of the closed-breech launcher as used by Atlantic Research is shown in Figure 1. The rocket, centered in the launching tube by three or four spacer vane assemblies, is slid into position such that its nozzle exit is a short distance forward of the sealed after end (the "closed breech") of the tube. A piston-like device fits, but is not fastened, onto the rear of the rocket. The piston, like the rocket and spacers, is free to slide within the tube. In addition, it is provided with a hole through which the rocket nozzle may exhaust the gases of combustion. Electrical connections are provided near the breech, allowing the ignitor to be fired from an outside power source.

In operation the rocket, with spacer vanes hand-held in place, is inserted through the breech, which can be opened like that of an artillery piece for this purpose. The piston is then slid up into the tube until it brings up against the rear of the rocket, and the ignitor is installed and connected to its source of electrical power. The breech is sealed and the tube, which is usually mounted on pivots, is raised to a near-vertical position. The sytem is now prepared for operation.

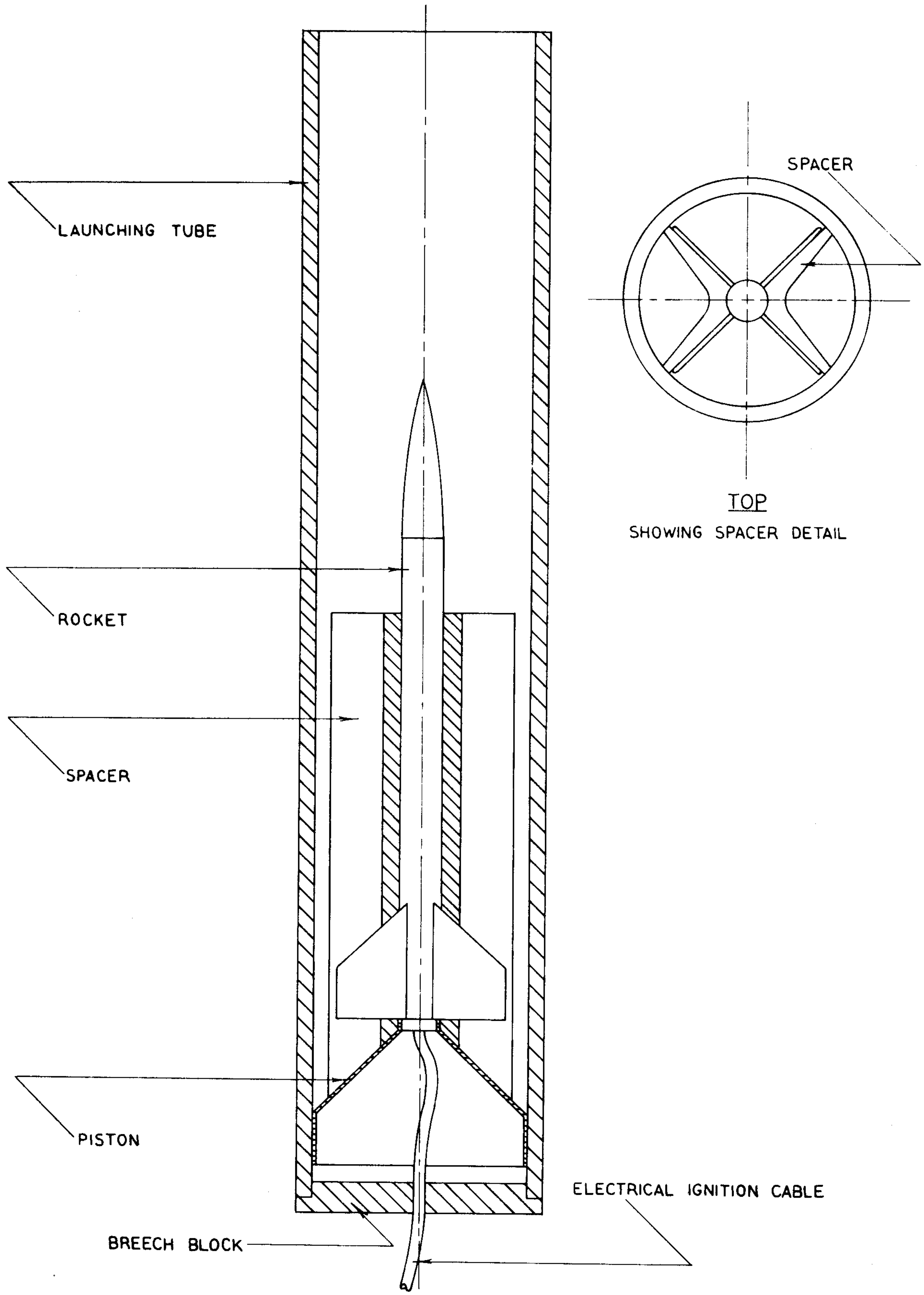
When the ignitor is fired and the rocket motor begins to operate, the exhaust gases pass through the hole in the piston and collect in the region between the piston and the sealed breech. From here they cannot escape, since the piston fits snugly both the rocket and the tube. Within a short time after ignition, therefore, a great deal of pressure builds up behind the piston. This pressure, multiplied by the cross-sectional area of the launching tube, constitutes a force which rapidly accelerates the rocket, piston, and spacers forward and out the open front end of the tube. As the rocket leaves the end of the launcher aerodynamic drag and the rocket's continuing acceleration cause the piston and spacers to fall away, leaving the rocket in a "clean" configuration to continue its upward flight. This launch sequence is shown in Figure 2. The acceleration produced by the pressure behind the piston is much greater than that which would occur due to the rocket thrust alone and the velocity achieved by the rocket at the instant the guiding influence of the launcher is left behind is therefore much greater in a closed-breech launch than in a launch from a rod or tower of comparable length. And, of course, no launch lug is needed.

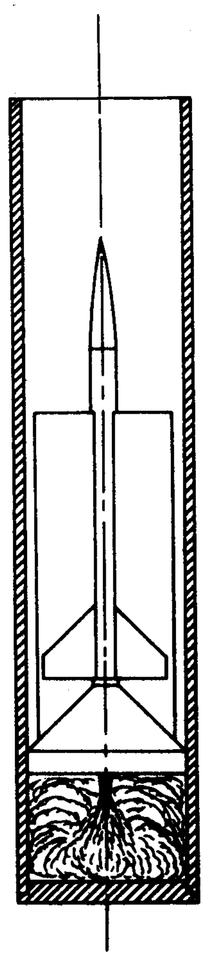
The capacity to collect exhaust gases in a region between a movable piston and a sealed breech, and thus to use them more efficiently than if they were simply expelled, is the characteristic which defines a closed-breech launcher. Bazooka-type launching tubes into which the rocket body fits snugly, or any other tubular launching devices whose after ends are left *open* to the atmosphere are *not* closed-breech launchers and *do not* produce accleration characteristics in any way superior to conventional rod and tower launchers.

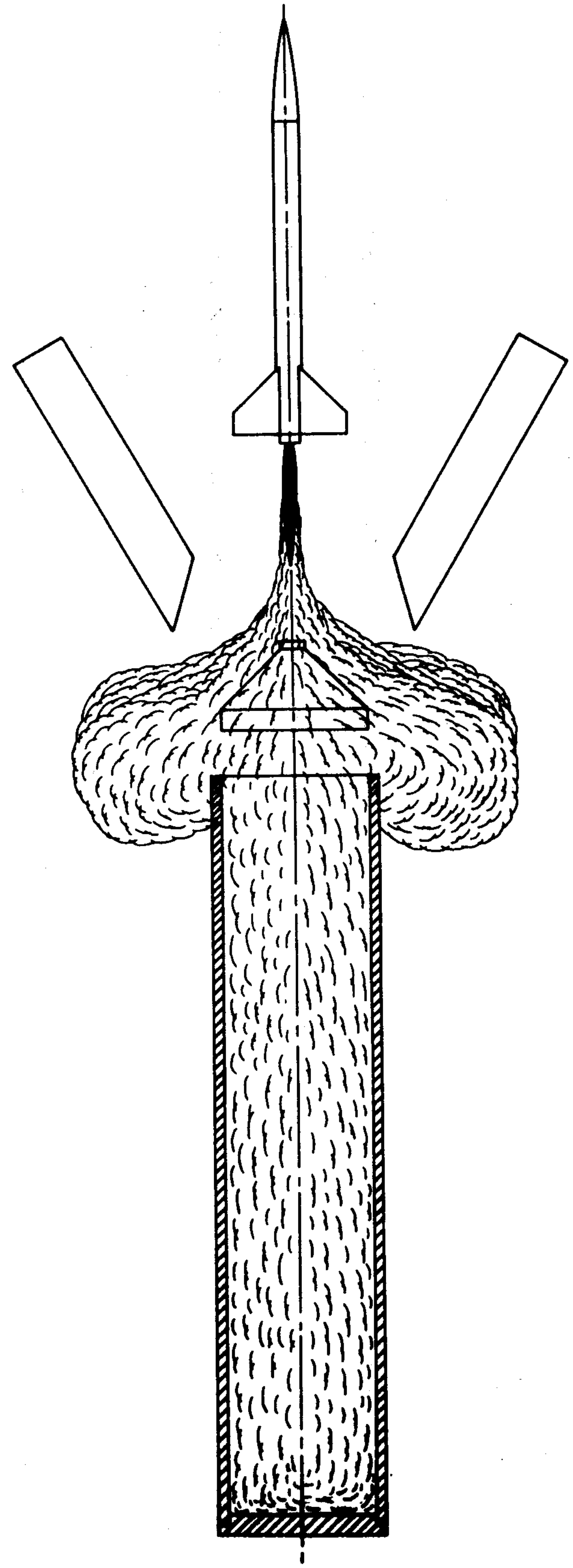
So much for a technical description; now for the important question: If the closed-breech launcher offers such great advantages in launch velocity, it should be able to *increase the altitude performance of a rocket having a given engine beyond that possible with the same engine in the same rocket using any other means of launch,* as well as to reduce the rocket's susceptibility to being deflected by surface winds. Why, then, has no effort been made to use closed-breech launchers in model rocketry?

Well, to a certain extent, there has. Tubular forms of launching equipment have appeared from time to time throughout the history of model rocketry, and although most of these have had no pressurization capability, the trend toward a recognition of the advantages of a piston-expulsion, closed-breech system is evident.

The first tube-launch of a model rocket I can remember occurred at Denver, Colorado in August of 1961 as part of the Research and Development event at NARAM-3. The tube in this case served neither a pressurization- expulsion nor a guidance function; its sole purpose was to provide a waterproof envelope around a conventional rod launcher, enabling rockets to be launched underwater. Over the top of the tube was stretched a rubber membrane, so that the entire assembly could be submerged in water several feet deeper than the height of


SPACER
LAUNCHING TUBE
TOP
SHOWING SPACER DETAIL
ROCKET
SPACER
PISTON
ELECTRICAL IGNITION CABLE
BREECH BLOCK





the tube. Rockets fired from this device carried nosecones to which toothpicks were affixed to break the membrane during launch, after which the rocket flew through the water and into the air, emerging like a Polaris missile and throwing spray in all directions. Though this arrangement was a far cry from a true closed-breech launcher, the seed of the concept was clearly present in the hobby.

The following year saw at least two tube launchers constructed which had full guidance, if not pressure-expulsion, capability. Paul Hans of Manhasset, New York, built a tube launcher from which to fire his scale model HASP sounding rocket. Since this particular version of the HASP had folding fins– which were faithfully duplicated on the model– its fit within the tube was fairly snug and a high degree of guidance constraint was achieved. Were the tube sealed at the bottom, a fair degree of pressure-assistance to the launch would have been achieved. Unfortunately, the range safety people at NARAM-4 were worried about the operation of the spring- loaded fins and so forbade the model to fly. We never got a chance to see the system in operation.

1962 also saw a large tube launcher built by Tom Rhue of Colorado Springs. This one looked to be about eight feet high and a foot in diameter and was meant to fire an F-powered scale IRIS, as I remember it. It could not have been pressurized, since a port had been cut in the tube to allow the firing leads to be hooked up from the outside, but it must have had either spacers or permanent rails affixed to the inside of the tube to guide the relatively large-finned IRIS. To the best of my knowledge this launcher, like Paul Hans', was never operated.

The Research and Development event at NARAM-5 (Hanscom Field, Bedford, Massachusetts, 1963) saw the first application of pressurization to the launching of model rockets. Wes Wada, also of Colorado Springs, developed an "augmenter tube" designed to increase the acceleration of a rocket at the moment of its ignition. The Wada augmenter was essentially a sleeve constructed from a length of body tubing, sealed at its lower end and mounted on a standard 1/8 inch launching rod. Provisions were made for firing the ignitor through small openings in the otherwise closed end of the tube. To fire from the augmenter, Wes prepared his rocket with the engine casing protruding about half an inch from the back of the airframe and slid it down the rod, inserting the after end of the engine casing into the augmenter. When ignited, the rocket would be fired from the augmenter like a torpedo due to the pressure of the trapped exhaust. Though only a tiny portion of the liftoff sequence had a pressure assist in the Wada system, the increase in performance of the rocket was noticeable. Wes Wada's augmenter, a significant advance in launcher technology, won him a first place in Junior R & D.

From then on, though, the development of tube launchers virtually ceased. The final step of combining the Wada system with the guidance-only type of launching tube to produce a true closed-breech launcher was never taken. A number of designs came close– notably those built by members of the Fairchester Section of the NAR in the fall of 1964– but no such launching system has ever demonstrated consistent reliability or come into general use.

As with the tower, the hiatus in closed-breech development was partly due to the technological trend of model rocketry in general. 1963 was part of the era of the short, squat, monster-finned designs characteristic of the hobby in the five-year span between 1962 and 1967. Rockets of this configuration did not lend themselves to tube launch any better than they did to tower launch.

But to a far greater extent than towers, tube launchers posed fundamental technical problems of design and construction which were never really solved before development ceased. The launching tubes themselves were invariably carpet-shipping containers or telescope tubes of fiberboard. The cardboard surfaces of such tubes were rough, creating a great deal of friction in the case of spacer-guided rockets, and what was worse, they were hygroscopic– they tended to absorb moisture from the air after being exposed to rocket exhaust. Not only did this make the inner surface problem worse, but it also contributed to a deterioration of the fiberboard itself, making it "mushy" and prone to shredding. No surface coating seemed able to correct this situation, since the coating itself deteriorated under the rocket blast.

Ignition was also a major difficulty. Most modelers just cut a port in the bottom of the tube through which they could insert an ordinary pair of leads with micro-clips attached, thereby removing any internal pressurization capability the tube might have had. A few of the more daring types tried special hookup arrangements built into the tube. Pressurization, though, was still questionable and the electrical components took an awful beating from the blast. Hooking up a rocket was no easy chore in one of these things, either.

At the present time, it seems clear that two major design breakthroughs are required to make the closed-breech system a practical device for the model rocketeer: the use of a metal launching tube and the development of a system for running the ignitor leads through the breech to an external power hookup. The injunction against the use of metals in flight hardware in model rocketry is due to the two hazards associated with metallic components: that of explosion, and that of heavy falling objects. There can obviously be no falling object hazard associated with launching equipment and the explosion hazard can be eliminated, even with a pressurized tube, by using metal of sufficiently heavy gauge. You can overdesign to your heart's content with launching equipment, since it never has to fly and weight is no obstacle (except when you have to carry it to the field!). As a first guess, a three-foot length of four-inch O.D., 1/8 inch wall thickness 6061- T6 aluminum alloy tube should allow you to launch 1/4A- through D-class rockets in perfect safety (how about it, NAR Standards and Testing? Let's have a ruling!). A six-foot length of six-inch O.D., 1/4 inch wall thickness 6061-T6 tubing should be used for E- and F-powered birds. As you can see, tube-launched rockets ought to have fins of relatively slight span.

A breech sealing cap for such a launcher can be machined from half-inch aluminum plate. Many designs are possible, the simplest being a "plug" type of fitting bolted to the tube by machine screws around the after tube circumference (*DON'T* rely on a press-fit!). Various types of hinging and buckling arrangements would also do the job.

In any case, the sealing cap would have to be provided with gaskets around its circumference and also with two small, gasketed orifices in its face to pass ignitor leads. I really think a kind of "extended" ignitor formed by soldering lengths of copper wire to a standard nichrome ignitor, then passing these lengths through the breech cap to be connected to a standard firing system, is going to be the answer to the ignition problem rather than gadgetry built into the tube itself. The piston and spacers, which can be disposable, are no problem. Spacers can be made either from styrofoam (the way Atlantic Research does it) or from balsa wood. Both will slide easily over the aluminum tube surface, provided it is cleaned after each flight. An altazimuth mount for such a launcher is a trivial design problem; just remember– a tube launcher, like any other launcher, must always be operated within thirty degrees of the vertical.

After all this, you probably think that a closed-breech launcher must be an awful nuisance to design, build, and operate. I agree with you 100%. I do not see such systems ever becoming common...*but*, as our technology advances and the altitude record figures climb higher and higher, there is going to be greater and greater emphasis on obtaining the absolute maximum of performance from a given class of rocket engine in competition. Given such a situation, I can see where substantial numbers of competition rocketeers might go to the effort of designing closed-breech systems. The prospect of tacking 60 or 80 feet per second onto his burnout velocity and substantially increasing his chances of a perfectly vertical flight should be more than enough incentive to send a top competition man of one or two years hence back to his drawing board– to redesign his bird for closed-breech launch.

MODEL ROCKETRY

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(**Club Notes** continued.)

flown to altitudes of over 300 feet. Also on display was another rocket constructed by James Snarski, a 6th grader at Valley Road School in Clark. The display has created further interest in model rocketry. Borrowers are taking out books on model rocket construction from the Clark Public Library.

Under the direction of science instructor Charles Hedrick, students at the Jefferson Davis Junior High School, West Palm Beach, Florida, conducted a demonstration launching on February 5th. The school's Science Club participated in the launching of several rockets to altitudes up to 2,000 feet. The event was reported in the **Palm Beach Post**, thus providing publicity for the club and the hobby of model rocketry.

A model rocket launching was held in observance of Boy Scout Week by Troop 306 of Lumberton, North Carolina and Troop 320 of Fairmont, North Carolina. The event featured launchings of about 30 rockets, including single-stage, multistage, cluster, and boost-glider rockets. The public was invited to the demonstration which was directed by Don Rogers and Eagle Scout Bill Sellers.

A new NAR section is being formed in New Orleans. Interested modelers should contact E.V.Blaise, Jr., 600 Deckbar Ave., New Orleans, La. 70121.

The YMCA Space Pioneers have scheduled a record trials, open to any NAR member, for July 13, 1969. The Space Pioneers Universal Record Trials No. 2 (SPURT-2) will be held from 1:30 PM to sunset at the Lapham Rocket Range, New Canaan, Connecticut. All categories of NAR and FAI records will be flown. Contact the YMCA Space Pioneers Contest Director, G. Harry Stine, 127 Bickford Lane, New Canaan, Conn. 06840 for further information.

The Space Pioneers also announce two Regional Meets, open to all sections and NAR members in Connecticut, Rhode Island, Massachusetts, New York, New Jersey, and Pennsylvania. On June 22, 1969, the Plastic Model, Super Scale, Scale, Drag Race, Swift B/G Duration, and Class 2 Parachute Duration events will be flown. On June 27, 1969, the Quadrathon and R&D events are scheduled. For the plastic model competition, the contest director has ruled that entry is limited to plastic models of rockets, guided missiles, and space vehicles. Plastic slot cars, ships, etc. are excluded from competition. Further information is available from Contest Director G. Harry Stine at the above address.

The Con-Roc Club of Wolcott, Connecticut, meets regularly in the basement of the local hobby shop operated by Rit Lawson. Most of the members are studying the technical aspects of model rocketry. Club plans include a contest for the most original rocket design by a club member, organizing competition with other Connecticut area clubs, and forming an NAR section.

The Crestwood Rocketeers, a new model rocket club in Crestwood, Illinois, has been formed. The club presently has 12 members, and is planning its first spring rocket contest about May 1st. Interested rocketeers should contact Nick Abramovitz (569-2130) or Gene Forkin (389-5983).

The Parent Advisory Council of the West Covina Model Rocket Society has been active in obtaining the support of the local Recreation and Park Department in establishing a new workshop. Located in the Cortez Park Civil Defense Building, the workshop will be outfitted with a small machine shop, a clean room for painting, workbenches, drafting tables, handtools, a library, and a high velocity electric wind tunnel.

The Park Department has supported the club by providing an advisor, a club room, launch site, use of their facilities and supplies. The WCMRS launch site, located at the Brutoco Recreation Area, is one of the few permanent model rocket launch sites in the United States. The site will be complete with undergroundwiring, a communication system, a fire control center, a mission control flight tower, and a concession stand.

The club is divided into three groups based on ahcievement. The Mercury Ground School is for beginners, while the Gemini Flight School is for the advanced rocketeer. The Apollo Aerospace Team is composed of those rocketeers who have completed the Mercury and Gemini requirements and have become members of the NAR. Workshop briefings, seminars, construction projects, and attendance at meetings form the basic requirements.

With the help of the parents, special badges, silk-screened tee-shirts, and membership cards have been made available to all members of the WCMRS.

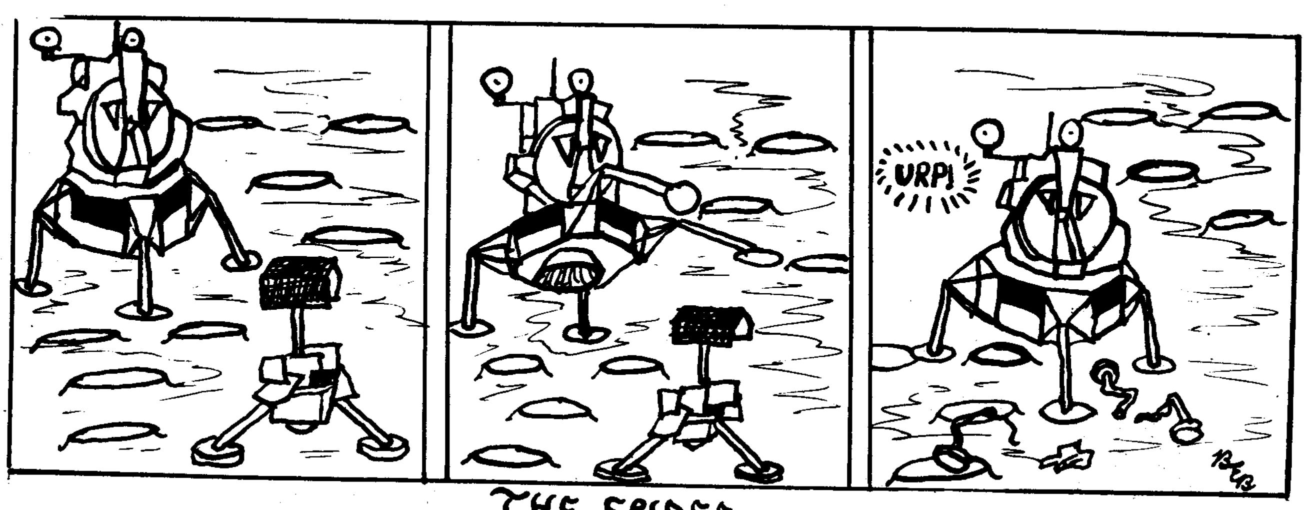
Send your club or section newsletters, contest announcements and results, and other news for this column to:

Club News Editor
Model Rocketry Magazine
P. O. Box 214
Boston, Mass., 02123

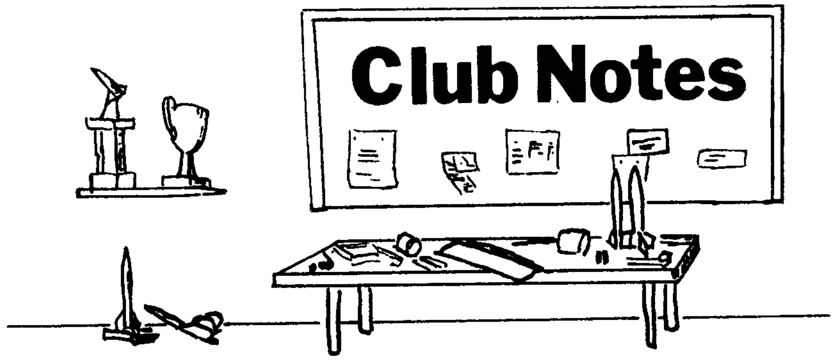
(**From the Editor** continued)

Under the other system, each B/6 would be flown three times. Flights on which the B/6 goes out of sight would be reflown. The times would be totaled and the winner would be the contestant with the highest total time for three flights. This method would eliminate the *luck* factor resulting from thermals, etc.

We hope the NAR Contest Board will soon meet and consider these and other possible revisions to the NAR rules. As the hobby develops, the rules must be modified in order to encourage advancement in the state of the art.



THE SPIDER



A group of Freshmen at the Marist High School, Sandy Springs, Georgia, have formed a new model rocket club to promote a better understanding of the Aerospace Age. Since the club's formation in December, its membership has grown to 22. Competition launches are held weekly, and bi-weekly classes on various aspects of model rocketry are scheduled. Officers of the club are Chip Morrison, President; Mark Jolly, Vice-President; Mike Mangione, Secretary; and Clayton Powell, Treasurer. The club hopes to hold contests with various schools in the Atlanta area in the near future.

The Eastern Connecticut Model Rocket Association's Third Annual membership drive has just begun. Model rocketeers interested in joining or desiring further information should contact Vin Crosbie, 215 Church Street, Willimantic, Connecticut 06226. Meetings are scheduled for Saturdays and Sundays.

The Fairmont Estates Model Rocketry Association (FEMRA) is regrouping. Modelers interested in joining are requested to contact Eric Max, 9827 Hampton Lane, Fairfax, Virginia, 22030.

The Northwest Rocket Club was recently formed at Lincoln High School, Portland, Oregon. The club's objective is to use model rocketry as a way to experiment safely in fields such as mathematics, optics, physics, etc. The club has obtained permission to use the West Sylvan Grade School field as a launching site. As its first project, the Northwest Rocket Club will take a series of aerial photographs of Lincoln High School for use in their annual. The camera, an Estes Camroc modified to accept a glass lens, is expected to be flown in April. The club also plans to donate technical reports, rocket plans, and general model rocket literature to the Lincoln Library to increase its availability.

The latest edition of the Apollo-NASA News reports the election results for that section of the NAR. New officers are: Gary King, President; Bob Sievers, Vice President; Mark Evans, Secretary/Treasurer; Mr. Vincent, Senior Member at Large; Scott Duncan, Junior Member at Large; Steve Hill, Librarian; and Mr. McDowell, Contest Director.

Results of the February 16 meet held by the Apollo-NASA Section are as follows: Scale Altitude - Scott Duncan won the Junior division with McDowel placing first in the Leader-Senior division; Scale - Gary King won Junior, and McDowel the Leader-Senior; Space Systems - Duncan won Junior, and Mark Evens the Leader-Senior; Super Scale - Steve Hill won Junior, and Evans the Leader- Senior; Plastic Models - Bob Sievers won Junior, and McDowel the Leader-Senior; and in Design Efficiency - Sievers won Junior while McDowel won Leader-Senior.

Members of the junior high Science Club in the Whiteford Schools, Ottawa Lake, Michigan recently gave a public demonstration of model rocketry. Dennis Zaenger fired the first rocket, an Astron Alpha. Rick Crawford followed by launching an Apogee II single stage rocket. The club is advised by Robert Pawlicki.

The February display at Cleveland's Natural Science Museaum is an exhibit of model rockets constructed by the museum's model rocket class. All rockets on display were capable of actual flight.

A display on model rocketry was recently featured at the Clark Public Library, Clark, New Jersey. The main rocket in the display was built by Lawrence Sullivan, a 7th grader at St. Agnes Parochial School in Clark. Larry got the plans and necessary construction information from Harry Stine's **Handbook of Model Rocketry**. The rocket stands about 18 inches tall, and has been

(Continued on page 39.)

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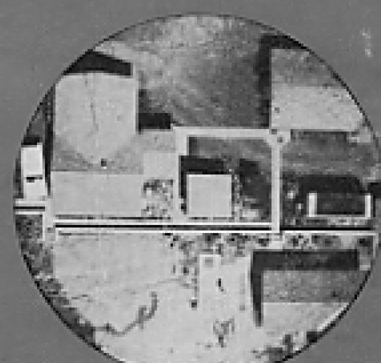

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