MODEL ROCKETRY

THE JOURNAL OF MINIATURE ASTRONAUTICS

47755
SEPTEMBER 1971
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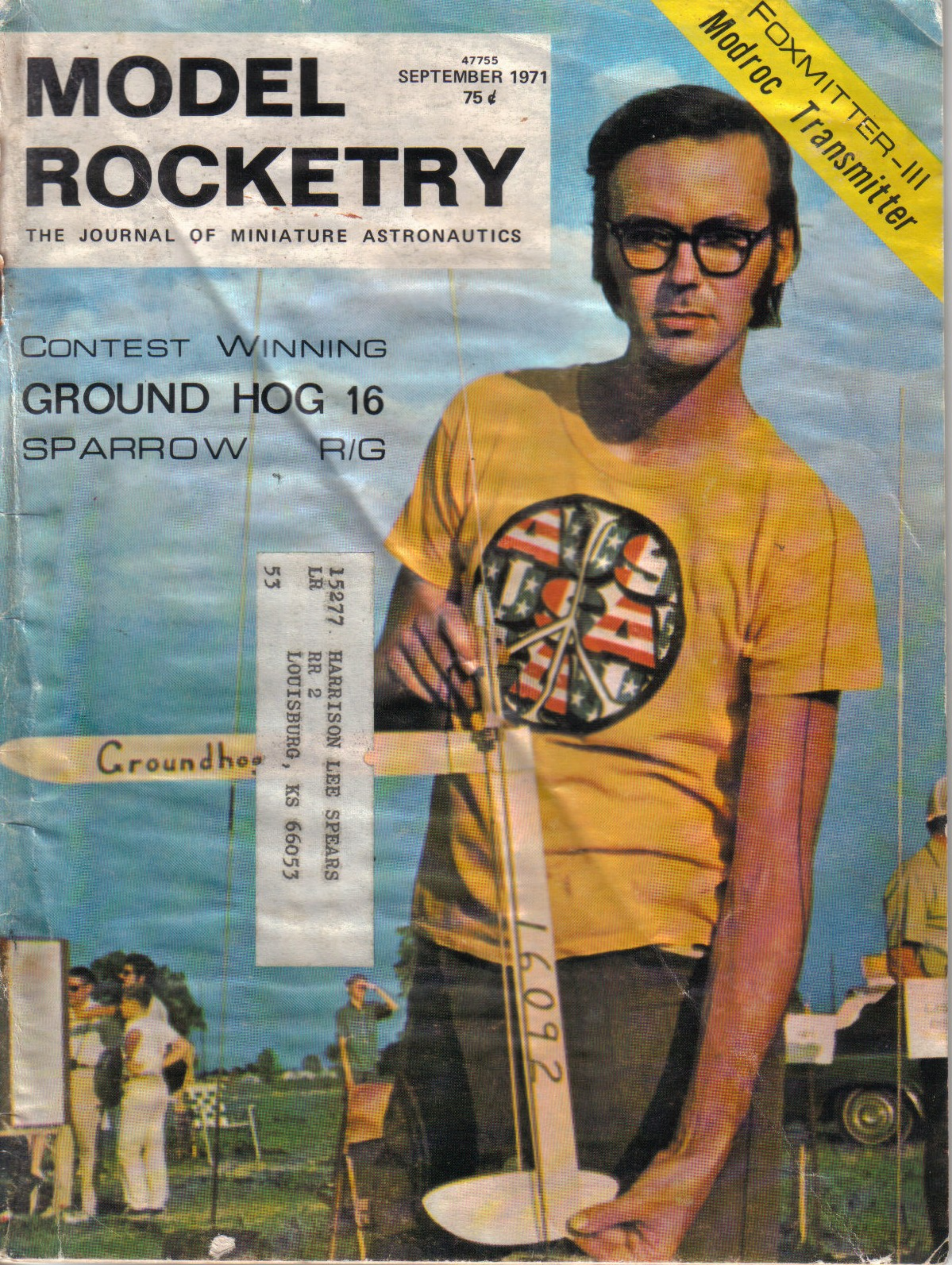
FOXMITTER-III Modroc Transmitter

CONTEST WINNING
GROUND HOG 16
SPARROW R/G



Model Rocketry

Volume III, No. 11
September, 1971

Cover Photo

This month's cover shows Jon Robbins prepping his Ground Hog 16 Sparrow Rocket/Glider. The Ground Hog series of swing-wing R/G's have set new records in Hornet, Sparrow, and Condor R/G this year. A complete set of Ground Hog plans begins on page 23. (Photo by Bob Mullane).

From the Editor

Two months ago in this space I commented that the generation of pile after pile of computer output does nothing to advance the state-of-the-art of model rocketry *unless the results of that output are compared with experimental data.* To write a program which *predicts* the altitude of a model rocket is useless, unless the output of the computer is compared with the actual altitude attained by the described model. There's nothing wrong with using a computer as a tool to to further our understanding of the *behavior of model rockets.* However neither the program nor the output data should be considered the goal. After successfully running the program, much experimental work remains to be done in order to confirm its validity.

A few computer enthusiasts reacted quickly to the editorial, interpreting it as an attempt to downgrade the use of computers in the hobby. Actually the intent was to suggest to those rocketeers who are making use of computers that they direct their efforts into areas where the computer can be useful and effective. A program, for example, which computes the Center of Gravity of a simple model rocket probably takes longer to write than any rocketeer will spend computing Centers of Gravity by hand during his entire rocketry career.

Recently, much effort has been devoted to refining the basic altitude prediction programs. As yet, however, I've seen nothing from any programmer which indicates that he has done anything to his computer-generated altitude predictions with experimentally measured altitudes.

One specific case stands out in the battle to develop a good altitude prediction program. In 1969 Charlie Andres wrote such a program, and used the results to predict the altitude of his Excalibur design (published in the August 1969 **MRm**). Charlie flew this

(continued on page 31)

Regular Features

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German V-1 Scale Data

I'm trying to build a scale model of the WW II German V-1 "Buzz Bomb," but it is awfully hard to find even pictures on the thing. Do you know where I can get information on the V-1?

Douglas Van Winkle
10018 Mike Rd
Oxon Hill, Maryland

A set of plans for the German V-1 (FGZ-76) is available from Action Books, Dept. V, Box 5611, Buena Park, CA 90620. The plans are priced at 75¢.

Photos of the V-1 are not easy to find, but a number of books on German rocketry include one or two photographs. An in-flight photo appears on page 58 of The Birth of the Missile *(E. D. Dutton, publishers). A color photo of a camouflaged V-1 appears on page 1612 of* Above and Beyond *(New Horizon Publishers).*

An 8-page history of the V-1 program is included in the book German Guided Missiles *(Arco Publishing Company). These books should be available at a large library or can be purchased through your local bookstore.*

GJF

Engine Computer Calculations

The following is a FORTRAN program using S.W. Bowen's equations from *Simple Analytic Approximations to Model Rocket Engine Thrust-Time Curves* (**MRm** July 1971):

```
   READ(5,11) BURN, TMEAN, TMAX,
     TIMAX
11 FORMAT(4F6.3)
   S = TIMAX/BURN
   R = TMAX/TMEAN
   X = S/((2.*S-1.)+SQRT((1.-2.*S)**2
     -2.*S*(S-1./R)))
   TPLAT = TMEAN/((X-2.+(1./(2.*X)))
     *(S+1.))
   PTIME = (2.-1./X)*TIMAX
```

The four identifiers in the READ list are the burn time, the average thrust, the peak thrust, and the time at which peak thrust is reached, respectively. Input format may be changed to suit the programmer's convenience. The parameters S and R are the same as those in Bowen's formulae. X is the quantity M in the article renamed to conform to the rules of mode in the FORTRAN language.

After execution of this program segment, the values for the plateau thrust (TPLAT) and the time at which plateau thrust is reached (PTIME) are available for output and subsequent computations.

I enjoy seeing Bowen's work as well as other computer-oriented articles. Please continue to publish them, and I hope we can look forward to another one soon.

Rich Noble
Wheaton, Illinois

Black Brant III Data

In the March '71 edition of **Model Rocketry** I noticed a photograph of Al Lindgren's Black Brant III and launcher. My friend and I were painstakingly examining it and it finally dawned on me to write you. Could you try to get a hold of a set of plans and publish them.

John Kuthe
St. Louis, Missouri

Complete scale plans for the Black Brant III sounding rocket were published in the September '69 issue of **Model Rocketry**. *A limited number of copies of this issue are available at 75¢ each from Back Issues, MRm, Box 214, Astor Sta., Boston, Mass. 02123.*

Thus far we have seen no good blueprints or detailed drawings of the Black Brant III launcher. Those entered in contests have generally been scaled from photographs of the launcher. **MRm** *attempts to obtain authentic scale data from official sources before publication of such an article.*

GJF

Boost Glider Categories

I have often read in your magazine the different boost/glider classifications such as Hornet, Sparrow, Swift, etc. Please explain the specifications for each of these categories.

Bill Rhoney
Hickory, North Carolina

Boost/Glider categories are based on the total impulse of the engines used for propulsion. The commonly accepted designations are as follows:

Category	Total Impulse
Gnat	*¼A (0.0 to 0.625 nt-sec)*
Hornet	*½A (0.626 to 1.25 nt-sec)*
Sparrow	*A (1.26 to 2.50 nt-sec)*
Swift	*B (2.51 to 5.00 nt-sec)*
Hawk	*C (5.01 to 10.00 nt-sec)*
Eagle	*D-E (10.01 to 40.00 nt-sec)*
Condor	*F (40.01 to 80.00 nt-sec)*

The same categories apply to the Rocket/Glider competition events.

Rocketeers

We've learned a lot about model rocketry since my 8 year old son Donald got us both started in it in March of this year. The friendliness and cooperative spirit of rocketeers has been most impressive, as evidenced by the photo attached. You'll recognize Jon Robbins (the creative, busy Grandfather of the "Ground-Hog") taking time out from the Phillipsburg Annual Convention and Record Trials to chat with son Donald about mutual rocket interests and experiences.

Great sport! Great people!

William Heatley
Wayne, New Jersey

Night Aerial Photography

I am working on an idea for rocket photography that I thought might interest other shutterbugs, night photography via a flash bulb outfit. While this might add extra weight to the bird, it might also procuce interesting results not achieved before. Another interesting field of experimentation could involve the use of infra-red film for aerial photography.

Perhaps a new event could come into being where you combine rocket design with photograph clarity -- points awarded for each, and the winner being the rocketeer with the highest point total.

David L. Koehne
Manchester, Iowa

You'll need a pretty large flashbulb and quite a good camera on the model in order to obtain aerial photographs from any significant altitude during night flight. Using normal flashbulbs, simple cameras, and standard film, photographs are only possible out to distances of 20 or 25 feet. If you substitute a higher speed film, such as Kodak Tri-X, a more powerful flashbulb, and a camera with a very "fast" lens, it's possible that good quality photos from altitudes of up to 100 or 200 feet could be taken. It certainly seems to be worth a try, but don't be discouraged if the first few shots don't work out as planned.

"Micro-Hi" Comment

Peter Clay's "Micro-Hi" rocket (pg 3, July '71 **MRm**) looks like a very good idea. However, I have found that its concept is far from new. The winning entry in the 1963 Estes "Idea Box" contest, as described in the February 1964 issue of *Model Rocket News*, was a general interior arrangement for a streamer recovery model utilizing the empty interior of a small impulse 18 x 70 mm engine. Although Mr. Clay's model uses a parachute instead of the original streamer, the proposed rockets are otherwise practically identical.

Greg Smith
Champaign, ILL.

Modroc Safety

Not too long ago I shot off a model rocket engine buried in a pile of dirt. It was pointed at me. I did not think it was going to break through. But it did, and missed me by about a half a foot. I think I should tell other rocketeers about this so if they want to try a stunt like this, *do not* do it. I have been launching rockets for years and it took me this long to find out not to *fool around* with rocket engines.

Robert Rogacki
Harrison, New Jersey

Model rocket engines are not toys, and to "fool around" with them can prove dangerous. When used properly, in accordance with the Hobby Industry Association of America "Safety Code," rocketeers can experience years of enjoyment from the hobby without fear of injury. However, if the engines or rockets are used improperly, in a manner not permitted by the Safety Code, a hazard does exist. Other rocketeers should take note of this incident, and re-read the Safety Code which is printed on this page. Adherence to these reasonable guidelines, and the exercise of common sense, will allow you to continue flying.

Underwater Launching

On the subject of underwater launchings, I would like to add two successful flights to your list. The first model I flew was a converted Estes Stinger, powered by an A8-3. The first attempt was unsuccessful, but the second was highly successful. The Stinger returned and was recovered in good condition. However, the design of the Stinger made it hard to prep for underwater flights.

Because of this, I decided to design my own underwater rocket, and thus the "Calypso 1" was born. This model was fired successfully before a group of about 250 Boy Scouts at a demonstration sponsored by the Coughlin High School Model Rocket Society. The Calypso used a B4-2 engine, and its flight was recorded on film.

At the time of this letter, the "Calypso 2B" has been completed and its test firing is nearing. For a change of pace and something really spectacular try an underwater launch.

David Rajchel
Wilkes-Barre, PA

Saturn Launcher

On page 38 of your July issue there is a picture of a semi-scale launcher for the Saturn rocket. My question is can this launcher be purchased, from whom, and the cost?

Emerson Tornatta Jr.
Evansville, Indiana

Unfortunately, no Saturn launchers are available from any model rocket manufacturer. Several companies have considered the possibility of marketing a Saturn launcher, however the high cost and limited sales potential of such a launcher have caused them to drop these projects.

Presently **Model Rocketry** *has a semi-scale construction article on the Saturn tower in the works. An actual scale model, in the 1/100 size used for the biggest Saturn V kits, is impossible because of the great complexity of the launcher. However, the* **MRm** *article will include enough information to allow construction of a realistic launcher, eliminating only the smaller beams and wires which would not show up in 1/100 scale.*

SOLID PROPELLANT MODEL ROCKETRY SAFETY CODE

1. CONSTRUCTION – My model rockets will be made of lightweight materials such as paper wood, plastic, and rubber without any metal as structural parts.

2. ENGINES – I will use only pre-loaded factory made model rocket engines in the manner recommended by the manufacturer. I will not change in any way nor attempt to reload these engines.

3. RECOVERY – I will always use a recovery system in my model rockets that will return them safely to the ground so that they may be flown again.

4. WEIGHT LIMITS – My model rocket will weigh no more than 453 grams (16 oz.) at liftoff and the engines will contain no more than 113 grams (4 oz.) of propellant.

5. STABILITY – I will check the stability of my model rockets before their first flight, except when launching models of already proven stability.

6. LAUNCHING SYSTEM – The system I use to launch my model rockets must be remotely controlled and electrically operated, and will contain a switch that will return to "off" when released. I will remain at least 10 feet from any rocket that is being launched.

7. LAUNCH SAFETY – I will not let anyone approach a model rocket on a launcher until I have made sure that either the safety interlock key has been removed or the battery has been disconnected from my launcher.

8. FLYING CONDITIONS – I will not launch my model rocket in high winds, near buildings, power lines, tall trees, low flying aircraft or under any conditions which might be dangerous to people or property.

9. LAUNCH AREA – My model rockets will always be launched from a cleared area, free of any easy to burn materials, and I will only use non-flammable recovery wadding in my rockets.

10. JET DEFLECTOR – My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly.

11. LAUNCH ROD – To prevent accidental eye injury I will always place the launcher so the end of the rod is above eye level or cap the end of the rod with my hand when approaching it. I will never place my head or body over the launching rod. When my launcher is not in use I will always store it so that the launch rod is *not* in an upright position.

12. POWER LINES – I will never attempt to recover my rocket from a power line or other dangerous places.

13. LAUNCH TARGETS & ANGLE – I will not launch rockets so their flight path will carry them against targets on the ground, and will never use an explosive warhead nor a payload that is intended to be flammable. My launching device will always be pointed within 30 degrees of vertical.

14. PRE-LAUNCH TEST – When conducting research activities with unproven designs or methods, I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

FROM THE LAUNCHING PAD

Scale modelers interested in constructing models of the recent Apollo 15/Saturn V should take note of a number of modifications which have been made to the basic launch vehicle: In order to accommodate the increased payload requirements of the Apollo 15 mission, the following significant changes to the AS-510 vehicle were necessary:

1) The number of retro-rockets on the SI-C (first stage) was reduced from 8 to 4,

2) The SII (second stage) ullage rockets were deleted.

In an upcoming issue of **Model Rocketry** we will present a series of Apollo 15 photographs documenting the paint pattern. These photos were specially taken to allow rocketeers to construct more accurate scale models of this vehicle.

This month we are quite pleased to present detailed construction plans for one of Jon Robbins' Ground Hog gliders. In recent issues of **Model Rocketry** the Ground Hogs have been mentioned quite frequently because of their superb performances and all of the contests in which they have been flown. Right now the NAR Contest Board is processing only three Rocket/Glider record applications. If you check this month's *Model Rocketeer,* you'll note that they are all for flights of Jon's Ground Hogs. The subject of this month's article is the Sparrow R/G — Ground Hog 16 — which set a U.S. Record at the Buckeye II area meet last April. Later this year we hope to bring you plans for the larger Condor R/G which turned in a spectacular record setting flight at NART-II.

Jon's work on the Ground Hog should serve as a guide to other rocketeers who are interested in developing a contest winning design. First he sat down and did some thinking to select a possible winning concept — in this case the "swing-wing". Then Jon went out and built, and tested,... and built, and tested,... and built, and tested,... until he got a good performing and reliable bird. To date Jon has built almost 50 Ground Hogs, and flown them in everything from Hornet to Condor in both R/G and B/G. The early ones were unreliable in their deployment, but a few little modifications here and there have given Jon a superbly performing competition glider. This is precisely the type of development and testing program which is almost guaranteed to result in a contest winner. *Happy Ground Hog flying!*

Several months ago we reported on Jim Bunce's semi-scale Polaris launched from underwater in accordance with the plans given in the October '70 issue of **Model Rocketry**. Now Jim has carried this underwater launching system one step further. At a recent launching of the Boward County (Florida) Model Rocket Association, he displayed a scale model of the U.S. Navy Posiedon submarine launched missile.

This rocket, also designed for underwater launching, was flown from a 50 gallon oil drum. A large hole had been cut in the side of the drum and replaced with a plexiglass window so that the underwater ignition could be observed. According to the description given in

Jim Bunce's semi-scale Polaris A-3 viewed through the side of its 50 gallon oil drum launcher.

WHAT'S YOUR FAVORITE ARTICLE THIS MONTH?

Vote here for your favorite articles. Let us know what type of material you want to read. List them in order — the most liked first, etc.

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Clip this section out or use a facsimilie. Paste it on a postcard or put in an envelope and mail to:

Reader Survey
Model Rocketry Magazine
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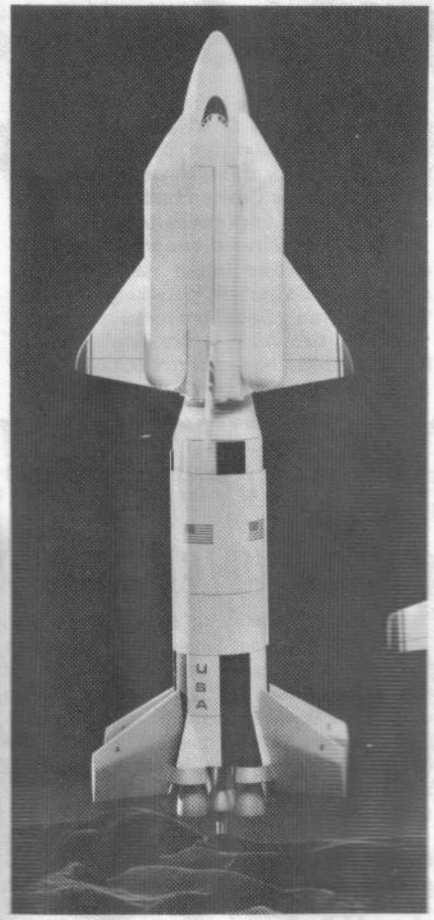
CapCom, newsletter of the BCMRA, "as movie cameras whirred and tape recorders hummed, the modroc blew up out of the water and climbed close to 1000 feet." Sounds like underwater launches are real crowd pleasers, but we've heard little on this subject from rocketeers outside the Florida area. I'm sure there is no shortage of 50 gallon oil drums in the rest of the country!

Montreal's Atmospheric Rocket Research Association plans on doing some pioneering work into small field events at their Montreal Eggloft Contest on September 18th. On the schedule will be a B-powered eggloft event, which they have named "Humming Bird Eggloft." Competitors shouldn't have too much difficulty launching an egg with a B14-5, and the trackers certainly should be able to close. We'll have a complete report on this new event later in the year.

A new NASA plan for development of the "Space Shuttle" may result in some strange looking scale models towards the end of this decade. Originally NASA planned to develop the Shuttle "Orbiter" and "Booster" vehicles simultaneously, with the first Orbiter test flights being launched by the Booster. However a new plan, currently under study, suggests a "phased approach" to the development of the shuttle system. Under this plan the orbiter vehicle would be developed first, and initially test launched by an interim expendable booster.

For the interim booster NASA and its industrial contractors are studying the use of a modified Saturn IC (first stage of the Saturn V), a booster based on the Titan III, and a booster using solid rocket engines. In the "phased approach," full scale hardware development of a reusable booster would be started later, but some design and preliminary development work for it would proceed concurrently with development and test of the orbiter.



Grumman Aircraft model shows how the Space Shuttle Orbiter would be mounted atop the S1-C stage of the Saturn-V for initial orbital test flights.

In describing progress on Space Shuttle development to date, NASA Administrator James Fletcher said: "The preferred configuration which is emerging is a two-stage delta-wing reusable system in which the orbiter has external propellant tanks that can be jettisoned. Although our studies to date have mostly been based on a 'concurrent approach' in which development and testing of both the orbiter and booster stages would proceed at the same time, we have been studying, in parallel, the idea of sequencing the development, test, and verification of critical new technology features of the system. We now believe that a 'phased approach' is feasible and may offer significant advantages. We believe that the additional studies we are now undertaking, together with those previously undertaken and now being completed, will put us in a position to make a decision this fall on the technical and programmatic approach to be followed in the Space Shuttle program."

Now, let's see, we take a Space Shuttle kit, mount it on a Saturn-V, and everything works out according to NASA's plan.

Several months back, in **MRm**'s coverage of the East Coast B/G Championships, we reported that Condor B/G had been flown only three times on the East Coast and Dave Crafton had placed first *all three times* with parasite B/G's. Now the secret to Dave's success has been disclosed. In the latest issue of *Starburst*, newsletter of Pittsburgh's Steel City Section, Dave presents plans for the G.C. Crusader — his Eagle-Condor Parasite B/G. In his introduction, Dave explains how success was achieved: *Once upon a time there was a design for a Condor B/G, which no one thought would work. But then the handsome prince kissed the ugly frog, and the G. C. Crusader was created.* Parts required for construction are one two-stage Estes Omega, one CMR Manta, one handsome prince, and one ugly frog. We wish our readers success in locating the prince and the frog in time for NART-3 next Spring!

George

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:

Model Rocketry Magazine,
Box 214,
Boston, Mass. 02123

1971 Boeing Management Model Aeronautics Scholarship Contest

The 1971 Boeing Management Association Model Aeronautics Scholarship Contest was held June 19 and 20, 1971, at the Boeing Company's Space Center in Kent, Washington (near Seattle). At the contest, 71 boys and girls competed in model airplane and model rocket events, with a $1,500 college scholarship being awarded to the winner.

Events flown included Class 0 Altitude and Swift Boost/Glide, flown under NAR rules, and 15 model airplane categories, flown under AMA rules. Contestants were permitted to enter any number of events, and the entrant's best scores from four events were combined to determine the winner.

As at last year's contest, interest centered on the model airplane events, but there were more rocket competitors this year than last. Both rocket events were dominated by the local South Seattle Rocket Society, with SSRS members placing 1st, 2nd, and 3rd in Class 0 Altitude, and 1st and 2nd in Swift B/G. Tony Medina took first place in both modroc events, while the lone non-SSRS member to place was Bruce Kimball (of North Bend, Washington) who took third in Swift B/G.

Five U.S. model airplane records were also set during the two day contest which attracted an estimated 7,000 spectators. Contestants came from California, British Columbia, Idaho, Oregon, Ohio, and Washington for the annual contest.

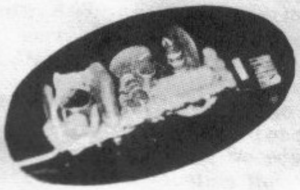
Sixteen year old Marty Thompson of Livermore, California was named Contest Grand Champion and winner of the 1971 Scholarship. He won all four of the events which he entered — Indoor Glider, Easy "B," Design Craftsmanship, and Unlimited Rubber Free Flight. Phil Hainer (16) of Seattle was the second place winner with 85 points, while Rich Sironen (16), also of Seattle, placed third with 80 points.

After the close of contest flying the South Seattle Rocket Society, which had maintained a static rocketry display, provided a flight demonstration for the spectators. The half hour show included the firing of a salvo of four Goblins, each powered by a D-13.

Plans are underway for a third BMA Scholarship Contest for June 1972.

Marty Thompson receives the first place award for his performance at the 1971 BMA Scholarship Contest.

An Improved, Light-weight, Telemetry Transmitter, Using an Integrated Circuit . . .



FOXMITTER-3

by Richard Q. Fox

The field of model rocket telemetry has developed considerably since **Model Rocketry** magazine published the plans for the Foxmitter-1 in May of 1969. Several manufacturers have introduced transmitters for use with model rockets, and some significant model rocket research projects have been based on data telemetered from rockets to the ground.

The Foxmitter has been the most widely used model rocket transmitter because of its modular design, its simplicity, and its low cost. The design has proven itself as a reliable 100 milliwatt transmitter suitable for a number of telemetry applications. In the year since the Foxmitter-2 was published, users have indicated three areas for improvement — size, weight, and ease of construction. The Foxmitter-3 solves these problems by using an integrated circuit, a printed circuit board, and a smaller battery.

For those not familiar with the articles previously published on the Foxmitter, it is a 100 milliwatt transmitter which operates on the 27 megacycle Citizen's Band. The transmitter is the foundation of a modular telemetry system which may be carried aboard model rockets. When a temperature sensor module is plugged into the transmitter, the temperature of the air outside of the rocket may be transmitted back down to the ground. Other sensor modules allow the Foxmitter to transmit information about spin rate of the rocket, the breathing rate of a live payload, the acceleration of the rocket, the exact time of ejection and landing, or even the sounds heard on board the rocket.

The information is transmitted to the ground as an audio tone signal on the Citizen's Band. A rise in the pitch of the audio tone indicates a rise in the measured quantity. A fall in the pitch means a drop in the quantity. The tones transmitted during the flight can be recorded on a portable tape recorder. If proper calibration procedures are followed, the transmitted data can be converted by hand to quantitative graphs of the measured variable as a function of time.

Only three pieces of equipment are required for this simple but quite workable telemetry system: The Foxmitter and a sensor module, a walkie-talkie or other Citizen's Band receiver, and a portable tape recorder. The results obtained from the system can be quite spectacular. Some first rate science fair projects have been carried out using only the above equipment.

Design Improvements

The circuit of the Foxmitter-3 is functionally identical to the circuit of the Foxmitter-2, but three of the transistors have been replaced by one pseudo-integrated circuit. In addition, a smaller battery may be used with the Foxmitter-3. The range of the transmitter in the air is still over one mile, and the transmitter is still compatable with all of the sensor modules developed for the Foxmitter-2.

The Foxmitter-3 uses a printed circuit board for ease of construction. Previous articles on the Foxmitter have advocated the use of perforated vector board for construction, because of its low cost and ease of repair after a crash. The disadvantage of the vector board was that the wiring had to be done by hand. Feedback from users indicated that an alarmingly high percentage of the modelers made wiring errors while building their transmitters, and that some of the modelers even abandoned construction of the transmitter because of these errors.

Astro Communications is now offering a strong fiberglass-epoxy circuit board for use with the Foxmitter-3. The strength of this circuit board was demonstrated in repeated test flights in which a payload capsule containing a Foxmitter-3 was intentionally ejected onto a grass field from 1000 feet, without a parachute. The metal battery holder and the battery were repeatedly bent out of shape, but the whole unit was always ready for another flight in 5 minutes. The printed circuit board remained undamaged.

Construction

The use of a printed circuit board makes construction very easy. The assembly procedure involves mounting the parts in the pre-drilled holes of the circuit board, and soldering them into place. The tools required are a *low wattage* soldering iron or gun, a pointed nose pliers, and a pair of wire cutters. Figure 1 shows the schematic diagram of the Foxmitter-3. Figure 2 shows a full scale reproduction of the printed circuit board pattern (for those who wish to make their own), and Figure 3 shows the parts lay-out on the *top* of the circuit board.

Start construction by cleaning the copper surface of the printed circuit board with household cleanser to make it shiny and remove oil and dirt. Mount the transistors and the crystal on the board first, since they are the most difficult to position. The transistor leads must be placed in their proper

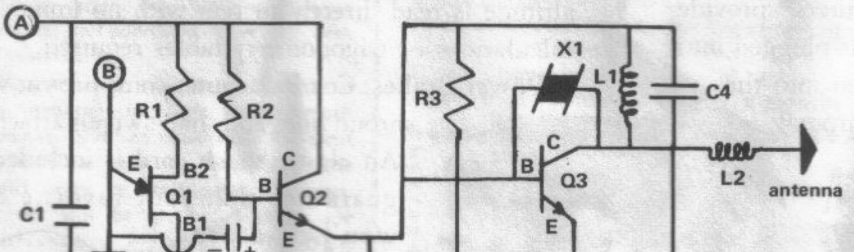


Figure 1: FOXMITTER-3 SCHEMATIC DIAGRAM. The Foxmitter-3 is a 27 MHz C.B. transmitter putting out approximately 100 mw. Circled letters refer to the pins of the 6-pin connector.

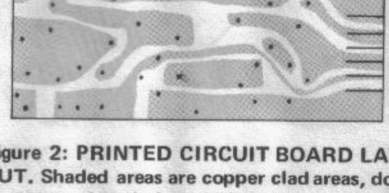


Figure 2: PRINTED CIRCUIT BOARD LAYOUT. Shaded areas are copper clad areas, dots are mounting holes drilled in the board.

holes. Q1 is a unijunction transistor with a peculiar shape. Insert its leads into the holes as shown in Figure 3.

Press the transistor leads through the holes as far as possible without stressing them. Turn the board over, and cut off all but ¼ inch of the leads so that each one contacts the copper pattern surrounding its hole. Solder the leads to the copper, but be careful not to overheat the joint, as heat may damage the transistor.

Figure 3 shows the proper orientation for mounting Q2, and the only other device which must be mounted with a specific orientation is capacitor C3. Figure 3 also shows its orientation. The remaining components should be mounted as shown. Keep all leads straight, neat, and as short as possible.

Use good soldering techniques. If you have not had much experience with soldering, try building a simple project first, such as a light flasher (MRm, September 1969) or a minimitter (MRm, October 1970). Also, write to Astro Communications for their free pamphlet on soldering techniques. *Poor soldering technique is the biggest cause of problems encountered with the Foxmitter.*

The antenna should be made from approximately 48 inches of thin stranded hook-up wire. The length is not critical, but short antennas radiate a weaker signal than longer antennas, and antennas over 4 feet in length have an undesirable effect on transmitter stability. Antennas over 5 feet long are illegal. The exact length of the antenna will depend on how carefully the transmitter was constructed. Some transmitters will work better with short antennas than others. The antenna length can be optimized once the transmitter is operational.

The male half of the 6 pin connector is soldered directly to the printed circuit board. The colored side of the connector should face the *top* side of the printed circuit board. Use enough solder to hold the connector firmly in place, but be careful not to short out adjacent pins of the connector.

Once construction is complete, check that all connections are soldered properly, that there are no shorts between adjacent connections, and that the transistors are mounted with each lead in its proper hole.

Foxmitter - 3 Parts List

R_0	100,000 ohms
R_1	220 ohms
R_2	4.7 megaohms
R_3	27,000 ohms
CAPACITORS: rated at 25 volts or higher	
C_1	.01 mfds
C_2	.02 mfds
C_3	2 mfds, electrolytic, 25 vdc
C_4	3 mmfds
C_5	47 mmfds
C_6	10 mmfds
INDUCTORS: Do not make substitutions	
L_1	27 microhenry RF choke, Miller 9230-54
L_2	10 microhenry RF choke, Miller 9230-44
TRANSISTORS	
Q_1	2N2646 or GE-X10
Q_2	2N998
Q_3	RCA 40080
MISCELLANEOUS	
Antenna	48 inches of thin stranded hook-up wire
XTAL	27 m.c. Citizen's Band Walkie Talkie Crystal (Astro Communications XTAL-1 or similar)
B_1	22.5 volt battery, Burgess Y15 for long life or 15 volt battery, Burgess Y10 for small size, but shorter life
Battery Holder	Keystone No. 139A for 22.5 volt battery or Keystone No. 225 for 15 volt battery
Ultra-miniature Connector	R/C Craft connector model No. 19K61, 6 pin, 49¢ from Ace R/C Higginsville, Mo. add $.50 for handling
Printed Circuit Board	An etched and drilled printed circuit board is available from Astro Communication, 3 Coleridge Place, Pittsburgh, Pa. 15201 for $1.75

A complete kit of all of the above parts, plus solder and wire is available from Astro Communications, 3 Coleridge Place, Pittsburgh, Pa. 15201, for $14.95. The kit includes the 22.5 volt battery, and its holder, but not the 15 volt battery.

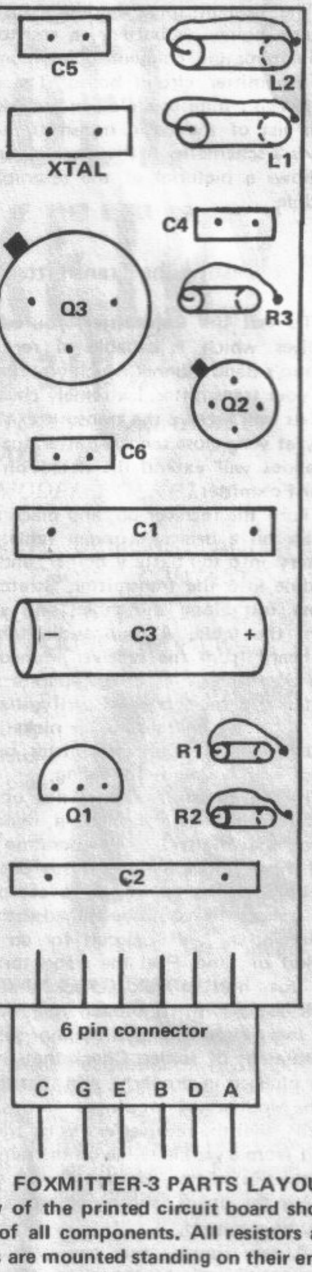


Figure 3: FOXMITTER-3 PARTS LAYOUT. Top view of the printed circuit board shows location of all components. All resistors and inductors are mounted standing on their ends.

Beacon Tone Module

The Foxmitter is operational only when it is plugged into a "Sensor Module." These modules are described in the July 1970 through January 1971 issue of this magazine, and are available from Astro Communications (see the parts list). The simplest sensor module is the Beacon Tone Module, which transmits a steady audio tone from the transmitter to the receiver. This module is useful for testing the transmitter, and for flying as a recovery aid. When the rocket lands, the user homes in on the rocket by searching for the location where the transmitted audio tone is coming from.

The beacon tone module consists of a battery holder, a battery, a resistor, and a 6 pin miniature connector, for plugging into the Foxmitter circuit board. The parts for the beacon tone module are included in the parts list of the basic transmitter. Figure 7 shows a schematic of the module, and Figure 8 shows a pictorial of the assembly of the module.

Testing the Transmitter

To test the transmitter, you will need a receiver which is capable of receiving the Citizen's Band channel which you have chosen for your transmitter. Extremely cheap walkie-talkies will receive the transmitter signal, but only at very close ranges. Better quality walkie-talkies will extend the detection range of your Foxmitter.

Turn the reciever on, and place the transmitter on a nearby *wooden* table. Plug the battery into the battery holder, and plug the module into the transmitter. Stretch the antenna out along the table, and step back from the table. A loud audio tone should be heard from the receiver immediately. If you do receive the tone, separate the transmitter and reciever, and verify that the signal is strong enough to be picked up over a distance. If your transmitter passes this check, you are ready for flying.

If the transmitter does not operate the first time that it is turned on, make a quick check that the receiver is operating properly, and then remove the transmitter battery from its holder. The battery or a component of the transmitter could be ruined if the battery is left in a faulty circuit for an extended period of time. Feel the transistors. If they are too hot to hold, check that each of their leads is in its proper hole. Also check for short circuits caused by poor solder joints or splashes of solder. Check that the battery was plugged in properly, and that the Beacon Tone Module was not plugged in upside down. Verify that the receiver works by transmitting to it from a walkie-talkie on the same channel as the Foxmitter. Have a friend check the wiring for opens, shorts, or errors that you may have missed.

A few simple tests can help to isolate the problem. If plugging the battery into the transmitter causes a hiss on the receiver, but no tone, then the trouble is in the area of transistor Q1 or Q2. In either case, check that the unijunction transistor, Q1, is oscillating. This is done by placing the leads of a cheap crystal earphone (from a transistor radio) between Base 1 and Base 2 of transistor Q1, with the battery plugged in. If no audio tone is heard, the trouble is in the sensor module, or R0, C2, R1, C3, or Q1. If the tone is heard, place the earphone between the collector and emitter of Q2. A louder tone should be heard. If the louder tone is heard, then the trouble is associated with the RF section and transistor Q3. If no tone was heard, check R2, C3, and Q2.

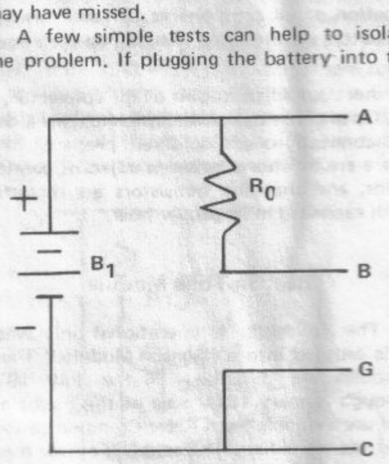


Figure 4: BEACON TONE MODULE SCHEMATIC DIAGRAM. The Beacon Tone Module consists of a battery and a resistor. It generates a continuous tone, which can be used as a locator beacon to find downed rockets.

If the trouble has been isolated to the RF section, double check the contact between the crystal pins and the rest of the circuit. Check the connections of R3, C4, C5, C6, L1, L2, Q3, and the antenna. Check the crystal for damage by plugging it into a walkie-talkie and broadcasting to the receiver. A damaged crystal will not work at all. Try touching the antenna of the transmitter directly to the antenna of the receiver. If this produces an audio signal, the problem is a weak battery or an antenna that is much too long or much too short.

If a voltmeter is available, check the voltages from the "-" side of the battery to the points listed in table 1. The battery should put out at least 12 volts when it is plugged into the transmitter.

Most problems are caused by poor solder joints, errors in the parts placement, dead batteries, and unintentional open circuits and short circuits. If all else fails, reheat all of the connections.

Flight Preparation

The transmitter fits into a 7 inch length of 0.8 inch diameter body tube. It should be oriented with the battery towards the nose of the payload and the antenna trailing out from the rear of the payload section, as shown in Figure 6. This arrangement allows the antenna to hang straight during the upward flight, and minimizes damage to the transmitter if the rocket should crash. Place a small amount of cotton at the front and rear of the payload tube to act as a cushion, and place a wad of cotton between the battery holder and the transmitter board to keep them from being pushed together by the lift-off acceleration.

The booster vehicle should be powered by a large engine with a short delay. A C6-3, a D13-3, or a pair of staged D engines are all satisfactory. Do not use the low thrust, long duration type E or F engines. The payload is too heavy for them.

Foxmitter-3 Test Voltages

Point	22.5 volt battery	15 volt battery
Pin A	22	15
Q1 Base 2	19	14
Q1 Emitter	4	2
Q1 Base 1	0	0
Q2 Collector	22	15
Q2 Base	2	1
Q2 Emitter	7	5
Q3 Collector	7	5
Q3 Base	-1	-½
Q3 Emitter	0	0

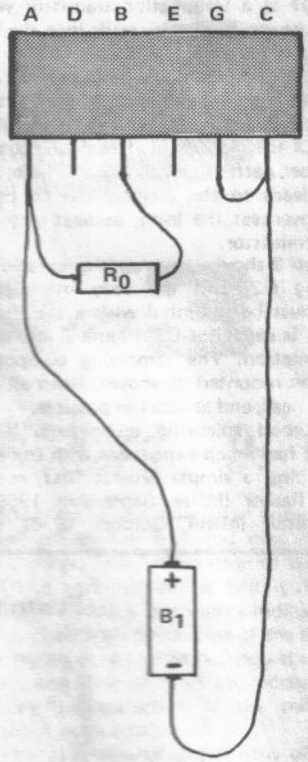


Figure 5: BEACON TONE MODULE WIRING DIAGRAM. The battery and resistor are connected directly to the six pin connector.

Use separate parachutes for the payload and the boosting vehicle. Attach the shock cord of the parachute for the payload section to the nose cone of the payload section, and attach a small weight to the end of the antenna. (See Figure 6) This arrangement minimizes the chances of tangling the antenna in the parachute lines, and it optimizes the signal strength of the Foxmitter.

Flight Operation

The only extra pieces of field equipment necessary for the operation of the transmitter are a portable Citizen's Band receiver, such as a *good* walkie-talkie, and a portable tape recorder. When preparing the rocket for flight in the field, leave the preparation of the transmitter until the end. The battery has enough power to last many flights, but it will be drained if it is left in the transmitter for long periods of time.

When the boosting vehicle is ready, place the battery in the transmitter, and check the receiver for a signal. Place the transmitter in the payload compartment of the rocket, and securely tape the nose cone into the payload compartment. This step is important because the inertia of the transmitter at ejection of the parachute is enough to push the nose cone off, and let the transmitter fall free to the ground.

The next step is to place the rocket on the launch pad and position the antenna so

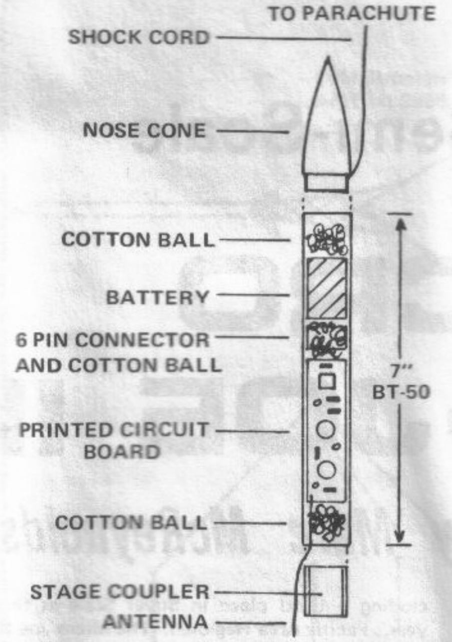


Figure 6: FOXMITTER-3 PAYLOAD SECTION. To provide maximum protection for the transmitter and keep the antenna from tangling in the chute, the parachute should be attached to the nose cone, and the battery should be mounted ahead of the transmitter circuit board.

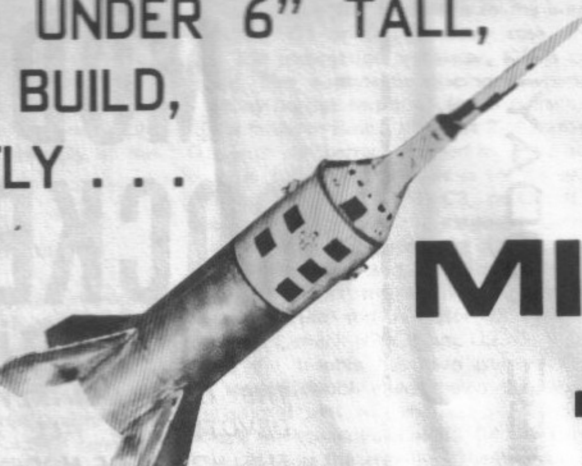
that it will not tangle in the launch equipment. Turn the receiver on, and check for a signal. Turn the tape recorder on, and place its microphone next to the speaker of the receiver. Launch the rocket, recover it, and remove the battery from the transmitter as quickly as possible. The tape recorder now contains a permanent record of the information transmitted during the flight.

The strength of the signal received during the flight is a function of the quality of the receiver, the strength of the transmitter battery, the relative orientation of the transmitter and receiver antennas, and the distance separating the transmitter from the receiver. For best results, stand about 50 feet from the launch site, and hold the walkie-talkie receiver in your bare hand. The receiver is much more sensitive when it is grounded by a human body than when it is sitting by itself. The reason for the separation of 50 feet is that the signal from the transmitter antenna is radiated sideways, not straight back towards the ground. The worst place to receive the signal is directly next to the launch pad as the rocket climbs.

The beacon tone module which is described in this article will not produce any scientific data, but it will allow you to test out the transmitter and the flight procedure. In addition it can be used in conjunction with the direction sensitive antenna described in the October 1970 issue of this magazine to locate the rocket once it has landed.

The Foxmitter-3 is completely compatable with the previously published Foxmitter-2 Sensor Modules. In addition, it may be used with several additional sensors now under development, and with a multiplexer, which allows the transmitter to send back up to 3 signals at once. These newest developments will be published in this magazine as soon as they are completed.

STANDING UNDER 6" TALL, EASY TO BUILD, FUN TO FLY . . .



Semi-Scale

MICRO-JOE II

by Marc McReynolds

The present trend in scale modeling seems to be towards large models requiring two or three engines for power. But there's more to scale than just how big the model is. It doesn't have to be three feet tall to get attention from your rocketeer friends. The Micro Joe (1/200 scale Little Joe II) is an example of this. Becasue it's so small, it's sure to get attention.

It uses Series III (short) engines because a regular engine is too long to fit in it. Due to its small size and stability characteristics, it is overpowered even with a ½A! This limits the engine selection to a ¼A3-1 or 2, but even with a ¼A it will reach an altitude of about seventy-five feet. I have launched mine eight times to date, and it has placed in both Spot Landing and Super Scale — including a third place in Super Scale at this year's Pacific Area Regional. The Micro Joe II is fun to fly, exhibiting a noticable whistle during the ascent.

Construction is simplified by using the parts from a plastic kit in building the Service Module, Command Module, and Escape Tower (Launch Escape System). This AMT kit costs 50¢ and is called "Apollo Spacecraft—Including Snoopy (Lunar Module) and Charlie Brown (Command Module)." You might want to buy two so you'll have some spare parts. A 1/200 scale Saturn could also be built around this kit. The base of the LM housing (included in the kit) is the same diameter as an Estes BT-55.

The "Micro Joe II" attracts quite a bit of attention at any flying session — mostly due to its size. A standard engine (at right) is too large to fit in its airframe. By using the AMT plastic kit for the CSM structure a highly detailed micro-scale model is possible.

Construction

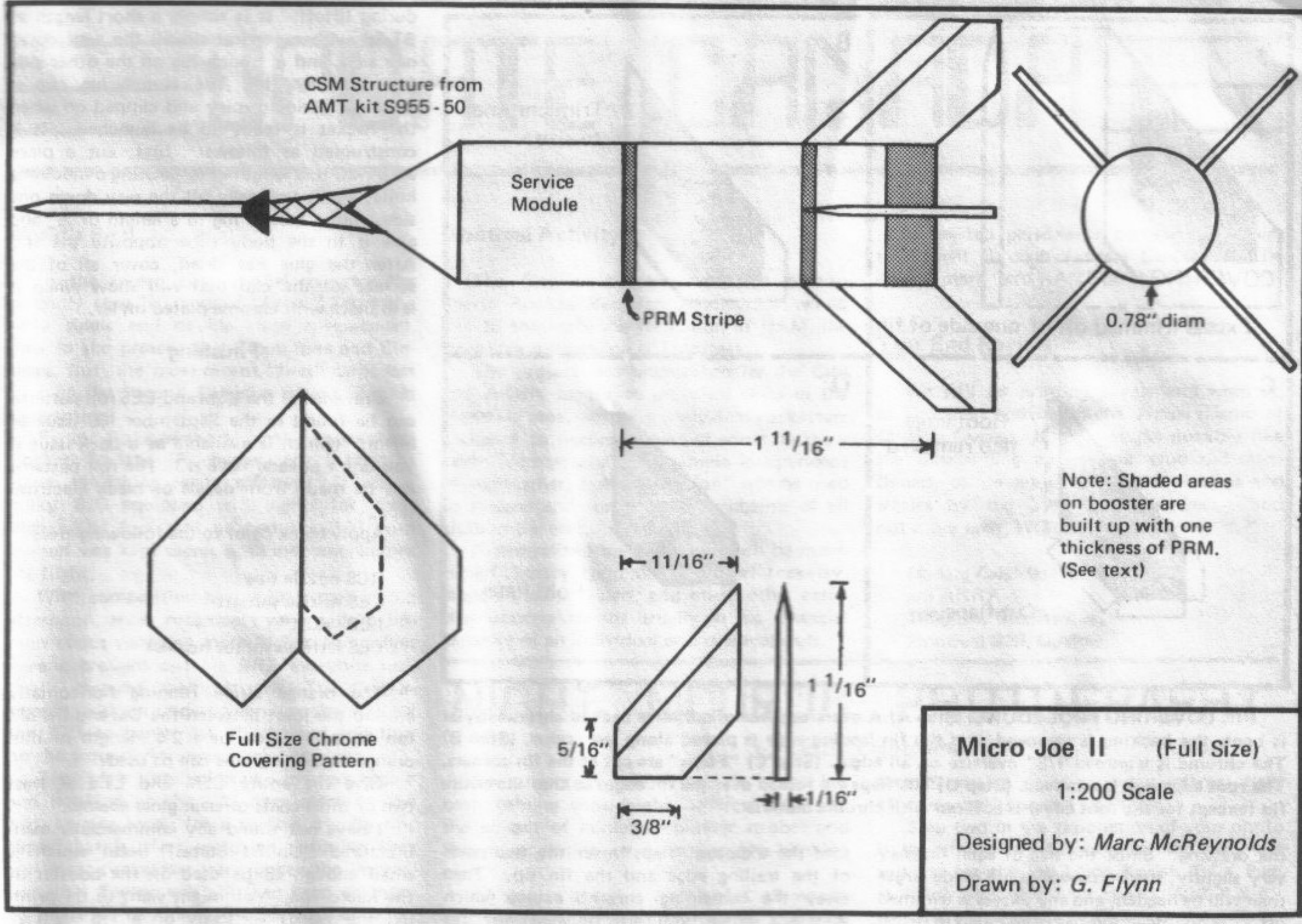
The Micro Joe uses tumble recovery. This is the only feasable method I have found because once the engine is in place, there is hardly any room for the shock cord, let alone the parachute. But it is so light that tumble recovery causes no problems.

When assembling the plastic kit, remember that only the Command Module (CM), Service Module (SM), and Launch Escape System (LES) will be used. Assemble these three units as shown in the kit instructions with the following exceptions:

- Glue the CM heat shield to the SM.
- Don't glue the large SPS nozzle to the SM.
- Don't glue the CM to the heat shield. That way, if the LES is the first part to hit the ground upon landing, the force of impact will be lessened since the CM will "pop apart" from the rest of the rocket.

The lower end of the SM must be removed to allow the shock cord to be stored inside of it. This can be accomplished by melting away most of the plastic with a small soldering iron and then filing down any rough edges. A Dremel Moto-Tool or a similar device could also be used. When finished, the SM should be open at the back with no flange protruding from around the edges.

Cut a BT-20 to a length of 3/4". Slide it up inside of the SM until it touches the heat shield. If it fits loosely, wrap masking tape around it until it is fairly tight. Smear a small amount of epoxy glue around the inside of the SM. Insert the BT-20 tube all the way into the SM until it can go no



farther. It should be flush with the back end of the SM.

Now cut a 1" length of BT-20. Cut a 3/32" wide slit lengthwise down the 1" tube. Apply a thin film of glue to the outer surface, and insert the tube inside the 3/4" long tube already mounted in the SM. It should be firmly pressed against the inner surface of the 3/4" long tube and protrude ¼" from the bottom of the SM.

Make a small paper shock cord mount and glue an 8" long shock cord to it. Apply glue to the back of the mount and place it up inside of the BT-20 as far as it will go. Make a Rear-Ejection Clip like the one featured in the April 1970 issue of MRm. Slide the other end of the shock cord through the "eye" of the REC clip and tie a knot in it.

Booster Assembly

Cut a BT-20 to a length of 1-11/16". Also cut a sheet of Estes Paper Reinforcing Material (PRM) or other adhesive backed material to a width of 1-11/16". Slide the CSM into place at one end of the tube. Wrap the PRM strip around the body tube five or six times until the body tube is built up to the outside diameter of the SM. Cut out three 2½" long bands from the leftover PRM. Make the first two 1/16" wide and the last one ¼" wide. Wrap one of the 1/16" bands horizontally around the top of the booster body tube so that its upper edge is flush with the upper edge of the body tube. Wrap the second 1/16" band horizontally around the body tube so that the bottom edge is 5/8" from the rear of the tube. The last band is also wrapped horizontally around the rear of the tube, its bottom edge flush with the bottom edge of the tube.

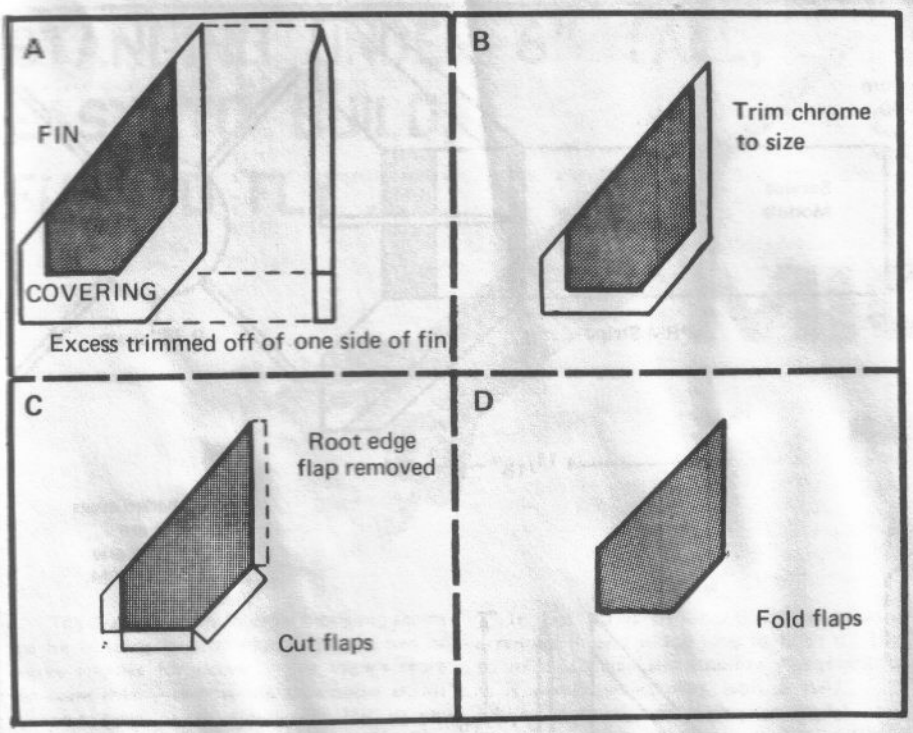
Cut out a piece of chrome plated mylar measuring 1-1/16" x 2½". Wrap it around the body, making sure that there are no gaps between the chrome and the tube. Press down on the mylar until the PRM bands become visible. Then, using a butterknife or other blunt object, apply pressure all around the edges of the three bands so that they will stand out better. Be careful not to tear or slit the chrome — all you want to do is make a sharp crease.

Make marks at the bottom end of the tube dividing it into four equally spaced sections. Since glue will not adhere to the chrome surface, it will be necessary to remove the chrome where the root edges of the fins will be glued. This should be done with a *sharp* razor blade or modeling knife so that the chrome won't rip or tear. The section that should be cut out for each fin should measure approximately 1/16" x 11/16". Remember that only the chrome should be removed, not the layers of PRM under it.

The four fins are cut from a sheet of 1/16" balsa measuring no less than ½" x 5". They are small enough that you may have a piece of scrap balsa that can be used. Transfer the pattern in the drawing to the balsa and cut out the fins. Make sure that the grain runs parallel to the leading edge of the fins. Bevel the leading edge of each fin as shown in the drawing.

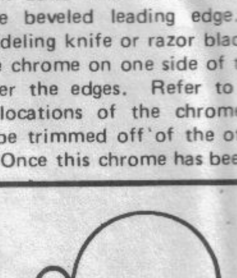
Cut out the fin coverings from a sheet of chrome-plated mylar using the pattern in

NASA's Little Joe II on the White Sands Missile Range launcher in 1964. Note that the paint pattern on this version is quite different from the decals supplied with the AMT capsule kit.



FIN COVERING PROCEDURE. (Step A) A oversize piece of adhesive backed chrome-mylar is bent, the backing is removed, and the fin leading edge is placed along the crease. (Step B) The chrome is trimmed 1/8" oversize on all edges. (Step C) "Flaps" are cut at the fin corners. The root edge flap is removed. (Step D) The flaps are folded over the fin edges so that the entire fin (except for the root edge) is covered with chrome material.

the drawing. Since the size of each fin may vary slightly, the fin coverings are made larger than will be needed, and any excess is trimmed off after the covering has been glued in place. Fold and crease one of them along the dotted centerline. Open it back up and remove the mylar backing. Place the fin covering over one of the balsa fins so that the crease runs along the beveled leading edge. Using a sharp modeling knife or razor blade, trim off all of the chrome on one side of the fin that hangs over the edges. Refer to drawing 1 for the locations of the chrome that will have to be trimmed off of the other side of the fin. Once this chrome has been trimmed,



LAUNCH LUG MOUNT. Slit a ½" length of BT-20 so that it can be slipped over the rocket body. Glue a launch lug to this ring. This split mount is removable, so that the model can be displayed without the lug in place.

fold the exposed "flaps" over the two parts of the trailing edge and the fin tip. Trim away the remaining chrome excess which is left. When you are finished, the fin should be completely covered with chrome except for the root edge, which should be bare. Repeat this procedure with the other three fins.

Preglue the four fins and the places where they will be attached. After the glue has dried, again apply a line of glue to the root edges of the fins and position them on the body at the four locations where the chrome was removed. Set the booster aside to dry.

The primary purpose of the clear plastic fin unit, mentioned earlier, is to protect the semi-scale fins you have just built from possible damage upon landing. It also serves as an added means of stability.

Cut out a rectangular section of .020" thick clear plastic fin stock measuring 2½" x 3/8". Wrap it as tightly as possible around an engine casing. The ends should overlap about ¼". Glue the strip together with clear butyrate dope and apply a piece of masking tape over the overlapping area until the butyrate dope has dried. Lay the clear plastic fin stock over the plastic fin pattern in the drawing. Make a dot on the plastic at each of the five corners of each of the four fins. Use a ruler to connect the dots. Cut out the fins using a pair of scissors or a modeling knife. Equally space them around the plastic band and glue them to it with clear dope. Cut a launch lug to a length of 3/8". Glue it to one of the corners formed by the plastic band and the fin root. Allow all of the dope on the fin unit to dry thoroughly. Then apply a fillet of butyrate dope to the fin-band joints and the launch lug.

A launch lug clip is needed to insure that the rocket slides smoothly along the rod during liftoff. It is simply a short length of BT-20 with a vertical slit all the way down one side, and a launch lug on the other side (see drawing 2). The launch lug clip is removed during display and clipped on when the rocket is ready to be launched. It is constructed as follows: first, cut a piece of BT-20 to a length of ½". Using a modeling knife, slit it vertically all the way down one side. Cut a launch lug to a length of ½" and glue it to the body tube opposite the slit. After the glue has dried, cover all of the surface of the clip that will show when it is in place with chrome-plated mylar.

Finishing

Drawings of the CSM and LES roll patterns can be found in the September '69 issue of MRm. (which is available as a back issue if you don't already have it.) The roll patterns can be made from decals or black electrical tape.

Apply black paint to the following areas:

RCS nozzle tips
LES nozzle throats
LES "skirt"
LES jettison motor nozzles

The orange stripe running horizontally around the joint between the CM and the SM can be painted on or a 2¼" length of thin orange decorating tape can be used.

Give the entire CSM and LES at least two or three coats of clear gloss enamel.

I have not found any commercially manufactured "United States" decal which is small enough to be used on the booster of the Micro Joe. You might want to try printing the words vertically on a 1/8" x 1¼" strip of PRM and then transfering the PRM to the booster, locating it as shown in the September '69 drawing.'

Flight Preparation

Slide the shoulder of the CSM "nose cone" into place to join the CSM and booster. Pull the Rear-Ejection Clip down through the booster and out the back end. Squeeze the clip and install it in the ejection end of the casing as far back inside as possible. Give it a couple of "wiggles" back and forth to "set" the teeth in the engine casing.

Wrap tape around the engine for a tight fit in the body tube. Insert the igniter into the nozzle and tamp in wadding. Press a square piece of masking tape over the engine's nozzle to make sure that the weight of the clips does not pull the igniter out of place on the launch pad. Slide the engine into place in the body tube so that it sticks out of the bottom 3/8". Slide the plastic fin unit over the bottom of the engine. If necessary, wrap masking tape around the protruding part of the engine until the fin unit fits tightly. If the engine and fin unit fit tightly as instructed, there should be no need for an engine block since you will only be using ¼A engines.

Clip on the launch lug clip just above the fins and line up its launch lug with the one on the plastic fin unit. The Micro Joe is now ready to fly.

You might want to try building a launch complex like the one shown in the photos. Mine is for display only but it could easily be modified to launch the rocket.

UPDATE CANADA

World's First

In the recent past, model rocketry has certainly seen its share of "firsts." From the early single and double stage spectaculars, thru to the present day Foxmitters and Cinerocs. But, the most recent "first" came last July at the Second Canadian Model Rocket Convention.

Ferenc Roka of the Monroe Astronautical Rocket Society (Rochester, N.Y.) brought along something really different. It was a bulky B/G equipped with lights for night flight. The fact that he had the B/G with himself was kept secret until moments before the flight.

With competition having been held in the afternoon, most rocketeers were a little ho-hum about watching more flights. But, when Ferenc brought out his B/G, everyone suddenly changed their attitude. The first attempt, with an underpowered engine, caused the B/G to barely get off the rod and flop on the ground. An unsuccessful attempt.

Then after installation of a stronger engine and hooking up the B/G once more on the pad, he was ready for a second try. By this time, that is after watching a fizzled first try, most rocketeers were under the impression that Ferenc was going to keep us there all night till he finally got his B/G to work. Then at 10:13 p.m., July 3, 1971 the B/G took birth, cleared the rod, and slowly climbed to about thirty feet. It then looped over and began a 45 degree decent. The B/G used about 20 feet or ground as a runway to make a three point landing. This whole spectacular flight lasted only about seven seconds, but long enough to make Ferenc Roka the first rocketeer to ever launch and track a B/G in the dark of the night.

It is hoped that this event will inspire other rocketeers to conduct all sorts of flight characteristic studies with B/G's, because now for the first time will a rocketeer be able to capture the entire flight for analysis in a single frame of film.

The Greatest!

At a recent Canadian Rocket Society launch in Toronto, a CMR egg capsule was launched on what turned out to be a spectacular flight.

Paul Shindman saw his single stage, D engine, egglofter climb to over a thousand feet into the blue sky. As it arched over the parachute didn't eject, the engine did, and the rocket began a death dive.

The rocket crashed into the grass and soft sod. And, to the amazement of the rocketeers present, the egg was recovered undamaged. The egg capsule was also recovered undamaged.

That just goes to prove again that those CMR eggcapsules are indestructable. A good design for one is the Beaver IC in the December MRm.

Montreal Activity

The City of Montreal and the Atmospheric Rocket Research Association would like to announce the formation of RAM, the Rocketry Association of Montreal.

The project was undertaken by the City and ARRA to try to unify all clubs in the Montreal area, and give individual rocketeers a chance to become a part of some rocketry body. Member clubs will remain independent of each other, but this "union" will be used to discuss and try to solve problems of all clubs in the area.

A centralized meeting place will be maintained, library supplied on model rocketry, launch sites provided, and many other activities undertaken not usually in the financial capacity of an individual or individual club.

Interested persons or parties may direct their mail through *Update Canada*, but be sure to mark "c/o RAM" on the envelope.

Year End Review

We will be printing a year end wrap up of Canadian activity in the January issue of *Update Canada*. If you would possibly like the outstanding event your club did mentioned, please let us have any pictures and stories by the 30th of September — and not a day later. Write to:

Update Canada
c/o ARRA
7800 Des Erables Ave.
Montreal 329, Quebec

NIGHT MODROC PHOTOGRAPHY

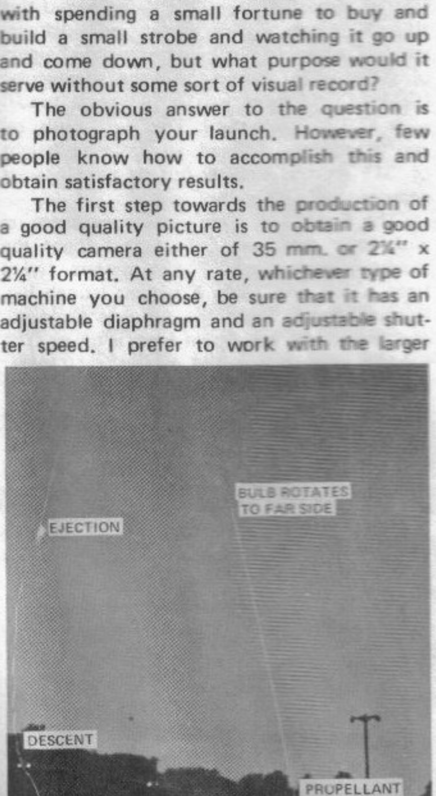
by Lester Lightstone

One aspect of model rocketry which has been gaining considerable interest has been the advent of miniature blinker strobes and the more simple to construct non-blinking ones.

Of course there is nothing at all wrong with spending a small fortune to buy and build a small strobe and watching it go up and come down, but what purpose would it serve without some sort of visual record?

The obvious answer to the question is to photograph your launch. However, few people know how to accomplish this and obtain satisfactory results.

The first step towards the production of a good quality picture is to obtain a good quality camera either of 35 mm. or 2¼" x 2¼" format. At any rate, whichever type of machine you choose, be sure that it has an adjustable diaphragm and an adjustable shutter speed. I prefer to work with the larger format camera as it provides a larger field of view with its square viewfinder.



Night launched A8-3 Estes Shrike.

Step two in the production of your photo is the choice of the proper film; the most suitable for the job being Kodak Tri-X Pan. It is of relatively high speed (400 A.S.A.) and the graininess is moderate under enlargement. The use of a good quality tripod is essential. It must be rock steady in order to avoid camera jiggle and the consequent ruining of your photograph. Another important piece of equipment is the cable release, which will be used to trip the camera's shutter without causing unwanted vibration. If the camera is of reputable make there should be a cable release socket built into the camera's housing.

A light meter reading is usually unnecessary as the sky and background are completely dark anyway. That is why it is a good idea to carry out night launches in a totally dark area free of interfering lights. An even more important reason for having a completely black background is that your model's strobe will leave a more distinct trail without having any competition!

When you are preparing for your exposure, stop down your lens to about f/8 or f/11 for maximum depth of field, and turn your shutter speed down to B.

If your shot is at *close*, and you expect your rocket to leave your field of view . . . you hope . . .you should open your shutter approximately 1 sec. before launch, and close it as soon as it leaves the field of view.

If you wish to photograph your entire flight as I have done, you will have to calculate the approximate altitude, and then move your camera back far enough to encompass its complete trajectory. In a case such as this you should open your shutter 1½-2 seconds before lift-off, and keep the shutter open until the rocket touches down. This may take as long as 10-12 seconds depending upon which engine you select.

RECORD - SETTING MIDWESTERN MEET WITH 311 METER ROBIN EGGLOFT FLIGHT

MMRR-71

June 25-27,1971 Columbus, Ohio

by George Flynn

Over the past two years the Midwest Model Rocket Regional has become established as a meet at which the "old standby" low to medium power events are flown — and generally flown well. This meet, sponsored by the Columbus Society for the Advancement of Rocketry, is traditionally more a test of designing and construction skill than other contests where the better flights go untracked or untimed. MMRR-71 was no exception. It marked the introduction to NAR competition of the revolutionary new MPC Minijet engines, and saw a new U.S. record set with a Minijet powered bird. Writing in the Steel City Section newsletter, one of the MMRR contestants said of this meet: "The competition was the most sophisticated, and the toughest ever seen at a regional."

Midwestern rocketeers from Ohio, Illinois, Iowa, and Pennsylvania gathered in Columbus over the June 25-27 weekend for MMRR-71. The site was a large, open field on the grounds of Lockbourne Air Force Base, just outside of Columbus. Contest Director Jerry Gregorek wasn't too optimistic the night before the meet, as a four inch rain flooded Columbus, but by morning only a low cloud ceiling remained to remind contestants of the downpour.

The first event on Saturday's schedule was Predicted Altitude. In this event, open to any engine power, each rocketeer predicts his altitude before the flight, and the contestant with the lowest percentage error between predicted and tracked altitude is the winner. A 0% error is, of course, the best possible score, and that's just what Bob Starks managed in the D Division. Flying an Estes Big Bertha he predicted 123.5 meters, the altitude he had tracked the model to on a previous occasion, and got it exactly. Until that time, George Pantalos seemed to have a sure first place with his 0.5% error. In all divisions, the prediction had to be accurate to within 8% to assure even a third place in the contest.

Robin Eggloft, the smallest of the egglofting events, was next on the schedule. When this event was flown at MARS-V last fall the winning altitude was 193 meters. At MMRR almost a dozen flights exceeded this altitude. Most of the models were single-staged, C-powered birds which reached heights of 200 to 250 meters. But the spectacular flight of the meet was a two-stage model with a B in each stage. This bird, built by Jon Randolph, reached an amazing height of 311 meters, beating out its next nearest competitor by 62 meters.

The Fox Team did a little experimenting with their egglofter. On its first flight the model was tracked to 174 meters flying from a rod and using a regular launch lug. For its second flight the lug was removed, and the model was flown from a tower. The tracked altitude was 184 meters, a 10 meter increase over the previous performance. Not quite a scientific experiment, since they didn't take enough data to be conclusive, but the ten meter altitude gain indicates that towers may be an advantage in high-performance altitude competition.

There were few good thermals — the type that result in ten or twenty minute flights — for the Class 0 PD event, but with just a little help from the rising air J. Mechtly managed a 211 second duration. In the C Division the four top-ranked competitors all turned in flights of over two minutes. Howard Kuhn had an amazing Break-Away PD flight. He used a large chute, and the model fell quickly out of the sky. After 30 seconds it had floated to within 20 feet of the ground, but then it caught one of the best thermals of the day. It went "up, up, and away," with Howard giving up the chase after 6½ minutes. He was DQ'ed, of course, for failing to return the model.

Hornet Boost Glide was the final event on the Saturday schedule. It looked like the racks were full of Bumble Bees, with this being the most popular glider flown, but there were enough other designs to provide some variety. Howard Kuhn flew a Manta, of course, but this one was different. It was a small, styrofoam Manta parasite, which was boosted attached to the side of a standard

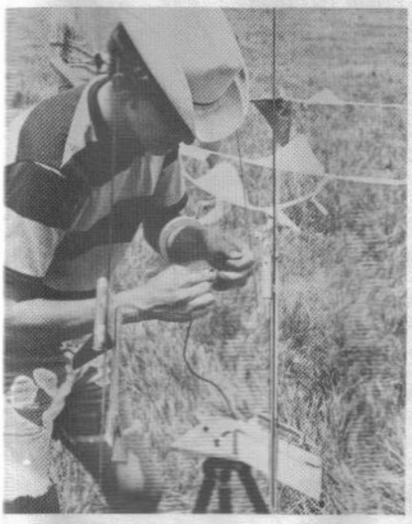
The typical egglofter was a single stage, C - powered model topped by the CMR egg capsule . . .

. . . but the winning Egglofter was Jon Randolph's two-stage model, powered with a B in each stage, which reached 311 meters.

Richard Brandon's swing-wing, a copy of Jon Robbins' Ground-Hog, had a 2½ foot span and 1¾" chord. Its duration was 23.2 sec.

Craig Streett's Hornet B/G took second place in Division C with a flight of 116.6 sec.

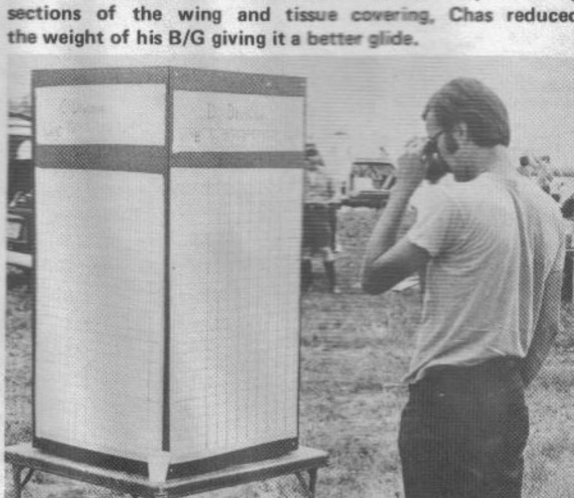
Once again big scale models dominated, with Chuck Krallman's hugh Astrobee 1500 taking second place in the B Division competition.



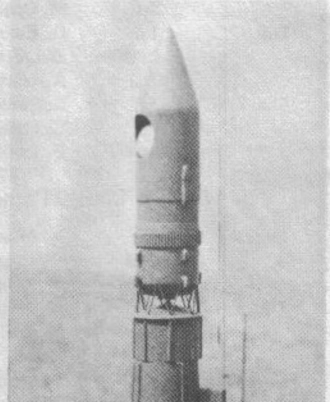
Brian Dolezal's Sparrow R/G, a moving canard, flop wing, moving engine model, met with limited success when one wing failed to open.

Chas Russell's 14" span cut-out wing B/G took first in Swift B/G with a 139.0 second duration. By removing sections of the wing and tissue covering, Chas reduced the weight of his B/G giving it a better glide.

The scratchbuilt scale Jupiter-C by Kerry Mechtly looked so good that many contestants thought it was the plastic Hawk model.



An on-the-field "Results Board" allowed MMRR contestants to check their standings in each event while the contest is still in progress.



The Fleischer-Pearson Team's scale Vostok, standing over two feet tall, was plenty large enough to allow considerable detailing. In this scale it was possible for them to include much detailing on the upper stage.

MMRR-71 Results

Predicted Altitude

Div. A	1st	G. Fornes	4.7%
	2nd	W. Page	5.3%
	3rd	J. Starks	7.8%
Div. B	1st	M. Scipione	3.2%
	2nd	D. Ducharme	7.0%
	3rd	U. Nuniviller	7.2%
Div. C	1st	T. Secrist	5.5%
	2nd	P. Kauffman	5.7%
	3rd	M. Micci	6.6%
Div. D	1st	B. Starks	0.0%
	2nd	G. Pantalos	0.5%
	3rd	Fox Team	1.6%

Robin Egg Loft

Div. A	1st	J. Gordon	249 m.
	2nd	K. Mechtly	189 m.
	3rd	J. Starks	170 m.
Div. B	1st	K. Mengel	217 m.
	2nd	M. McMasters	192 m.
	3rd	M. Copcut	189 m.
Div. C	1st	D. Evans	248 m.
	2nd	B. Dolezal	226 m.
	3rd	A. Van Jones	218 m.
Div. D	1st	J. Randolph	311 m.
	2nd	C. Russell	232 m.
	3rd	F. Long	224 m.

Class 0 Parachute Duration

Div. A	1st	K. Mechtly	150.5 sec.
	2nd	G. Fornes	31.2 sec.
	3rd	A. Peters	27.5 sec.
Div. B	1st	M. Scipione	73.0 sec.
	2nd	M. Wells	55.0 sec.
	3rd	K. Mengel	50.7 sec.
Div. C	1st	B. Smith	150.3 sec.
	2nd	M. Micci	140.0 sec.
	3rd	Fliesher-Pearson Team	125.0 sec.
Div. D	1st	J. Mechtly	211.8 sec.
	2nd	J. Randolph	186.3 sec.
	3rd	J. Robbins	79.1 sec.

Hornet Boost Glide

Div. A	1st	K. Mechtly	31.0 sec.
	2nd	M. Wladecki	28.1 sec.
	3rd	W. Page	16.0 sec.
Div. B	1st	Gloger-Goddard Team	55.4 sec.
	2nd	J. Nuniville	45.0 sec.
	3rd	C. Krallman	43.1 sec.
Div. C	1st	A. Van Jones	339.9 sec.
	2nd	C. Streett	116.6 sec.
	3rd	R. Gerard	79.0 sec.
Div. D	1st	D. Ball	114.5 sec.
	2nd	J. Gregorek	94.5 sec.
	3rd	J. Adnet	77.8 sec.

Swift Boost Glide

Div. A	1st	M. Wladecki	102.8 sec.
	2nd	W. Page	70.5 sec.
	3rd	J. Gordon	52.0 sec.
Div. B	1st	C. Krallman	141.0 sec.
	2nd	Gloger-Goddard Team	127.6 sec.
	3rd	M. McMaster	67.6 sec.
Div. C	1st	H. Heimann	98.6 sec.
	2nd	D. Leckington	62.0 sec.
	3rd	J. Shafer	61.3 sec.
Div. D	1st	C. Russell	139.0 sec.
	2nd	D. Ducharme	127.0 sec.
	3rd	G. Flynn	117.0 sec.

Class 2 Streamer Duration

Div. A	1st	A. Peters	55.6 sec.
	2nd	J. Beyne	50.4 sec.
	3rd	J. Diamond	49.0 sec.
Div. B	1st	W. Dillon	64.5 sec.
	2nd	M. Nowak	54.0 sec.
	3rd	J. Starks	51.6 sec.
Div. C	1st	M. Micci	64.3 sec.
	2nd	A. Van Jones	57.1 sec.
	3rd	R. Gerard	55.4 sec.
Div. D	1st	G. Lutz	112.0 sec.
	2nd	J. Randolph	85.9 sec.
	3rd	J. Adnet	70.5 sec.

Sparrow Rocket Glider

Div. A	1st	W. Page	7.0 sec.
		(no other qualified flights)	
Div. B	1st	C. Krallman	31.2 sec.
		(no other qualified flights)	
Div. C	1st	B. Cline	39.4 sec.
	2nd	F. Schubert	31.3 sec.
	3rd	Fleischen-Pearson Team	25.5 sec.
Div. D	1st	J. Robbins	41.9 sec.
	2nd	H. Kuhn	36.5 sec.
	3rd	F. Long	17.9 sec.

Scale

Div. A	1st	J. Gordon	784 pts.
	2nd	K. Mechtly	702 pts.
	3rd	W. Page	407 pts.
Div. B	1st	M. McMasters	765 pts.
	2nd	C. Krallman	670 pts.
	3rd	M. Nowak	584 pts.
Div. C	1st	Fleischer-Pearson Team	893 pts.
	2nd	C. Streett	739 pts.
	3rd	B. Dolezal	718 pts.
Div. D	1st	H. Kuhn	875 pts.
	2nd	J. Randolph	860 pts.
	3rd	D. Ducharme	725 pts.

Plastic Model

Div. A	1st	W. Page	700 pts.
	2nd	J. Starks	648 pts.
	3rd	K. Mechtly	573 pts.
Div. B	1st	Gloger-Goddard Team	824 pts.
	2nd	J. Starks	630 pts.
	3rd	M. McMasters	625 pts.
Div. C	1st	Kasper-Lundberg Team	719 pts.
	2nd	B. Dolezal	699 pts.
	3rd	Fleischer-Pearson Team	644 pts.
Div. D	1st	G. Pantalos	842 pts.
	2nd	J. Randolph	800 pts.
	3rd	D. Ducharme	675 pts.

Overall

Div. A	1st	Walter Page	330 pts.
Div. B	1st	Chuck Krallman	315 pts.
Div. C	1st	Fleischer-Pearson Team	186 pts.
Div. D	1st	Jon Randolph	210 pts.

Section Standings

1st	Columbus Soc. for Advancement of Roc.	1650 pts.
2nd	North Royalton Rocket Society	984 pts.
3rd	Upper Arlington Rocket Club	567 pts.
4th	Socio-Darby Rocket Club	426 pts.
5th	Hawkeye Section	240 pts.

model. It turned in a 77 second flight to tie for 4th place. The most spectacular of the Hornet flights, coming towards the end of the day's flying, was a 339 second performance by A. Van Jones. Unfortunately, he didn't recover the glider and had no pre-flight photo of it, so he was unable to file what should be an almost unbeatable Hornet record.

On Saturday evening many contestants gathered at the motel to view films of NARAM-12, previous Ohio meets, and other rocket activities.

Sunday really marked the introduction of MPC Minijets into competition. Though a few were flown on Saturday, most contestants didn't have models or engines for that day's flying. However MPC's range store was selling kits and engines on Saturday, and by Sunday morning at least 30% of the contestants had been ambitious enough to build new, and *smaller* models for the Streamer Duration event.

In the Class II (B-engine) Streamer Duration event the two top flights of the meet were both powered by Minijets. Gilbert Lutz took first place with 112 seconds (a new U.S. record), using a T-15 size rocket and quite a large streamer. Just behind him was Jon Randolph, also flying a T-15 tube model, with a duration of 85 seconds.

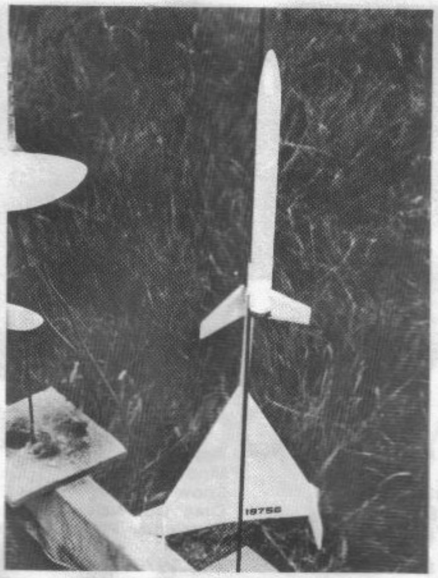
There were no spectacular flights in the Swift B/G event, however the durations were consistently *good* with nine contestants turning in 90 second plus flights.

The best flight of the day, and the only time at MMRR where an A or B Division contestant beat out the C or D winner, was a 141.0 second duration by Chuck Krallmann. This barely edged out the 139 second flight by Chas Russell in D Division. Chas, flying a cut out wing B/G with only a 14" span got enough of a circle on his glider to keep it in sight throughout its entire flight.

Next on the schedule was the new Sparrow Rocket Glider event. Flown only once before at a major regional contest, the best Sparrow R/G time previously reported was 40.0 seconds turned in by Doug Plummer at MARS-V. Jon Robbins exceeded this, flying a Ground Hog naturally, with a duration of 41.9 seconds. This swing-wing Ground Hog had a span of 36 inches and a chord of 1½ inches. With a 24:1 aspect ratio it looked more like a sailplane than an R/G, but it worked! (Complete plans for Jon's Sparrow R/G begin on page mm of this issue of MRm.) an "imitation Ground Hog," by Richard Brandon, didn't do as well as the real thing. Brandon's 2½ foot span, 1¾" chord swing-wing turned in a duration of only 23.2 seconds when a construction misalignment put it into a tight gliding turn.

Perhaps the most imaginative R/G of the meet was Brian Dolezal's model on which almost everything moved. He flew a canard, flop-wing, on which the engine was supposed to move back after boost to set the glide trim. On its first flight the model arced over and impacted. The second flight was a little better, when one wing opened fully and the other only partially deployed, giving the R/G a high sink rate and an 18 second duration.

The Plastic Model event showed more variety than has ever been seen in this event. The most unusual of the entries was a flight converted Robot, from the TV series "Lost in Space," entered by the Gloger-Goddard team. They used clear plastic fins attached to the Robot's base to capture B Division first place.



The new MPC "Delta-Katt" B/G, flown by Gil Lutz, is a fast gliding bird which turned in a 33 second duration powered by a ½A Minijet.

Larry Brown of Centuri Engineering preps the Centuri "Lifting Body," a unique gliding recovery model which made its first appearance at MMRR. This model generates lift for the gliding recovery by airflow over the body.

In D Division most of the models looked more "rocket-like" with first place going to George Pantalos' conversion of the Revell 1/48th scale Apollo Command Module. No fins were used, and the model was quite stable using just the Command Module's conical shape to shift the CP rearward and a little nose weight to move the CG forward. The flight was quite stable, netting George 842 points in the event. Second place in D Division went to a hybrid plastic model built by Jon Randolph. Jon combined the Hawk Jupiter-C (a Redstone booster) with the 1/48th scale Revell Mercury capsule to give him a Mercury-Redstone plastic model.

Other plastic conversions include several beautifully done Revell Solaris spaceship kits. These models flew well without the addition of any clear plastic fins, making it an easy beginner's conversion (but not a high point-getter). Two contestants attempted flights of the Revell Vostok capsule, but the lack of plastic spin-fins (as described in Bob Parks' conversion of this model, MRm September '70) caused them to go unstable. Richard Brandon's plastic USAF Phantom met the same fate, and landed within inches of the range trash can. A flying Red Fire Truck, using big plastic fins, proved that "you can make anything fly with enough noseweight and plastic fins, when it turned in a good straight up flight.

D Division scale was the expected contest between Jon Randolph and Howard Kuhn — both challanging for the scale title at the National Championships. Competing against each other for the first time since NARAM-12 (where Jon's Asp edged out Howard's Nike-Tomahawk). Howard flew his Nike-Tomahawk to a 15 point victory over Jon's 2½ foot tall D-Region Tomahawk.

One of the nicest scale birds built by a younger modeler in recent years was a 1/48th scale Jupiter C entered by Kerry Mechtly. This model was so well done that other contestants thought it was a Hawk Jupiter-C for plastic model, though it was really scratch-built from paper tube and balsa.

The flying concluded with a manufacturers' demonstration launching by Larry Brown of Centuri and Gil Lutz of MPC. Centuri's new Mercury Redstone, now available after a production delay involving the plastic Mercury capsule, is beautifully done, with a highly detailed capsule section. Its flight performance was also good with a boost to over 100 feet when powered by a C6-3. Centuri has also introduced a slip-on plastic fin section for the Saturn-V kit, allowing the model to be flown with scale balsa fins and the slip-on unit. This item is now standard in the Centuri Saturn-V kit. Still in the experimental stage is the Centuri "Lifting Body" — a unique cardboard model which Larry designed. The Lifting Body, using a construction technique similar to the Point, is a gliding sport model which boosts straight up, ejects it sengine, and goes into a glide similar to that of a NASA lifting body. The lift is generated from airflow over the fuselage, making wings unnecessary.

From MPC it was Minijets that were happening, as Gil Lutz took the opportunity to introduce the new engines and the Miniroc line of kits which accompany them. The Delta-Katt, an unusual canard wing B/G, had already proven itself in the Hornet competition, with a 33 second flight on a ½A. The difference in Altitude between a standard 19 or 20 mm diameter rocket and the 15 mm models made possible by the Minijets was clearly evident. Included in the MPC display was a scale model of the Astrobee-D, standing 15.6" tall, and available in kit form from MPC.

MMRR-71 concluded, as has become tradition, with an awards banquet and the presentation of medals to the winners. With his first place overall, Jon Randolph added another 210 points to his total in his effort to emerge National Champion for the 70-71 Contest Year. Other overall winners were Walter Page in A Division, Chuck Krallmann in B Division, and the Fleischer-Pearson team in C Division.

U.S. RECORD SETTING SWING-WING ROCKET / GLIDER...

GROUND HOG 16

SPARROW ROCKET/GLIDER

By Jon Robbins

The Groundhog 16 is a variable-geometry (swing-wing) glider, specifically designed for the new Rocket Glider event. In designing the bird for this event, various other configurations were examined and subsequently discarded. Basically there were two methods which were considered. The first was a shift of the center of gravity position. This was discarded as the CG shift did not present any advantage over current B/G technology — there was no reduction in drag during the boost phase, hence lower altitude and duration would result. The second method is a shift in the center of pressure (moveable wings). Here you have two basic possibilities, the first being the flop-wing (see MRm, August and September 1970). This method provides an improvement in boost phase drag, but still wasn't what I was after. Besides, someone else thought of it first!

The method utilized with the Ground Hog 16 is the "swing-wing" concept, where the wings pivot parallel to the fuselage during boost and swing out upon reaching apogee. Previously only in the larger classes of gliders was any thought given to the swing-wing design due to the misgiven idea that swing-wings had to be *heavy*. The Ground Hog 16 weighs in at a little over 30 grams in glide configuration. This includes 10 grams for an expended engine. The 20 gram net weight for a glider of this wing area (54 square inches) should dispell this overweight theory.

The reduction in frontal area during boost (wing cross-section less than ½ square inch) allows maximum altitude to be realized, and hence gives a longer glide duration.

As of this writing, the Ground Hog Rocket/Glider concept has been entered in one Area meet (Buckeye II), two Regionals (PRANG-II and MMRR-71), and two Record Trials (NART-II and PACT-I). Events have ranged from Hornet to Condor, and the Ground Hog design *has yet to be beaten* by the competition.

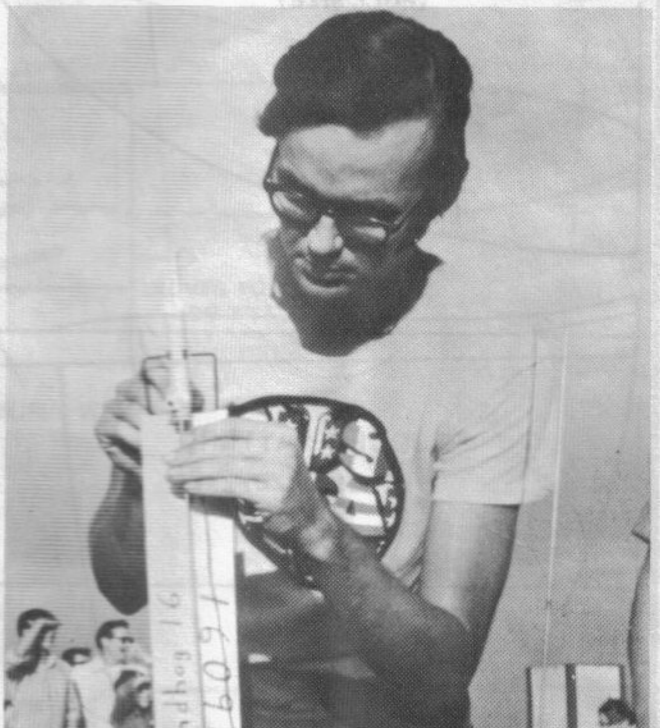
If the Ground Hog is to be your first glider, *don't build it!!!* Instead, build, trim, and fly a dozen or more of the gliders sold in kit form or those published in **Model Rocketry**. The Ground Hog is a winning Rocket/Glider, but should only be attempted by the experienced rocketeer due to its complexity.

Construction

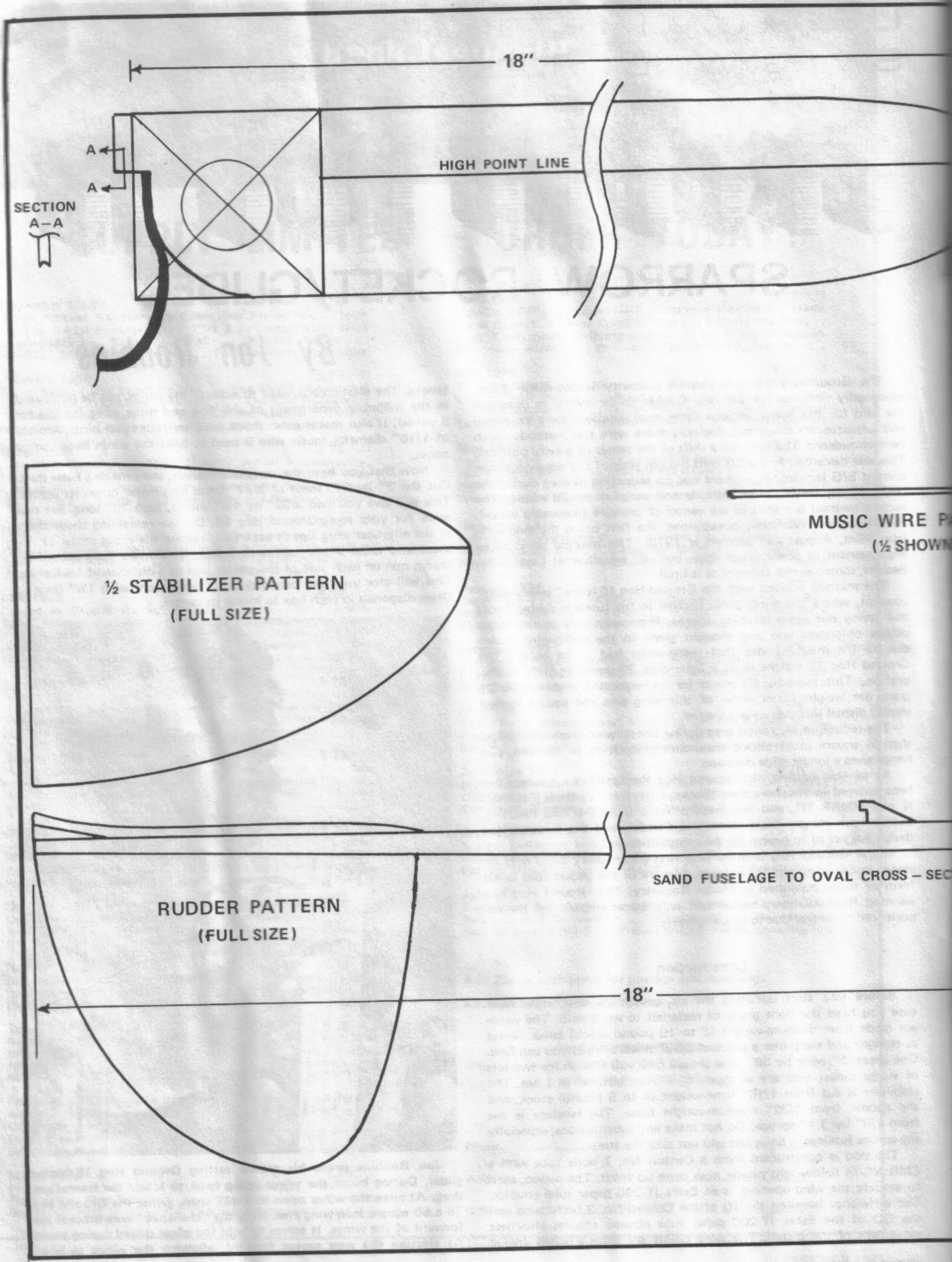
Before you start polluting the air with balsa dust, let's make sure you have the right grade of materials to work with. The wings are made from medium-weight (8 to 10 pound stock) balsa. Select as straight and warp-free a piece of 3/32" thick balsa as you can find. One sheet, 3" wide by 36" long should give you enough for two sets of wings unless you are as much of a balsa butcher as I am. The stabilizer is cut from 1/16" light-weight (4 to 6 pound) stock, and the rudder from 1/32" medium-weight balsa. The fuselage is cut from 1/8" by 3/4" spruce. Do not make any substitutions, especially the spruce fuselage — balsa just will not take the stress.

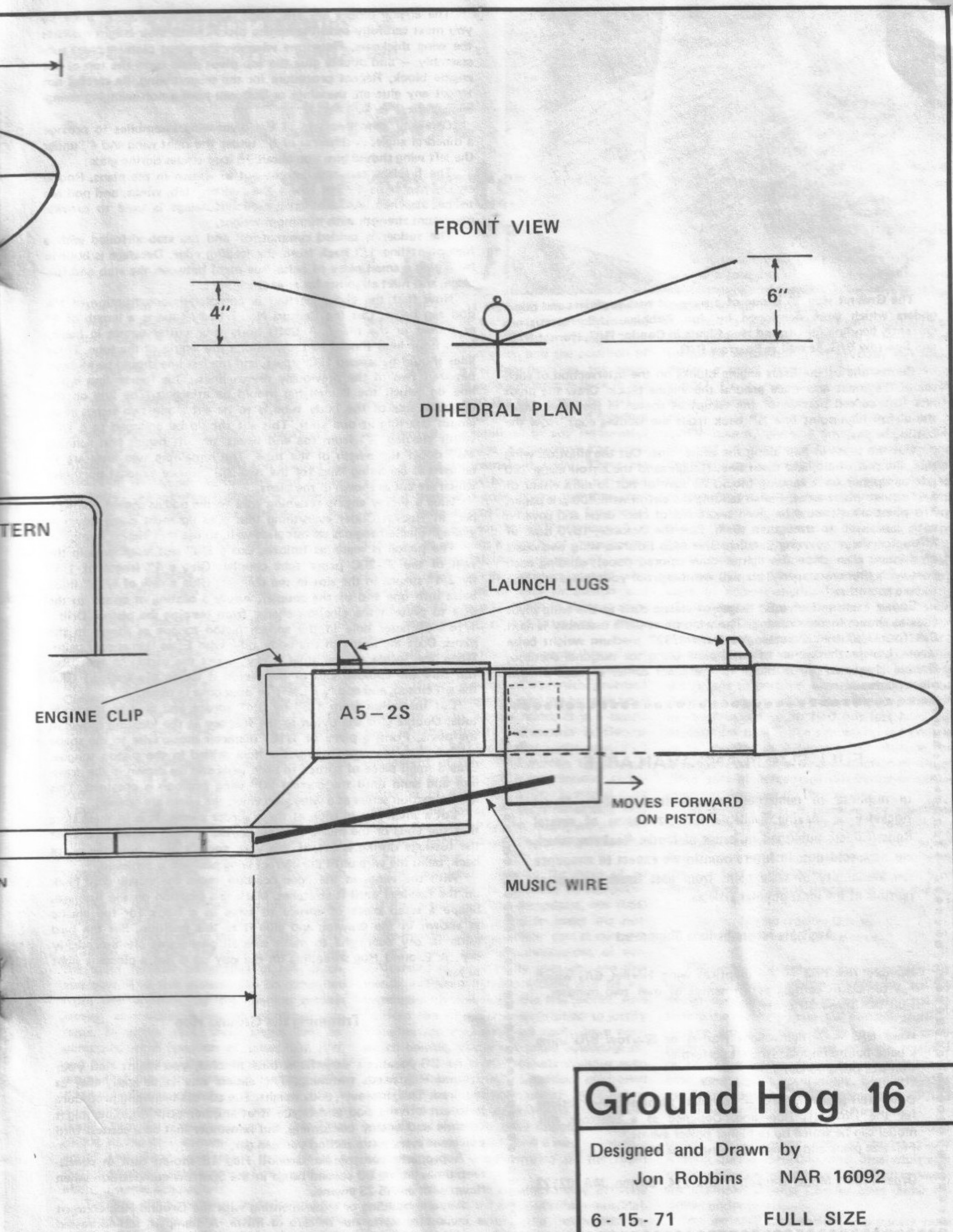
The pod is constructed from a Centuri No. 7 body tube with a CMR NC-74 lightweight plastic nose cone up front. The piston, used to actuate the wing opening, is an Estes JT-20C paper tube coupler. The difference between the ID of the Centuri No. 7 body tube and the OD of the Estes JT-20C paper tube coupler ensures effortless movement of the piston. The wing pivots are Estes EB-20B engine blocks. The elastic cord, used to actuate the wings, can be purchased in the millinery department of any five and dime store (at 35¢ for 8 yards). It also makes great shock cord for your other birds. A piece of 1/16" diameter music wire is used to hold the wings back during boost.

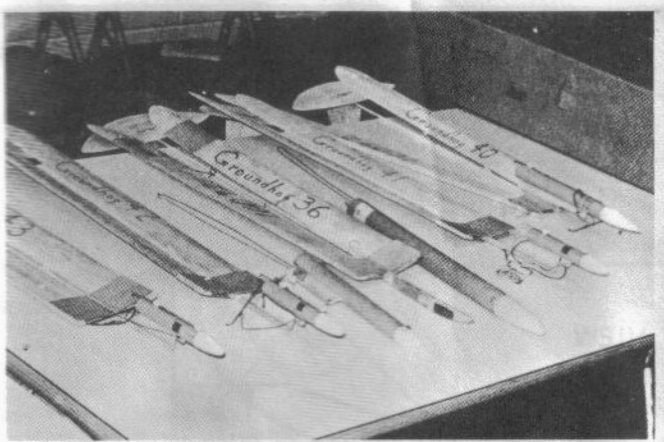
Now that you have the correct materials, start making balsa dust. Cut the 3" by 36" sheet of 3/32" balsa lengthwise down its center. This will give you two 3/32" by 1½" sheets, each 36" long. Set one aside for your next Ground Hog 16. On the remaining sheet draw in the elliptical wing tips at each end. Locate the exact center of the sheet and draw a line across its width. Two more lines should be drawn one on each side of the center line at a distance of 1½ inches. This will give you two boxes, side by side, each being 1½" square. Draw diagonals in each box to locate its center.



Jon Robbins preps his record setting Ground Hog 16 rocket glider. During boost the wings swing back to lower the frontal area drag. At apex the wings open to a 36" span, giving the Ground Hog 16 a 50 square inch wing area. Note the "U-shaped" wire bracket just forward of the wings. It serves to hold the wings closed during boost. At ejection the wire moves forward, allowing the wings to open.


18"
A
A
SECTION
A–A
HIGH POINT LINE
MUSIC WIRE
½ STABILIZER PATTERN
(FULL SIZE)
SAND FUSELAGE TO OVAL CROSS –
RUDDER PATTERN
(FULL SIZE)
18"


FRONT VIEW
4"
6"
DIHEDRAL PLAN
TERN
LAUNCH LUGS
ENGINE CLIP
A5–2S
MOVES FORWARD
ON PISTON
MUSIC WIRE
Ground Hog 16
Designed and Drawn by
Jon Robbins NAR 16092
6-15-71 FULL SIZE



The Ground Hog 16 is one of a series of rocket gliders and boost gliders which were developed by Jon Robbins. U.S. records are currently pending for Ground Hog flights in Condor R/G, Hornet R/G, and Sparrow B/G, as well as Sparrow R/G.

Center one of the Estes engine blocks on the intersection of each set of diagonals and trace around the engine block. Draw the pivot line (the curved portion of the wings) as shown in the plans. Mark the airfoil high-point line ½" back from the leading edge. Now the cutting begins.

Cut the sheet in half along the center line. Cut the elliptical wing tips, the pivot hole, and pivot line. Rough sand the airfoil using 220 grit sandpaper on a sanding block. Be careful not to sand either of 1½" square pivot areas. Finish sanding the airfoil with 400 grit paper. The pivot areas should be given two coats of clear dope and covered with Jap tissue to strengthen them. (See the October, 1970 issue of MRm for tissue covering details). Give each finished wing two coats of thinned clear dope (its lighter than colored dope), sanding each coat with fine sandpaper. This will weatherproof your wings and give them a smoother finish.

Epoxy each end of a 5" length of elastic cord to the wing pivot ends as shown in the drawing. The wing pivot plate assembly is next. Cut four 1½" by 2" rectangles from 1/32" medium weight balsa stock. Locate the center of each plate using the diagonal method. Double glue one engine block to the exact center of each of two pivot plates.

The engine blocks are 1/8" high, and the wings 3/32" thick, so you must carefully sand the engine blocks until their height matches the wing thickness. Place one wing on the pivot plate – pivot sub-assembly – and double glue the top pivot plate onto the top of the engine block. Repeat procedure for the second wing. Be careful not to get any glue on the wings or you will have a non-swinging swing-wing glider.

Carefully sand one end of the pivot-wing assemblies to provide a dihedral angle. A dihedral of 6" under the right wing and 4" under the left wing should give you about 75 foot circles during glide.

The fuselage can now be cut out as shown in the plans. Round all sharp corners except where the rudder, stab, wings, and pod are to be attached. An oval cross-section fuselage is used to provide maximum strength with minimum weight.

The rudder is sanded symmetrical and the stab airfoiled with a high-point line 1/3 back from the leading edge. Decalage is built in by gluing a small piece of balsa (see plan) between the stab and fuselage, and fillet all joints for strength.

Now that the glider portion is completed, construction of the pod can begin. Cut the Centuri No. 7 body tube to a length of 4" as shown in the plans. A CMR body tube cutter comes in handy here. Four lines should be drawn along the length of the tube. Three lines should be spaced 120° apart, and the last line should be midway between two of the previously drawn lines. This fourth line is the line on which the launch lug should be attached. The line on the opposite side of the body tube is to be slit along two inches of its length (starting at one end). This slit should be enlarged to a 1/8" width starting ½" from the end where the slit begins and running 1½" down the length of the tube. The remaining two lines are to be used as centering lines for the two 3/8" square exhaust portholes which are cut as shown in the plans.

Glue a shorty engine retaining wire to the pod as shown. Remember, in Rocket/Glider everything that goes up must come down – *gliding!* Ejected engines do not glide well, so use that engine hook.

The piston is made as follows. Cut a 1/8" slot lengthwise in the wall of the JT-20C paper tube coupler. Glue a 1" length of 1/8" by 3/4" spruce in the slot in the coupler. Glue a disk of 1/16" thick balsa into one end of the coupler. Apply a coating of epoxy to the disk to prevent the ejection charge from burning the piston. Drill a 1/16" diameter hole in the spruce piston tongue as shown in the plans. Coat the inside of the body tube with Estes flameproof paint. When the inside of the tube is dry, insert the piston in the tube. (Be sure the epoxied end of the piston is facing the engine.) Glue the slit closed, and epoxy a CMR 74 nose cone in place.

Cut the pylon from 1/8" by 3/4" spruce and glue to the body tube. Double glue the pylon to the fuselage at the location shown in the plans. Form a piece of 1/16" diameter music wire to the shape in the plans and epoxy into the hole drilled in the piston tongue. Glue a small piece of spruce to each wing end (as shown in the drawing) and sand until the correct 90° wing position is obtained. This spruce section serves as a wing stop when the wings are opened.

Cut a small slot in each of these spruce pieces. It is in these slots that the ends of the music wire are seated to hold the wings against the fuselage during boost. If this wire doesn't quite hold the wings back, bend the wire until the correct wing position is achieved.

With the wings in the open position, move the elastic cord back on the fuselage until it stretches. Mark this position on the fuselage. Shape a scrap piece of spruce to serve as a hook for the elastic as shown in the drawing and glue it to this position. Set the bird aside to dry overnight to make sure all glue joints are thoroughly dry. A Ground Hog shredding on the way up is not a pleasant sight to see.

Trimming the Ground Hog

As CG locations vary from bird to bird, you might find your Ground Hog needs trimming. The easiest way is to apply clay as required. This, however, adds weight. The correct trimming procedure is to cut off the pod and reglue it at another position. This might be time and energy consuming, but remember that on a contest bird you want every extra second you can get.

A properly constructed Ground Hog 16 should turn in consistent times in the 90 second range in the Sparrow competition when flown with an A5-2S engine.

Anyone building or experimenting with the Ground Hog concept is invited to write me in care of **MRm**. A stamped, self-addressed envelope will assure your questions being answered. *Good Flying!*

A NEW, MONTHLY FEATURE OF MODEL ROCKETRY MAGAZINE

Current Comments

by Len Fehskens

The use of computers in model rocketry has not yet come of age, and it is about time it did. I began using computers for trajectory calculations (and coincidentally for dimensional scaling of scale models) in the Spring of 1965. The programs I wrote then, and the uses to which I put them are not significantly different from most of the model rocketry programming going on nowadays.

At the MIT Technical Model Rocket Convention, where I judged R&D and chaired the discussion group on Computers and Model Rocketry, the computer programs presented fell into two groups — one dimensional discrete trajectory simulation, and design by computers. I will discuss each in turn.

Discrete Trajectory and Flight Simulation

A flying model rocket is of course a three dimensional body moving through three-space. It is thus characterized by its position and orientation. Its position is characterized by three translational coordinates, generally a Cartesian system whose origin is the point of launch. One of these three axes, z, is the altitude; the other two, x and y, are range coordinates.

A trajectory simulation will compute these coordinates as a function of time, *i.e.*, $x(t)$, $y(t)$, and $z(t)$; the model rocket is treated as a point in space, its orientation is ignored and only its path is considered. A flight simulation will also compute the model's orientation, which is characterized by three rotational (angular) coordinates. There are two such coordinate systems generally used — one is relative to the translational coordinate system selected, the other relative to a similar set of coordinate axes fixed in the model itself, with its origin at the CG. The latter system defines the more familiar parameters of roll, pitch, and yaw. The two systems can be computed from one another, by the magical process known as transformation of coordinate systems. In either case, three angles will be computed as a function of time; $\alpha(t)$, $\beta(t)$, and $\gamma(t)$. These six parameters comprise what are called the six degrees of freedom of a three-dimensional object.

Such a simulation can be analog (continuous), like the one demonstrated by Tom Milkie at the MIT convention, or digital (discrete) like those most often used. Being a digital machine programmer, I will talk only about discrete simulations.

To date, the trajectory simulations I know of have all been one degree of freedom, altitude only. The extension to the two dimensional case is relatively trivial, involving the resolution of the thrust and drag vectors (they really are vectors) into x (range) and z (altitude) components, and the addition of some trigonometric functions to the equations. I did some such simulations back in the good old days, and the results can be useful.

The extension to all six degrees of freedom is within the capabilities of any resourceful high level language programmer/rocketeer with a little mathematical savvy. There are no hairy equations to solve — you just have to find them and code them, and then start making assumptions about some functional relationships. Gordon Mandell's Dynamic Stability series contains a wealth of immediately applicable material. Anyone seriously interested in tackling this project should also consult a text on discrete simulation and modeling. This is a big field in current computer applications, so the literature is there in quantity.

(I will be using the term *model* throughout to mean a *scientific model*. A computer simulation is such a model of a physical process.)

The one dimensional case has by now been beaten to death, to my mind. It is a classic case of the situation discussed in George Flynn's July 1971 editorial — the unverified refinement of unverified models (*theories* if you will, but a model is just another representation of a theory). When someone does finally attain (or speak up if he already has) the six degree of freedom satori, we will still have just another exceedingly elegant *untested hypothesis*.

The fact could serve as the basis of an extended vituperative diversion at this point, but this article is about computers, not R&D in general, so I'm going to make the not-really-that-brazen assumption that these models are pretty good representations of simplifications of what really goes on, and that trends indicated by the models can be extrapolated to trends in the real world. And I would like to use that assumption to justify the assertion that what we really have now, which nobody has as yet taken advantage of, is a way to fly model rockets without even building them. A way to conduct controlled experiments in seconds rather than hours. A way to conduct experiments that would be difficult if not virtually impossible to perform in the real world. And a way to increase immensely our understanding of the flight of model rockets.

(It is possible to conduct many of these experiments with the Bernoulli/Fehskens/Malewicki equations, within the limitations imposed by those equations' assumptions.)

I'll describe a few experiments I'd like to see done; I'm sure there are many more possible.

For a given total impulse, is there an optimum thrust-time profile? What effects does the profile shape have on performance? Or is there some optimum acceleration profile? How would the shape of such a profile depend upon things like the drag and weight characteristics of a model rocket?

On a multistaged flight, is there an optimum staging delay? Should staging occur right after burnout, or after some coast?

How sensitive are altitude and range to launch angle? What does the flight profile look like?

Is it possible to get some idea of dispersion as a function of stability parameters and various types of wind loading? How about dispersion due to staging?

There is also the as yet untapped area of boost-glider (and parachute and streamer) performance simulation. Can anybody out there devise a good model of gliding in gusting winds? Or a reasonable approximation of what happens during the boost/glide transition?

Of course, given a good enough understanding of the basic factors involved, one can simulate just about any process. Model rocketry's problem is that it hasn't looked at simulation as an experimental tool, and that in a lot of cases, we don't have the empirical data necessary to provide a firm foundation for simulation experiments.

I think it would be more profitable all around if model rocketeer/programmers were to address themselves to the problems of simulated experimentation, rather than elaborating on ever more minute details of already quite adequate computations. There's no question that even the simplest programs are capable of indicating trends and providing the means to perform experiments like those described above. An interesting experiment in itself would be to find out just how significant are details like simulating the change in air density as a function of altitude, or propellant consumption as a function of thrust. What sort of percentage difference in calculated performance do they make?

In any case, it is possible for modelers indifferent to getting their hands dirty doing extensive experiments out on a real world launch site to do the same experiments in the comfort of an air-conditioned computer room. And it's about time somebody did so.

Model Rocket Design with and by Computers

Design with computers involves using the machine to provide additional data for making design decisions; design by computers means letting the machine make the decision itself.

The simplest case of design with computers is to compute the altitude attained by various engine/airframe combinations, and base your design accordingly. Similarly, one can "design in" stability by computing CP/CG relationships for various configurations.

Bernard Biales and I have also used computers to get some idea of boost glider loading during thrusting, and thus what sort of construction would be necessary to keep, for example, a large Condor class glider together under boost.

At the MIT Convention, two papers were

(Continued on page 31.)

An Introduction To

Cold-Propellant Rocketry

by Alan Forsythe

Cold propellant model rockets were first introduced by Vashon Industries in 1969. The intention was to make a safe, flying model rocket that was not subject to the fireworks laws which restricted model rocketry in many areas. The Valkyrie, which uses a completely non-flammable propellant, is not subject to such laws, nor could it be logically associated with fireworks. However, the fact that the Valkyrie engine was substantially made of metal led to a public controversy that raged for a year and a half. The Valkyrie and Vashon became well known if not altogether popular.

The controversy centered around whether the well-established rules prohibiting metal parts in "model rockets" applied to the Vashon rockets. Eventually it became clear that there were fundamental differences between the Vashon cold propellant rockets and "model rockets" — conventional solid propellant rockets for which these rules were written. Whereas it is and always has been hazardous to use metal bodies with solid propellants, it became obvious the same hazards simply did not exist with the Valkyrie, and that it was indeed safe, sound engineering to use metal for major parts of a cold propellant rocket. At the 1970 Hobby Show the dispute was finally resolved when a separate category for "cold propellant" rockets was established and Vashon rockets were officially sanctioned.

The differences between solid propellant and cold propellant rockets are significant. Both types use the same rocket thrust principle, fly to good altitudes, and deploy parachutes; but here the similarity ends. Solid propellants are of course solid; Vashon uses a liquid propellant. Solid propellant burns to produce thrust; cold propellant does not burn. A solid propellant model rocket uses a small amount of high energy propellant; a cold propellant rocket uses a large amount of low energy propellant. While a solid propellant rocket derives its energy from a chemical reaction, Vashon rockets are basically mechanical, with no chemical changes involved.

The propellant makes the fundamental dif-

The Vashon "cold-propellant" rockets are quite different from the more familiar "solid-propellant" model rockets. This demonstration launch, on the mall in Washington, D.C., shows that the cold-propellant rockets can be safely launched with the rocketeer in close proximity to the model. An entirely new Safety Code had to be written to govern the operation of these models.

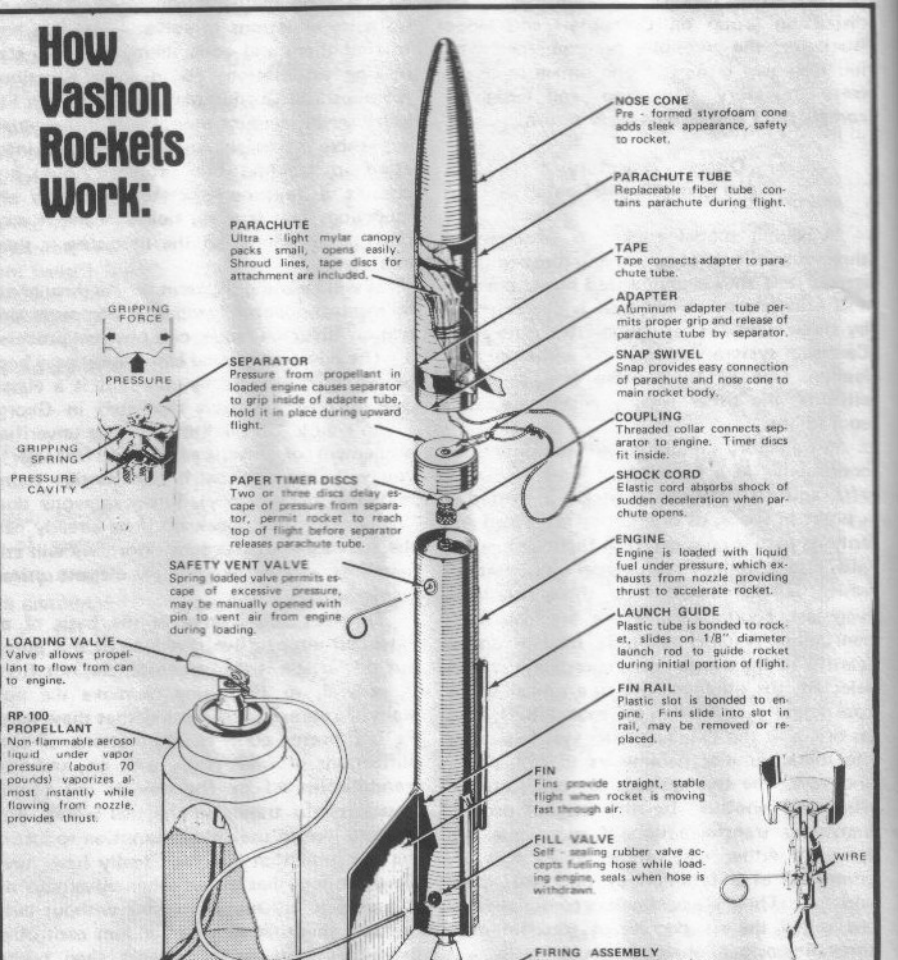


Figure 1: Operational Details of the Cold-Propellant Model Rocket. This internal diagram of the Vashon Valkyrie-II rocket shows the function of each part of the highly-engineered model.

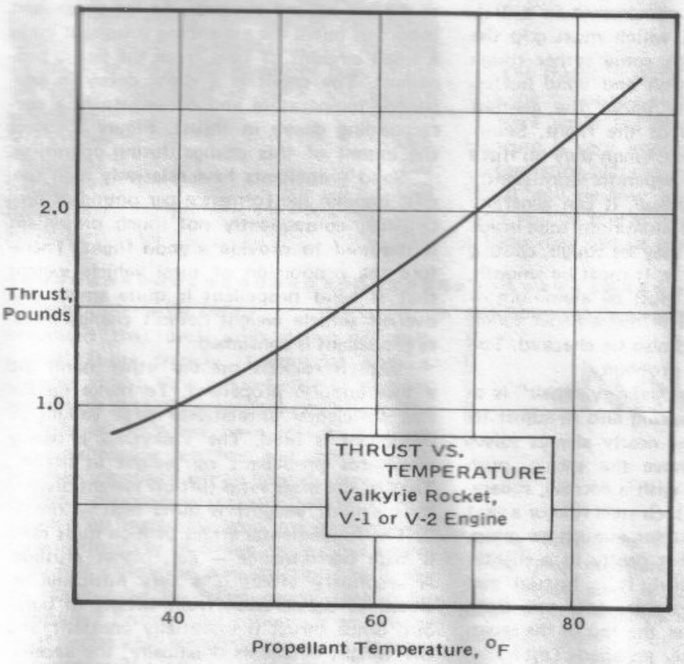


Figure 2: Thrust vs. Temperature Curve. The thrust of a Valkyrie I or II motor is a function of the temperature of the motor. At higher temperatures the thrust is greater.

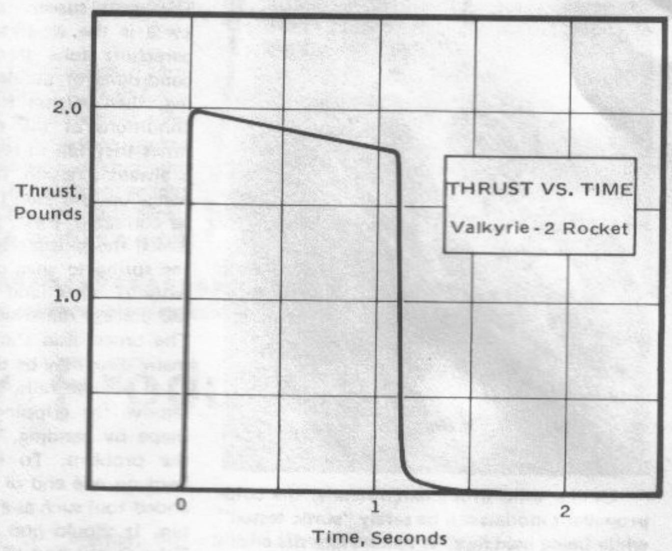


Figure 3: Thrust vs. Time for Valkyrie-2 Motor. The Valkyrie-2 motor produces an almost constant thrust during its entire thrusting time. The slight deviation from a constant thrust is a result of the cooling of the Freon propellant as the motor fires. Expansion of the gas to fill the motor causes a slight cooling, and this slight decay in the propellant temperature results in a slight decay in the thrust (as shown in Figure 2).

ference. Vashon's RP-100 is a liquified gas refrigerant technically known as "difluorodichloromethane" or "Freon 12" (DuPont trademark). It is virtually as inert as water; it cannot burn or explode, and has no odor. Normally a gas at room temperature, it is packed in aerosol cans under pressure, in liquid form. The liquid produces a vapor pressure of about 70 pounds per square inch (gage) at room temperature, which provides the motive force for expelling the liquid from the can or the rocket engine. When it is released, being a refrigerant, it almost instantly vaporizes and refrigerates itself to about minus 20 degrees farenheit. The rush of combined liquid and gas escaping from the nozzle of the rocket engine provides thrust.

In preparation for flight, a Vashon rocket is assembled, then loaded with propellant through a hose from the aerosol can. While loading, some air is allowed to escape from the engine to allow room for the liquid to flow in. When full, some liquid escapes from the air vent valve in a visible white spray, giving indication that the engine is loaded. To launch the rocket a plug which seals the nozzle is allowed to blow out and the rocket lifts off. Thrust of the larger Valkyrie engine lasts for about 1¼ seconds, followed by an upward coast, and parachute release at the top of its flight. (Figure 1 illustrates the functions of all the parts of the cold propellant rocket).

The specific impulse of RP-100 is normally about 9 seconds, much less than flammable propellants can achieve. Specific impulse and thrust are also strongly influenced by temperature. At 70° F a Valkyrie produces about 2 pounds of thrust, but at 40° F the thrust is only about half of that, or 1 pound. (See figure 2) At -20° F the engine would produce no thrust at all — and no thrust means no flight for the brave but frigid rocketeer. However remember that the propellant itself is a refrigerant, and if allowed to boil or vaporize it will cool itself to right down to -20° F, even on a warm day. The result would be very disappointing rocket performance, so boiling or vaporizing the propellant should be avoided. In short, the rocket must be full of warm, liquid (*not gaseous*) propellant to get full performance from it.

There is always a temptation to rush directly to the launch pad as soon as a rocket is built. However, it is much wiser to follow the professional approach and test the rocket first. Unlike solid propellant rockets, a cold propellant rocket can be completely tested for every flight function before committing it to the air. It can be loaded, "fired," separated, and deployed all with the actual flight hardware. Such preflight testing often uncovers minor problems which could cause a bad flight or a parachute failure resulting in a "prang." First, a test will show whether the loading technique is right and whether there are any leaks that might unduly chill the propellant. Then a test will show whether the separator is functioning properly and whether the 'chute is rolled in such a way as to open fully and freely by itself. Also the time delay can be tested; for first flights it

COLD PROPELLANT MODEL ROCKET SAFETY CODE

1. **ENGINES** — I will use only factory made model rocket engines in the manner recommended by the manufacturer. I will re-load cold propellant rocket engines only with the propellant recommended by the manufacturer.
2. **RECOVERY** — I will always use a recovery system in my model rockets that will safety return them so that they may be used again. I will conduct pre-flight tests to assure the recovery system functions properly before launching the rocket.
3. **WEIGHT LIMITS** — My model rocket will weigh no more than 16 oz. at lift-off.
4. **STABILITY** — I will check the stability of my model rockets before their first flight, except when launching models of proven design.
5. **FLYING CONDITIONS** — I will not launch my model rocket in high winds, near buildings, power lines, tall trees, low flying aircraft or under any conditions which might be dangerous to people or property. I will never attempt to recover a model rocket from a power line or other dangerous place.
6. **LAUNCH ROD** — To prevent accidental eye injury I will always place the launcher so the end of the rod is above eye level or cap the end of the rod with my hand when approaching it. I will never place my head or body over the launching rod. When my launcher is not in use, I will always store it so that the launch rod is not in an upright position.
7. **LAUNCH TARGET & ANGLE** — I will not launch rockets so their flight path will carry them against targets on the ground and will never use an explosive warhead or payload that is intended to be flammable. My launching device will always be pointed within 30 degrees of vertical.
8. **LOADED ROCKETS** — I will never store or leave a loaded rocket untended. I will always keep a loaded rocket on a launcher or firmly restrained. I will never point a loaded rocket or its rocket nozzle at anyone, nor allow anyone to be in the flight path of a rocket during launch preparations.
9. **CONSTRUCTION** — I will never use metal nose cones or metal fins.

Unlike solid propellant rockets, the cold-propellant models can be safely "static tested" while being held in your hand. Here the entire flight can be simulated, and all parts can be checked for proper operation without risking damage to the model.

is best to use a relatively short (2 or 3 second) time delay to avoid a crash.

Parachute release on the Vashon rockets is accomplished by an unusual device called a separator which is screwed to the top of the engine. When the engine is loaded with propellant, pressure from the propellant passes into the separator, and causes a bent piece of clock-spring material to expand slightly inside the very aft edge of the tube in which the parachute is stored, gripping it in place. This spring holds the parachute tube in place throughout powered flight, and also during the upward coast that follows. Then it relaxes allowing the tube to fall off and the parachute to deploy.

The time delay from "burn-out" (when the engine runs out of propellant) to peak altitude is achieved by restricting the escape of pressure from the separator with porous paper in the form of small paper discs. Pressure in the separator consequently takes 3 to 5 seconds longer to escape through the discs before the spring can relax and release the parachute. The time delay is adjustable by the number of discs which are placed between the engine and the separator.

Even the most carefully constructed mechanisms can malfunction sometimes (witness any NASA program) — it's Murphy's Law. The most susceptible component in a Valkyrie is the separator, which must grip the parachute tube through some rather rough conditions of acceleration and wind buffeting, then release freely under the gentlest conditions at the top of the flight. Sometimes they fail to release; when they do there is always a reason. If a separator consistently hangs up and won't release, it can generally be corrected. First, the aluminum tube inside which the spring grips may be rough, causing the spring to snag on it. It must be smooth, without burrs (and it must be aluminum of the correct dimensions — not a paper tube.) The timer discs should also be checked. Too many discs may be the problem.

If all else fails, the "factory repair" is to remove the gripping spring and re-adjust its shape by bending. This nearly always solves the problem. To remove the spring, push hard on one end of it with a narrow, square-ended tool such as a 6-inch steel rule or a vent pin. It should pop out far enough to grasp. Take it out and bend it gently in a slightly more U-shape* (Careful, it is brittle) and replace it in the separator, toes up. Both ends should show under the top of the separator when it is correctly installed. Test again; this procedure usually corrects a separator that tends to hang up.

As mentioned above, the performance of a Vashon rocket is highly dependent on propellant temperature. Figure 2 shows the instantaneous thrust, if the propellant were at the indicated temperature. Actual thrust during operation is relatively constant; it can normally be assumed to be constant throughout a single flight. Thrust varies little from lift-off to "burn-out." The important thing to remember is that thrust can vary a great deal from flight to flight, depending on how carefully the rocket is loaded and consequently what the propellant temperature is.

Many rocketeers are still interested in thrust-time curves for the Valkyrie. Although we generally say it is constant, it does change slightly during operation, due to a change in propellant temperature. The operation should not be compared to a water rocket; it is not a "blow-down" system. Instead of simply expanding, the gas in the engine is continuously replenished from the propellant itself as the gas volume expands. As the propellant vaporizes to fill the expanding volume it takes a small amount of heat from the liquid propellant. The result is a slight decay in propellant temperature and consequently a corresponding decay in thrust. Figure 3 shows the extent of this change during operation.

Solid propellants have relatively high specific impulse (performance per pound of propellant), consequently not much propellant is required to provide a good flight. Therefore the proportion of total vehicle weight that is solid propellant is quite small, and over-all vehicle weight doesn't change much as propellant is consumed.

Vashon rockets on the other hand use a low impulse propellant. To make up for this deficiency a relatively large weight of propellant is used. The Valkyrie-2 is nearly two-thirds propellant by weight at lift-off. That is, the *mass ratio* (lift-off weight divided by burn-out weight) is quite high — almost 3. The fundamental effect of high mass ratio is high performance — *i.e.*, higher altitude. A secondary effect is a very noticable increase in acceleration from lift-off to burn-out. Since thrust is essentially constant, and the weight decreases drastically, the acceleration increases proportionately. For example, the Valkyrie-2 lifts off at about 4 g's, but just before burn-out is accelerating at about 12 g's. You will see this effect as a somewhat slow lift-off, followed by what seems like an increasing "kick in the pants" just before the rocket runs out of propellant.

Thus far we've discussed specific impulse and mass ratio. The third performance factor for model rockets is thrust-to-weight ratio. This factor is important only because model rockets normally are launched vertically against the pull of gravity. The thrust therefore must be considerably greater than the weight, or the rocket simply would not move upwards. For example, if the thrust-to-weight ratio is 2, one-half of the thrust is consumed counteracting gravity and the other one-half accelerates the rocket upwards. If instead the ratio were 10, only one-tenth of the thrust is needed to counteract gravity and the remaining 90% is available to accelerate the rocket.

Because of the mass change during powered flight the thrust-to-weight ratio changes. Vashon rockets exhibit a large change in thrust-to-weight ratio. At lift-off this ratio is usually smaller than for solid propellant rockets because of the large mass of the propellant in a Vashon rocket. Later in powered flight when the propellant is nearly gone the ratio may be as large or larger than for solid propellants, not because thrust has changed but because weight has drastically decreased. Therefore it is clear that if thrust-to-weight ratio is adequate at lift-off, it will be better later in the flight.

The real question to be answered is: "Will the rocket be moving fast enough to be stable in flight by the time it leaves the guidance of the launch rod?" Whether its velocity is high enough for fin stabilization depends upon its acceleration at launch, and the accelerating force depends upon the thrust-to-weight ratio. As a rule of thumb a model rocketeer should endeavor to have thrust at lift-off at least four times the weight of the fully loaded rocket (thrust-to-weight ratio of 4 at lift-off). This will assure that a normally designed rocket with fins will be stable.

*For those who have the measuring tools, the over-all length of the spring when relaxed should be between .910 and .925 inches.

Figure 4
Table of Weights
Vashon Rocket Components

Item	Weight (Pounds)
V-2 Engine with fins, dry	.085
V-2 Propellant load	.250
V-1 Engine with Fins, Dry	.063
V-1 Propellant Load	.125
Separator with Coupling	.020
Staging Plug (1st stage)	.002
Staging adaptor tube (2nd stage)	.008
Nose Cone, Balsa	.014
Nose Cone, Styrofoam	.010
Parachute Tube, Aluminum	.018
Parachute Tube, Paper, with adaptor	.012
Parachute, Complete	.004

Figure 4 gives weights of various Vashon rocket components, for use in calculating weight and thrust-to-weight ratio. For example to calculate the thrust to weight ratio at lift-off for a Valkyrie-2 at 60°F, the weights would be:

V-2 Engine	.085
Propellant	.250
Separator	.020
Balsa Cone	.014
Aluminum Tube	.018
Parachute	.004
Total	.391

The thrust at 60°F is 1.63 pounds. Therefore the thrust-to-weight ratio is 4.17 to 1.

Here again the effect of propellant temperature is very important to Vashon rocket performance. If the propellant is cold, the thrust will be low, and the thrust-to-weight ratio will be low as well. The resultant acceleration may not be enough to attain a stable flight velocity before the rocket leaves the pad. Warm propellant in the rocket will make all the difference.

Like any complicated modern device, a Vashon rocket requires some care, skill, and attention to detail to gain the best results, and offers considerable challenge to the rocketeer. But if reasonable care is taken in the assembly, testing and loading of a Vashon rocket, the resulting flights are very gratifying and a lot of fun.

(Current Comments, cont.)

presented that dealt with design by computers. Quite frankly, I consider such attempts at this time a blind alley or bottomless pit, depending on how you look at it. The techniques described were essentially brute force exhaustive searches, and gobble up incredible amounts of computer time. As a systems programmer, I find anything that gobbles up incredible amounts of computer time intrinsically offensive, nevermind expensive. But efficiency considerations aside, do we really need to design model rockets by computer? Professional rocketeers go only as far as design with computers, as do professional designers in any field. Design by computers still lies within the realm of artificial intelligence research, and anyone who thinks he'd like to take the venerable whack at it ought to first consult the extensive literature.

Designing a successful model rocket is just not that difficult, and unless one wishes to compile an encyclopedia of possible (and flyable perhaps?) configurations, the computer can best serve as design aid rather than designer.

(From the Editor, cont.)

model in the Predicted Altitude event at NARAM-11. His "predicted altitude," based entirely on the computer results, was off by only 7.4% — good enough for a third place at the National Meet. However, Charles Zetteck also flew an Excalibur in Predicted Altitude at NARAM-11. He used no computer altitude predictions. His method was to track the Excalibur nine times before the NARAM, and he used this tracking data to project the altitude. His prediction was off by only 0.6%, for a first place in the contest. The experimental data was certainly a better way to project the altitude than was an unverified computer prediction.

Refinements to our understanding of model rocket performance will not come from purely theoretical investigations. The theory *must be compared with experimental data* before any rocketeer can claim to have made a significant contribution to the hobby.

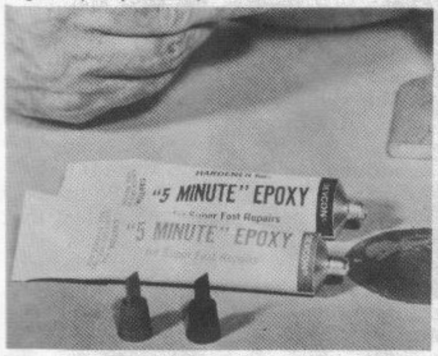
New Product Notes

The new Estes Series "T" engines, the mini-engines mentioned last month, measure 1.75 inches long (a full inch shorter than Series I or II engines) and have a 0.505 inch diameter (small enough to slip inside the casing of a C engine). Designed especially for high-altitude performance, tests conducted by the Estes Research and Development staff have shown that Series T powered models can have 46% less drag than the best "standard size" models. These engines are also ideal for record breaking boost/gliders. The

The new Estes mini-engines are 1.75" long — one full inch shorter than the Series I and II engines. (Actual Size)

new Series T engines are sold four to a pack and retail for $.99 (¼A's), $1.09 (½A's), and and $1.19 (A's). Each engine package will include five igniters. Complete information sheet available from Estes Industries, Dept. M-31, Box 227, Penrose, Colo. 81240.

Devcon Corporation has announced the availability of their super fast setting epoxy adhesive, popular for on the field repairs, in a new larger tube. Devcon "5-Minute Epoxy" provides all the superior physical strength of epoxy adhesives plus the advantage of quick hardening — even in thin films and at low temperatures. Developed by Devcon Corporation, Danvers, Mass., "5-Minute" is easy to use: equal parts of resin and hardener are simply mixed together and applied. Non-shrinking, it cures at room temperature to a clear, semi-flexible mass with high impact, tensile, and chemical resistance.



Initial strength will develop in 3 to 7 minutes; full strength, in one hour. No heat, pressure, or special equipment required. This unique adhesive is available in collapsible metal tubes for small jobs, in a 1 pound pack, and in gallon containers. Each unit contains epoxy resin, the exact amount of hardener, mixing sticks, and complete instructions. Prices start at $1.25 for 1¼ oz. tube size, $2.25 for 2½ oz. tube, $4.50 for 1 pound pack, and $28.00 per gallon. All units are sold only through authorized Devcon Distributors. The name of the Devcon dealer in your area is available from Devcon Corp., Dept. M, Danvers, Mass. 01923.

Rub 'n Buff Division, American Art Clay Co., has introduced new Stain 'n Buff, a one-step wood finish that combines stain and wax for easy finishing. Stain 'n Buff works wonders with any porous wood surface such as balsa or spruce. It applies in one easy motion, stains to shade desired and buffs gently to a rich, wax sheen. Available in six wood tones — maple, dark walnut, mahogany, walnut, golden oak, fruitwood, it can be blended into any combination to match any tone. The attractively packaged, airtight tubes are color coded to each wood tone. Ingredients can't dry out, stay fresh from start to finish. A 6-page full color instruction booklet is tucked into the back pocket of every package. Priced at $1.29, each ½ oz. tube covers 20 square feet. Stain 'n Buff can be purchased wherever arts and crafts supplies are sold, and in paint and hardware stores. Rub 'n Buff Division, American Art Clay Co, P.O. Box 68163 R, Indianapolis, IN 46268.

FLIGHT TEST

by Jon Randolph

SMALL ENGINES AND LARGE BOOKS...

Small engines and large books might well describe this month's column, as *Flight Test* reviews the MPC Minijets, the Cox D8, and **Above and Beyond, the Encyclopedia of Aviation and Space Sciences**.

The minijets are a new series of engines produced by the Model Products Corporation in their new computer-controlled engine plant in Mineral Point, Wisconsin. Designed by Mike Bergenske formerly of Model Rocket Industries, the engines produce the same power as conventional 1.25 to 5.0 newton-second engines but are smaller and lighter, allowing remarkable altitudes with relatively low-powered birds.

All Minijet engines are 13 mm. in diameter, 57 mm. long and fit into MPC T-15, Centuri ST-5, CMR RB50, and Estes BT-5 tubing. Using any of these tubing sizes for the airframe of your next bird will result in at least a 45% reduction in cross-sectional frontal area over conventional designs. If this doesn't sound too important, let's rephrase it *lower drag — higher altitude!* And that's not all. Expended casing weight is *half* that of a "short" (18 mm x 44 mm), previously the lightest of all available engine casings. Accordingly, not only is there reduced drag but also reduced weight.

Minijets are currently available in three types: ½A3-3m, A3-4m, and B3-5m. Other delay times are to be announced at a later date. Their weights are 6.75, 8.25, and 10.5 grams respectively. The substantial weight reduction over standard engines is attributable to their 4 gram casing.

Flight Test of the Minijets consisted of static tests and actual flights in Streamer Duration, Parachute Duration, Boost Glide, and Rocket Glide models. Their performance in all areas was excellent with the minor exception of Rocket Glide and to a lesser extent Boost Glide. In these models (with A and B engines), unless one is flying light, low drag birds, a *slightly* shorter delay might be in order (A3-3m, B3-4m) for optimal performance. The Minijets should also be highly competitive in such events as Scale Altitude, Design Efficiency, and Plastic Model, because of their small diameter and light weight.

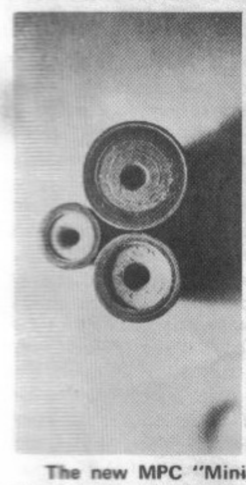
On the basis of their performance in testing, *Flight Test* recommends the MPC Minijets to all rocketeers involved in NAR competition and/or interested in small, high performance, model rockets. Types ½A, A, and B Minijets retail at $1.25 for four engines, five igniters, and special recovery wadding. These engines should be available from your local hobby dealer; if not, you may order direct from:

Model Products Corp.
Customer Service
126 Groesbeck Highway
Mt. Clemens, Mich. 48043

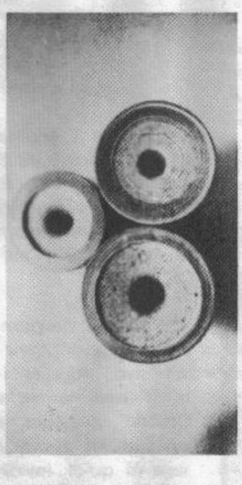
New from the L.M. Cox Company is the Cox D8. This is the first commercially available D engine in a standard 18 mm. x 70 mm. casing. Although only (only?) 15 newton-seconds — 20 newton-seconds is the maximum total impulse for D engines — these engines are excellent performers. Having 50% more power than previously available in a standard engine casing, they offer many possibilities in Boost Glide, Rocket Glide, Plastic Model, Scale, and Egg Loft events to say nothing of high performance sport flying. Weighing in at 25.5 grams, the new D is available as types D8-3 and D8-0. Why aren't there any longer delays? Simple — *they won't fit into the casing!*

The initial *Flight Test* of the D8-3 was disasterous — not because the D8-3 was bad; rather, that it was so good! A Swift B/G, the wing joints and leading edges covered with epoxy, was fitted with a D8-3. To quote an observer, "At an approximate altitude of 10 meters there was a large cloud of balsa dust and epoxy!" *Flight Test's* entry in Eagle B/G at NARAM-13 will be D8-3 powered; however, I guarantee the glider will be *much* stronger. The next series of tests used a Hawk Jupiter-C plastic model converted for flight. In a dozen flights engine performed flawlessly, carrying the model to impressive altitudes and deploying the chute right at apogee. Mr. Stine (YMCA Space Pioneers) reported to *Flight Test* that these engines also turn in impressive flights in the Centuri Saturn IB.

Flight Test recommends the new Cox D8 to rocketeers looking for high power in a small casing. Don't be misled by



The new MPC "Minijet," only 13 mm in diameter, has 45% less frontal area than the next smallest available engine. Comparison of the Minijet, a standard 18 mm engine, and the 21 mm FSI engine, should give the competition oriented rocketeer some ideas for new designs.



The Cox D engine, more power in a standard 18 mm diameter engine, also allows a substantial reduction in frontal area. With only 15 nt-sec total impulse it's not a "full range D" as are the other two D's shown, but the performance increase is still impressive.

its small size; this engine is a real stormer, so build your models accordingly. Both the D8-0 and the D8-3 retail at $1.35 for three engines and four special igniters. If you have problems with these igniters (as we did) you can substitute the conventional nichrome wire type. The D8 should be available from your local hobby dealer; if not, you may order direct from:

L.M. Cox Manufact. Co.
Customer Service
1505 East Warner Ave
Santa Ana, California 92705

The third item reviewed for this month's *Flight Test* is **Above and Beyond, the Encyclopedia of Aviation and Space Sciences**. This is a large (14 vol) comprehensive (2500 entries), and well-illustrated (4000 illustrations) reference work of aeronautics and astronautics. Astronautics are *very* well represented, comprising approximately 50% of the set, including such entries as Apollo, Atlas Rockets, Cosmonauts, Jupiter Rockets, Launch Vehicles, Lifting Body, Mercury Program, Model Rockets, Russian Rocketry, Saturn Rockets, U-2, etc. Also included are biographies of over 400 leaders in space and aviation.

As one would expect, **Above and Beyond** contains an amazing amount of information on all aspects of aviation and space exploration. But *Flight Test* feels that its primary value to *model* rocketeers is its lavish use of color photographs. Modeling the Titan III-C? **Above and Beyond** gives you photos on the pad and in flight. What about the Soviet Vostok? Here you'll find not only the Paris Air Show mock-up but close-up color photos of actual flight versions on the pad. Arcas, Atlas, Little Joe, Mercury-Redstone, Minuteman, TAD – you name it, they're all here, and most of them in full color.

Above and Beyond is available only on a subscription basis from the publisher. The first volume is free; thereafter, succeeding volumes arrive on approval. Each volume is 8½" x 11", contains about 200 pages, and has a purchase price of $3.95 plus shipping charges. At a total cost of approximately $50, the encyclopedia may seem "above and beyond" the financial resources of the younger rocketeers. If you fall into this category, and can't interest an education-minded relative in its potential as a birthday or Christmas gift, contact your school librarian. A special library edition is available and your school may be interested in adding one to their shelves, if they haven't already done so. For your first volume or further information, write:

Above and Beyond
Book Services Offices
P.O. Box 18324 B
Louisville, Kentucky 40218

Next month, *Flight Test* brings you an in-depth review of the new Estes Transroc. Until then - 5, 4, 3, . . .

MODROC CALENDAR

AARM–2 – August 21-22, 1971. The Second Annual Alberta Regional Meet is open to all rocketeers from Alberta, British Columbia, and Saskachewan. Events: Class 1 Altitude, Class 1 PD, Pee Wee Payload, Pigion/Ostrich Eggloft, Swift B/G, Hawk B/G, Scale, Parachute Spot Landing. Site: Edmonton, Alberta. Contact: AARM-2, 10635 - 48th St., Edmonton 80, Alberta, Canada.

FLAM – August 28-29, 1971. Area meet sponsored by the Upper Arlington Rocket Club in Hilliard, Ohio. Events: Hornet B/G, Sparrow B/G, Sparrow R/G, Class I PD, Class II Streamer Duration, Design Efficiency, Robin Eggloft, Pee-Wee Payload, Open Spot Landing. Contact: Fred Long, 456 Bigelow Dr., Hilliard, Ohio 43026. Phone: (614) 876-7628.

NYRS–1 – September 4-5, 1971. Sponsored by the New York Rocket Society. Features: Contest, Discussion Groups, R&D Presentations, Banquet. Open to all rocketeers. Contact: James Enny, 88 Tehema St, Brooklyn, New York 11218.

Gettysburg Regional Meet – Sept. 10-12, 1971. Regional contest sponsored by the NARCAS Section of Harrisburg, Pennsylvania. Events: Class 00 Altitude, Gnat B/G, Hawk R/G, Plastic Model, Roc Eggloft, and Class 2 Streamer Duration (Limited to 2" x 2' streamer). Contact: Doug Plummer, 930 Ledig Dr., Chambersburg, PA 17201.

Wisconsin Area Meet – September 18, 1971. Contest, sponsored by the Mariner Rocket Society, open to all NAR members from the state of Wisconsin. Events: Class 0 PD, PeeWee Payload, Robin Eggloft, Hornet B/G, and a non-sanctioned Payload Boost/Glide event. Contact: Russ Schmunk, 118 Highland Street, Whitewater, Wisconsin 53190.

Montreal Eggloft '71 – September 18, 1971. Regional Egglofting competition in Montreal, Canada. Site: Maisonneuve Park complex, Montreal. For rules and information write: ARRA, 7800 des Erables Ave, Montreal 329, Quebec, Canada.

ETR-1 Regional – Sept. 25, 1971. Regional Meet open to NAR members from Illinois, Ohio, Iowa, Minnesota, Indiana, and Wisconsin. Events: Swift R/G, Hornet B/G, Design Efficiency, Class 0 PD, and Pigeon Eggloft. Fee: $1.50 per contestant. Sponsors: EMRA Section and TIROS Section. Deadline Sept. 1, 1971. Contact: Bob Finch, 415 Lambert Tree, Highland Park, Illinois 60035 or phone (312) 432-8986.

WESNAM–3 – September 26, 1971 at Bridgewater, Mass. Area meet for rocketeers in Mass., RI, NH, Me, and Conn. Events: Condor R/G, Class 4 altitude, Hornet B/G, Robin Eggloft, and Plastic Model. Contact: Trip Barber, c/o MIT-MRS, MIT Branch P.O. Box 110, Cambridge, Mass. 02139.

Pascack Valley Regional – Oct. 9-10, 1971. Regional sponsored by New Jersey's Pascack Valley Section. Events: Space Systems, Swift B/G, Hawk R/G, Open Spot Landing, Pigeon Eggloft, Class 2 Drag Efficiency, Class 2 Streamer Dur., Class 2 Para. Dur. Contact: Victor Dricks, 1547 East 21st St, Brooklyn, NY 11210.

NETS–2 – November 6, 1971. North East Technical Symposium sponsored by the Pascack Valley NAR Section. Site: Bloomfield, New Jersey Public Library. Tentative topics: Scale, B/G, Making Your Own Decals. Contact: Brian Skelding, 9 Appleton Rd., Glen Ridge, New Jersey 07028.

FLOP-1 – Nov. 6, 1971. Sponsored by the Pueblo (Colorado) Model Rocket Club, and open to all rocketeers. Events: Sparrow B/G, Class 0 Alt., Class 2 SD, and Robin Eggloft. Site: Pueblo, Colo. Advance registration before Nov. 1 required. Overnight lodging available with club members. Contact: Larry Clark, 39 Normandy Cr., Pueblo, Colo. 81001.

NERFAM-II – November 7, 1971. Area meet sponsored by the New England Rocketry Federation. Events: Condor B/G, Class 0 PD, Sparrow B/G, and Class 3 Streamer Duration. Contact: Patrick Griffith, Legion St., Milford, Mass. 01757.

Oklahoma Area Meet – November 14, 1971. Contest sponsored by the Oklahoma Model Rocket Society, open to all modelers from the state of Oklahoma. Events: Class 1 PD, Sparrow B/G, and Class 1 Streamer Duration. For information contact Mike Clay, 4609 N.W. 35th St., Oklahoma City, Oklahoma 73122.

ATTENTION CONTEST DIRECTORS
Mail notices of your contests at least 90 days in advance for listing in Model Rocketry's "Modroc Calendar" to:
Modroc Calendar
Model Rocketry Magazine
Box 214
Astor Station
Boston, MA 02123

A New Condor B/G Record of 219.0 Seconds, and Three Other U.S. Records at...

PACT-1

CONVENTION AND RECORD TRIALS

by George Flynn

A new idea in convention activities was given a try by the Phillipsburg Area Rocket Club at their first convention in late June. Instead of the usual "sport launching," the New Jersey group flew a sanctioned Record Trials during one day of the 2½ day convention. With the flying emphasis on serious competition models, discussion at many of the convention sessions was directed towards particular models and innovations which had been seen on the flying field.

The convention got underway on the evening of June 18th with an explanation of the basic ground rules by Chairman David Klouser. To keep the flying reasonable, a safety check was required for all models entered in the Condor, Eagle, and Hawk B/G or R/G events.

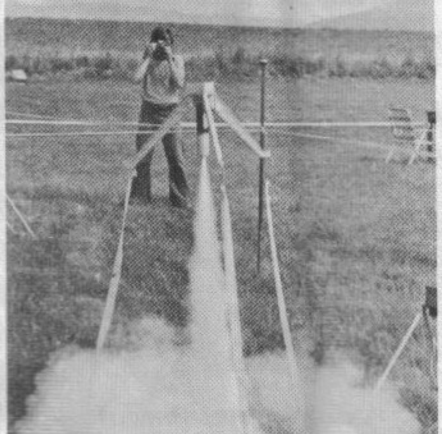
In his opening address, Bob Mullane discussed the purposes of conventions and the way "Discussion Groups" should work. To promote the *exchange* of information, the discussion group should *not* simply be a lecture — with the group leader presenting all the facts and opinions and the other rocketeers merely listening. Ideally, the discussion group should be small enough so that an effective "seminar-type" of exchange can take place. The participants should feel free to add ideas from their own experience, so that everyone including the group leader will come out of the session with more information than he went in with.

On Friday evening Dick Fox and George Flynn presented a discussion on "Model Rocket Aerial Photography." This group considered the modifications which can be made to the Estes Camroc to improve the quality of its aerial photos and the use of color film in the Camroc. The basic Camroc modification consists of substituting a high-resolution glass lens for the plastic lens supplied with the Camroc. The lens Dick used in his conversion was a 67 mm focal length compound lens available from Edmund Scientific. By mounting this highly corrected lens (in accordance with the specifications given in **Advanced Model Rocket Aerial Photography**, available for 60 cents from **Model Rocketry** magazine) in the Camroc a significant increase in resolution can be obtained.

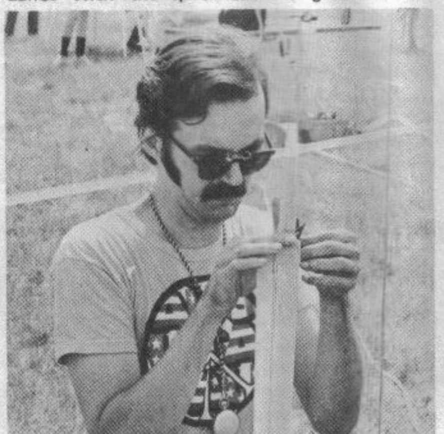
Bob Mullane led a group which considered how to get started in R&D. He suggested areas for potential experimentation and the technical details of writing a good report.

On Saturday morning the Record Trials got underway. The field was over a mile in length and a half-mile wide, but much of it was planted with corn and was "off limits" to anyone but the designated recovery crew. The sky was clear, but the gusty wind caused quite a bit of downrange drift on the high power B/G and PD models.

An early demonstration model was a three-stager using the new Cox D's. With a D8-0 in each of the first two stages, and a D8-3 in the upper stage the only thing that was certain was that ejection would take place long before apex. Boost on the first two stages was excellent, and the dense white Cox tracking smoke allowed everyone to see the model through third stage ignition, but by then it



The Flanagan-Skelding flight conversion of the MPC "Lunar Lectric Launch Pad" stole the show for "oddball" models at Phillipsburg. The pad, with launch rod removed, was flown from a "zero length" launcher. Streamers attached to each of the legs provided stability.



Once again "Ground Hog" swing-wings dominated the glider events. Here Jon Robbins preps his Sparrow R/G which took first with a 50 second duration. Jon's "Ground Hogs" also placed first in Hornet R/G, Sparrow B/G, and Hawk R/G, demonstrating the versatility of the design.

At PACT-1, for the first time, copies of the "Ground Hog" began showing up. Here Convention Chairman David Klouser shows the Klouser Team's "Ground Hog" which placed second in Sparrow R/G with 31.3 seconds — second only to Jon's original "Ground Hog" at left.

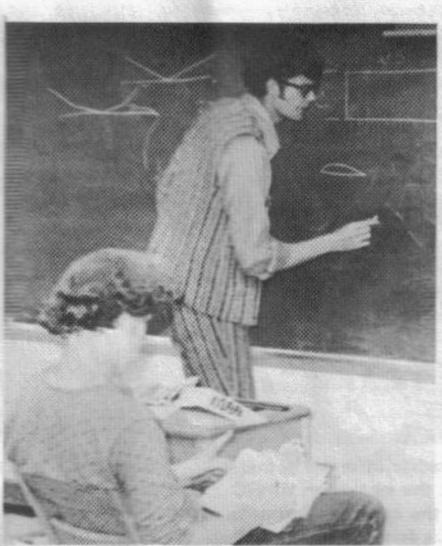
was up so high that the model had to be given up for lost.

Another unusual demo flight was the "MPC Flying Launch Pad" — a plastic conversion by Kevin Flanagan and Brian Skelding of Pascack Valley. They removed the launch rod from an MPC Lunar-Lectric Launch Pad, tied drag streamers to each of the three legs, and mounted an Estes D in the base of the pad. A zero-length launcher was used since the "Flying Launch Pad" did not fit on the launch rack. Amazingly, it worked, proving that just about anything can be made to fly if you try hard enough and exercise some care in the design.

A total of eleven events, all duration events, were on the schedule for the Record Trials. Most rocketeers chose to concentrate their efforts on only three or four of the categories, so there was little competition in each age group but a surprising number of good flights.

Four U.S. records were established by performances at the Record Trials. In the relatively new Streamer Duration event, for which no previous records had been established, two records were filed. Dave Hendricks flew a small, high-performance model using a T-20 tube, plastic cone, and modified "Stine Low Drag" fins to first place in Class 0 SD. Using a 3 foot long, 2 inch wide, crepe paper streamer, Dave managed a 22.8 second duration in the ½A powered event. In the C-powered Class 3 Streamer Duration event Robert Cather set a 63 second record also flying a standard rocket with a relatively small streamer. Those models with much larger streamers fared worse than the record setters, since they didn't boost high enough to turn in good durations.

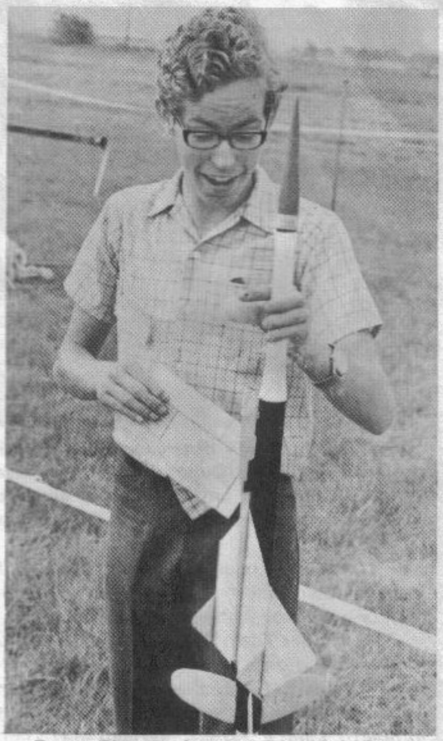
Doug Plummer's BT-50 model packed with a 28" cleaner bag chute had the longest duration of the day in Class 3 PD. The rocket itself, using 1/32" plywood elliptical fins on a 12" long model, boosted straight and deployed near apex. The chute caught rising



PACT Discussion Groups were held at a local school. Here Jim Sparks leads a discussion of basic B/G design parameters.

thermals over the planted cornfields, and Doug had to walk ¾ miles through the field to recover the model. The 299 second duration was a new U.S. record.

Doug Plummer also managed the only record setting flight in the B/G categories. His Condor entry was a full size Manta parasite mounted on a standard booster rocket. Unlike most of the other F7 powered parasite birds, Doug's model was stable during boost. Stability was assured by inserting seven nickels in the nose cone to move the CG forward. Deployment took place about two seconds after arc over, so high up that the full-size Manta was barely visible. The glider was beautifully trimmed, and began drifting downwind in the light breeze. It went out of sight after 219 seconds, and though Doug attempted to find the glider, he was unsuccessful.



Doug Plummer's record setting Condor Boost Glider, a full size parasite Manta, was boosted with an F7. After a chase across the New Jersey cornfields, Doug gave up and returned to find out that his 219 second duration was a new U.S. record.

There were a number of other interesting, but non-record setting, flights at the trials. Jon Robbins, who had introduced the swing-wing Ground Hog B/G to the east at the East Coast B/G Championships, was back with a "fleet" of Ground Hogs. This time he had B/G's and R/G's — at least one for each glider event. But Robbins' Ground Hogs

PACT-1 RECORD TRIALS

Hornet B/G	Div. B	1st	Jeff Risberg	38.7 sec
	Div. D	1st	Jon Robbins	28.7 sec
Hornet R/G	Div. C	1st	Klouser Team	3.0 sec
	Div. D	1st	Jon Robbins	30.0 sec
Sparrow B/G	Div. B	1st	Steve Smargassi	10.6 sec
	Div. D	1st	Jon Robbins	50.9 sec
Sparrow R/G	Div. C	1st	Klouser Team	31.3 sec
	Div. D	1st	Jon Robbins	50.0 sec
Hawk R/G	Div. D	1st	Jon Robbins	96.0 sec
Eagle R/G	Div. C	1st	Doug Plummer	12.8 sec
Condor B/G	Div. C	1st	Doug Plummer	219.0 sec
	Div. D	1st	Jon Robbins	32.5 sec
Class 0 Streamer Duration	Div. B	1st	Robert Cather	10.2 sec
	Div. C	1st	Peter Obst	15.6 sec
	Div. D	1st	Dave Hendricks	22.8 sec
Class 3 Streamer Duration	Div. B	1st	Robert Cather	63.0 sec
	Div. C	1st	Doug Plummer	60.0 sec
Class 0 Parachute Duration	Div. B	1st	Rich Famularo	19.3 sec
	Div. C	1st	Bob Otlowski	48.9 sec
	Div. D	1st	Dave Hendricks	20.3 sec
Class 3 Parachute Duration	Div. B	1st	Jeff Risberg	115.2 sec
	Div. C	1st	Doug Plummer	299.0 sec
	Div. D	1st	Bob Otlowski	58.0 sec

Sunday morning's discussion groups were rather informal gatherings held outdoors. Guppy, center, explained the operation of RC Boost Gliders using an RC plane to illustrate the control functions. Here he explains the operation of the elevator as Jon Robbins assists.

Dick Fox's group on Advanced Cineroc Photography was climaxed with the launching of a Cineroc from the school parking lot. The outdoor discussion session allowed Dick to fully prep and fly a Cineroc — probably a first for a Convention.

weren't the only ones at the meet. Dave and Steve Klouser, who had earlier seen the Robbins' Ground Hog, had one of their own.

The Klouser Team flew their small Ground Hog in two events — Hornet R/G and Sparrow R/G, and captured *second* place in each of those events with a 31.3 second flight in Sparrow and a 3.0 second flight in Hornet. First place in both events went to Jon Robbins, flying "original" Ground Hogs with a 50.0 second duration in Sparrow and 30.0 seconds in Hornet.

Jon also flew Ground Hogs in the higher powered events and managed a first place in Hawk R/G with 96 seconds, and a second (to Doug Plummer's record-setting flight) in Condor B/G with 32.5 seconds.

Mike Angelo, who flew the "Feather" in Condor at NART-II was back again with a feather for boost/glide. This time his Condor entry was a 14" long pheasant feather, again trimmed to glide by adding a pin to the nose. On three F100 powered flights deployment was a little erratic, and the feather never entered a stable glide.

In an attempt to settle the long-standing debate as to where in the model rocket trajectory a "mercury switch" would trigger, Dick Fox flew a mercury switch attached to his Foxmitter. As expected, triggering took place during the deceleration immediately following engine burnout. Thus, the mercury switch can be used as an upper stage ignition switch, but not to operate a light flasher or other tracking device at apex.

On Saturday evening additional discussion groups on the topics of Basic Rules of B/G Design by Jim Sparks and Scale Topics by Al Lindgren were on the schedule. In the scale group Al Lindgren discussed methods of obtaining scale data. He pointed out that data on military vehicles is much harder to obtain than that on civilian sounding rockets since most military work is classified. Jim Sparks discussed the generally accepted relationships for size and location of the stabilizer and fin in relation to the wing size on standard configuration boost gliders.

Later that evening, Jay Apt delivered the keynote address on the "Non-Flying Aspects of Model Rocketry." He suggested that a club can retain members who might otherwise lose interest in rocketry by assigning them responsibilities in the area of newsletter preparation and distribution, public relations and publicity, or "lobbying" for favorable model rocket legislation. Other rocketeers may find summer employment in the hobby by teaching rocketry at a summer camp or through a youth group program.

Sunday morning's discussion groups incorporated another convention "first" — they were held outdoors, in the parking lot behind the school which served as a site. This allowed the group leaders to give practical demonstrations of the concepts under discussion.

Guppy led the group on Radio Control Techniques, using an actual RC airplane to demonstrate the control functions. Jim Sparks suggested that for light weight superregenerative receivers (such as the Ace unit) be used, but he cautioned that other CB equipment (such as Transroc, walkie-talkie, etc.) could "shoot it out of the sky." Guppy insisted that "there's no way to learn to fly RC by reading and studying. The only way to do it is by wrecking planes." He then gave a graphic demonstration of RC flying techniques by putting the plane he had been using to demonstrate control functions into the air.

Meanwhile, Dick Fox was discussing Cineroc Photography at the other side of the parking lot. Using an Estes film changing bag (sold as a Camroc accessory), Dick explained how to load the Cineroc film cassette with bulk purchased film. For a demonstration flight he selected a Cineroc cassette of Tri-X black and white film. (It seems strange that for two years Dick tried to make the Camroc take color pictures, and now he's experimenting with a black and white Cineroc.) For research projects requiring many Cineroc flights, Dick pointed out that the use of home loaded and home processed black & white film can substantially reduce the project's cost. He also suggested that, especially in cold weather, the use of Eveready E90 Alkaline batteries in the Cineroc will result in a better and longer motor run.

Since no one had planned on launching rockets on Sunday morning, Dick had a problem finding a booster for his Cineroc. Finally Doug Plummer volunteered an old cluster model. After a search for engines, Dick made the decision to fly with two B's and a C "because we didn't have all the same engines." Only *one* ignited, the rocket climbed to about 25 feet and impacted in the firing area, crushing the front section of the Cineroc. However, the film was salvaged and should be something to view.

The Convention concluded with the presentation of awards to the winners. Overall it was a victory for the Ground-Hogs, with Jon Robbins receiving so many trophies and ribbons that his two young sons had trouble carrying them all away. In fact, Jon took first in Hornet R/G, Sparrow R/G, Sparrow B/G, and Hawk R/G. His Ground Hogs only managed second place in Condor B/G and Hornet B/G, and in the only other glider event, Eagle R/G, he failed to qualify. No doubt, Ground Hogs will be cropping up all over as the word of their success spreads.

At the close of the Convention, Carl Guernsey presents a model signed by all PACT-1 participants to Convention Chairman David Klouser.

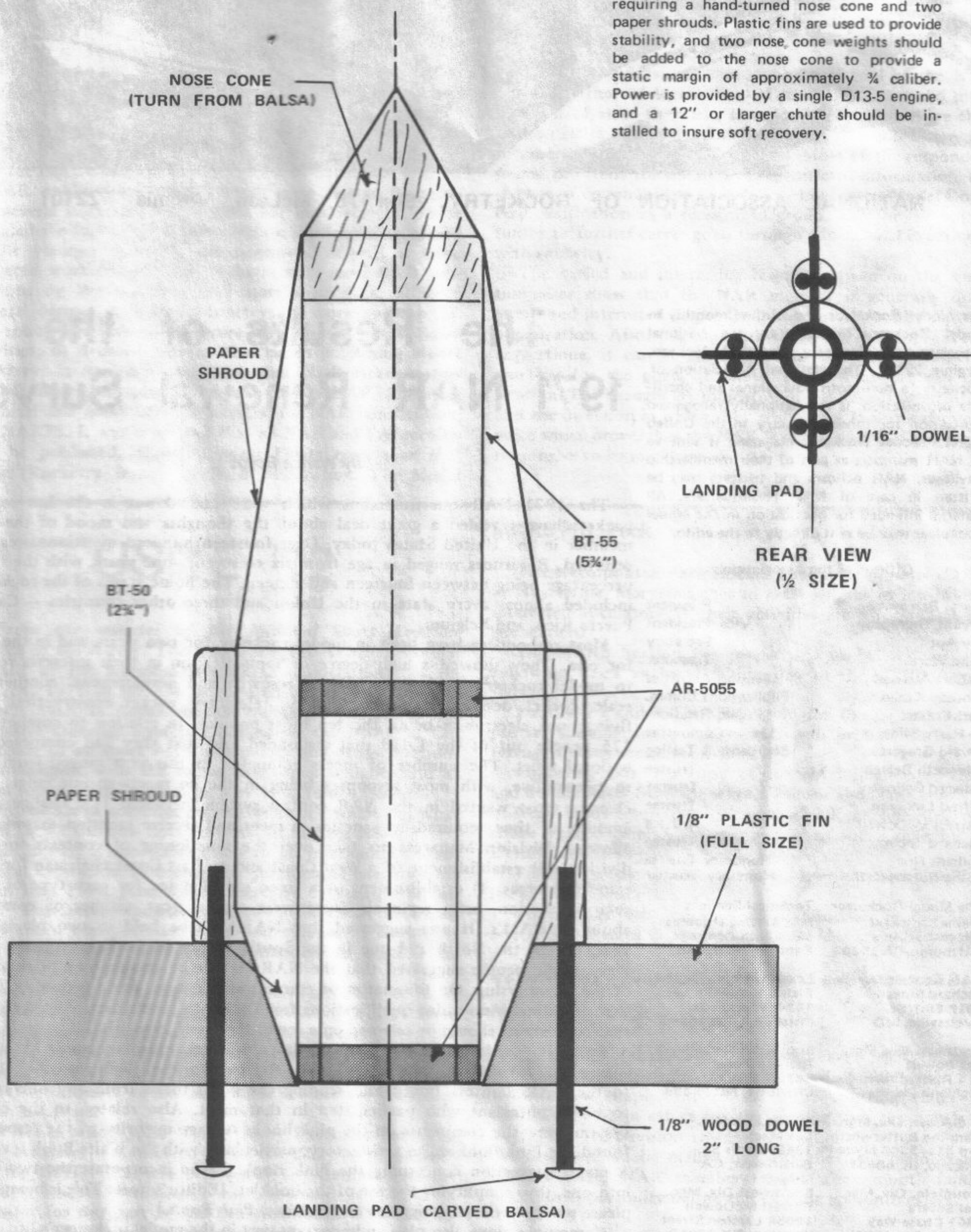
Next Month in Model Rocketry:

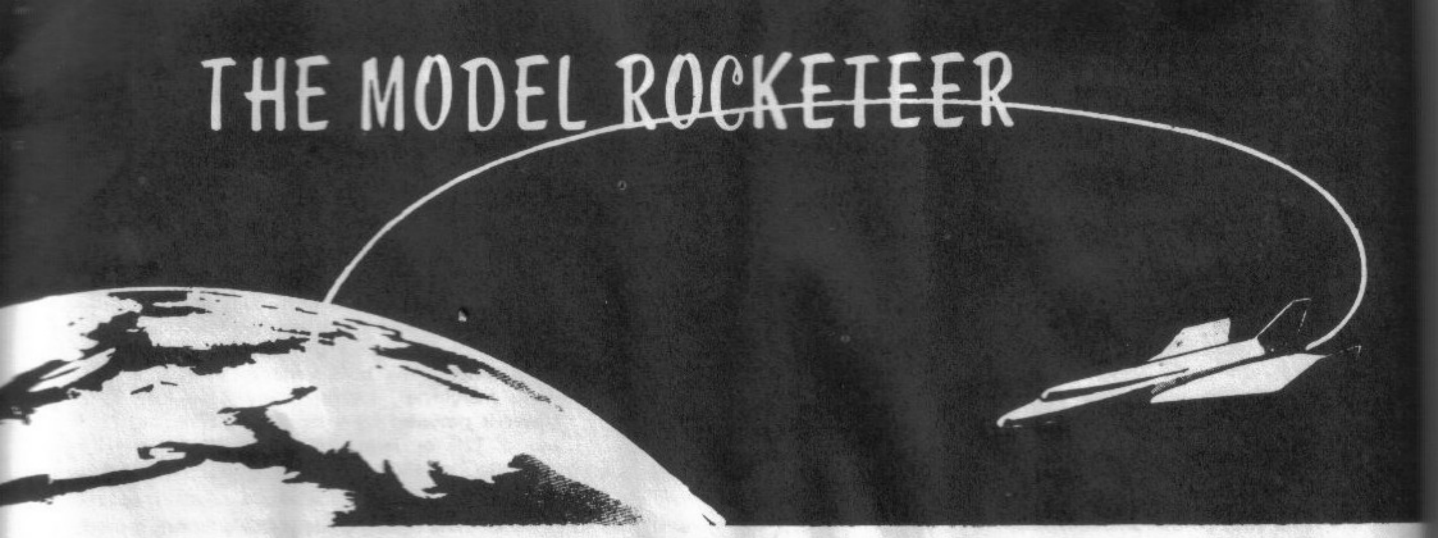
COMPLETE COVERAGE

CANADIAN NATIONAL MODEL ROCKETRY CONVENTION

Reader Design Page

This month's Reader Design by Claude Lebrun of Dallas, Texas, is a sport model based on the "single stage to orbit concept of satellite launching." Construction of this model is complex for a model of its size, requiring a hand-turned nose cone and two paper shrouds. Plastic fins are used to provide stability, and two nose cone weights should be added to the nose cone to provide a static margin of approximately ¾ caliber. Power is provided by a single D13-5 engine, and a 12" or larger chute should be installed to insure soft recovery.





NATIONAL ASSOCIATION OF ROCKETRY, Box 178, McLean, Virginia 22101

The Model Rocketeer is published monthly in **Model Rocketry** magazine by the National Association of Rocketry, Box 178, McLean, Virginia 22101. The National Association of Rocketry, a non-profit educational and charitable organization, is the nationally recognized association for model rocketry in the United States. **Model Rocketry** magazine is sent to all NAR members as part of their membership privileges. NAR officers and trustees may be written in care of NAR Headquarters. All material intended for publication in *The Model Rocketeer* may be sent directly to the editor.

The Results of the 1971 NAR Renewal Survey

by Wanda Boggs

The 1971 NAR questionnaires which were mailed out in the last renewal packets have revealed a great deal about the thoughts and mood of the NAR member in the United States today. Over fourteen hundred questionnaires were returned. Returnees ranged in age from six to seventy-one years, with the largest percentage being between fourteen and sixteen. The home states of the rocketeers included almost every state in the Union and three other countries – Canada, Puerto Rico, and Belgium.

Most respondees have been in model rocketry for two years and in the NAR for one. They showed a high degree of sophistication in their interests relating to model rocketry, with boost/gliders, research and development, competition, scale, rocket design, aerial photography, telemetry, rocket construction, sport flying, and electronics being the ten most popular. In relation to competition, 175 people out of the 1,410 that responded said that they had competed in a national meet. The number of meets competed in this year ranged from none to twenty-five, with most responses being in the no meets to one range. The changes most wanted in the NAR contest system included: 1) a change in the amount of time required to sanction a meet and receive sanction materials; 2) allowing Division Managers to take over the sanctioning of contests for their divisions; 3) establishment of a West Coast and an East Coast chairman for those respective areas; 4) establishment of a fixed sanction fee for each type of meet, such as section, area, regional. There were also a great number of comments about NARAM's. It was suggested that NARAM's be held in two places each year, one in the North and one in the South, or one in the East and one in the West. Some people suggested that the NARAM site be chosen by a popular vote of the membership. On the matter of contestant selection, some people felt that there should be no point qualifications for NARAM's, and others voiced the idea that contestants should be selected on a regional run-off basis.

Some opposition to the present flight card system was expressed. Among the suggestions for changes were dropping the requirement that flight cards be returned to the NAR Contest Board and sending the point totals from any one contest to each contestant who participated in that meet. Also related to the contest system were the comments on the pink book. A large majority of the respondees found the Pink Book quite satisfactory, particularly with the White Book revisions. A major suggestion concerning the Pink Book was to incorporate the two books into one, thus simplifying the use of the booklet. [Editor's note: This is being done; please see the article in this issue entitled *New Pink Book*.]

Communications also play an important part in the model rocketeer's life. There were sixteen major ways of keeping up with rocketry news indicated in the responses, including: **Model Rocketry** magazine, section newsletters, manufacturers' catalogs and pamphlets, contact with other rocketeers (correspondence, conventions, etc.), sections, meets, NARTS, other magazines, hobby dealers, trustees, non-NAR clubs, teachers, NASA, State Department Heads, and LAC.

Concerning NAR Headquarters service, 407 people had dealt with Headquarters aside from membership renewal, with a majority replying that the response was quick and adequate. NARTS was also rated well by those who had dealt with it. Most members rated the information good to excellent, although it was generally felt that the response was somewhat slow.

When asked whether or not they were familiar with the organization and the committees of the NAR, over half of the respondees said that they were. Only 410 were familiar with the LAC, however, leaving 1000 who were not.

NAR publications on the whole were felt to be good, but several suggestions were given for improvement. These included the following: 1) more technical information geared to the younger members and beginners, as well as more advanced work for the older rocketeers; 2) more R&D publications by the members and more scale data; 3) more readers' designs in **Model Rocketry**; 4) more coverage of convention discussions; 5) more coverage of West Coast activities; 6) decrease in the time lag in publishing **Model Rocketry**. It was also suggested that NAR Headquarters publish more descriptive literature on the NAR, including technical and administrative services, the NAR constitution, and NARTS. It was suggested that all NAR and FAI records also be published. [*Editor's note: Please remember that* **Model Rocketry** *is not an NAR publication.* The Model Rocketeer *is the NAR's newsletter. Events on the West Coast will be mentioned in* The Model Rocketeer *if people on the West Coast will send in articles about them. One more thing, NAR and FAI records will be published in this newsletter in an upcoming issue.*]

A majority of NAR members do not belong to sections, although more than half of these stated that they were willing to join or form sections. Of those who belonged to sections, several indicated the desire to help form other new sections. It was suggested that membership lists be sent to members in the same general area to aid in the formation of new sections.

Most respondees felt that the general goal of the NAR should be that of legalization of model rocketry and modification of state fireworks laws in those states where they are too strict to permit model rocketry. It was felt also that membership fees should be reduced. Most of the respondees joined the NAR for the insurance, contests, information, the chance to communicate with fellow hobbyists, **Model Rocketry**, unification as a recognized group, and for the opportunity to further career goals through educational experience with rocketry.

The varied and interesting responses given on the questionnaires show that the NAR member is generally quite aware and interested in the livelyhood of his hobby and his organization. Also, judging from the types of responses and suggestions, it can be concluded that the NAR member is working for the goals of safety, communication, and unification. The changes are indicative of the desires of members and the direction in which they wish to go. It is this common voice which proves that the NAR is responsible and (we hope) responsive to its members.

USITE '72

(*From the minutes of the National Sport Aviation Council of the NAA*) "The National Sport Aviation Council (NSAC) of the National Aeronautic Association met on May 14, 1971 at 10 AM in the Conference Room of the Federal Aviation Administration building . . . USITE '72 Executive Director Spurgeon designated the NSAC as Coordinator of all sport aviation activities and demonstrations in connection with the exposition which will be held at Dallas International Airport on May 27 – June 4, 1972."

OK, we know something about when and where but what is USITE '72 and how does the NAR fit into the NSAC?

USITE '72 is the name given to an international aeronautical exposition authorized by presidential executive order in June 1970. John Volpe, Secretary of Transportation, says, "This novel exposition will cover the entire spectrum of advanced transportation ideas and equipment from subways to satellites, from cargo containers to tracked air cushion vehicles."

And to liven up the hardware displays a bit the Dept. of Transportation (DOT) has asked the NSAC to provide some of its activities to the affair. The NAR being a member of the NAA sat in with the NSAC and its representatives (from balloonists to race pilots, from parachutists to experimental aircraft enthusiasts et al.) and made its bid for providing launch activities.

At the meeting John Worth (AMA Executive Director, NAR Treasurer) volunteered to be NSAC's overall coordinator for USITE '72, and afterwards Joe Cimmino of the Wheaton Rocket Association was appointed as NAR's coordinator for our part of the demonstrations. This is a big event – watch for news in the coming months.

MARS P.R. Pack

The Metropolitan Area Rocket Society Section (No. 130) in Hyattsville, Maryland goes to great lengths to insure that interested spectators at their activities are informed about the section.

The MARS Section has prepared a packet with all the following items enclosed within one of the NAR's 2-page flyers:

First is a membership application for the section then a poster, suitable for putting on a wall or bulletin board, telling of many section activities.

Following this is a copy of the NAR single page flyer and a short letter from the section advisor about the club.

Next is an up-to-date calendar of all meetings for the entire year, a map to the meeting place and a schedule of section launches planned for the coming year.

Finally a copy of the section by-laws is enclosed with a list of the section officers.

The section also puts its name and address on each item (via rubber stamp) in the packet. Good idea for sections, eh?

New Pink Book

The NAR Contest Board has announced that the new U.S. Model Rocket Sporting Code will be delayed. The White Book supplement to the 1967 sporting code will continue to be in effect for the coming year through June 30, 1972. The revision committee's schedule now calls for the new code to be mailed out with the 1972 membership licenses giving NAR members about a six month familiarization opportunity before the 72 code goes into effect.

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(July 1, 1971)

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NOTE: If you can't find a particular section in the proper state, check bordering states. Sections have been classified by mailing address and those in borderline areas may include people from more than one state.

STANDARDS & TESTING COMMITTEE REPORTS

by Chas Russell

From out of the thick, swirling smoke comes the excited exclamation, "Fantastic, do you have another one ready?" The NAR Standards and Testing Committee is at work.

What is S & T and what does it do?

Okay. The chairman of S & T is Dr. Gerald Gregorek. To aid him, Dr. Gregorek appointed Doug Ball, George Pantalos, and Charles Russell to the committee. All three are Aeronautical Engineering students at Ohio State University (where Dr. Gregorek teaches), and Leader members of the NAR.

Photo by Chas Russell

Mike Bergenske, a representative of MPC (left), Dr. Gregorek, S & T chairman, and S & T member Doug Ball (right) watch the plotting of a minijet. Doug is manning the plotters through the computer and is in constant communication with the firing crew.

The Standards and Testing Committee was set up under the NAR By-Laws for the purpose of testing and certifying components used in model rocketry. S & T sets, defines, evaluates, and enforces standards and specifications for model rockets and model rocket engines. Most notably, S & T handles engine certification, awarding safety and contest qualifications. The committee also has the authority to withdraw or suspend certification on any engine which proves to be consistently faulty or out of specs.

S & T handles engine testing at two separate facilities. One is a test cell at the OSU Propulsion Lab. The cell, known affectionately as the "Boom Room," allows S & T all-weather testing capabilities. Amplifiers and plotters are available at the lab to produce thrust-time curves. The other

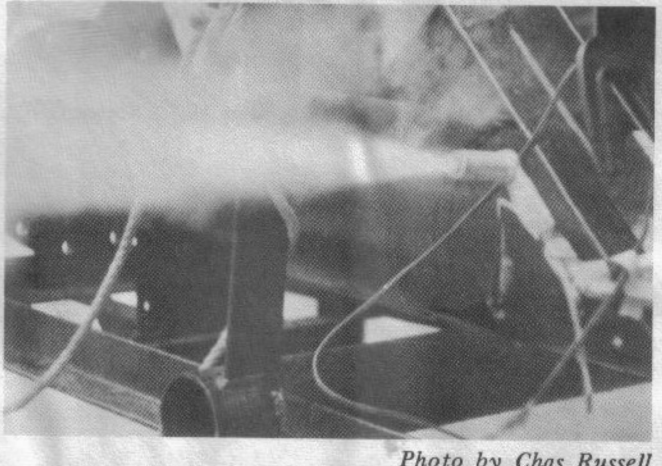

Photo by Chas Russell

A minijet *A* in static test. The engine is mounted on a metal bar, and the thrust may be determined by measuring the deflection of the bar.

facility has a central computer complex that allows the plotting of thrust-time curves and the integration of total impulse.

The committee uses two test stands designed and built under the direction of Dr. Gregorek. The smaller of the two is for ¼A through D engines, while the larger is for E and F class engines. Each stand uses a strain gauge bridge to convert the deflection of a metal bar due to the engine's thrust into an electrical signal. The voltage output is thus proportional to the thrust of the engine. The voltage is then amplified and used to control a calibrated plotter. The result is a record of the engine's thrust characteristics: a thrust-time curve.

If an engine shows consistent reliability, it is awarded a safety certificate. Total impulse must be within plus or minus 20 percent of the engine's stated impulse for the safety certification. For an engine to be contest certified, it must not vary more than plus or minus 10 percent of its stated impulse.

(Note: more info on S & T can be found in the **Model Rocketeer**, *October, 1970.)*

Record Attempts

The following people have filed for U.S. records. No altitudes or times are being listed because these are not records. A list of existing records will appear in a future issue of the *Model Rocketeer.*

Condor Boost Glide
Division C
Doug Plummer, NAR 12120, 19 June 1971, Stewartsville, N.J.

Hornet Rocket Glide
Division D
Bob Parks, NAR 7871, 29 May 1971, Cambridge, Mass.

Sparrow Rocket Glide
Division C
Mike Burzynski/Tim Fornshill, NAR 17871/18286 (T067), 23 May 1971, Manassa, Va.

Class I Parachute Duration
Division D
James Worthen, NAR 7095, 5 June 1971, SAMEE I (Also FAI)

Class III Parachute Duration
Division C
Doug Plummer, NAR 12120, 19 June 1971, Stewartsville, New Jersey.

Class 0 Streamer Duration
Division D
Dave Hendricks, NAR 17743, 16 June 1971, Stewartsville, New Jersey.

Class I Streamer Duration
Division C
Gary Lindgren, NAR 10678, 6 June 1971, Conackamack Jr. High School, Piscataway, N.J.

Class II Streamer Duration
Division D
Gilbert E. Lutz, NAR 19756, 4 June 1971, MMRR-71, Lockbourn AFB, Ohio.

Class III Streamer Duration
Division B
Robert Cather, NAR 17034, 19 June 1971, Stewartsville, New Jersey.

Pee Wee Payload
Division C
Roy Rosenfeld, NAR 13165, 19 June 1971, Southern H.S., Annapolis, Maryland.
Division D
George Meese, Sr., NAR 12973, 19 June 1971, Southern H.S. Annapolis, Maryland.

No. 1 for AFA for '71

by Cadet Peter Schocker – NAR 20129

Up at 7250 ft. the United States Air Force Academy's first rocket meet of 1971 got off to a wet start. The rain kept the meet from starting until 2:00 PM, but when it finally did let up and the sun peeked through, the USAFA NAR section and NAR members from the Colorado Springs and Denver areas were eager to get started. This first meet of the year was initiated by the launching of Cadet Bill Arthur's 10 foot tall rocket (see photo). Powered by tandem D's, this bird really gave the contestants, judges (including Bill Roe, NAR No. 13), and spectators a real thrill. After all the opening antics (a duel between Bill Arthur's 10 foot tall rocket and Dave Newill's F-powered scale Saturn 1B), the heat of competition got underway. The top event winners were as follows:

Hawk B/G	Steve Evans	2:52 min.
Robin Eggloft	William Bailey	207 m.
Class II streamer Duration	Robert Finch	1:02 min.

Prizes were given for the top three places and the top four overall winners got plaques. Estes also provided some demonstration flights.

Cadet Bill Arthur's 10 ft tall rocket takes off at U. S. AFA meet. *(Photo by Pete Schocker)*

NAR By-Laws Revision Committee Named

Manning Butterworth, Chairman of the NAR By-Laws Revision Committee, has announced the names of the other committee members. Comments and suggestions for the revision of the By-Laws will be welcomed by the committee. Just contact Manning or the committee member nearest you. Here is a chance for all NAR members to express their opinions. (If you haven't got a copy of the NAR By-Laws, they're available from NARTS.) The committee members and their addresses are:

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William Hall
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Severna Park, Maryland 21146

Ben Russell
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Houston, Texas 77047

An NAR Section is being formed in the Shreveport-Bossier City, Lousiana area. Interested rocketeers around there should contact Mark Knox Jr., 1117 James St., Bossier City, Louisiana 71010, for more information.

****

On May 15 the Hawkeye Section (No. 178) in Davenport, Iowa, held its first annual Hawkeye Invitational Model Rocket Demonstration and Sport Launch. The launch was flown to try and bring in new members and help gain support and acceptance for the section. The launch was open to all rocketeers in the area. The section gained 7 new members from over 125 spectators.

The NARCAS Section (Camp Hill, Pa.) has started working on its own section film similar to the one made by the Steel City Section. The film will include scenes from club launches, ECRM-5, NART-2, and "anything else they can find."

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Congratulations to the Elwood Association of Rocketry Section (East Northport, New York) on the publication of Vol. 1, Number 1 of their section newsletter, *Burnout.*

****

"Mickey Mouse Sanctioned Section, Sanctioned Section Meet, Meet - 1" was held May 29 in Anaheim, California. Besides the long name the meet is also notable because every contestant (there were fifteen) walked away with at least one 4th place from one of the 3 events flown!

****

The Annapolis (Maryland) Association of Rocketry section newsletter, *Voyager*, contained the following short, "Overheard at a Recent Meeting:"

"I think the old method of tracking stinks. Why don't we ask the fire department to lend us a very tall ladder..."

"Yeah, then we could have someone on the ladder about every ten feet and..."

"When the rocket reaches its apogee the person who is at that point on the ladder calls out and we know exactly how high it went."

(Now why didn't we think of that?)

Remember, you can send your section news to:

Charles M. Gordon
NAR Section News
142 Harford Hall
University of Maryland
College Park, Maryland 20742

MRRA-CAP Demonstration

The Midwest Rocket Research Association (MRRA) and the Group VII CAP Section of the Civil Air Patrol's Kansas Wing held a model rocket demonstration on June third at Richards Gebaur Air Force Base's Harrisonville Annex. This was the first such activity to be held at the base. Among the rockets flown were a Cineroc, a Camroc, and a transmitter rocket. The demonstration was requested by the base safety office, fire department, and special services to assure that the area was large enough for recovery purposes and to determine whether or not normal aircraft operations would be interfered with. It was found that the launching posed no problem, and more launches and contests are planned for the future.

The left-hand photo shows an ARCAS built by MRRA member Harold Mayes. This model had a good flight, as did the seven others launched. In the other photo, Dean Troxel (on the left), a Junior member from MRRA is given some help hooking up his rocket by CAP Cadet Pat Moss, also an NAR Junior member. Pat is from the Group VII CAP Section. ***(Photos by Capt L. Loos)***

Index to Model Rocketry Magazine

Volume II: October 1969 – September 1970
Compiled by Douglass W. List

This index is intended as an aid for locating known or unknown articles in **Model Rocketry** magazine from October 1969 to September 1970. Any comments you may have on how to make the index more useful should be sent to Doug List, care of **Model Rocketry** magazine. Each index is described below.

Article Index

This index contains all major articles appearing in **Model Rocketry** magazine, Vol. II. Much multiple listing is used. If you can not find what you are looking for under a given topic, try a related topic. An article may have been accidentally omitted from a topic pertaining to it. If you can not find the item anywhere, check the News Notes Index.

News Notes Index

This index contains all material printed in *News Notes* or elsewhere in the magazine of a news nature. Materials are listed by title only. If no page number follows the issue, the material is found on the *News Notes* page for that issue. (See Regular Features Index.)

Regular Features Index

A listing of page numbers for all regular features.

Index to Kits Reviewed in New Products Notes

A listing by manufacturer of kits reviewed during the year. If a page number does not appear, the kit is covered in the *New Products Notes* section for that issue. (See Regular Features Index.)

Article Index

-A-

Index to News Notes, Etc.

Index to Regular Features

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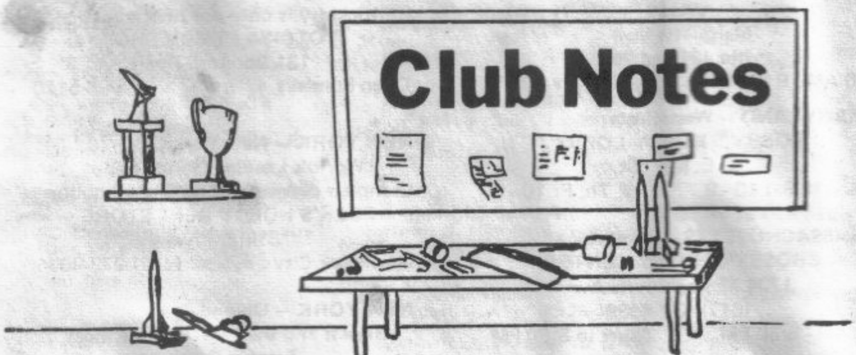
DEALER DIRECTORY

Hobby shops desiring a listing in the **Model Rocketry** Dealer Directory should direct their inquiries to Dealer Directory, **Model Rocketry** magazine, Box 214, Boston, MA 02123. Space is available only on a six month contract for $18.00, or a twelve month contract for $35.00, payable in advance.



The Michigan Area Rocketeers Society held it's third launch and first contest on Sunday, May 9. Two prizes were given out for most total points accumulated in drag racing, parachute duration, boost-glide duration, and spot landing competition. First prize was an A-20 Demon kit which went to Bill Beasinger and the second prize, an Astron Sprint, went to Steve Boggess. One of the day's two major highlights came with the launching of Bob Boggess's six foot tall five D engine rocket. Only one engine failed to ignite and the rocket roared aloft in a beautiful flight only to have the recovery system not deploy. The other highlight occurred when an A-20 Demon, converted to fly with an Enerjet 'E', was launched. It was recovered intact about a half-mile away. The Society now meets in a room recently acquired from St. Matthews School every other week. MARS is getting closer to its goal of becoming an NAR section. Anyone interested in joining should contact the Activities Co-ordinator, Bill Beasinger, at 5753 Audubon, Detroit, Mich. 48224 or fill out a membership blank at Tel-Star hobby shop.

The Portland Area Rocket Association (PARA) has been quite busy the last few months. On the drawing board is a wind tunnel, a study into the effectiveness of boattails, and the development of an onboard recording system. The plans for this system have not been released yet, but it seems as though information from various sensors is not sent to the ground through radio transmitters, but is stored inside the rocket. Interested rocketeers can contact the club through Ricky Snodgrass, 229 Llano Drive, Portland, Texas 78347, or call (512)643-3459.

The Viking Rocketry Society of Richmond, Virginia sponsors monthly meets at the Virginia State Fairgrounds. Trophies are given to the winners. Interested rocketeers should contact Ronald Gabeler, 6803 Staples Mill Rd., Richmond, Va. 23228.

The Greater Jacksonville Model Rocket Club is a year old now, has almost one hundred members, and invites any model rocketeer over 8 years old to join. The club meets on the second and third Saturdays and has meets on the third Sunday of each month. For more information call or write: Chuck Vaughn, 2548 Parental Home Rd., Jacksonville, Fla. 32216, 725-2670.

The Granite City Rocketry Society, located in Mount Airy, N.C., was started a little over a year ago. Club facilities include a multiple launch system, field radio communications, altitude tracking equipment, and a good launching site. They are currently investigating the launching of small, tropical fish, and are preparing to study underwater launchings and telemetry communications. The members would like to correspond with other clubs. If interested contact: Joe Brown, 124 Orchard St., Mount Airy, N.C. 27030.

The Elwood Association of Rocketeers, a new NAR section in Huntington, New York, now has 15 members and is growing fast. Since their last sport launch, shown above, the club has obtained a launch rack, a panel, and a pair of Centuri Sky Tracks. Long Island area rocketeers interested in more information can write Tom Whymark, 17 Eltona Place, East Northport, New York. 11731.

The latest issue of *The Spotter*, newsletter of the Turks Head Organization of Rocketry (West Chester, PA), reports the results of THORSM-1 a club-sponsored section meet. Six events were flown at the May 22nd contest, with M. Griffith taking first in Class 1 PD with 193 seconds, P. Covell taking first in Swift R/G with 25 sec., and M. Griffith taking first in Sparrow B/G with 225 seconds. In the altitude events, which were unofficial since only the elevation angles were recorded, M. Griffith placed first in Pee Wee Payload, P. Covell in Design Efficiency, and M. Griffith in Robin Eggloft. Rocketeers in the West Chester, Pennsylvania area can contact the club through Andrew Bennett, P.O. Box 135, Exton, PA. 19341.

A new model rocket club is being formed in the Aurora, Colorado area. Rocketeers interested in joining the Aurora Rocket Society are invited to contact Steve Sande, 15301 E. 11th Avenue, Aurora, Colo. 80010 or call 364-4585.

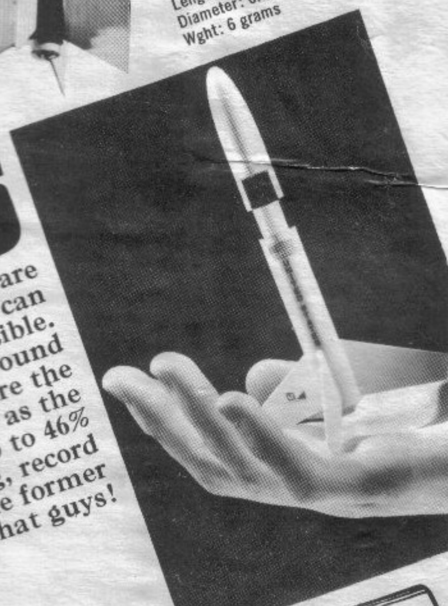
The Model Rocket Club of Willingboro, New Jersey celebrated the inauguration of the new National Postal Service with the launching of a two-stage, letter-carrying model rocket. Mark Jefferson, David Russell, and William Luebkemann successfully launched and recovered the rocket carrying a letter from the president of the Greater Willingboro Chamber of Commerce to Winton Blount, Postmaster General of the United States. After retrival of the letter, it was sent on its way by more conventional means.

A new club has been organized in Tigard, Oregon. Any interested rocketeers should contact Tracy Hardman, 18728 S.W. Kristi Way, Lake Oswego, Oregon.

Twenty students from San Clemente, Cal. participated in the Aerospace Class Rocketry Project, under the supervision of teacher Don Schwenn, during a seven week period culminating in June. The students designed and built their own model rockets, which were judged for workmanship by Douglas Malewicki, Manager of the Rocket Science and Education Division of Cox. Model rockets manufactured by L.M. Cox were presented to Steve Heath, Carol Robinson, Agosto Alarcon, Frank Perio, Sally Grab, and John Farr, who were winners in the event.

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
Astor St. Station
Boston, Mass. 02123



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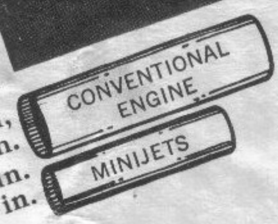
minijets T.M.



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For an MPC Miniroc catalogue send 15c to: MPC/Miniroc Catalogue, Dept. Q
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