MODEL ROCKETRY

The Journal of Miniature Astronautics
Incorporating THE MODEL ROCKETEER

January 1970
50¢

USSR Report:
KALUGA NATIONAL MEET

RETURN TO GREEN MOUNTAIN

RETRO-ROCKET DESIGNS

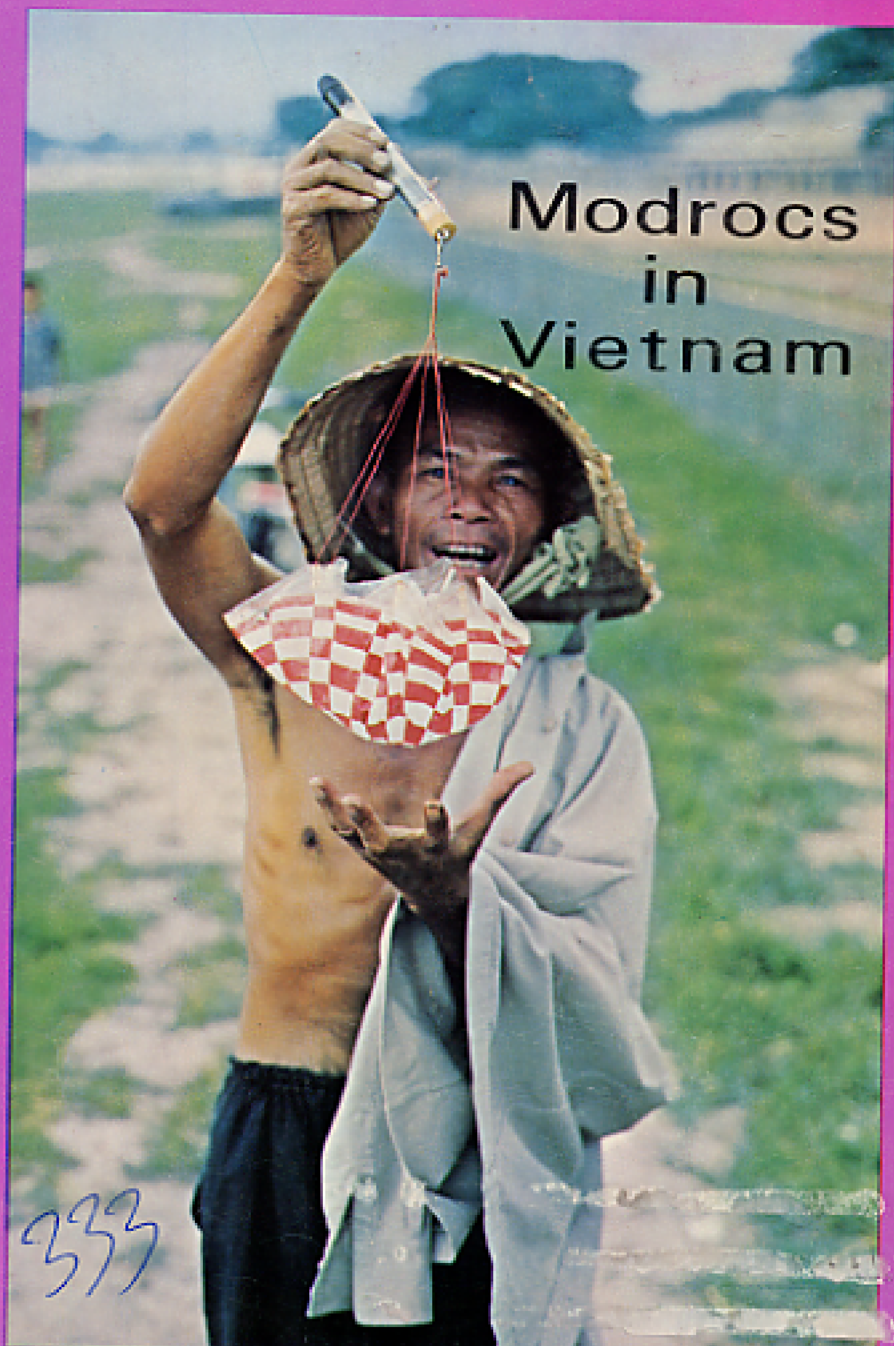
CALCULATING DRAG COEFFICIENTS

EDUCATIONAL USE OF MODROCS

BOOST GLIDE PERFORMANCE

BUILD THE TILT-A-TOWER

MARS-IV REGIONAL RESULTS



Little Joe.

A winner in style, performance, and looks! An authentic 1/100 scale version of NASA's famous Little Joe II which lifted off from White Sands on May 13, 1964. You'll be proud as can be of this gleaming silver and white beauty which is easy to build, fun to fly, and a joy to behold. Enjoy the most up-to-date technology in a kit which costs but $3.00. No painting! Pre-printed roll pattern and corrugated metallic wrapper and fin covering make it a snap to build. The authentic plastic escape tower and capsule are really keen. "Baby Joe" will arch skyward on a single engine, too. Buy it! Fly it! You'll be glad you did.

Centuri

Centuri Engineering Company
P.O. Box 1988, Dept. MR-2
Phoenix, Arizona 85001

1/100th SCALE
LITTLE JOE II
Cat. No. KS-9
$3.00
Engines not included.

AT YOUR HOBBY DEALER OR ORDER DIRECT.

Free Catalog with order.

ENGINES TO USE
A5-2 A8-3 B4-4

Model Rocketry

Volume II, No. 4
January 1970

Cover Photo

This month's cover shows a Vietnamese after recovering one of Forrest Mims' experimental rockets launched from the Saigon Racetrack. An article on Mims' experiences in Vietnam begins on page 23. (Cover photo by Forrest Mims.)

From the Editor

Its Convention season again. Planning goes foreward on the Pittsburgh Spring Convention and the MIT Model Rocket Convention, both scheduled for early Spring. The Southwestern Model Rocketry Conference, scheduled for Summer, is also being planned. Rumors from Canada indicate considerable interest in a Canadian Convention later this year. The sponsoring clubs for all Conventions, however, need widespread support from the model rocketeers as well as the manufacturers.

These Conventions, bringing together rocketeers from large regions of the nation, stimulate a regional interest in the hobby and help stimulate the needed technical advances. Five years ago the Pittsburgh Convention was just an idea. An idea that many rocketeers rejected as impractical. It worked, and has continued to bring together rocketeers every year since.

As the Steel City Section will testify, planning a convention isn't easy. The behind the scenes details – arranging for rooms, guest speakers, manufacturer displays, food, etc. – occupy considerable time for the organizers. But the results make it a rewarding experience.

Each Convention has its own character. Pittsburgh has principally been aimed at raising the level of the beginners. Thus introductory sessions on construction techniques, scale modeling, etc. have been featured. Technically oriented topics such as instrumentation have not, however, been ignored. At MIT the emphasis has been on theoretical performance. Computer calculations, research on dynamic stability, and technical papers on other topics have been

(Continued on page 46)

Regular Features

Worldwide newsstand distribution by Eastern News Distributors, Inc., 155 West 15th Street, New York, New York 10011. Hobby shop distribution by Kalmbach Publishing Co., 1027 North Seventh St., Milwaukee, Wisconsin 53233.

Second class postage paid at Boston, MA and at additional mailing offices.

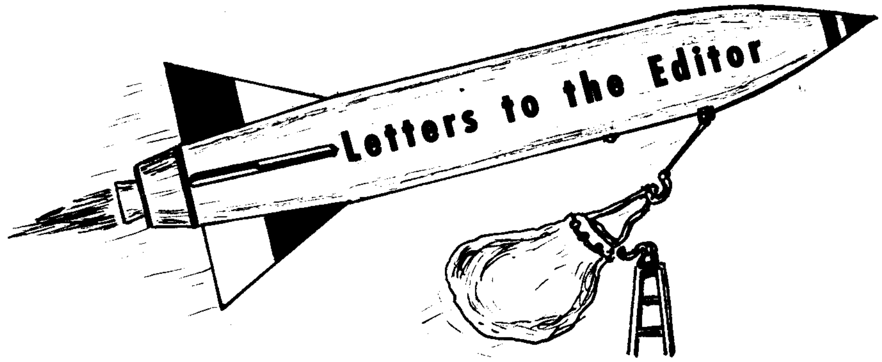
Model Rocketry magazine is published monthly by Model Rocketry, Inc., 595 Massachusetts Avenue, Cambridge, MA 02139.

Subscription Rates: US and Canada $5.00 per year, $3.00 for 6 months, 50 cents for single copy; Foreign $9.00 per year, $5.00 for 6 months, $1.00 for single copy. For change of address please notify Subscription Department, Model Rocketry, Box 214, Astor Street Station, Boston, MA 02123 at least 6 weeks in advance. Include former address or mailing label with the new address.

Material submitted for publication should be accompanied by a self-addressed, stamped envelope if return is desired. Model Rocketry can assume no responsibility for material lost or damaged, however care will be exercised in handling. Articles accepted for publication will be paid at the rates current at the time of publication. Letters, contest information, news, announcements, etc. are assumed to be submitted gratis.

Undeliverable copies, notices of change of address, subscriptions, and material submitted for publication should be submitted to Model Rocketry, Box 214, Astor Street Station, Boston, MA 02123.

Printed in USA



Expansion Problems?

I have been selling rocketry in my store for over four years, but I can only depict gloom for this science hobby. In the past few months I have grown concerned over the number of new manufacturers entering the field. Rocketry is not a toy; it was never meant to be a toy. As the number of manufacturers increases, the need for mass merchandising will increase, thus leading to an increase in the number of firings.

Economically, this might be good, but what of the safety regulations set by the states? When the science hobby is treated as a toy, what happens to individual safety?

It is important that the industry police itself before it becomes one of the "Whatever became of . . .?", as did slot car racing when every "fast buck Johnny" got into the act.

Harold M. Zafeman
Totowa Hobby Shop
Wayne, New Jersey

The industry recognizes the need for a self policing effort to maintain high safety standards in the model rocket hobby. Just recently, Tim Skinner, Chairman of the HIAA Rocket Division, released the following statement: 'Rocketeers and manufacturers of model rocket supplies have, in the past twelve years, established an enviable safety record; manufacturers, wholesalers, and dealers are deeply interested in maintaining this record....To assure the continued healthy growth of model rocketry as a hobby, it is essential for all manufacturers and importers considering model rocketry as a business to secure all pertinent information on the subject. Ignoring established guidelines can prove to be costly."

The established model rocket manufacturers deserve credit for their efforts in promoting the safe use of model rocket products. Estes Industries, Centuri Engineering, and Rocket Development Company have prominently displayed safety rules in their mail order catlogues. Model Rocket Industries included copies of the NAR safety code with their engines. The new MPC brochure continues in this direction by providing a copy of the NAR safety code on the back page. Other manufacturers and potential manufacturers would be well advised to follow the pattern set by the major manufacturers in the industry. With a continued emphasis on safety, the model rocket hobby can continued to grow without the fear of accidents which result only from the violation of accepted safety standards. No manufacturer can benefit from encouraging violation of reasonable safety standards.

Bolsey Camera Report

I just received the November issue of **Model Rocketry**, and all I can say is, "It's great!" Your mag gets better with every issue.

I also noted that my letter about the launching of a, Bolsey movie camera appeared in the "Letters to the Editor". I have something to add – since I wrote that letter in April, I have launched the same camera 11 times.

Presently I am stationed in Vietnam, as you can see by the address. Even though I can't launch them here, I am still building rockets and reading your magazine.

Terry A. Hollinger
FPO San Francisco, California

Flat Cat

In your August issue you included plans for the flat cat boost/glider. In the parts list the nose cone catalog number was stated as being MRI no. 620A. However, on the plans sheet (page 44) the number was stated as being 620B. The proper catalog number is 620B. I believe this correction will aid in building the model. Thank you.

Pat Maio, Jr.
River Vale, N.J.

"The Spider"

I have to congratulate your cartoonist of your May, 1969 issue (page 39)! "The Spider" anticipated by more than six months the mission of Apollo 12. It showed the idea of a pinpoint landing near a Surveyor landing site and the cutting apart of the Surveyor by Conrad and Bean. Could you tell me the name of the artists who do your cartoons?

Mark Barkasy
NAR 5038
Wallingford, Connecticut

"The Spider", reprinted below, was drawn by Bruce Blackstone (note the BEB initials in the lower right corner of the third panel).

Most of our cartoons have been initialed by the authors, but for the record, Tom Milkie is responsible for the October 1968, November 1968, January 1969, February 1969, August 1969, September 1969, and November 1969 cartoons; John Starling for the June 1969 cartoon; Robert Singer for that of July 1969; and Alan Stolzenberg for the December 1969 cartoon.

Competition Info

I would very much like to participate in a national meet (NARAM'S), but I can find no information on who to contact to apply. I think many modelers would like to go to such meets but do not know who to contact. Sometimes an article is published on a regional meet a couple of weeks in advance or the *results* on a national meet but never anything on how to *get* to a national meet. It might be good to publish such information even a year beforehand, to let "out-of-the-way" rocketeers plan for transportation, etc. I, as well as many others, would appreciate it if you could tell me who to contact in regards to NARAM-11 or 12 if it is too late for 11. I do not belong to an NAR section, as many NAR members, because there is a lack of enthusiasts in our area. It is these, "out-of -the-way" rocketeers that have new ideas that could be shared at a national meet.

Steve Smith,
Elkhart, Ind.

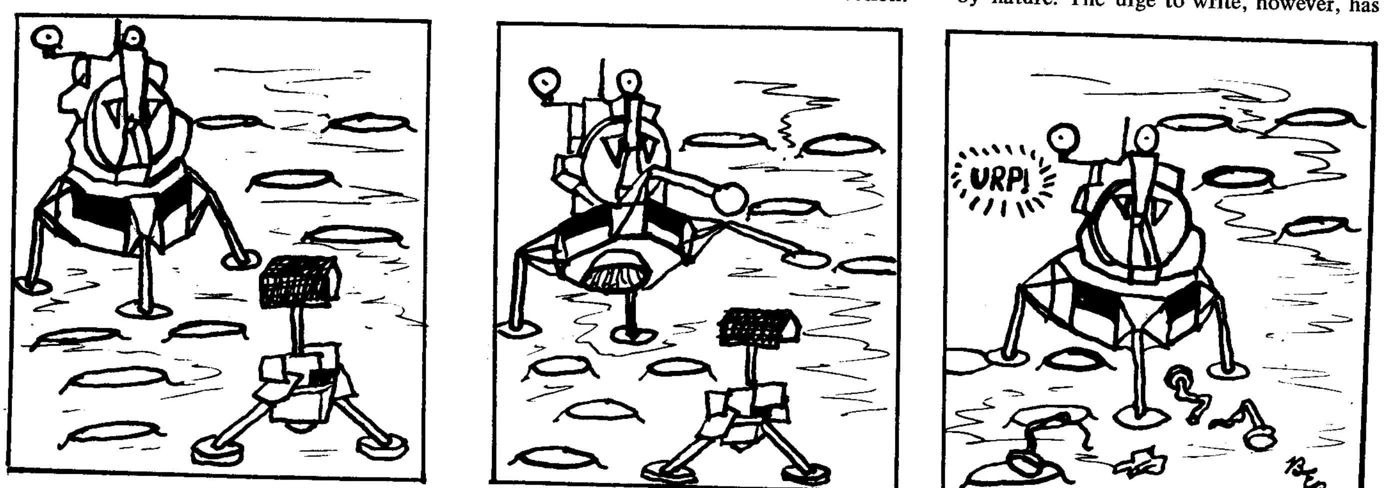
NARAM-11 entry forms were mailed to NAR members in advance of the event. However, apparently due to the time delay in adding new members to the mailing tape, many new members did not receive forms. Next year's national meet will be given adequate advance publicity in *The Model Rocketeer* section of **Model Rocketry**.

As for area and regional competitions, if the CD will send us a note 90 days or more in advance of the event, we'll list all the information in the *Club Notes* section.

Remember CD's include the date, site, restrictions on participation, events and your address.

R & D Articles

For the nine months that I have been reading your fine magazine, the urge to respond to some of your articles and requests for material has steadily grown stronger. This desire to write to you has been hampered, though, by the unfortunate fact that I am somewhat of a procrastinator by nature. The urge to write, however, has



THE SPIDER

finally overcome my procrastinator by nature. The urge to write, however, has finally overcome my procrastinatory instincts—and this letter is but a preliminary consequence of that breakdown.

The primary purpose of this letter is to request some information that I have been needing for quite some while. I desperately need information on where to obtain Enerjet engines (name address, and catalog cost, if any).

I would like to mention that at the time of this writing, I have already written one article for your magazine, to be submitted very soon.

I also have in the planning stage at least four other articles (mostly of the R&D type) for future submission. And I plan to continue this trend, quite possibly (as the financial factor permits) submitting one article each month.

William E. Mixon, Jr.
Raleigh, North Carolina

The Enerjet-8 engine is manufactured by the Rocket Development Corporation, Route 3-R, Seymour, Indiana.

We are glad you are working on a series of R&D oriented articles. In the past, many significant R&D projects have been done. However, since the results have not been published nor widely distributed, the work must be painstakingly duplicated by other rocketeers desiring similar information. We hope that by providing space in the pages of **Model Rocketry** *magazine for the publication of this research, that the field may advance more rapidly and that unnecessary duplication of effort can be avoided.*

Transmitters

Your model rocket transmitter (page 5, May 1969) is basically a very good circuit. I would however make some small changes.

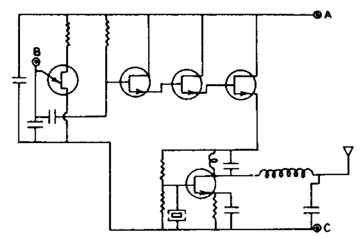
First of all, in place of the RCA40080 transistor you use as Q5, I would use the RCA40081 type transistor; which will handle 400 mw on the collector. (400 mw may be used if the person desiring higher power obtains a Class C Citizens Band radio license.) With the crowded frequency spectrum, this slightly higher power may be desirable.

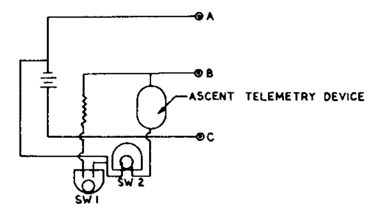
Secondly, I show on my enclosed drawing two mercury switches. These may be utilized so that the rocket can have two telemetry devices—one on the ascent and the other on its descent.

I imagine that if I took my time, I could devise several other devices that could be incorporated into the radio telemetry design you show. But I feel that I should get this in the mail before it slips my mind.

Gerald Loewe
Wire and Repeater Technician
Western Union Telegraph Company
Gardner, Kansas

Thanks for the suggested revisions to the transmitter. The prototype was, of course, not intended as a "final" design. We expect that as many readers construct the transmitter, they will send in revisions and additions to the original circuit.





Pershing 1

US Army Tactical Missile

by Mark Pescovitz

The Pershing missile was conceived in 1957 to replace the Redstone missile. A contract was awarded to Martin Marietta in 1958. Twenty-two months later the first Pershing-1 was launched from Cape Canaveral.

The Pershing-1 missile system went into Europe in 1964. Now the Pershing-1 is being replaced by the Pershing 1-A, an improved system, through project swap.

Guidance

The Pershing missile is a two-stage, ballistic weapon with all inertial guidance. The missile is placed on a preselected ballistic trajectory using data put into the computer before firng. Thus, once airborne, it is impossible to change the course.

An airborne computer detects any deviation from the flight path and corrects it using hydraulically controlled vanes.

Missile Design

The Pershing is 3.3 feet in diameter and 34.6 feet long. It weighs 10,000 lb., and is divided into four sections.

The main thrust is provided by the first stage. The main structure of this section is high-strength steel.

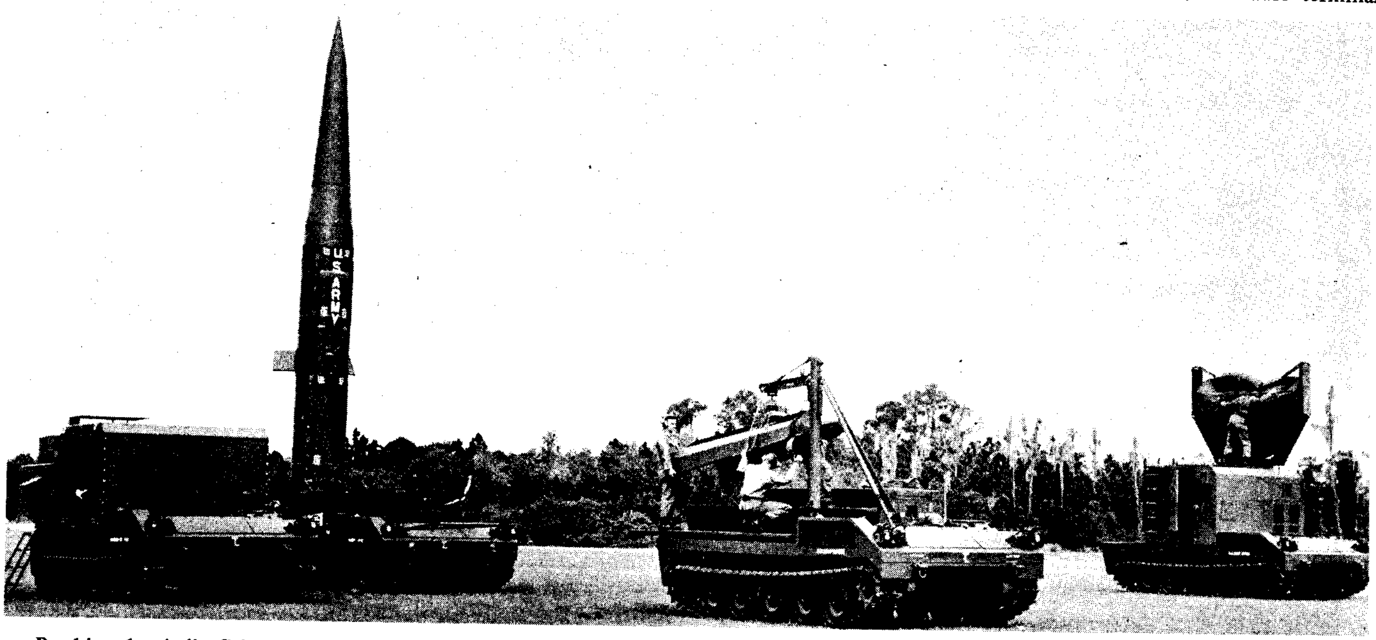
The second stage is much like the first, with the addition of large control vanes. This stage also has impulse control ports to terminate the thrust at the right time.

The guidance equipment is in an airtight aluminum alloy cone.

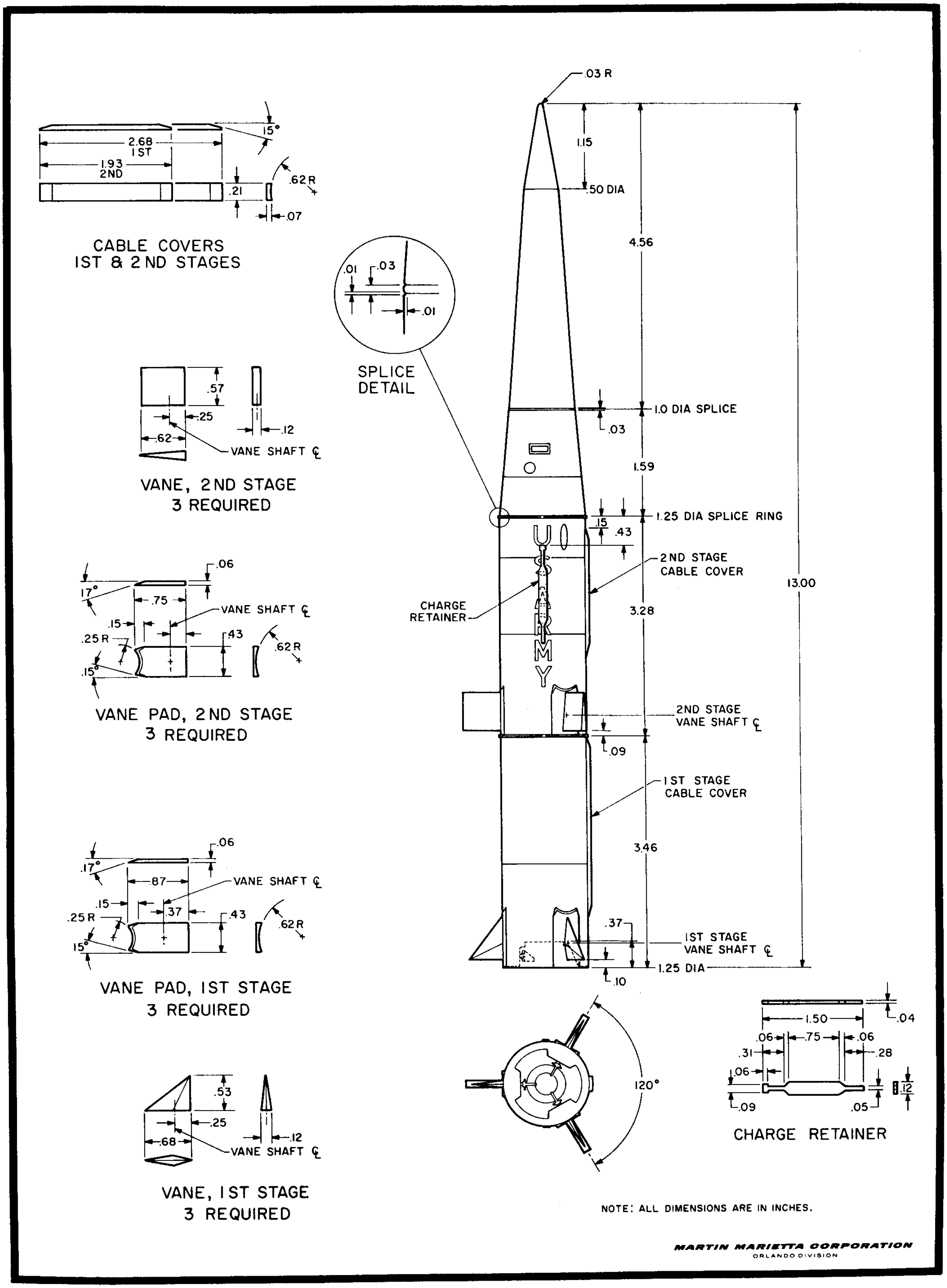
The warhead is a conical re-entry vehicle coated with an ablative material. Splice bands join the four sections of the missile.

Launcher

The Pershing-1 launch group consists of four tracked vehicles. The first holds the missile and erector launcher; the second the warhead and azimuth laying set; the third the programmer-test station and power station, and the fourth, the radio terminal



Pershing 1 missile firing battery on station in Germany. Note the operational missile is painted flat olive drab, with "U S Army" painted vertically down the side in white.


CABLE COVERS
1ST & 2ND STAGES
VANE, 2ND STAGE
3 REQUIRED
VANE SHAFT ℄
VANE PAD, 2ND STAGE
3 REQUIRED
VANE PAD, 1ST STAGE
3 REQUIRED
VANE, 1ST STAGE
3 REQUIRED
SPLICE
DETAIL
1.0 DIA SPLICE
1.25 DIA SPLICE RING
2ND STAGE
CABLE COVER
CHARGE
RETAINER
2ND STAGE
VANE SHAFT ℄
1ST STAGE
CABLE COVER
1ST STAGE
VANE SHAFT ℄
1.25 DIA
.50 DIA
.03 R
13.00
120°
CHARGE RETAINER
NOTE: ALL DIMENSIONS ARE IN INCHES.
MARTIN MARIETTA CORPORATION
ORLANDO DIVISION

set.

The main difference in the Pershing-1A's launcher is that the tracks were replaced by wheels. The Pershing 1-A missile is on the same truck as the warhead, but is not hooked up. The Programmer-Test Station automatically counts down and test the vehicle. A radio terminal set with an inflatable antenna provides communication with high command. New to the system is the Battery Control Center which commands all missiles at the firing site.

Flight Path

When the fire button is pushed, the missile springs up on its launcher and the first stage ignites. At the first stage burnout the missile coasts for a preset time after which the first stage falls away and the second stage ignites. The second stage burns until terminated by the computer. When the second stage is shut off the warhead separates and heads on a ballistic trajectory toward the target several minutes and up to 400 miles away.

Paint Scheme

The production model of the Pershing is flat olive drab. U.S. Army is painted on both sides as shown in the plan. Earlier test models launched from White Sands and Cape Kennedy were painted in white and black for tracking purposes.

Model Construction

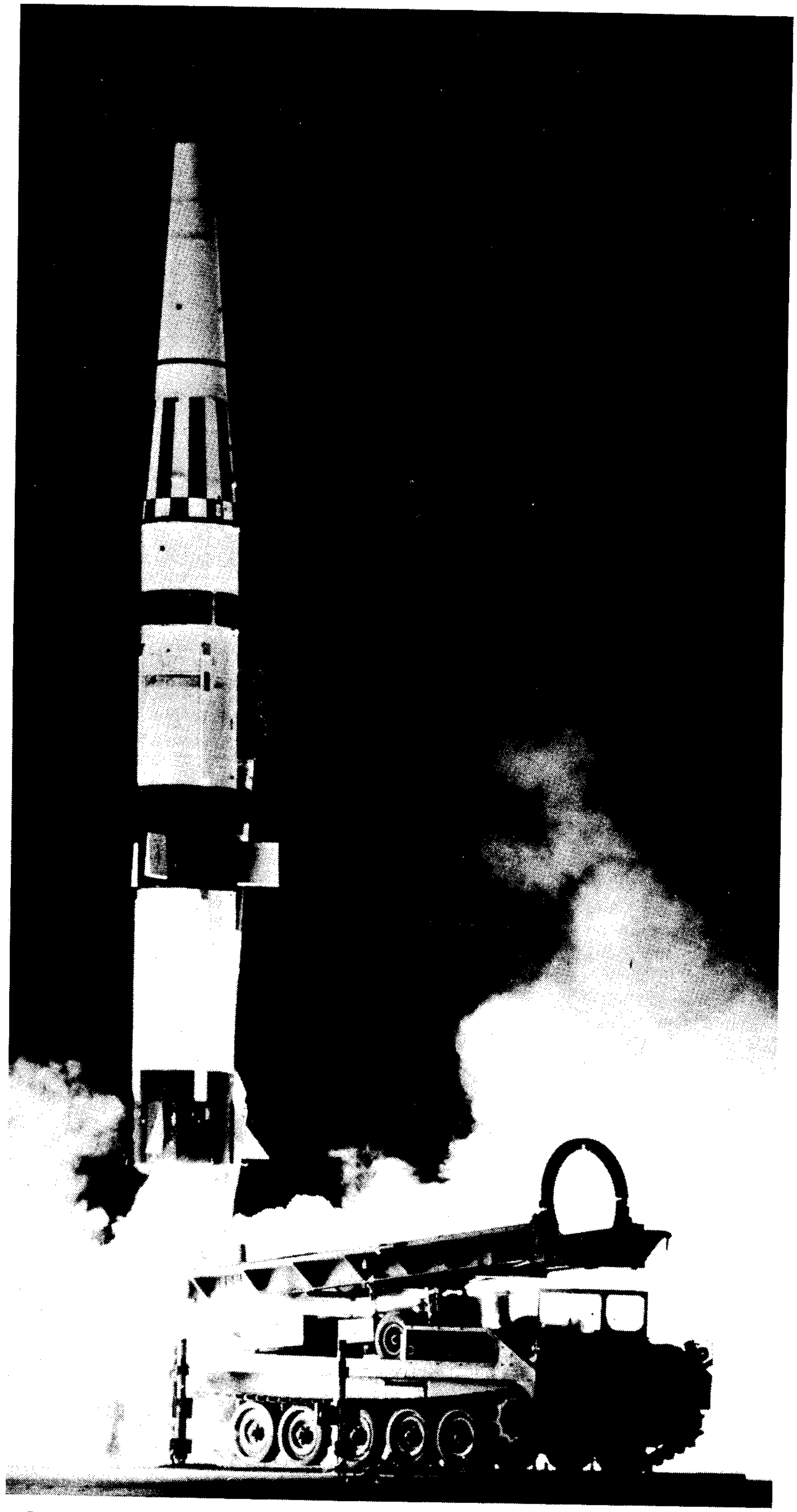
Since no Pershing nose cone is available commercially, you will have to turn this part on a lathe. Since 50% of the rocket length is nose cone, you may find it easier to turn the entire rocket from balsa. In this case a solid balsa nose cone from the 1.25 inch diameter splice ring forward is advisable. Even with the solid balsa cone, additional nose weight will be necessary to assure stable flight.

All dimensions in the drawing are scaled for a 1.25 inch body diameter. You can either turn the body from balsa (then hollow out the center to accept a BT-20 tube for the engine and chute), roll your own body tube (as described in the November 1969 MRm), or rescale the data to a commercial tube.

If you scale your Pershing to a 1.00 inch body diameter (i.e. divide all the scale dimensions by 1.25), the first stage length is approximately 70mm. This allows an operational second stage with standard 18x70mm engines. But watch out, you will need plenty of nose weight to successfully fly a two-stage Pershing.

References

U.S. Army Pershing Weapons System, Martin Orlando Division, Ordinance, September-October 1968, Lt. Col. Edwin A. Bud, Pictures, Pamphlets, and Plans obtained from Martin Company, Orlando Division.



Pershing 1 firing from the tracked launcher during a night test launching. Test missiles are painted for ease of tracking.

University of Maryland employs model rockets to teach Aeronautical Engineering methods

Modrocs in Education

by Ed Pearson

Rocketeers admit there is an "educational value" in model rocketry, but other than what one learns by flying on one's own or with friends, model rocketry takes on more of a "sport", "hobby", or "entertainment" tone than an educational endeavor. Of course there are growing exceptions to this statement. The American Institute of Aeronautics and Astronautics, certainly not a "craft"-oriented organization, advocated model rocketry in 1967. Several "science"-type summer camps such as Camp Minnowbrook in Lake Placid, New York have developed aerodynamic programs utilizing model rocket instruction. Various high school science teachers across the country employ model rocketry as a teaching aid. NASA space-mobile lecturers have long made use of small model rocket engines to demonstrate the retro-fire effect. Independent college instructors around the nation, such as Dr. Gerald Gregorek of Ohio State, use model rocketry to present physics concepts. Recently, Dale Shanholtzer, a graduate student at Northeast Missouri State College, revealed his plans to perfect a college course devoted solely to model rocketry. (Dale has mailed a quite extensive survey questionnaire to modelers throughout the nation asking their advice on what to emphasize in such a course. His report is available at Missouri's bookstore for 85 cents.) So, in spite of the "sport" or "modeling" interest, model rocketry has been able to make headways in the education field—and rightfully so. It is always interesting to note these advances, so you can imagine my surprise when I found the place model rocketry had made at my own alma mater—the University of Maryland.

Maryland is a "multi-university" with an overseas extension program covering most of the free world. The University boasts of having one of the better engineering schools in the US. and has even developed its own rocket—the Terrapin—which was launched by NASA in the late fifties and early sixties. Lately, at a local rocket club meeting, an engineering senior (Lou Israel of Silver Springs) told of Maryland's use of model rocketry in higher education. Seniors majoring in Aeronautical Engineering at Maryland have a choice in their last seminar class: either conducting an independent research project or doing one chosen by the teacher. In the first instance, the student is on his own and may or may not choose a topic related to model rocketry. But for the last two semesters, seminar professors have been assigning lab projects reminiscent of Douglas Malewicki's altitude prediction studies to those students not choosing independant research. The students are divided into two groups, and each "team" is given identically constructed Arcon and Arcon-Hi model rocket kits. The task of each group is to organize itself similarly to an industrial setting and to pitch in and find the altitudes their one and two stage birds will reach. Later, their predictions will be compared against the actual performance of the models. (Sounds simple, eh? Just pull out an Estes or Centuri prediction chart, match the engine with the body diameter and presto—your altitude in meters. Well, perhaps it is easy for us, but remember, most of these students have never seen model rockets before and are accustomed to working with large clumsy drag numbers, air forms, etc. The twenty-one and twenty-five inch models must really baffle them..."You mean that thing *flies*?)

They are assigned a graduate assistant who acquaints them with a simplified typical industrial project breakdown, helps them over the rough areas they do not quite understand, and otherwise acts as godfather consultant giving references, not answers. The team itself is broken into three branches—the propulsion group, the dynamics group, and the ballistics group—with each branch consisting of an elected "chief," and his working "indians."

The propulsion group is given engines of the same classification to be used in flight (nothing larger than a "C"). They must find the thrust-time curve of each engine, the weight of the fuels, the casing weight, and whatever else is needed to determine the performance of the engine in flight. (As each branch and team is given the option of seeking outside assistance and equipment—one propulsion group went as far as visiting the Atlantic Research Corporation—the makers of the real Arcon sounding rocket—and borrowed their static thrust stand for these determinations.

The dynamics group alternately buries itself in the math and engineering library – doing research to find the rockets' final drag coefficient – and the laboratories of the University's Glenn L. Martin Building – to test the rockets in their subsonic wind and smoke tunnels and to develop a drag balance device.

The ballistics branch dictates to the propulsion and dynamics groups what is required to calculate the models' trajectory. This results in answers, extensive library research, more questions, more answers, more library research, and so on, until ballistics submits a program to the University's Univac 1108 computer, which when correct (and "debugging" is half the work) chalks up the trajectory of the teams models at each 0.02 second interval.

In charge of all three branches (each branch being coequal in responsibility) is the project administrative office. This office consists of the (overall elected) project manager, a consultant engineer, and (optionally) a technical writer.

The project manager is responsible for coordination of the activities of the three branches beneath him (via the group's chiefs) and making certain that the project is finished on time within the resources available to the team. The consultant engineer is really the graduate assistant. The technical writer (who may be the project manager) must submit a report to the professor on the team's activity; i.e., what they did, how they did it, how far off their calculations were, why, what corrections were needed, etc. This resulting material may come to resemble a junior NASA PDP (Project Development Plan).

Quite a bit of rivalry grows between the two teams as the semester progresses and the students work hard to perfect their calculations (oh, well, back to the "sporting" nature of model rocketry). It is not uncommon for the students, as college students are prone to do, to make side bets on how accurately their team has made its predictions. (One project manager to another: "My team will bet a quarter keg of beer that our calculations are more accurate than yours.")

The big day comes when the groups get to see just how accurately their diligence has paid off. The professor, graduate assistants, teams, and members of a local NAR section journey out to the Goddard Space Flight Center (communication center of NASA and the Apollo missions) Antenna Range, where the rockets will be flown and tracked. Members of the NAR lend their services as theodolite operators – at the last such venture members of the MARS Section tracked sixteen straight flights within an allowable ten percent margin of error.

The rockets streak upward and the results come pouring back within seconds (thanks to an enormous computer printout yielding altitude values).

The young engineers seem surprised or perplexed that their calculations are not very close, but this is natural enough; after all, this is their first launch and they have planned on straight-up flights, no interfering wind, drag-free launch rails, engine performance unaffected by humidity, perfectly aligned fins – factors which do not quite hold true in a model's actual flight. Even though the teams are a bit reluctant to tell exactly how far off they were, one can see the use of model rocketry as a fine educational tool.

Jim Barrowman, NAR trustee, former NASA co-op student, and possessor of a degree in engineering welcomes this use of model rocketry in the type of program he has advocated for years. "Students in engineering don't really have that many practical experiments . . . not like they do in physics; mostly it is theory." Jim goes on to say that this sort of practical lab is the best experience a budding young engineer could have. How about you – don't you agree?

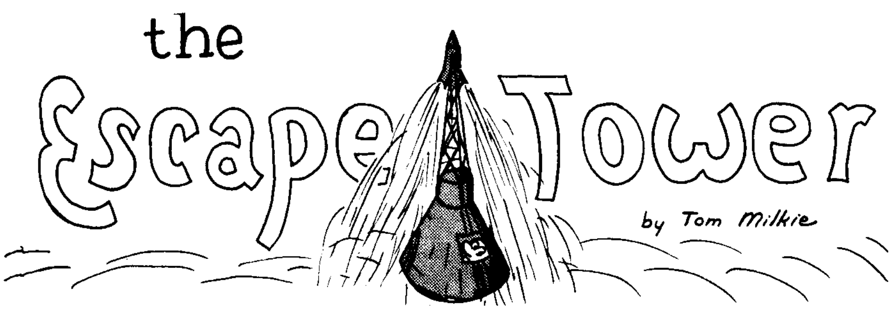
WHAT'S YOUR FAVORITE ARTICLE THIS MONTH?

Vote here for your favorite articles. List them in order - the most-liked first, etc.

1.____________
2.____________
3.____________
4.____________
5.____________
6.____________
7.____________
8.____________
9.____________

Clip this section out or use a facsimile. Paste on a postcard or enclose it in an envelope and send to:

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

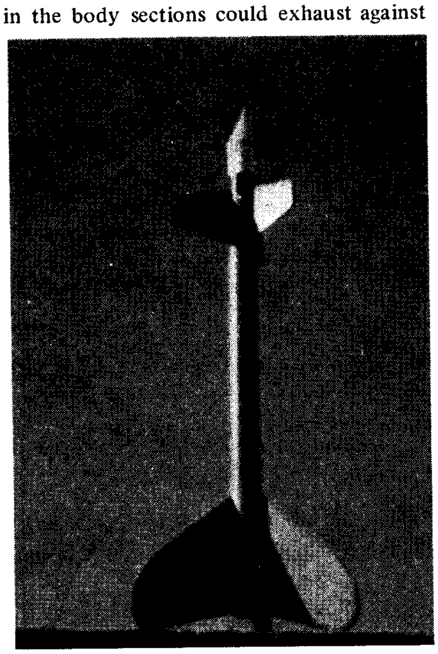


RETRO ROCKETS FOREVER!!!

Whenever the subject of odd-ball rockets arises, someone inevitably brings up the question of retro-rockets. It seems as though everyone has at least thought of building a retro-rocket. (See Gordon Mandell's collection in *The Wayward Wind* **Model Rocketry** August 1969.) Have I ever built a retro-rocket? The collection at the top of the drawing illustrates my many attempts at perfecting a retro-rocket system.

Actually, my idea was not to build a rocket which returns safely to the ground employing retrograde thrust, but to construct a ping-pong type missile. (See the flight diagram for an illustration of the proposed trajectory.) The ping-pong type missile is designed to take off, and when downrage , it fires a retro engine which brings it back to the launch site. The idea is not so wierd, the Army once built a missile of this type to take aerial photographs over mountain ranges.

Many of• my earlier designs employed two seperate body tube sections joined by three music wire supports. Thrusting engines in the body sections could exhaust against metal deflector cones in the center of the rocket. The need for such a system arose when it was found necessary to constructing a rocket that would be stable going up, stable when reversing thrust, and stable when retro firing.



The RR-8 is shown in launch configuration. Prior to launching, tape the two bodies together and make a swing stability test. The forward fins make the rocket easily unstable.

To solve the problem of stability during retro thrusting, many novel methods were tried. One retro-rocket was designed to flip over at point 3 in the flight path. Another used a sliding fin structure which would change the center of pressure position when the retro-engine fired. These and other mentods, such as pop-off fins, were all, naturally, unsuccessful. (The worst thing about failures is that they caused the rockets to prang., thus requiring a completely new construction for the new RR.)

For many of the RR's (including the successful RR-8 described below), it was necessary to ignite a fuse system as well as the main thrusting engines (sometimes as many as three igniters). Systems of gantry towers with elaborate spring pivot systems and accurate fuse systems were developed. My set up looked so complicated you'd think it belonged at Cape Kennedy. The Fuse Test Vehicle was actually successful in that it produced a reliable fuse system of accurate timing and retro engine ignition independent of the rocket's velocity.

The hardest problem of all is to find any way of guiding the rocket back along the path that it came when it is stationary in the air. Since there is no relative air motion, no system of aerodynamic stability will work. The problem was eventually solved by using a Series II engine to reduce the time when the missile is remaining motionless, and by using a stability system that is retro stable immediately after retro fire.

The RR-8 was the last and most successful of the retro rocket test vehicles. However, that isn't saying anything, since its reliability is still about that of a six stage rocket. If the following construction and flight procedures are followed, the RR-8 will be fairly safe (and that's really something for a retro-rocket.)

The booster rocket and the retro body are basically simple rockets with slight modifications. The retro body should be made from a Centuri ST-8 tube to fit inside the booster tube. Fins are cut from 3/32 inch balsa, and are attached to the body with cloth reinforcement. (All experimental designs which do not require low drag should have cloth reinforced fins for prang protection.) The engine mount is assembled as usual. The mount, by the way, was swiped from a Centuri *Iris* kit, as was the body tube, fin material, recovery system, and modified nose cone. An engine holder is mounted on the body tube to hold the engine in the retro body. Position this so that the engine mount extends about 1/4 in. out of the body tube. Glue the centering rings of the engine mount on its engine tube in an exact position so that the entire mount is held snugly by the engine hook. The recovery system is a standard 12 inch parachute, mounted with a static line and shock cord attached to one of the fins. No launch lug is necessary, but if you want to fly this bird seperately you can add a launch lug in a fin root.

The booster is just a length of Estes BT-50, as shown, with three, 3/32 inch thick balsa fins glued on. The addition of a launch lug completes the booster. No engine mount system is employed, other than friction fit , though an engine hook made for the Flight Systems engine can be used. No recovery system is used on the booster, since it falls unstably anyway.

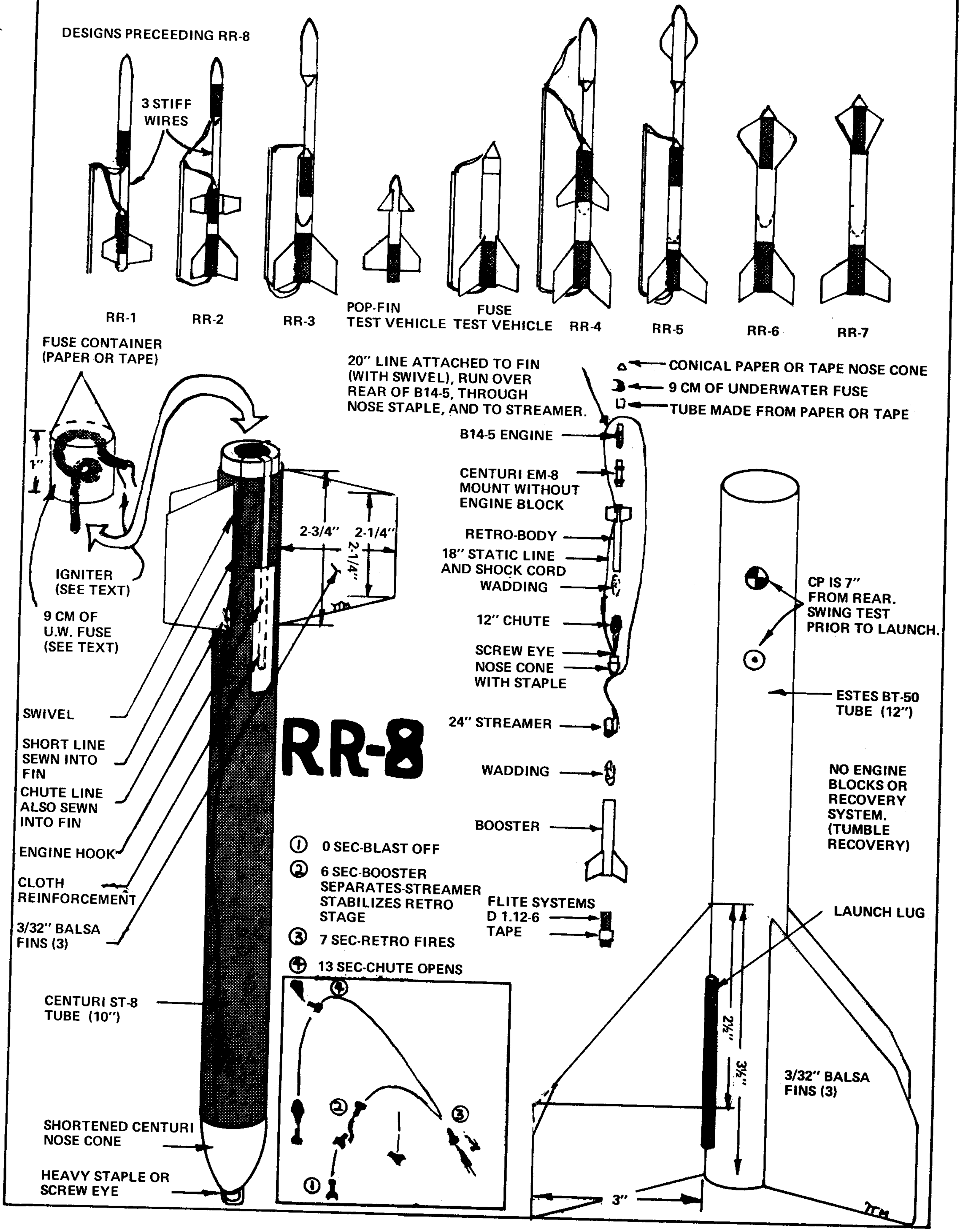
One minor modification to the retro body is the addition of a short line sewn into one of the fins. A loop is tied in the end of this two inch long piece of string. The nose cone of the retro body should be a rather short, stubby one, with a heavy round staple (similar to those used to fasten down electrical wire) or a screw eye put in the front end of the nose cone.

For each flight you will have to fabricate an expendable nose cone and fuse holder. This can be made out of BT-50 tube, rolled paper, a mailing tube, or even masking tape. It should fit tightly around the extending retro engine, with its engine hook in the retro body. A conical paper nose cone must be taped to this after the fuse is inserted.

To make RR-8 stable after the booster separates and before the retro engine fires,a streamer is mounted off the nose, making the retro body fly backwards. To prevent this streamer from interfering with the retro flight, its cord must be severed by the retro engine when it fires. Therefore, tie a 20 inch line to a 24 inch streamer, and tie a snap swivel to the other end. Prior to fusing, thread the swivel end through the staple in the nose of the retro body, over the rear of the B14-5 engine, and attach the swivel to the small loop in the short line sewn into one fin. The fuse system can be mounted over this.

The fuse is underwater type fuse about 1/8 inch in diameter. Jetex wick will not do because it burns everything around. Cut off about 9 cm of fuse, being careful to cleanly cut the ends. Insert one end of the fuse into the B14-5 engine (it should fit snugly) and be certain it is far enough in the casing to

Retro Rockets Forever!



ignite the engine. By twisting the fuse around into a helical shape (spiral) it should be possible to get all of it into the fuse container with only about 1½ cm sticking out the side. Now, very carefully, so as not to lose too much powder, slit the free end of the fuse. Insert the igniter wick of a Centuri Sure Shot igniter so that the fuse will be lit by the igniter. Carefully wrap an Estes igniter around the wick and fuse. Just prior to launching, remove the nose cap from the fuse container and carefully wet the fuse with a small brush. This is necessary to prevent the fuse wrapper from flaming and igniting other parts of the rocket. Do not add too much water, as this may run into the engine nozzle.

The B14-5 engine is first inserted into its engine mount. This assembly is then inserted into the retro body and is retained by the engine hook. Insert wadding and a well folded and powered parachute into the retro body. The parachute is attached to the nose cone screw eye. The drag streamer leader string should be threaded through the nose cone staple, around the engine, and attached to the short line on one fin. The fuse assembly is then positioned onto the front of the retro body.

Lifting power is provided by a Flight Systems D1.12-6 engine. Unfortunately, this engine is considerably smaller than an Estes BT-50 body tube, so it will have to be built up with several layers of masking tape (or you can make your own thin adapter). The engine is retained by a friction fit. Be certain to leave about ¼ inch of the D engine extending so that it can be removed later.

Some wadding is then inserted into the tube, and the rolled up drag streamer is attached. Now, carefully, lower the retro body into the tube. It should be inserted about seven inches down into the booster (including its nose cone length). Do not launch if the retro body extends too far from the booster. This configuration is unstable! Remove some of the wadding and cut down the width of the streamer to allow a proper fit.

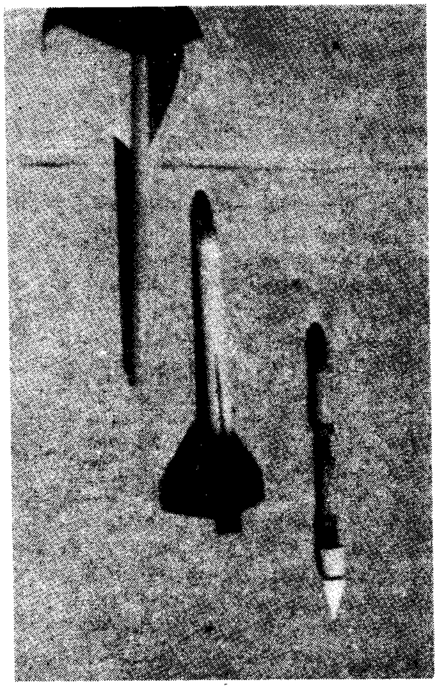
The launch setup for the RR-8 is somewhat complex, yet foolproof if done properly. The booster engine should be connected as you would any regular rocket. Make certain though that your clips are clean, your battery is strong, and the igniter is properly seated. *This ignition most work the first time* or you will be very embarassed when your bird retro fires while still sitting on the pad.

Ignition of the fuse system must be done on a separate set of leads from the booster igniter. A 1/4 inch dowel gantry holding the leads up near the fuse may make things easier, but such a system is not necessary. Long leads reaching up to the fuse system can be used for simple ignition.

If the fins of the booster and the retro body are aligned. If the fins of the booster and the retro body are aligned properly before launching, it is unlikely that the fuse ignition leads will get tangled in them. The major problem will be to prevent the weight and tension of the ignition leads from pulling the igniter off the fuse.

The fuse and booster igniters must be controlled from separeate launch systems. (*They are not fired simultaneously!*) A multi-unit launch system that employs a rotary switch can be used. The fuse igniter should first be ignited, and carefully observed from the launch control panel. If the fuse does ignite,allow a one second delay before you ignite the booster engine. The fuse burns at approximately one centimeter per second, so the fuse will be just entering the case at liftoff. Practice with fuse and igniters will allow you to determine whether the fuse has ignited.

If the fuse does not appear to be burning, let the RR-8 sit on the pad for a *long time.* The fuse may have burned into the fuse container and may be near igniting the retro engine. After removing the safety



The RR-8 with booster section, retro body, and fuse container separated. The retro body must have a stubby nose cone to prevent using up too much room in the booster.

from launch panel, approach the RR-8 very carefully, and knock the fuse container off the top of the rocket. *Never* stand over the rod while checking the fuse.

If, by accident, the RR-8 is launched when the fuse has not been lit, damage to the vehicle may not occur. The booster will recover as usual, and the retro body will have a streamer on it as it lands.

The ping-pong flight of the RR-8 can best be observed when the launch rod is at an angle from the vertical. The rocket blasts off as normal, and the retro body separates from the booster at the apogee of the flight. The booster, unstable without a nose cone, will tumble down. The retro body, with streamer attached to the nose cone, will begin to come down tail first. At step 3 the fuse ignits the retro engine (the exact timing is not too critical), the streamer is severed, and the retro body blasts back along its initial flight path. If the RR-8 is flown at a large angle, about 15 degrees from the vertical, this return effect will be more pronounced. Sometime later the recovery system of the RR-8 operates, returning the rocket safely to the ground.

From this design a somewhat workable retro-rocket may be constructed. There are some nice possibilities to consider for a modified RR-8. How about a "spy satellite." Adapt the RR-8 for a Camroc, and send it on reconnaissance missions over "enemy" territory.

Now for some real excitement, how about a three section, ping-pong-ping type rocket?....

Maryland Regional held at Aberdeen Proving Grounds, October 25-26, 1969

MARS-IV

In previous years the annual Mid-Atlantic Regional Shoot, sponsored by Maryland's Star Spangled Banner Section, had been plagued by wind, rain, and even a hurricane. This year, however, the TIROS forecast, provided by NAR Trustee Robert Atwood, predicted clear and favorable weather over the weekend of October 25-26th.

The field, a large area behind the base hospital at the US Army Aberdeen Proving Grounds, was clear in all directions. It was about 600 feet to the hospital, several thousand feet to the houses on theNorth, and over a thousand feet to the trees which guarded Chesapeake Bay on the East. The prevailing wind on Saturday morning was, of course, strong and towards the Bay. Over 50 spectators turned out on the near freezing morning to watch the competition, which had received advance publicity.

The launch site, which was laid out by the Army, conformed almost exactly to the specifications set down by Contest Director Howard Galloway. The baseline was "300 meters exactly, with only a four foot difference in elevation between the tracking scopes."

Over 100 contestants representing 14 Sections from Maryland, Pennsylvania, and Deleware were present at the 10:00 AM scheduled starting time. Problems with the tracking and range communications equipment delayed the start. A computer, brought in to aid with data reduction, failed during the delay, so data reduction proceeded with the Sipes reduction tables. Demonstration flights, including an F-powered boost/glider built by NARHAMS member Steve Kranish from a set of old Coaster Company plans, were permitted during the delay.

By 11:30 AM the range was ready, and the first Predicted Altitude rockets were on the pad. Tracking, as usual, was a bit weak on the first event, but Kris Lyon, a Junior from MARS, managed an amazing 0.0% – predicting his tracked altitude exactly. Hank Greco, an AAR Senior, placed first in that Division with a 0.7% deviation.

The next event off the pads was Quadrathon, actually a combination of four events -- Class 1 Altitude, Pee Wee Payload, Class 1 Parachute Duration, and Streamer Spot Landing. The contestant must fly the same rocket in each of the four events, with minor repairs allowed in case of damage, and is scored by adding his altitude in meters in the Altitude event to his altitude in meters in Pee Wee Payload and to his

MARS - IV SECTION STANDINGS

MARS	1185
AAR	921
SSB	747
NARHAMS	741
NARCAS	693
Rock Creek	255
Rockville	165
Gemini	159
UFO	129
Toftoy	129
Glenburnie Park	126
Wheaton	114
Vanguard	84
Hobby House	9

time in seconds for Parachute Duration then subtracting his distance in meters from the target in Spot Landing. The contestant with the highest number of overall points is the winner. Generally between 450 and 500 points is good enough to take a first place in Quadrathon.

The Quadrathon is quite an event, lose your rocket on the first flight and you have nothing to fly in the next three events. This certainly encourages some creativity on the part of contestants whose rockets are badly damaged early in the Quadrathon. Dick Sipes, the new NAR Contest and Records Chairman, learned the fine art of on-the-range repairs when a defective delay charge caused his Pee Wee Payloader to crash after a flight to several hundred meters. Most rocketeers would have given the bird up for lost, but this was Quadrathon. No rocket, and you're out of the competition. Dick

MARS IV Results

HORNET B/G

Junior (to age 13)			
1st	Jim Kerley	MARS	44.0 sec
2nd	Kent Lyon	MARS	40.2 sec
3rd	Carol Meese	AAR	39.7 sec
Junior (14 to 16)			
1st	Carl Guernsey	NARCAS	50.6 sec
2nd (tie)	Doug Plummer	NARCAS	46.3 sec
	Steve Kranish	NARHAMS	46.3 sec
3rd	Michael Coxen	NARCAS	31.8 sec
Leader			
1st	Meerdter Team	SSB	22.9 sec
2nd	Sheila Duck	NARHAMS	16.3 sec
3rd	Brewer-Hammond Team	SSB	11.2 sec
Senior			
1st	Howard Kuhn	MARS	49.7 sec
2nd	Barrowman Team	NARHAMS	40.2 sec
3rd	Hank Greco	AAR	36.5 sec

DESIGN EFFICIENCY

Junior (to age 13)			
1st	Scott Snyder	AAR	71 m/nt-sec
2nd	Tom Burris	MARS	69 m/nt-sec
3rd	Craig Kuhn	MARS	67 m/nt-sec
Junior (14 to 16)			
1st	Carl Guernsey	NARCAS	99 m/nt-sec
2nd	Jim Threatte	Rockville	76 m/nt-sec
3rd	John Anderson	AAR	74 m/nt-sec
Leader			
1st	Guppy	AAR	87 m/nt-sec
2nd	Bruce Blackistone	NARHAMS	36 m/nt-sec
3rd	Sheila Duck	NARHAMS	28 m/nt-sec
Senior			
1st	Barrowman Team	NARHAMS	64 m/nt-sec
2nd	George Meese, Sr.	AAR	46 m/nt-sec
3rd	Sipes Team	MARS	42 m/nt-sec

PREDICTED ALTITUDE

Junior (to age 13)			
1st	Kris Lyon	MARS	0.0%
2nd	Carroll Yung	UFO	3.0%
3rd	Jeff McQuaig	MARS	4.3%
Junior (14 to 16)			
1st	Rob Abromavage	NARHAMS	1.0%
2nd	Scott Staley	NARCAS	10.0%
3rd	Joe Quigley	Gemini	14.2%
Leader			
1st	Randy Bolton	Rock Creek	4.8%
2nd	Michael Keys	Rock Creek	13.0%
3rd	Brewer-Hammond Team	SSB	14.0%
Senior			
1st	Hank Greco	AAR	0.7%
2nd	Ken Lyon	MARS	2.7%
3rd	Ed Peterson	NARHAMS	26.9%

QUADRATHON

Junior (to age 13)			
1st	Jim Kerley	MARS	439
2nd	Carol Meese	AAR	410
3rd	Kris Lyon	MARS	377
Junior (14 to 16)			
1st	Carl Guernsey	NARCAS	439
2nd	Tom Stevenson	MARS	420
3rd	Michael Coxen	NARCAS	413
Leader			
1st	Brewer-Hammond Team	SSB	259
2nd	Meerdter Team	SSB	111
3rd	Chet Townsend	Rock Creek	103
Senior			
1st	Ken Lyon	MARS	451
2nd	George Meese, Sr.	AAR	312
3rd	Sipes Team	MARS	250

OVERALL POINTS

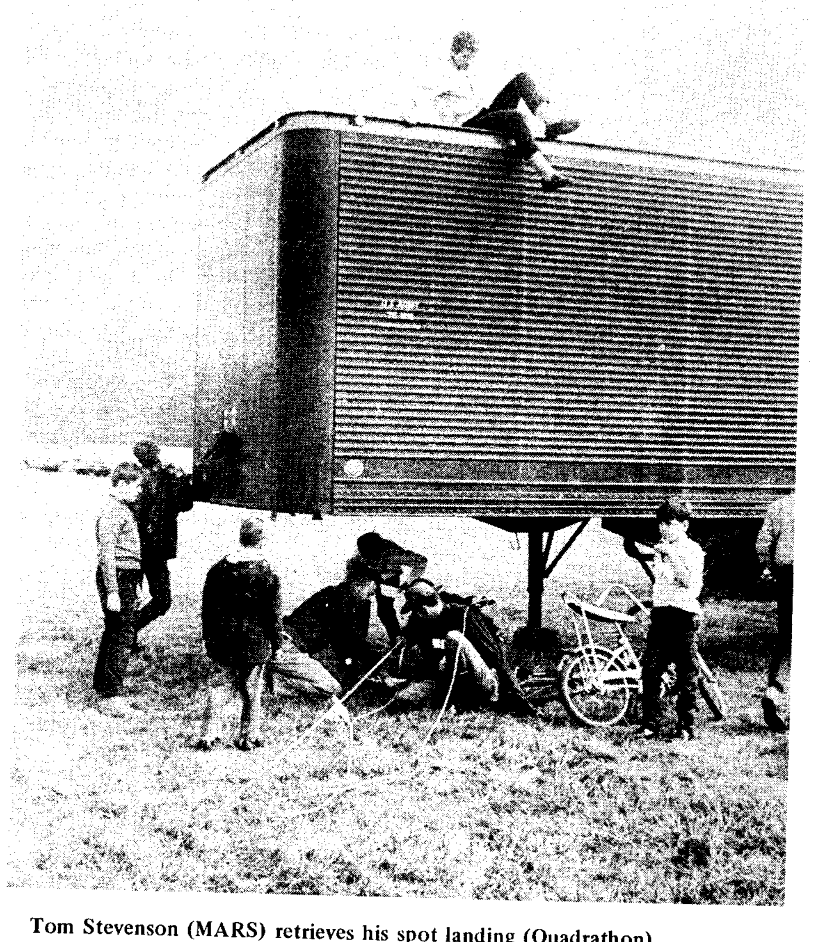
Junior (to age 13)			
1st	Jim Kerley	MARS	129
2nd	Kris Lyon	MARS	96
Junior (14 to 16)			
1st	Carl Guernsey	NARCAS	264
2nd	Tom Stevenson	MARS	90
Leader			
1st	Brewer-Hammond Team	SSB	198
2nd	Meerdter Team	SSB	156
Senior			
1st	Ken Lyon	MARS	198
2nd	George Meese, Sr.	AAR	135

Pamela Smith (SSB) examines her B/G, displaying an unusual "Falcon" paint pattern.

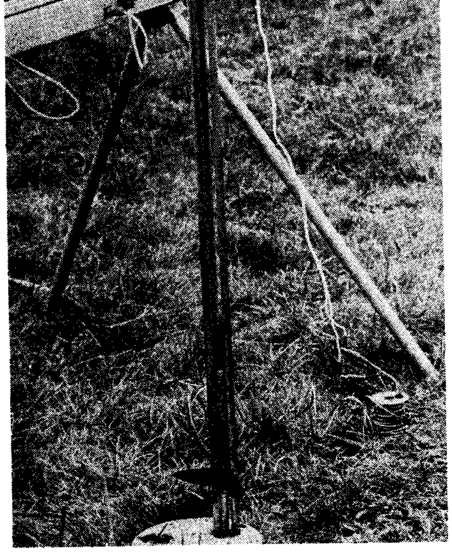
Carl Guernsey (NARCAS) watches as his B/G (right) lifts off. The novel design took first place with a 50.6 second flight.

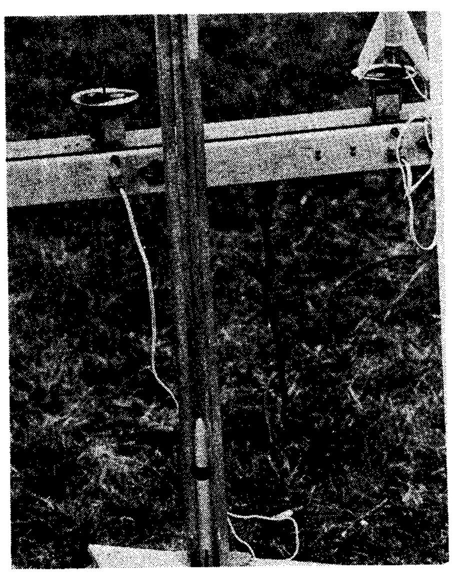
Shiela Duck (NARHAMS) prepares her boost/glider for flight. Her 16.3 second flight placed second in Leader Hornet B/G.

Bruce Blackistone (NARHAMS) prepares the Black Beast for the Predicted Altitude event. Unfortunately its 172 meter altitude was far in excess of the 100 meters he predicted.



Tom Stevenson (MARS) retrieves his spot landing (Quadrathon) rocket on top of the Army storage trailer. Below, the measuring team, Contest Director Howard Galloway and Bruce Blackistone attempt to locate the "impact point" receiving directions from Tom.





Scott Brown (left) (Gemini) prepares his delta-winged Hornet boost/glider, while Sam Atwood (AAR) preps a modified Thermic.

Launch towers made a reappearance at MARS-IV. (Top to bottom): Art Chapman's (NARHAMS) stainless steel tower, John Pollock's (SSB) aluminum guide-rail tower, and Guppy's (AAR) wooden tower employing wire coat-hanger braces.

went to his range box, found a new nose cone, and repaired the split body tube with white glue and tape. He flew the bird in the next event, though it looked like it had been run over by an Army tank. That night Dick spent several hours (beginning at 2 AM) making major repairs to the body tube. More glue and tape added weight to the rocket, but also returned the rocket to something resembling a cylindrical shape. Out on the range the next morning, he packed a 25 inch diameter chute cut from a plastic dry cleaning bag into the bird (a modified Break-Away), and got 127 seconds in Parachute Duration. A good Spot Landing distande, and the Sipes Team was rewarded with a third place in Senior Quadrathon with 249.85 points.

Sunset ended the flying day with about 30 predicted altitude rockets left to fly. Rocketeers found their way back to the main staging area – the Aberdeen Quality Motel, which prominently displayed a sign reading "Welcome Rocketry Association." The evening banquet was followed with a relaxing film and slide showing session, and then the rocketeers retired to their rooms to prepare their boost/gliders for Sunday morning.

The value of the Army's cooperation became clear the next morning when the range crew arrived at the launch site. The tent had been knocked down during the night and the rope which had encircled the firing area had been removed. An Army work crew under Chief Warrent Officer Murphy quickly repaired the damage. The range support equipment, however, was safe in a trailer also supplied by the Army. The Aberdeen Proving Grounds Operations Office and Mr. W. Ogle , and Lt. J. Wolfrom certainly contributed to the success of the meet.

Sunday's weather was windy, as expected, since Hornet Boost/Glide and Parachute Duration were on the schedule. The best B/G performance of the day was turned in by Carl Guernsey of NARCAS, flying a home design, with 50.6 seconds. Howard Kuhn's Manta, with 49.6 seconds, took first place in the Senior Division.

Towers were quite popular in the Design Efficiency event, with Art Chapman of NARHAMS, John Pollock of SSB, Guppy of AAR, and Scott Brown and Roy Rosenfeld of Gemini bringing theirs to the meet. At one point during the day, Art Chapman's stainless steel tower was in use by so many contestants that Art himself had to wait several racks in order to fly his rocket. Paul Conner of NARHAMS, using the Chapman tower, fired his monokote finished rocket employing elliptical plastic fins and powered by an A5-4 engine on a perfectly straight flight towards the clouds. The track was unfortunately lost, but this must have been one of the best A-powered flights of the meet. Elliptical fins, which are proving popular in the WAMARVA area, were also employed on the Barrowman Team Design Efficiency entry which took first place in the Senior Division with 64 meters/newton-second. Carl Guernsey turned in the best Design Efficiency flight of the day with an amazing 99.2 meters/newton-second. Guppy captured first place in the Leader Division with 86.8 meters/newton-second. The last Design Efficiency rocket left the pad just as the sun was setting in the West, and MARS-IV came to a close.

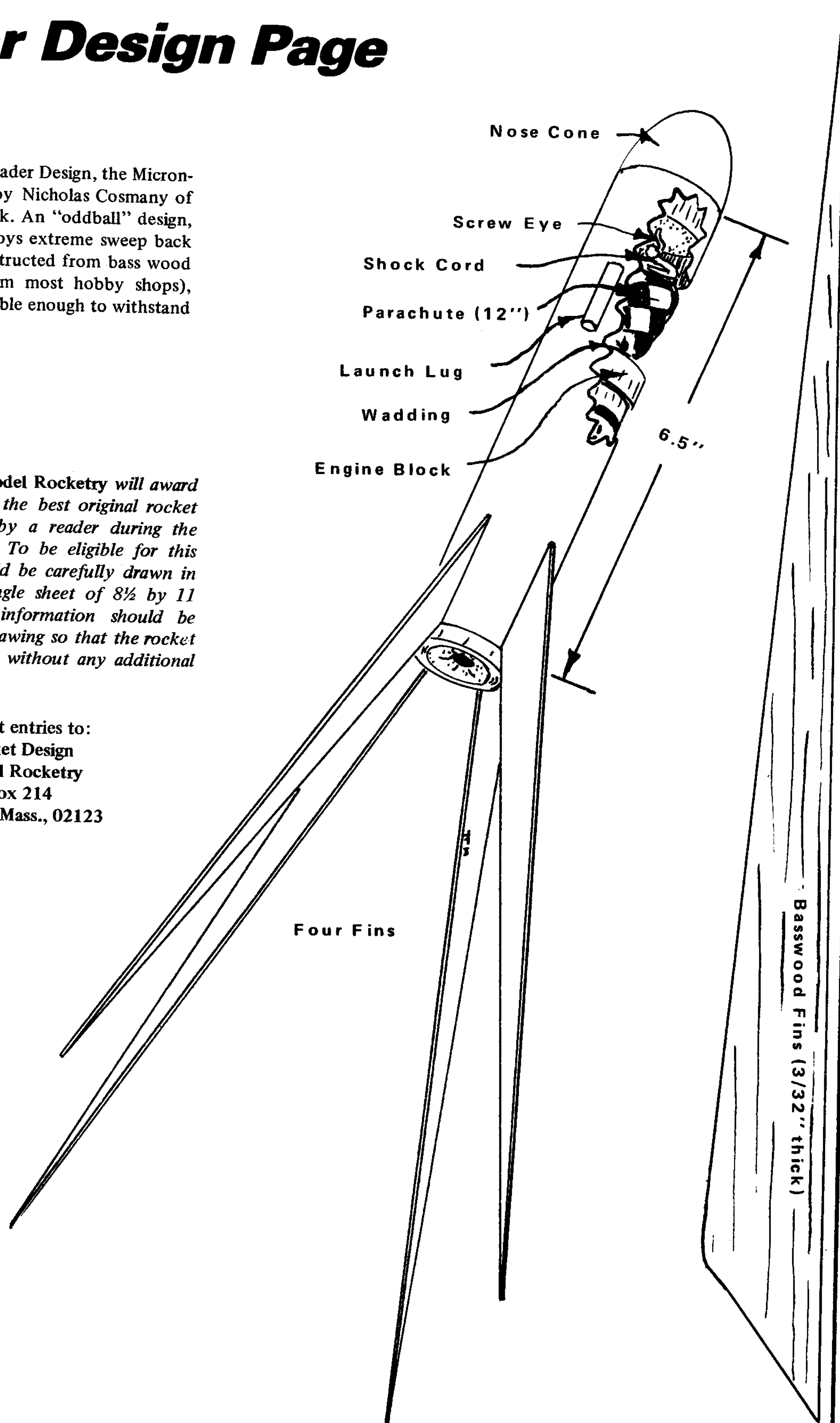
Howard Galloway, his wife Dottie, and the Star Spangled Banner Section deserve a well done for successfully conducting the first regional of the 1969-70 contest year.

Reader Design Page

This month's Reader Design, the Micron-II, was submitted by Nicholas Cosmany of Brooklyn, New York. An "oddball" design, the Micron-II employs extreme sweep back on the fins. If constructed from bass wood stock (available from most hobby shops), the fins will be durable enough to withstand even crash landings.

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

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



Technical Notes

by George Caporaso

VELOCITY DEPENDENCE OF DRAG COEFFICIENTS

For many years most model rocketeers concerned with developing methods of altitude prediction have considered the drag on a model as given by ½ AC_DV^2, with the assumption that C_D (the drag coefficient) is constant over the range of velocities of the model. "Not so!" whispered G. Harry with a twinkle in his diabolical eyeballs when last we met.

Upon glancing through the Gregorek report I became painfully aware, however, that if the C_D varied with velocity there was no simple, analytically feasible way of treating with the altitude equation.

From Professor Gregorek's paper, *A Critical Examination of Model Rocket Drag for use with Maximum Altitude Performance Charts* (puff!), the following equation representing the total model rocket drag coefficient multiplied by the drag reference area was obtained:

$$C_DA = C_F\left[2A_F\frac{C_F'}{C_F} + 1.02\left[1+\frac{1.5}{(L/d)^{3/2}}\right]A_S + \frac{0.029}{\sqrt{\left[1.02C_F^3\left[1+\frac{1.5}{(L/d)^{3/2}}\right]\frac{A_S}{A^3}\right]}}\right]$$

where A is the body tube cross-sectional reference area in square meters, (L/d) is the length-to-diameter (fineness) ratio of the rocket (with nose cone included in the length), A_S is the total body tube and nose cone surface area in square meters, and A_F is the surface area of one side of one fin multiplied by the number of fins.

The only quantities in this equation that have velocity dependencies are C_F, the coefficient of friction of the rocket body, and C_F', the coefficient of friction of the fins. In his report Prof. Gregorek graphed the C_F vs. Reynolds number for laminar and turbulent boundary layers. Unfortunately, it is extremely difficult, if not impossible, to determine the precise value of the Reynolds number at which the flow becomes turbulent.

Perhaps the gravity of this problem can be somewhat abated by using Prandtl's formulae for the C_F :

$$C_F = \frac{1.327}{\sqrt{(Re)}} \qquad \text{for } Re < 5 \times 10^5$$

$$C_F = \frac{0.074}{\sqrt[5]{(Re)}} - \frac{1700}{Re} \qquad \text{for } 5 \times 10^5 < Re < 5 \times 10^6$$

$$C_F = \frac{0.074}{\sqrt[5]{(Re)}} \qquad \text{for } Re > 5 \times 10^6$$

These functions are plotted for their respective ranges in Figure 1.

In computing the C_F or C_F' for a particular Reynolds number one must keep in mind the fact that the C_F is computed using the length of the entire rocket while C_F' refers only to the chord of the fins. The Reynolds number is computed from

$$R_e = 36100\,V\,L$$

where V and L are the forward velocity in meters/second and the length in the direction of motion in meters, respectively.

It is obvious from Figure 1 and the equation for the total C_DA that the drag coefficient will not vary in a simple manner with the velocity. In fact, the C_D will vary differently with the velocity for differently shaped rockets.

In figure 2 the diagram of a typical single-staged rocket, with dimensions, is given. Figure 3 is a plot of this particular rocket's total drag coefficient versus velocity and Reynolds number.

It can be seen from Figure 3 that, while the C_D experiences a significant change over the range of Reynolds numbers considered (10^2 - 10^7) on a semi-logarithmic scale, it shows no significant variation on the more important linear scale from about 10 meters/second out to 200 meters/second. *Within this region the C_D is virtually constant.*

Since the effect of drag on the rocket's flight is much more

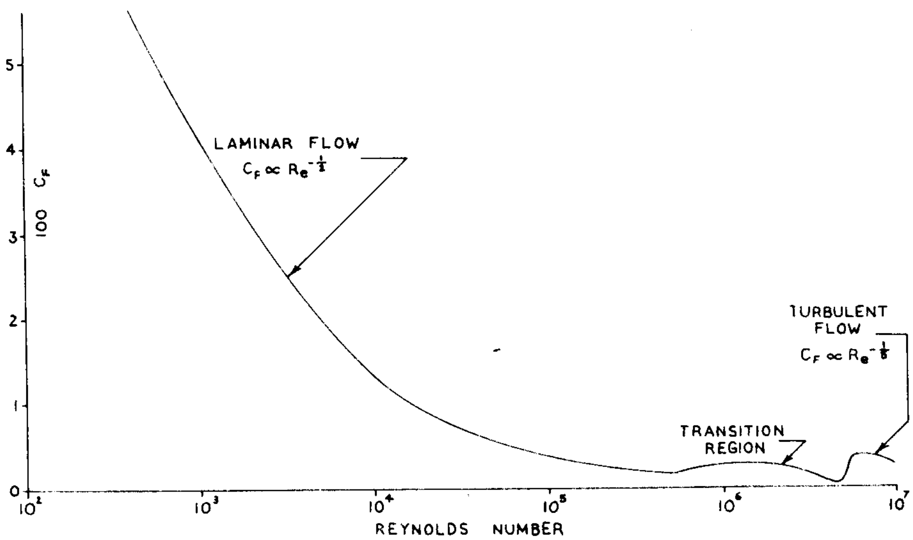


Figure 1

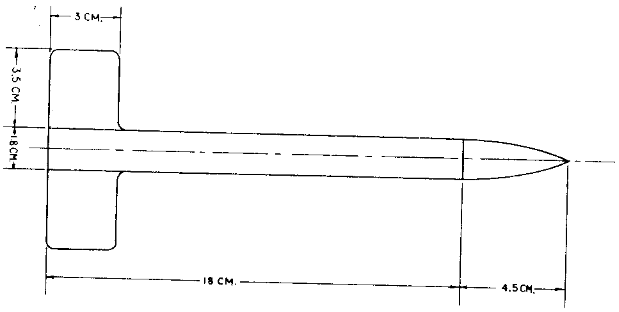


Figure 2

important at velocities greater than 10 meters/second (due to the V^2 drag law), and since the only significant C_D variation occurs at velocities less than 6 meters/second, it is clear that a scheme for computing mosel rocket altitude assuming a constant drag coefficient over the entire velocity range will be valid to a high order of accuracy for the vast majority of all model rockets, despite the velocity-dependence of C_D.

While these results are certainly encouraging, it must be borne in mind that the foregoing analysis assumes a transition of the state of the boundary layer according to the form given by Prandtl. The actual value of the Reynolds number at which the transition occurs cannot, in general, be accurately determined beforehand, and it is only through the experimental determination of the actual transition behaviour in each given case that true, physical accuracy can be achieved.

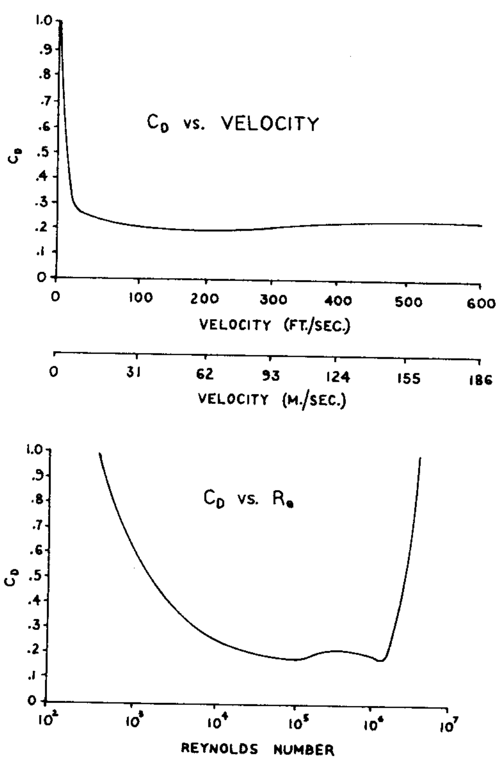


Figure 3

MARS-IV

The fourth annual Mid-Atlantic Regional Shoot (MARS) was held at the U.S. Army Aberdeen Proving Grounds over a cold mid-October weekend. Bruce Blackistone, "chief song-writer," gives his impression in the following song. (Complete MARS-IV coverage is on page 13.)

M. A. R. S.

(To the tune of Jean)

MARS, MARS, where hurricanes blow
In the town of Aberdeen
And the clouds come so low
You fly right in them and so
This makes the tracking real keen.

Down, down, in the baja
We held this meet two times
Where rockets did smash and B/G's did crash
The Army just recovered some lost mines.

And if you fly altitude near the Chesapeake Bay
Oh don't use a parachute, or it'll drift away
And then you will lose face
When it's sunk without a trace.

At MARS, MARS, where freezing winds blow
As you sit out on the scape
And the headphones won't work
And you shiver and jerk
And they'll thaw out your body (you hope).

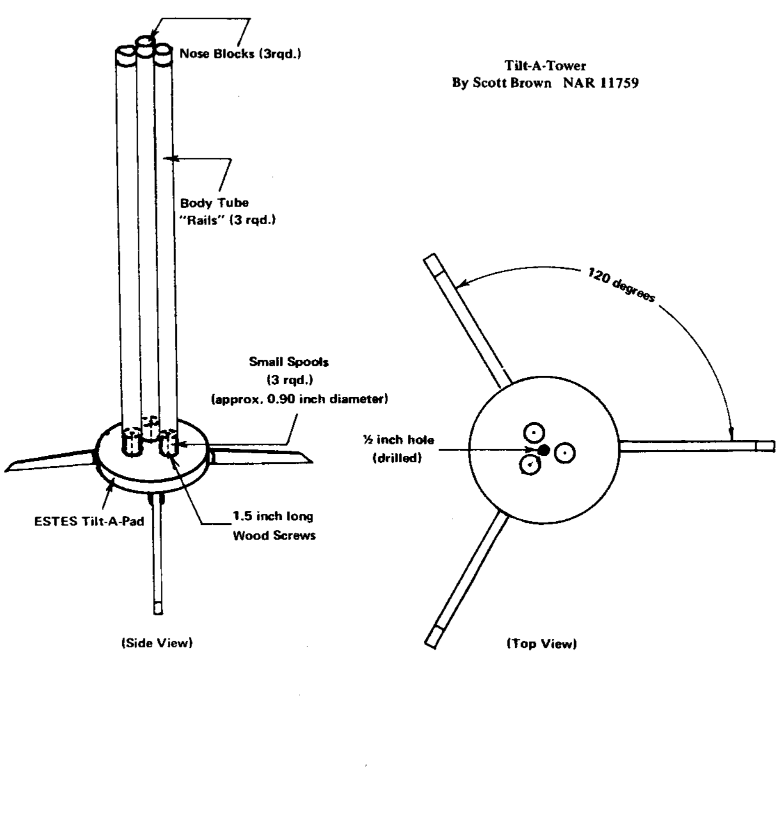
Build the
Tilt-A-Tower

A beginners launch tower costing only five dollars, which you can build in less than one hour.

by Scott Brown

The Tilt-A-Tower, an ideal beginner's tower, was developed for use with design efficiency and altitude rockets, where elimination of launch-lug drag can mean the difference between taking first and not placing. Other tower designs require elaborate metal-working equipment or long construction time. The Tilt-A-Tower, however, can be built in less than an hour, using only standard modeling equipment.

If you have never launched from a tower before, try the Tilt-A-Tower. Since it employs only 18 inches of guide rail, don't use it with rockets taller than twelve inches, or with heavy rockets which may not be stable as they leave the tower. With the small, light, altitude and design efficiency rockets for which it was designed, however, the Tilt-A-Tower will perform superbly.



Assembly Instructions

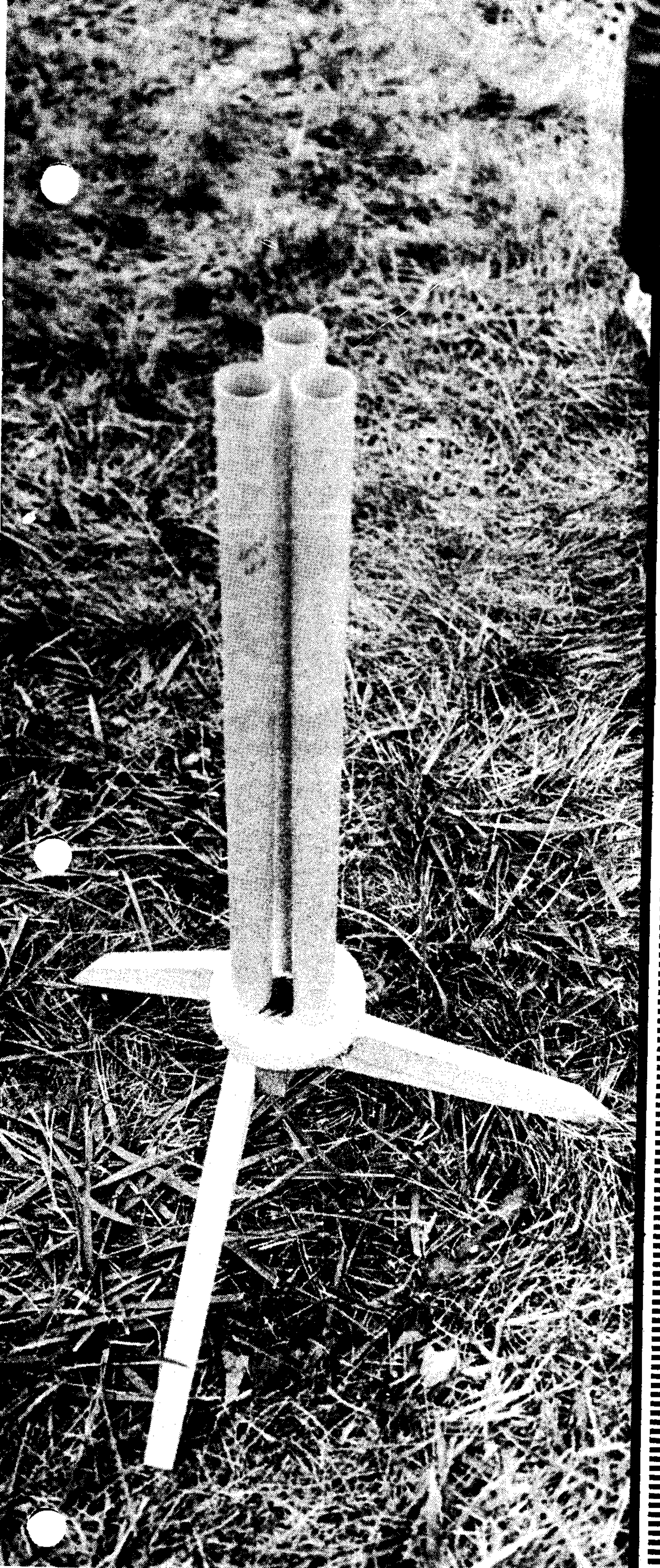
1. Assemble the Tilt-A-Pad as shown in the kit's instruction sheet. Eliminate the launch rod.
2. Trace a circle concentric with the launch rod hole. This hole should be the same diameter as the rocket for which you are building the launcher.
3. Drill a ½-inch diameter hole using the launch rod hole as the center guide.
4. Attach thread spools (of a size to fit inside a BT-50 tube) to the pad base using wood glue (such as Titebond) or 1½ inch long wood screws. The centers of the spools should be 0.488 inches radially outward from the circle drawn in step 2. The imaginary lines running from the spool centers to the pad center should form central angles of 120 degrees (as shown).
5. Use masking tape to build up the spools until the BT-50 tubes fit tightly over them.
6. Glue a nose block into one end of each of the BT-50 tubes. Slip the BT-50 tubes onto the spools.
7. Adjust the tubes until the rocket slides smoothly onto and off of the pad. Your Tilt-A-Tower is now complete.

Before each use, be sure to slide the rocket up and down the tower to check for a smooth fit. To reduce charring of the tower, it is advisable but not strictly necessary to paint the tubes with aluminum or heat-resistant paint.

If the body tubes become seriously charred, replace them before using the tower again.

PARTS LIST

1 Tilt-A-Pad	691-RL-3
3 Nose Blocks	651-NB-50
3 Body Tubes	651-BT-50
3 Thread Spools	
3 Wood screws, 1½ inch	



MPC Proposes NAR Professional Competion

Model Products Corporation has issued a proposal to clarify the question of "professional competition" in model rocket contest sanctioned by the National Association of Rocketry. Their recommendations, made public in a letter to all major model rocket manufacturers, NAR Trustees and NAR Sections, are as follows:

"1. MPC believes that competition within an ethical framework of mutually agreed-upon rules is not only a way of life in the United States but also one factor that has helped make this country a world leader. MPC believes in competition and encourages it. We do not believe that model rocket manufacturers and other "professional" individuals should be excluded from sporting competition in model rocketry.

"2. MPC believes that consultants and other 'professionals' who derive part or all of their personal income from model rocketry should not compete against those individuals who compete in model rocketry simply for fun and sport of it. MPC therefore believes that manufacturers and 'professionals' should compete among themselves in a new NAR contest division known as the *Professional Division* equal in all respects to the Junior, Senior and Leader age divisions among the non-professional model rocketeers. We would, however, exclude from the Professional Division those who are model rocket retail dealers, who receive payment for written articles and photographs published in books and magazines, and who receive only royalties from model designs produced as kits by model rocket manufacturers... provided said model rocket designs are not flown by the designer in sporting competition against non-professionals. Thus, a professional is one who: (1) is an employee or consultant of a model rocketry manufacturer on a temporary, part-time or full-time basis, or (2) is designated by a manufacturer as an expressed representative to participate in rocket competition.

"3. MPC proposes that trophies and awards for the Professional Class be totally paid from entry fees paid by manufacturers in the Professional Division competition. These entry fees can and should be greater than those paid by non-professionals. In other words, professionals will support their own awards and should not expect that the NAR or other outside firms do so. We propose that these awards should fall into two types: (a) an award for the best professional individual performance in each contest category flown, and (b) an award for the best cumulative performance of a manufacturer's team in each contest category.

"4. MPC suggests that each manufacturer be permitted two field only *one* team of three individuals in each contest category.

"5. MPC invites all interested manufacturers and professional individuals to participate in a special meeting to draw up specific rules applicable only to the Professional Division.

"MPC issues a challenge to all other model rocket manufacturers to compete in a Professional Division at the 12th National Model Rocket Championships, flying in the same competition categories as the non-professionals and under the NAR rules, plus any additional Professional Division rules established in Chicago. We propose that any manufacturer be restricted to compete using his own kits, parts, and accessories; each manufacturer should fly with his own model rocket motors if he manufactures and sells a type that can be used. However, a manufacturer is not restricted to using only those designs of his current kits, but may enter any free design *fabricated from his parts,* available on the market.

"Professionalism has its place in model rocketry just as it does in other fields. It should be encouraged within a proper framework. Competition among manufacturers and professionals for the sake of the publicity and advertising value inherent in such activity has helped gain public awareness and support of other sports; it will do the same for model rocketry. Competition in the sporting arena between manufacturers has resulted in advancement of the state-of-the art in other fields; it is capable of doing the same in model rocketry.

"MPC wants model rocketry to grow, too, in the spirit of competition within a mutually agreed-upon framework of fair and workable rules. And we are willing to take the risk of putting our model rocket products on the line in sporting competition as well as in the commercial area. MPC has thrown down the gauntlet. Any takers?"

NEWS NOTES

Colorado Springs Legalizes Rocketry

The Colorado Springs City Council adopted new regulations relating to the use of model rockets at its October 14th, 1969 session. The ordinance (No. 3920) authorized the City Manager "to adopt appropriate rules and regulations" on "the making and manufacture of rockets and rocket engines, the launching and testing of rockets and rocket engines, (and) the areas of operation and launching of rockets."

Willaim Roe, NARAM-11 Contest Director and long-time NAR member, spoke before the Council in favor of the new ordinance. He explained that the new ammendment would facilitate the updating of model rocket regulations.

Pittsburgh Spring Convention Planned

March 20-22, 1970

Site Changed to Allow 225 Participants

The Pittsburgh Spring Convention has moved to the Red Raven Motel. The motel has been used in past years as a housing site for the conventionites who could not be housed at Shady Side Academy. Due to the move the convention will now be able to accomodate 225 people. Along with the new location, many inovations are planned. New discussion groups, pertaining to telemetry, how to compete, and other aspects of the hobby, will be held. Lecture demonstrations are also being renovated. This year professors from local colleges and representatives from local space industry business will give lectures. On Saturday it is planned to bus the conventionites to a launch. Attempts are being made to use a bigger and larger field. The approximate cost will be $28. The dates are March 20 - 22, 1970. For more information write to: Alan Stolzenberg, Convention Chairman, 5002 Somerville St., Pittsburgh, Pa. 15201.

Mims prepares his radio-controlled rocket for a launching from the Saigon Racetrack in South Vietnam. The flight of the ram-air guided rocket was programmed by a tape in the tape recorder at right. The tape sequence was activated at liftoff by a microswitch under the rocket.

Think you've had problems finding a launch site? Well, things could be worse, unless of could course you've been chased by an Army helicopter gunship.

Model Rocketry in Vietnam

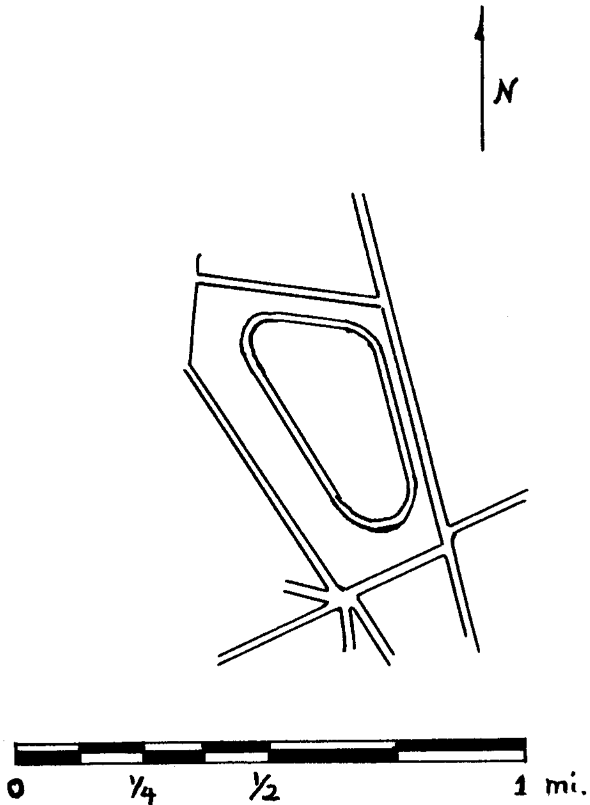
by Forrest M. Mims III

An avid model rocketeer since 1958, I was deeply involved in a rocket guidance and control project when in December of 1967, I received orders for duty in Vietnam. A crash program to complete the project before my departure proved to be more crash than program. Therefore, in early January of 1968, I found myself deployed in Vietnam with 66 pounds of baggage -- 40 pounds of electrical and rocket supplies and the remaining 26 pounds of uniforms, boots, and personal effects.

Upon my arrival in Vietnam, I found myself the junior Air Force Second Lieutenant at Tan Son Nhut Air Base. My job was interpretation of aerial reconnaissance photography taken over North Vietnam. Though working hours were long and fascinating I found time to set up a small work area in my one room apartment in Saigon. By March the guidance and control project was once again well underway. Construction of rockets and particularly the guidance device proved difficult due to the lack of materials -- or so I thought. Becoming more aware of my surroundings as time progressed, it soon became evident that practically all the materials needed were near at hand. Sturdy rocket body tubes could be rolled from the leftover ends of 10 inch aerial reconnaissance film and secured with scotch tape. A single coat of Vietnamese laquer provided a glasslike finish to complete the rockets. Mechanical components for the guidance system were cut from tin can lids, aluminum foil, and plastic pill bottles.

Having completed several test rockets I began a search for a suitable launch site. The country side was too wet (rice paddies) and dangerous for model rocket launchings. But a map of Saigon showed a hugh horse racing track called Phu Tho. The Phu Tho Race Track was a three mile ride from my room on a rundown 50cc French Mobylette motor bike. I built a combination range box/launcher from scrap wood and mounted it on the motor bike. The box held the launching apparatus and the rockets were affixed to its top by large rubber bands or masking tape.

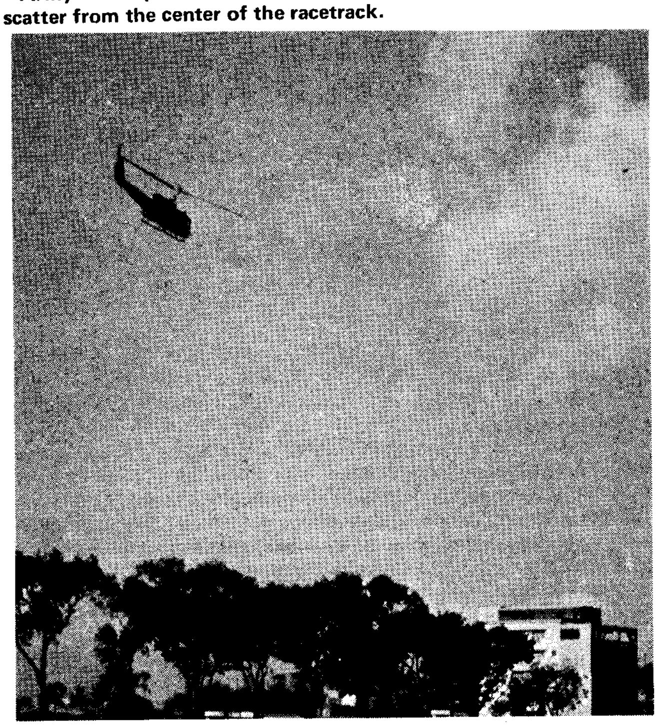
All was well with my project until my first trip through the busy Saigon streets with three bright red and yellow rockets affixed to the back of my motor bike. The normally friendly Vietnamese showed looks of curosity and suprise, and when I

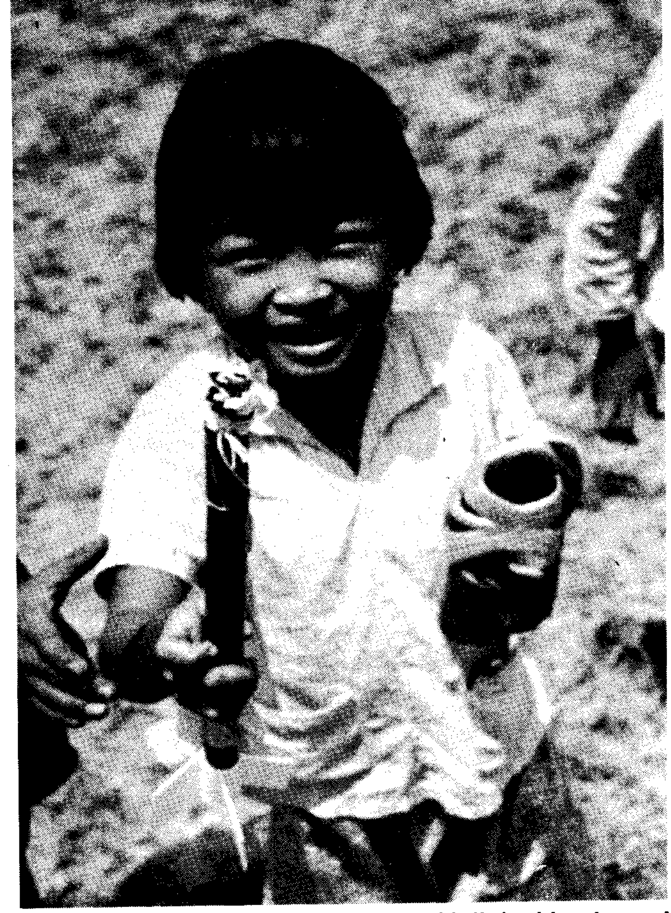


Saigon Racetrack

reached Phu Tho a large group of Vietnamese teanagers followed me through the gates and onto the track. As their curiosity was almost overwhelming, I indicated in feeble Vietnamese and sign language that they were welcome to watch the launch proceedings. Many in the group offered to help, resulting in the most cooperative recovery crew, countdown man (in Vietnamese of

Army helicopter comes in for a closer look, as the Vietnamese scatter from the center of the racetrack.





The rocket drifted at least a mile, but this little girl and several others chased it down and returned it. Amazing.

course), and a launch control officer. I manned a camera for photographing smoke trails. Several sessions at the track went quite well, until the day an Army helicopter gunship dropped out of the sky over the track and began eyeing the rockets, launcher, and me through the sites of a 50 cal. machine gun. The chopper was far in the distance when I launched the first rocket that day, but apparently the smoke trail provoked it, since it made a beeline for the track. As the hugh racetrack was surrounded by a high brick wall there was little I could do but wave my shirt and take pictures in an effort to show that I had no intention of rocketing downtown Saigon. The dozen or so members of the launch and recovery crew climbed onto the white fence bordering the edge of the track and waved their shirts and shouted at the now landed chopper. After a few minutes on the ground, the gunship rose and sped directly towards us. Just 20 feet above my head the chopper halted to get a closer look. What they saw was a hugh cloud of red dust stirred up by their rotor blast, rockets rolling over the ground, the recovery crew scattering for a ditch, and me taking pictures of the whole scene. They left for half a minute and then came back for a final look. After that I didn't have much stomach for rocket launching. In the future I learned to notify the appropriate military authorities before conducting launches from Phu Tho.

The guidance experiment progressed admirably until the summer monsoons and ever cloudy skys. The guidance devices were designed to home-in on the sun while a ground camera recorded the white smoke trail. However clouds obscured both the sun and the smoke trail. Therefore, I began a series of supporting experiments. Rockets fitted with a small tracking light and spin fins were launched at night and their flights recorded via time exposure photography to study the effects of the control components of the guidance system. Due to the situation at hand, I quickly concluded that the safest place to launch rockets at night was from the roof of the small apartment building where I lived, not from the racetrack. The first rocket was fitted with an appropriate recovery mechanism, control device, and a note in Vietnamese offering a reward for

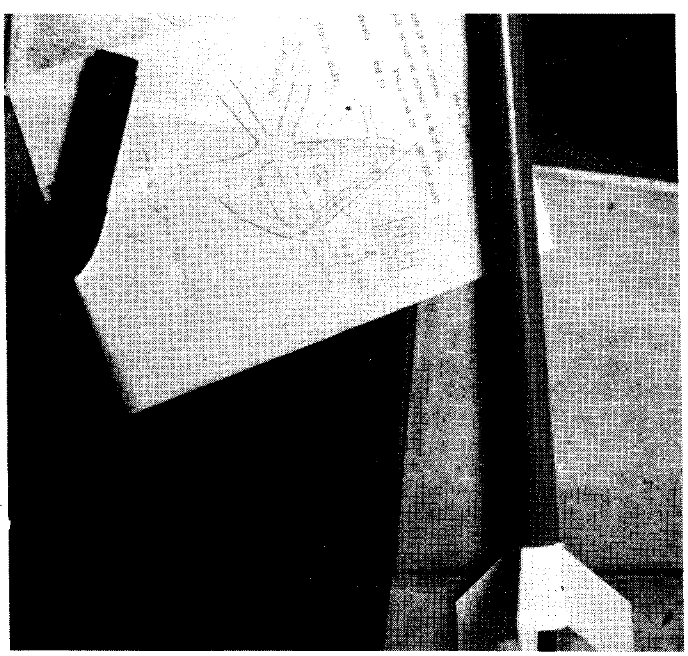
Local residents look over the rocket and launching system during a launch from the Saigon racetrack.

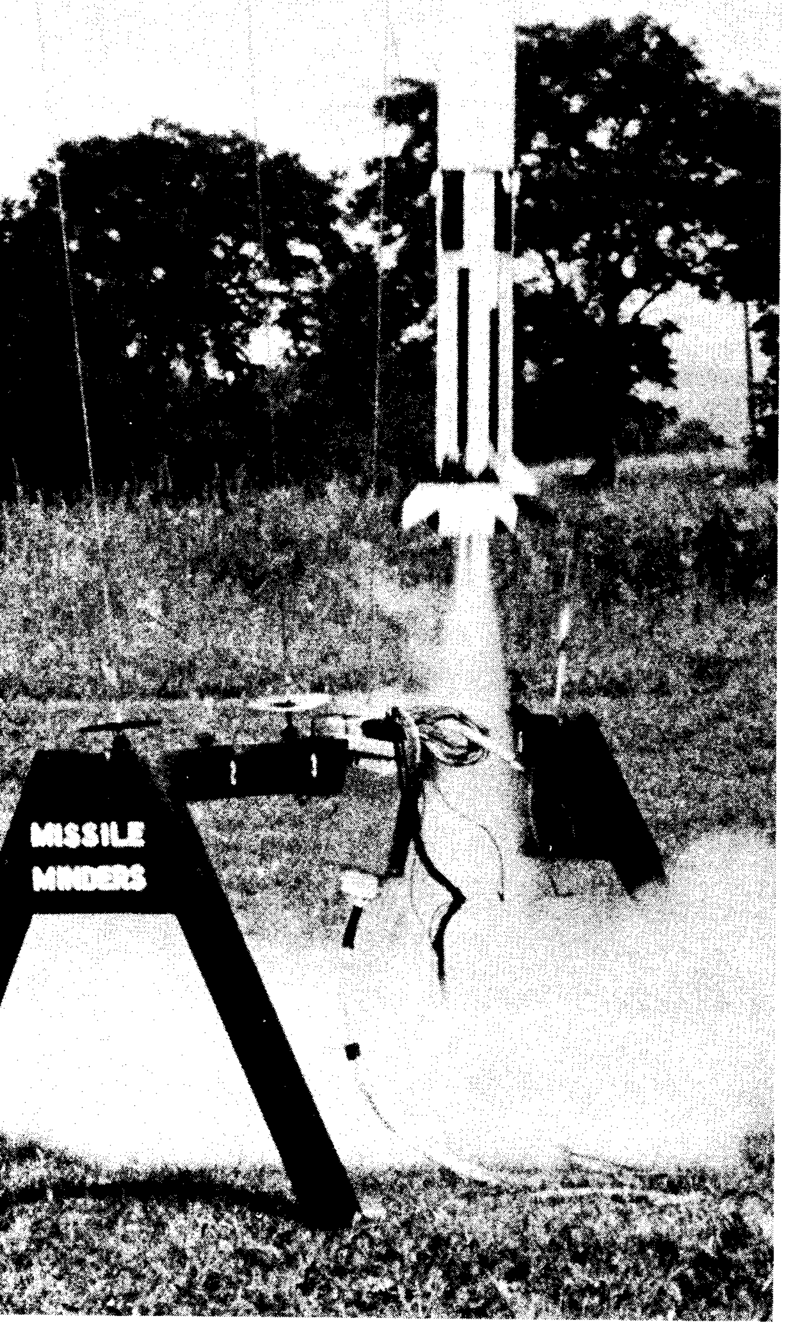
the return of the rocket. Still foolishly believing my roof to be a safe launching area, I proceeded to send a wind test bird followed quickly by the instrumented test rocket into the dark Saigon sky. This was to be the last time I was to contribute to lighting Saigon's nights. Brilliant floodlights from the nearby Tan Son Nhut Air Base swept across the area around my roof. I raced down to my motorbike in an effort to recover the instrumented rocket, only to be stopped within 100 feet by two jeeploads of heavily armed military police who ordered me to depart the area immediately. "The Air Base is under possible rocket attack!", said their leader. Well I must confess to second thoughts about the value of model rocketry at that point. I quickly told them about my experiment, and then received a stern warning never again to launch rockets at night or be on a motorbike in a swimsuit and nothing else after the military curfew.

That wraps it up for my experience with model rocketry in Viet Nam. I launched almost 50 rockets, obtained some good data and had some interesting and exciting launches. But I decided to work on quieter and certainly safer projects for the duration of my stay and leave rocket launching to the people wearing helmets and bamboo hats.

Next month **Model Rocketry** will feature the results of the "Ram Air Guidance" project which I conducted while stationed in Viet Nam.

Rocket with onboard tracking light, as launched from the apartment rooftop in May 1967.



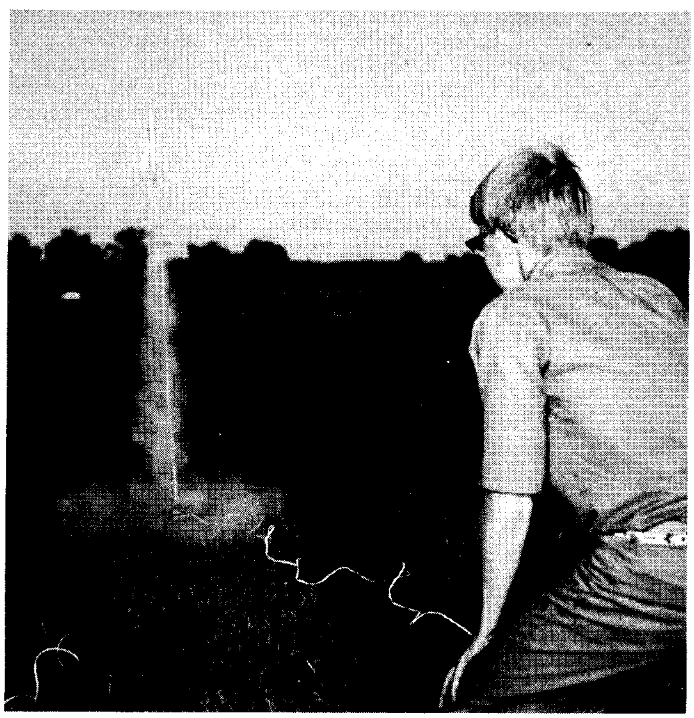


PHOTO

GALLERY

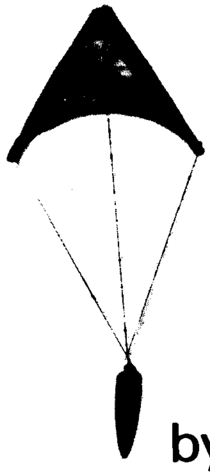
Readers are invited to submit photographs of their model rockets for publication on this page. Our staff will select those photographs having superior quality and composition for inclusion in the **Model Rocketry** *Photo Gallery. Send your photos to:*

Photo Gallery
Model Rocketry
Box 214
Boston, Mass. 02123



(Above) David Chandler of St Paul, Minnesota launches the 2nd stage of an Astron-Midget from a Minnesota field. (Photo by John W. Chandler.)

(Left) Mark Werner's Saturn 1-B launched from a Pottstown, Pennsylvania field. (Photo by Doris Fritchman.)



Parawing Recovery

by Leigh & Olaf Thorson

A triangular construction of plastic soda straws and thin plastic obtained from a dry cleaners garment bag, has been used successfully for landing small payloads safely. The idea for such an R&D program was Para-Wings or Para-Gliders.

The first model of our Para-Wing (PW-1) was basicly a V shaped construction using three (3) soda straws for the skeleton of the structure (see diagram PW 1). After several tests as to payload lift capability, the wing was scrapped. The three main reasons for the scrapping of the PW-1 were: (1) it was too heavy and bulky to provide even fair lifting capability, (2) it had no programable recovery area, (3) and, its construction was easily caught in the guy lines. After much discussion and bickering on the design of a new model, we came up with the PW-2.

The PW-2 is a highly maneuverable Para-Wing with a programable recovery field and which can support a fair sized payload. The new modified version makes use of the basic V-construction but without the center ridge of the old PW-1. This eliminates some of the weight and lessens the chance of entanglement of the guy lines and the soda straw structure.

Our R&D began on the PW-1 about two months ago, two weeks of careful testing showed that it would hardly bear any more than its own weight. So, PW-2 was started. It took two hours of careful construction to come up with the design that would meet our needs.

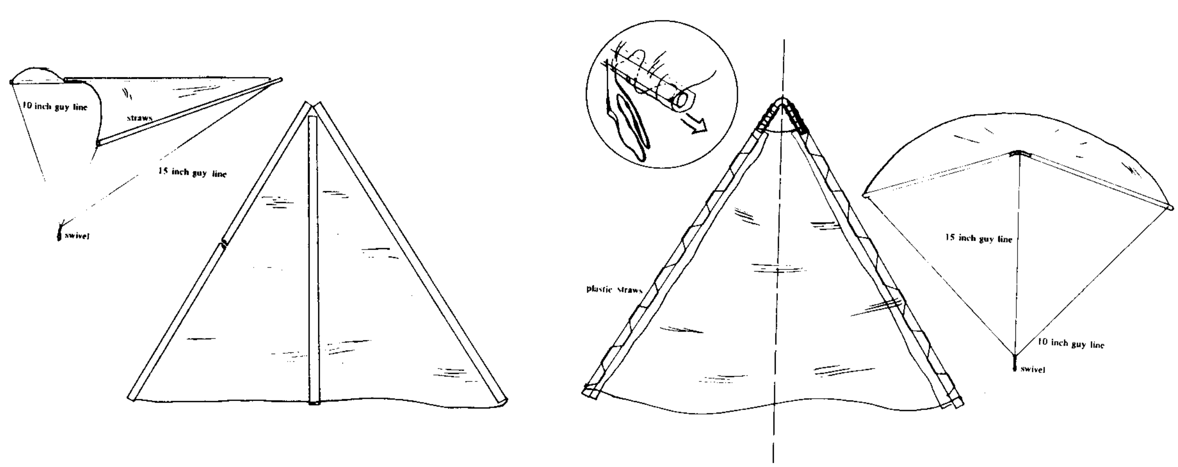
After construction, the PW-2 went into five days of strict testing to determine how this system would operate during and after the lift off of our test vehicle. Some of these tests were to determine how heavy of a payload that it could safely return to the ground, static landings after a simulated ejection from the test vehicle, movable or programable guy strings for glide control, and take over of the recovery in case of parachute failure.

The first actual flight took place on June 1st, using the Estes Big Bertha as the launch vehicle. Unfortunately, the rocket crashed into the ground just three seconds after lift off, leaving the original 24 inch rocket just 19 inches in length. Needless to say, this flight ended the testing for that day.

One week after the mishap, after assembling an Estes ARCAS sounding rocket, we were at it again. Learning from the failure of the Big Bertha, we used a B4-4 engine this time instead of a B14-5 engine as in the Big Bertha.

At 12:45, just 5 minutes from launch time, the ARCAS was prepared to receive the PW-2. This test almost terminated the whole program. The ARCAS had a beautiful lift off, reached an altitude of little over 500 feet and ejected the PW-2 and its own recovery system. All of the way down, the PW-2 gyrated or swung with a dead leaf motion. Disappointed at first, we decided to try it one more time. After readjusting the guy lines, we launched it again. This time, the rocket reached an altitude of a little over 450 feet (a new launch angle was used) and ejected the PW-2 for the second time. After ejection, the PW-2 became entangled in the ARCAS' shock cord. It was pulled down to an altitude of about 300 feet by the weight of the launch vehicle before it separated itself. For a moment the ARCAS looked like it was about to crash into the ground as had the Big Bertha; but lucky for us the PW-2 had been entangled in the shock cord for a short time, because the ARCAS parachute had failed to open. Before it had worked itself loose, the PW-2 had slowed down the ARCAS enough to permit a safe recovery (even though the rocket still fell unchecked for about 300 feet).

Meanwhile, the PW-2 was slowly gliding for a safe return which came to rest 90 seconds later about 300 feet away from us. The flight of the rocket was classed as a failure, but the flight or glide of the PW-2 was hailed as a success. On the drawing board now besides the PW-2, are plans for a larger more flexible version of the PW-2.



PW–1 PW–2

The Wayward Wind

by Gordon K. Mandell

From time to time over the recent months I have been urged by some rocketeers to present an article on rocket propulsion. Others have opposed the idea, claiming that it would be dangerous and contrary to the spirit of model rocketry for the principles of rocket motor design to become known to the general modeling public. Such knowledge, they say, would tempt many a junior from the paths of righteousness and lead him to bite into the forbidden fruit of *amateur rocketry* (shudder!). I've got some pretty strong feelings on this subject myself, and here they are:

First, any attempt to decide for others what it's "right" or "appropriate" for them to know is both immoral and impractical. The act of withholding or controlling information is totalitarian in character and totally unjustifiable. Furthermore, any rocketeer stupid enough to blow himself up with a ram-it-yourself Suicide Special will find a way to do so no matter what obstacles you place in his path.

Second, I am firmly convinced that an understanding of propulsion technology is an important part of our hobby's educational mission. "Oh," says the Basement Bomber disdainfully, "you don't do *anything* with motors or propellants? What kind of rocketry is *that*?" This individual's smug bubble of self-righteousness can only

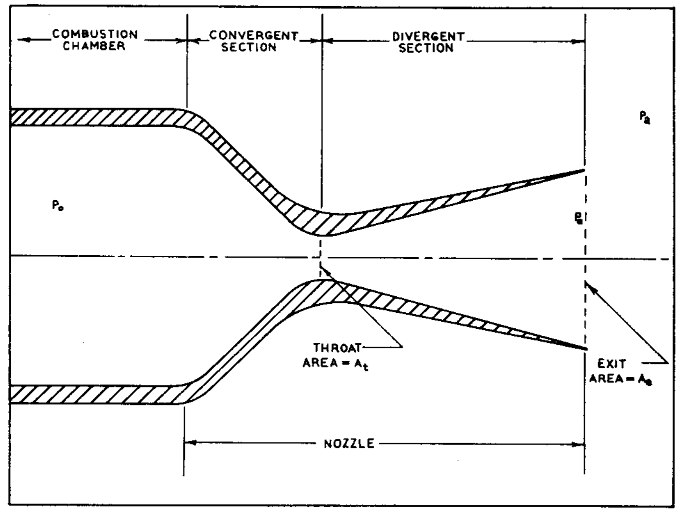


Figure 1. De Laval nozzle attached to the combustion chamber of a rocket motor, showing its various sections and the gas pressures involved in its operation.

be punctured by a community of model rocketeers who know the theoretical principles of rocket propulsion better than he does. The Bomber will then be shown up for exactly what he is – an irresponsible thrill-seeker who hides his emotionalistic adventurism in an aura of pseudo-scientific baloney by promulgating the insupportable myth that scientific competence and engineering skill are necessarily measured solely by tons of thrust and miles of altitude. The existence of a growing community of model rocketeers with a working knowledge of propulsion technology will prove once and for all that you can learn plenty about rocket engine design without having to build a working motor.

Third, a knowledge of how his premanufactured engines work cannot help but benefit the individual hobbyist. He can evaluate the relative merits of engine types for each particular application he has in mind. He can even compute the characteristics of the best engine for his purpose and select the one which comes closest to his specifications from among the types available. Decisions of this kind are made all the time in full-scale engineering – and we will have still another way that model rocketry is truly astronautics in miniature.

Finally, the response I've been getting to the *Wayward Wind* column – and particularly to the Krushnic Effect article in the November 1969 MR magazine – indicates that model rocketeers are just as interested in propulsion dynamics as they are in any other aspect of rocketry. And so I'm going to do my best to present a simplified treatment of rocket propulsion in a form that I feel will best serve the educational needs of the hobby and will most readily allow the modeler to perform the practical calculations he needs to choose a rocket engine for any application.

This month I'm going to concentrate on nozzle flow, since that's the most logical place to begin after the Krushnic article and also because it's the most generally applicable part of the presentation. When we get to combustion chambers and propellants I'll be talking only about solid propellants (eventually I hope to get around to physical liquid propellants such as Freon, too, but that's another story). Nozzles, though, work with just about any kind of propellant. For our purposes a nozzle is just a device for taking a gas at a given temperature and pressure and turning it into a high-speed stream of gas at a much lower temperature and pressure. Although the formulae which describe the operation of rocket nozzles are admittedly rather complicated and can only be derived by calculus, the basic physical principles behind them are not so difficult to understand.

First of all, if we're going to talk about nozzles, we'd better draw one and label it. I have done this in Figure 1. Those of you who read the November *Wayward Wind* will recall that most rocket nozzles are of the De Laval type, having a convergent section, a throat, and a divergent section to take maximum advantage of the fact that the exhaust gases are compressible. The cross-sectional area of the nozzle exit plane is called A_e; that of the throat is called A_t. The inlet area is unspecified, but it is assumed to be much larger than the throat.

The burning of the propellant in the combustion chamber generates high-temperature gas which would readily escape from the chamber were it not for the presence of the nozzle. Since the nozzle is there, however, the only way the gas can leave the chamber is by passing through the nozzle's throat. This is a restricted escape route, though, and the pressure in the chamber must become quite high before the gas escapes rapidly enough to prevent a further buildup of pressure. When the nozzle is operating steadily the gas entering its inlet has a pressure p_o which is much greater than the pressure (p_a) of the air (if any) outside the nozzle. The behaviour of the gas from this point on has a great deal to do with a number called γ (small Greek gamma), the *ratio of specific heats.* While the pressure, temperature, density, and velocity of the exhaust gas change markedly as the gas flows through the nozzle, γ remains virtually constant and can be considered a characteristic of the particular mixture of exhaust products produced by a given combination of propellants. First of all, for the nozzle to operate properly the following must be true:

$$\frac{p_o}{p_a} \geqslant \left[\frac{\gamma + 1}{2}\right]^{\left[\frac{\gamma}{\gamma - 1}\right]}$$

Equation 1 is called the *choking condition.* When it is satisfied the nozzle is said to be *choked.* To a rocket engineer choking refers to something that's *right* with a rocket nozzle, not something that's wrong with it. When a nozzle is choked, the exhaust gas enters it at a very low velocity at the inlet, speeds up in the convergent section, reaches the speed of sound at the throat, speeds up *more* in the divergent section, and leaves the exit at a supersonic velocity. If the nozzle is not choked, the gas will *not* reach the speed of sound at the nozzle throat, and will *slow down* again in the divergent section, emerging with almost no velocity and producing almost no thrust. Equation 1 states that a certain minimum chamber pressure (p_o) is needed to operate a De Laval nozzle, and that this minimum depends upon the γ of the particular exhaust gas. γ may vary from about 1.18 to 1.40, depending on the propellant used. For most model rocket propellants, γ may be considered around 1.35. The choking condition for a nozzle operating with such a propellant is $(p_o/p_a) \geqslant 1.83$. Since most model rocket engines operate at or near sea level, where p_a is 14.7 pounds per square inch, absolute (PSIA), this means that the pressure within the motor chamber must be at least 26.9 PSIA for its nozzle to run choked. Chamber pressures currently used by all model rocket manufacturers are, of course, much more than this.

Assuming a choked nozzle, we can write the thrust of the engine in pounds as:

$$F = p_o A_t C_F$$

where p_o is given in PSIA and A_t is given in square inches. C_F is called the *thrust coefficient.* It is dimensionless and may be computed according to:

$$C_F = \sqrt{\frac{2\gamma}{\gamma - 1}}\ \Gamma \sqrt{1 - (p_e/p_o)^{\frac{\gamma - 1}{\gamma}}} + \frac{A_e}{A_t}\left[\frac{p_e}{p_o} - \frac{p_a}{p_o}\right]$$

where Γ (the Greek capital gamma) is given by:

$$\Gamma = \sqrt{\gamma}\left[\frac{2}{\gamma + 1}\right]^{\frac{\gamma + 1}{2(\gamma - 1)}}$$

Equations 3 and 4 are valid only for $(p_e/p_a) \geqslant 0.36$. For lower values of p_e, readers of November's article will recall, the exhaust no longer follows the walls of the divergent section all the way to the exit. You will find, in fact, if you do the calculations, that C_F is greatest when $p_e = p_a$. This is called *optimum expansion* and under this condition C_F becomes:

$$C_F = \sqrt{\frac{2\gamma}{\gamma - 1}}\ \Gamma \sqrt{1 - (p_a/p_o)^{\frac{\gamma - 1}{\gamma}}}$$

The *nozzle expansion ratio* (A_e/A_t) associated with a given value of (p_e/p_o) is given by:

$$\frac{A_e}{A_t} = \Gamma \sqrt{\frac{\gamma - 1}{2\gamma}}\ \frac{(p_o/p_e)^{\frac{1}{\gamma}}}{\sqrt{1 - (p_e/p_o)^{\frac{\gamma - 1}{\gamma}}}}$$

The *optimum* expansion ratio is found by just setting $p_e = p_a$ in equation 6. A model rocket engine's nozzle should always be designed for optimum expansion. The following example should give you a feel for the kind of numbers you can expect from these calculations:

A certain model rocket engine uses a propellant whose combustion products have a γ of 1.35. It operates at a chamber pressure of 147 PSIA, is intended for use near sea level, and has a nozzle throat diameter of 0.1 inch. What should be the diameter of the nozzle exit, and assuming this diameter is used, what will be the thrust of the engine?

Performing the calculations, we find:

$$\Gamma = 0.673$$

$$\sqrt{1 - (p_a/p_o)^{\frac{\gamma - 1}{\gamma}}} = 0.667$$

$$\sqrt{\frac{\gamma - 1}{2\gamma}} = 0.359$$

$$\left(\frac{p_o}{p_a}\right)^{\frac{1}{\gamma}} = 5.52$$

Optimum expansion therefore requires $(A_e/A_t) = 2.0$, or a nozzle exit diameter of 0.1414 inch. C_F in this case is equal to 1.255, and A_t equal to 0.00785 square inch, the engine will have a thrust of 1.445 pounds.

So much for nozzle calculations. Next month I'll continue with a discussion of solid propellant combustion mechanisms and the effect of various propellant characteristics on combustion chamber and grain design and nozzle operation. Until then, good flying (and no do-it-yourself rocket motors, *please*).

USSR flyer-cosmonaut Alexi Yeliseyev gives his autograph to a young model maker at Kaluga.

Report From

Second USSR Model Rocket Championships

Rain did not stop the competition at Kaluga. Note the Vostok scale models held by two contestants in the rear.

Novosti Press Agency (APN)

The country-wide contest of young rocket-model constructors held for several days at Kaluga was opened with an air parade--the show of aerobatics and the mass bailing. Drivers of the Moscow children's motor road brought to the city a handful of earth from the place where Yuri Gagarin plunged to his death. Cosmonaut Alexi Yeliseyev, a fellow-townsman of the people of Kaluga, read out a letter from other spacemen to the boys who took part in the competition. "Learn, dare and create," the letter said. "The time will come when caravans of rockets will rush you forward from star to star."

The 140 rocket-model constructors participating in the contest brought to Kaluga models of rockets and rocket-planes of different classes and designs. Boys form the Pushkin district, Moscow Region, had assembled for the contest a special launching installation called "Baikonur Minor".

Thousands of people gathered at the competition heard the gramophone recorded parting words of Konstantin Tsiolkovsky, the father of causmonauts. Right after the record was played, the models of first experimental rockets designed by Tsiolkovsky roared upwards.

All these ceremonies being over, the contest of model constructors was started. Models of Soviet spaceships Vostok, Voskhod and Soyuz were launched among the first. The little Soyuz model built by Kestusis Brazis from Lithuania kept in the air for 3 minutes 45 seconds. It won the title of the champion for its designer.

Also successful was the launching of a one-stage rocket designed by Shakir Mekhtiyev, a pupil of school No. 167 from Baku. The third place went to Modris

Friends congratulate Shakin Mekhtiev of Soviet Azerbaijan, winner in the parachute duration event at the Second USSR Junior Rocket Model-Making Competition at Kaluga.

[left to right] Pavel Moskvin of Zhitomin, Modris Berzonis of Latvia, Victor Levshin of Kazakhstan, and Shakir Mekhtiev of Azerbaijan, prizewinners in the parachute duration trials at Kaluga.

Berzonis, a pupil from Riga. His junior brother was second in the lifting of payload. His model reached a height of 950 feet.

The team championship was won by pupils of the Moscow Region.

The 14-year-old Lithuanian pupil, Kestusis Brazis, who became champion in the models of the most complex class (scale-models of Vostok and Soyuz spaceships) was awarded the prize of cosmonaut Vladimir Komarov instituted by the journal "Model Constructor—Designer".

On returning to Moscow, the champions were asked by correspondents to describe how the contest proceeded. The boys felt at ease, in a manner befitting champions, at the first press conference of their lives.

Nikolai Yakovlev, their captain, instructor and former military flier, said:

"The contest was organized in the following way. The team which took first place in its region, got the right to enter the country-wide contest. Last year we took second place in almost the same composition. The team of Electrostal went then to the national contest. This year the team of the Chkolovsk young technician's club entered the national contest."

And here is what the contestants said.

Kolya Bulgakov: "My rocket pierced upwards, and everything seemed okay. But suddenly it got entangled in the parachute. The time of flight was 58 seconds. That was bad, of course."

Kolya Maximov: "I was prejudiced by a cloud, that damned cloud. Nobody could, of course, see where my Soyuz flew. I knew that it flew high. But how could you prove that to the umpires?"

Zhora Yakovlev: "I also have the band of a champion, but only for last year's competitions, unfortunately. This time too, I wanted to show the high class, but failed."

Igor Bychkov: "The boys were fine. Many were younger than I. In the Uzbek team there was a boy who studies in the second form only. Boys from the Estonian team were also very young but tall."

Kolya Bulgakov: "Thousands of people came to watch the competitions. When a rocket landed in the crowd, you would not get it back. It was taken to pieces as souvenirs."

Igor Bychkov: "I didn't know to the end who will be the first."

Zhora Yakovlev: " We told him he became a champion but he didn't believe. He was then led to the table of results, but he didn't believe again, Finally, he realized that he had won."

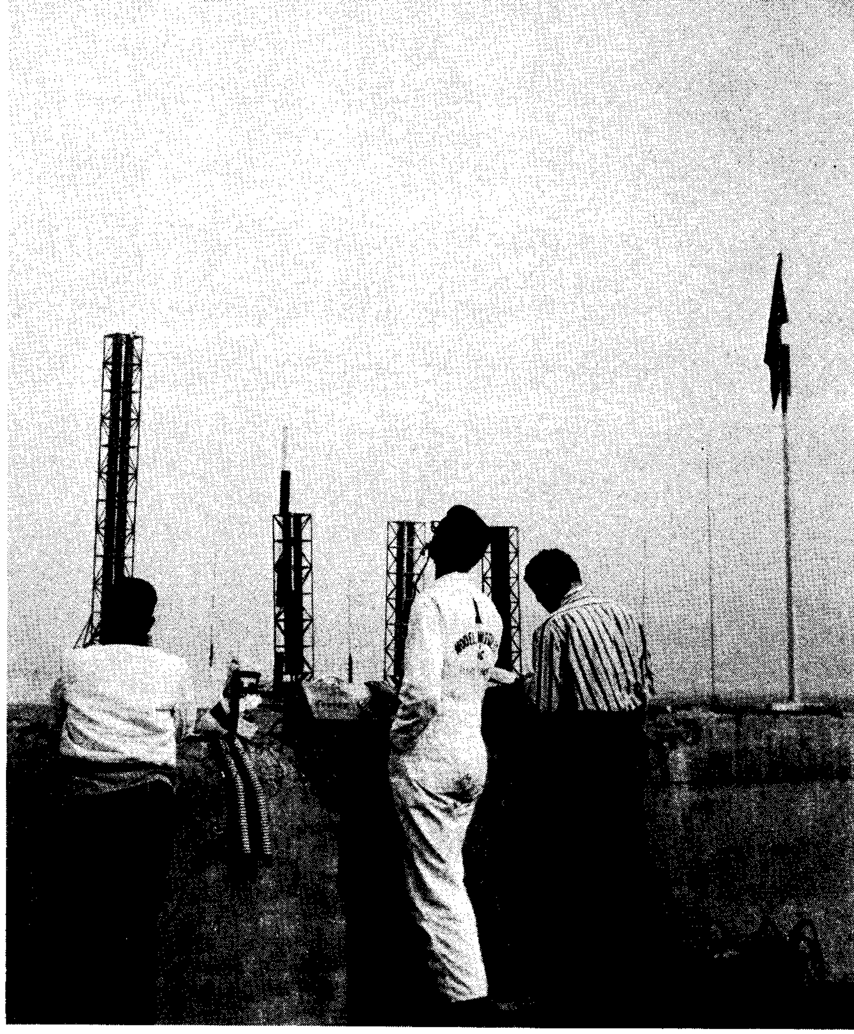
Nikolai Yakovlev: "Igor is a fine fellow. He has been engaged in rocket modelling for the first year and studies in the fifth form, but is already twice champion: in the personal and team competitions."

Kolya Bulgakov: "You know, Igor shouted in his dream: Maximov, our rocket is being outpaced!"

Nicolai Ukolov, the chief umpire of the contest, said what the champions did not mention:

"The class of rockets models has risen considerably. The duration of flight is more than ten minutes. You even get tired of watching the flight. The team of the Moscow Region won the title of champion for the second year. Last year it won three out of four personal prizes, and this year only one out of six. Competitions grow tenser from year to year. In general, the Chkalovsk team consists of brilliant boys. It was they who made scale-models of Soyuz. Boys in many cities are assembling models according to their drawings.

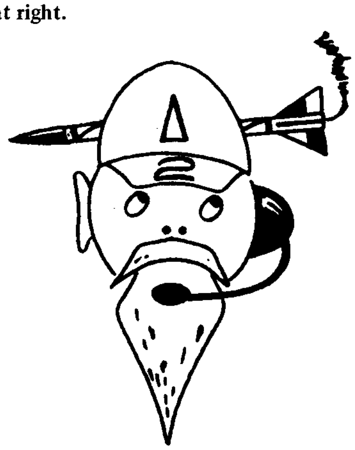
This silver urn, with soil taken from the site of the tragic death of USSR Cosmonaut Yuri Gagarin, was delivered to the Tsiolkovsky Museum of the History of Cosmonautics in Kaluga on the opening day of the national model rocket competition.



Photos by Stine

They don't look like rocket pioneers, but they are. Standing, left to right, are John Meeker, Norm Mains, Rick Tydings, Gary Grant, and Art Ballah. Kneeling, left to right, are Bob Smith, Dave Jenkins, Colin Peecher and John Jackson. The Hogback Rocket Range was originally called "Yuccapucca Rocket Range", as the sign on the side of the truck indicates, but the name was quickly changed! Photo taken in May 1959 at the loading dock of Model Missiles, Inc., 1165 South Cherokee Street, Denver, Colorado.

(Right) An original Model Missiles "Aerobee-Hi" lifts off from pad 1 at Green Mountain Proving Ground near Denver in 1958. Left to right: Bob Smith, Del Hitch (in MMI coveralls), and Chuck Olson. Note the old MMI steel launch towers, and original NAR range flag at right.



The Old Rocketeer

by G. Harry Stine NAR#2

Return to Green Mountain

On May 16, 1959, the world's first model rocket competition was held at Green Mountain Proving Ground, a 560-acre former ammunition dump situated just to the west of the Denver Federal Center in Colorado.

Ten years later in 1969, I returned to Green Mountain and also to the site of the First National Model Rocket Championships held in 1959 at the nearby Hogback Rocket Range.

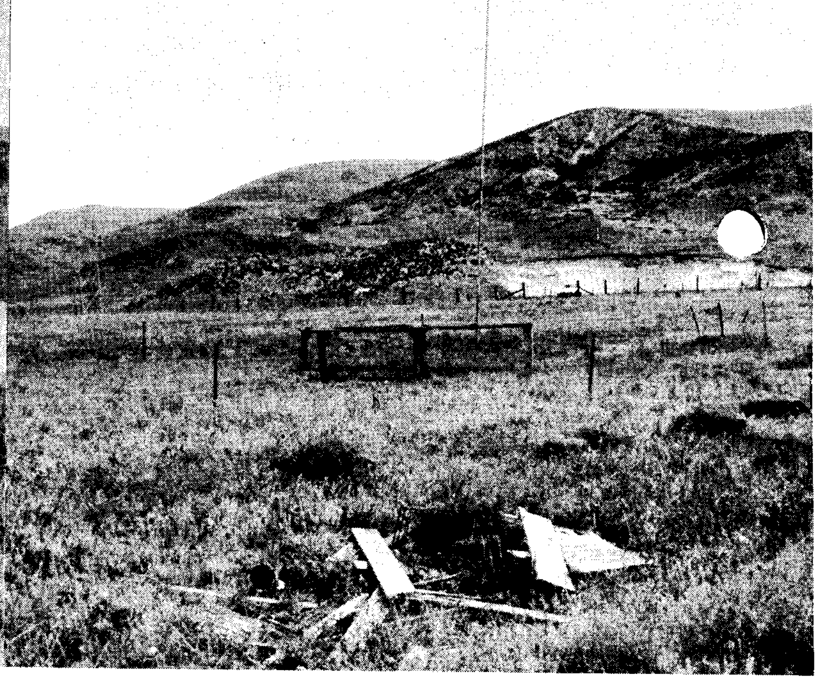
A decade of progress in model rocketry has changed the hobby almost beyond recognition and certainly beyond our wildest dreams in those days. But, save for the encroaching works of man, little change is evident at Green Mountain or at Hogback.

In the Fall of 1957, I had just moved to Denver, Colorado from White Sands in New Mexico where I had had no trouble at all finding a place to fly model rockets. But the Denver metropolitan area was a different matter. An attorney friend of mine, Robert Appel, who had helped me set up the pioneer model rocket company, Model Missiles, Inc., suggested that we go out and use the 560-acre area west of the Federal Center that belonged to a client of his.

The spot, located on the northeastern slopes of Green Mountain, was ideal. During World War II, it had been used for ammunition storage. However, by 1957 all the munitions storage bunkers had been torn down, leaving only the heavy reinforced concrete foundations of over 24 buildings. These foundations were laid out in a rectangular grid and spaced 500 feet apart. A network of gravelled roads connected all magazines. There was one tree (and it was of the common rocket-eating kind) in sight. From the center of the area, it was almost impossible to see anything but hills surrounding the place.

At the time, there were only two model rocketeers, myself and Orville H. Carlisle of

July 1959, NARAM-1 was held at the Hogback Range. A two stage clustered altitude model lifts off. This view is looking roughly north-northeast. Note the old MMI towers. Left to right: Norm Mains, Bruce Unruh, Del Hitch, (kneeling) Rick Tydings.



August 1969, the Hogback Range today, in a view taken from the same spot as the 1959 photo. The flagpole was added in 1960. The original firing tables and racks are still in place. A gravel operation and power lines have changed the scene.

Norfolk, Nebraska, who had introduced me to his brainchild. I was soon joined in Denver by an old college chum, Del Hitch (who is NAR No.3).

On November 9, 1957, Del and I loaded up our cars with model rockets – prototypes of the yet-to-be-produced MMI "Aerobee-Hi" semi-scaler – and some of Carlisle's hand-loaded model rocket motors. At 2 PM that afternoon, we launched the first of many model rockets from "Green Mountain Proving Ground."

Thereafter, we were out there every Saturday morning to stay all day, flying model rockets, testing designs, checking motors, and developing all of the things that you take for granted today in model rocketry.

At that time, the Soviet Sputniks were the only spacecraft in orbit, and I gave many talks about space flight to local organizations. After one such talk in Littleton, Colorado, I was approached by a couple of young men (one with his arm in bandages) wanting to know more about the little rockets that I was flying. I invited them to Green Mountain to see them.

They were Art Ballah, NAR No.26, and Grant Gray, NAR No.43. Art is now an executive in a trucking firm while Grant is an engineer with the National Committee for Atmospheric Research (NCAR) in Boulder, Colo.

Art and Grant wanted to take part... and shortly there were other young men in the Denver area who were interested in rockets and who dropped in at Model Missiles, Inc. Before long, MMI had its historic "Flight Test Crew" made up of young men who certainly put model rocketry through its most grueling test period. These guys tried everything and anything, since at that time we were operating under the philosophy of, "When in total ignorance, try anything and you will be less igorant." Fortunately, because of my safety training at White Sands and Del Hitch's experience in handling explosives as an exploration geologist, there were no accidents – except Del nearly getting his fingers taken off flying a model helicopter at Green Mountain one day! The MMI Flight Test Crew worked out all range procedures, most static stability criteria, optical tracking and data reduction, firing systems, range communications systems, and a host of other everyday model rocketry techniques. You may not have heard their names before, but they are the pioneers of model rocketry – Art Ballah, Grant Gray, John Wong, Chuck Olson, Norm Mains, Paul Hubble, Ron Gotsch, Dick Krushnic, Bob Smith, Lynn Ericson, Dan Oberhausen, Lee Erb, and Rick Tydings. When the NAR was first formed on December 7, 1957 as the "Model Missile Association," these young men were the first members.

The weather in Colorado is such that it is possible to fly model rockets nearly all year long. We even went out to Green Mountain when there was snow on the ground, mainly because we were trying to discover what could possibly happen to model rockets under all possible combinations of weather. Snow didn't bother us. Winds didn't bother us. The only thing that shook us up a little bit were thunderstorms. . .particularly one day when lightning was striking nearby and the tops of all the launching rods were crackling with static corona discharge!

The magazine foundations were about 4 feet above the ground and were about 15 x 30 feet in size. There were concrete steps at either end. They made perfect launching pads as well as places to set up tracking stations. We had one special foundation that was our main pad because it was centrally located. We'd set up 6 to 12 launchers on the concrete and use the first of the many multiple-launcher electrical firing panels that have been built in the years since. When all launchers were loaded, everybody would clear off the foundation and stand around its edges on the ground. If anything ever went wrong or there was an ape model, all you had to do was duck your head down below the edge!

We flew the first model rocket competition there on May 16, 1959 between the NAR's Mile-High Section from Denver and Colorado Springs' Peak City Section.

That was about the end of Green Mountain Proving Ground, however. Some local amateur rocketeers discovered that we were using the place, and they started to use it, too. . .on the sly and in the middle of the night. One day, a large section of barbed-wire fence was blown up. Pieces of metal were scattered all over. Next door to Green Mountain, about a mile away, was a huge turkey farm devoted to raising Thanksgiving dinners by mass production. The owner, who also owned the Green Mountain land, came over and threw us off . . . which certainly was not the first time that model rocketeers suffered because of the sins of the steel pipe gang.

We found Hogback a couple of weeks later, thanks to Officer Smith of the Denver Police Department . . . and this time we got written permission to use the land. . .only 15 acres this time, but surrounded by thousands of additional acres with nothing much on them. In June 1959, we labored mightily to construct the new Hogback Rocket Range. Lacking the old magazine foundations, we had to build from scratch. Art Ballah's dad donated the lumber, and we constructed a launch rack and firing table, permanently imbedded in the ground. We surrounded it with a barbed wire fence. Vern Estes supervised the construction of this. A local junkyard donated an ancient wooden house trailer to the club and put it on the range for us to store our range equipment in. We buried nearly 2000 feet of surplus army field telephone wire to provide communications to the tracking stations. We hung a big sign and a big lock on the gate in the fence that led to the range from nearly West Alameda Avenue.

Then we held NARAM-1 there.

On August 10, 1969, just before the opening of NARAM-11, I went back to see Green Mountain and Hogback where it all started.

At Green Mountain, the ammunition magazine foundations are still there, and I had no trouble locating the old launch pad. But the trees and weeds had grown up considerably. New roads had been cut through the area. Somebody had obviously tried to sub-divide the 560 acres for a housing development, but had failed for some reason. Bulldozers had smashed the corner of our launch pad.

There was nothing to indicate that model rocketry had gotten its fledgling start there. No exhaust deposits on the concrete. No empty motor casings on the ground. No pieces of busted models lying around. Nearby, the local AMA group was flying its radio-controlled model airplanes, and some motorcycle riders were tearing up and down the hills.

But Hogback Rocket Range was still there, now being used by the Metro Denver Section of the NAR with their sign on the gate just where the old Mile-High sign used to be. Mile-High folded up in about 1965, and Metro Denver has been going for the past year or so. Not having a key to the big lock on the gate, I crawled under and made a short visit to the old haunt.

The wooden launch racks and firing table built by Vern and the Flight Test Crew are still there. . .sagging a bit, but not yet about to fall down.

The old house trailer is gone, but has been since about 1960 when a bad storm sent 100 mph winds roaring over the hogbacks to flatten the trailer over about 10 acres. The range shack built by Del Hitch, Vern, and Frank Oberhausen is still there. In fact, it hasn't really changed much since we held NARAM-3 there in 1961.

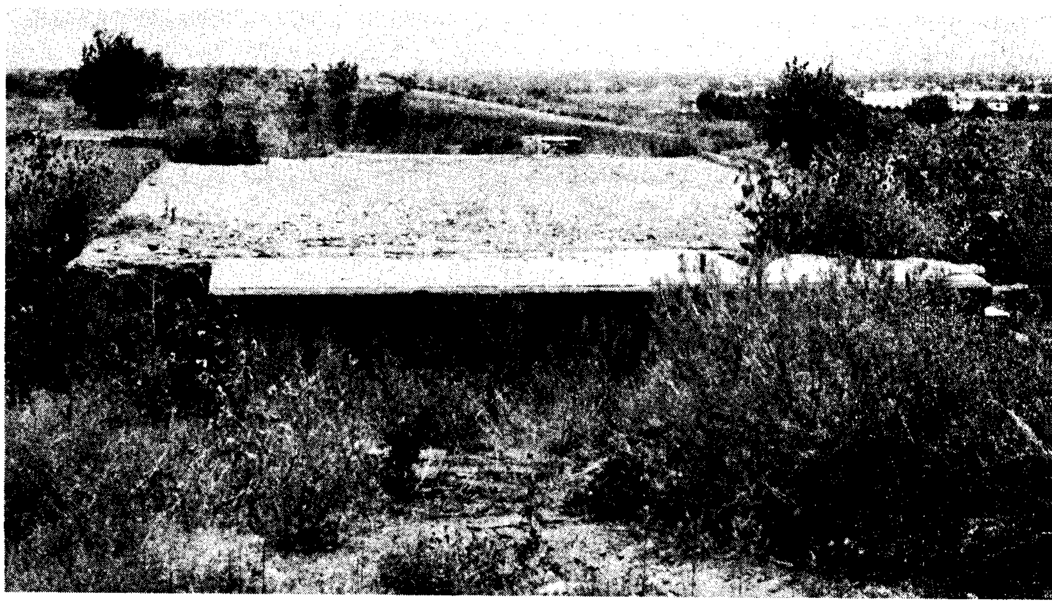
The flag hoist on the permanent flag pole – a donation from some forgotten friend of the NAR – clanked against the metal pole in the breeze. . .a lonely sound.

The electric power company had strung a high voltage transmission line across the eastern side of the range.

Photos by Stine

(Above) On November 9, 1957, Del Hitch, NAR 3, sets up launchers and prototype "Aerobee-Hi" model rockets on the concrete launch pad at Green Mountain.

(Below) Pad 1 at Green Mountain was still there on August 10, 1969, but weeds had grown up around the old launch site. This view is looking east. Launchers were set up in an east-west line in the center of the pad. The firing panel was at the right, and the missile prep area was on the "porch" in the foreground.



Somebody had removed the cable troughs that led the wires from the firing panels out to the launch rack to keep them off the ground.

But it was still there. . .the oldest working model rocket range in the world. . . legendary Hogback Rocket Range, where model rockets have soared into the sky longer than anywhere else.

In my mind, I was not alone there at Hogback. I could see the NAR pioneers and hear them. . ."Going next from rod number 3, Dick Krushnic's 'Cool Yule' with an MMI Type A4 motor. . ." "That's a Type B6 in there, Del!" "Okay, Grant, are you ready on Tracking East? Wong, get on the ball out there on Tracking West. . .Chuck, clear those kids back from the barrier. . .Safety is go. Panel is armed. . .X-minus 5. . .4. . .3. . .2. . .1. . ."

But I was only dreaming of the past. Del Hitch's countdown on the PA system has now echoed all over the world in many languages.

I took a few photos, recalled that someone had once said that "you can never come home again," and crawled back under the gate to get in the car to go down to fly in NARAM-11.

THE MODEL ROCKETEER

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

THE WASHINGTON SCENE

The NAR has received some welcome news from the Food and Drug Administration. After about six months of discussions, the FDA has signed an order that exempts model rocket engines from classification as a *banned hazardous substance* (bet most of you didn't know that).

The exemption was realized following action by Estes Industries and the NAR. It was done without fanfare and with a willingness to compromise. Fortunately, the petitions for exemption, prepared by Estes Industries and the NAR, were accepted without any substantial change

. . . .

NAR has been notified that model rocket legislation is on the books or near implementation in the states of Massachusetts and Pennsylvania. The Pennsylvania code was passed largely through the the efforts of Mr. Tim Skinner and others who had worked on the code for a number of months.

In the September issue it was mentioned that a number of states have adopted permissive model rocketry legislation. We have been reminded that the state of Washington has a model rocket code, somewhat on the restrictive side; only designated individuals may purchase and possess model rocket engines. Few details are available about a model rocket code in Oregon.

. . . .

A recent launch by NAR members in the Chicago area prompted an investigation by regional FAA officials. At the request of the FAA regional office the rocketeers limited their launching until a number of questions were cleared up. Because of the excellent cooperation given by the NAR section, the FAA people are now helping rather than hindering model rocketry in the area.

. . . .

The skyrocketing (pardon the pun) interest in model rocketry may prompt a reevaluation of federal regulations on the use of model rockets. The reason for a possible review is the indiscriminate use of model rocket engines by a very small number of individuals who are ignorant of current rules and regulations or who don't care to follow them. These hard-fought-for codes are not to be treated lightly.

Know and understand the rules and regulations that may exist in your state. Be particularly aware of the restrictions on the amount of propellant and weight of model rockets.

. . . .

In 1967 when the current "pink book" was issued all measurements were changed from the English to the Metric system. Consequently the NAR increased the maximum allowable rocket weight from one pound to 500 grams and the maximum allowable propellant from four ounces to 125 grams; the new values were chosen for aesthetic reasons. Unfortunately the Federal Aviation Agency (FAA) rules have not made this change and remain at their former values coincident with those of the old "pink book". Rockets which exceed these limitations *may* be flown providing a waiver is issued by the FAA for *each flight*. An application for waiver FAA form 400 must be submitted to the agency at least 30 days before the proposed flight. This waiver does not relieve you from compliance with any state or municipal laws. It would be wiser to launch within the FAA limitations but if you insist upon exceeding them without exceeding the NAR limitations you must obtain the waiver in advance.

TRI-SEC I

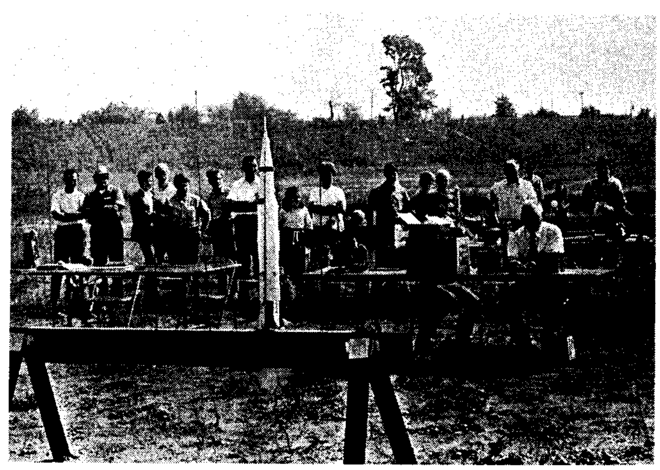
by Scott Brown NAR # 11759

September 27, 1969, will be a day long-remembered by rocketeers in the DELMAR-New Jersey area as the day we staged our first sanctioned model rocket contest.

What a contest it was! Members of our section (Gemini) rose early to set up the equipment at our Sand Pits Launch Facility. Things were going smoothly when a car pulled into the range. We sensed that it could be none other than Tag Powell, president of Space Age Industries, but what we did not know was that Mr. Powell had brought a friend – George Flynn, Editor and Publisher of **Model Rocketry** magazine. Mr. Flynn passed out advance copies of the October issue of **Model Rocketry**, but his presence alone added much to the overall feeling of the contest.

As Mr. Powell set up his display, this reporter wandered over to take a look at some of the new products from SAI. Lo and behold, a scale Nike-Hercules, which, I might add, had beautiful flight characteristics. I also examined their new scale Falcon, which had a fantastic paint job, and made it a point to purchase one of their kits (the Judge); those die-cut fins almost blew my mind! The SAI line is a massive one for such a new company, and well worth a modeler's time to investigate.

Almost before I knew it, Star Spangled Banner and Toftoy Sections pulled up. Greetings to the group of over 150 spectators were announced, after which the contestants were directed to begin preparing their models.



The Mayor of New Castle, Delaware, launches the first rocket to open Tri-Sec I.

Almost immediately following the announcements, a rather elegant automobile was seen pulling into the Sand Pits. It was the Mayor of New Castle, the Honorable Edward F. McDaniel. After a short opening ceremony, in which Gemini Section presented the Mayor with an honorary membership, Mr. McDaniel fired my Saturn V, which pranged itself rather throughly. I felt so embarrassed that I thought seriously of crawling into the vast crater the Saturn V had made and pulling it in on top of me, to remain there forevermore. Fortunately, Dave Menard came to the rescue with his Astron Avenger, which performed perfectly – much to my relief!

The competition began as the contestants slid some of the most ornate models I have ever laid eyeballs on down the launch racks. Competition was hot, as the Toftoy Section emerged triumphant, with Gemini close on their heels and SSB not far behind.

At 5 pm the range closed and our section, weary from the excitement of the day, sluggishly began to pack up.

One final, very ambitious comment – this was the first contest that our section has ever held; therefore, I feel safe in saying that TRI-SEC II will, most assuredly, be twice as much fun!

SECTION STANDINGS

1st	Toftoy	161
2nd	Gemini	126
3rd	Star Spangled Banner	22

OVERALL WINNERS

1st	Scott Brown	70	Gemini
2nd [tie]	Roy Rosenfeld	40	Toftoy
2nd	Guy Norlin	40	Toftoy
3rd	John Swift	35	Toftoy

EVENTS

Class I Parachute Duration

1st	Roy Rosenfeld	136 sec.	Toftoy
2nd	Dave Menard	132 sec.	Gemini
3rd	Scott Brown	101 sec.	Gemini

Scale

1st	Scott Brown	Honest John	Gemini
2nd	Guy Norlin	Saturn IB	Toftoy
3rd	(All other entries were disqualified.)		

Pee Wee Payload

1st	Roy Rosenfeld	187 meters	Toftoy
2nd	Joe Quigley	113 meters	Gemini
3rd	John Swift	73 meters	Toftoy

Swift Boost/Glide

1st	John Swift	63 sec.	Toftoy
2nd	Dave Menard	28 sec.	Gemini
3rd	Scott Brown	25 sec.	Gemini

Egg Loft

1st	Ira Grollman	240 meters	Toftoy
2nd	John Swift	179 meters	Toftoy
3rd	(All others recorded "track lost".)		

From the Standards and Testing Committee

Based on the Committee's testing and data supplied by the manufacturers, the following engines have been Safety and Contest Certified:

Estes	D13-0
Estes	D13-3
Estes	D13-5
Estes	D13-7
MPC	A3-2
MPC	B3-3
MPC	C6-0
MPC	C6-4

IF I WROTE THE PINK BOOK

(Any member wishing to espress his opinion on local contest decisions or pink book rules is invited to submit his comments to the editor for publication in this column. The current edition of the pink book is being revised by Contest Board Chairman Richard Sipes, who will gladly consider any comments mailed to his home at 5427 85th Avenue, Apartment 101, Lanham, Maryland 20801. The deadline for consideration for the new pink book is January 15. The following dissertation concerning the plastic model event was received from Carl Kratzer, former Contest Chairman of the NARHAMS.)

Those of you who were with us before NARAM-9 and the 1967 Pink Book must surely recall the contention over the **Plastic Scale** event. This event differed from the current **Plastic Model** event by two ideas: the models were judged by the same scoring system used in the Scale event, and entries were restricted to plastic scale model kits of existing or historical guided missiles, rockets, or space vehicles. Perusal of the newer rules reveals the inclusion of non-scale rockets and even non-rocket models in the category.

Examination of plastic model availability during the past few years will provide some insight as to the reason for these rules changes. Plastic scale was seldom flown except at national meets due to one primary factor: plastic scale model rocket kits were nearly extinct. After the initial thrill of the space age wore off in the early sixties, plastic model manufacturers discontinued production of these poorly-selling kits. Consequently, only those modelers who were fortunate enough to have been around when the rocket kits were plentiful or who stumbled across some dust-covered kit hidden away in some obscure corner of a hobby shop were able to compete in this event. From time to time large caches of one particular model were discovered, after which every contestant had a replica of his friends' model. I still distinctly remember the barrages of Mercury-Redstones at NARAM-7, Mercury-Atlases at NARAM-8, and Jupiter-C's at NARAM-9. Needless to say, these models seldom won a trophy. It was the sentiment of many competitors to have the event deleted from the pink book entirely; however, the Contest Board provided a compromise by creating the Plastic Model event in its place.

To be truthful, I have not yet attended a contest where Plastic Model was held (though I did attend a regional meet at which it was cancelled due to lack of entries). I shudder at the thought of rocket-powered Fireball-XL5's and Enterprizes, not to mention the flying Superman and U.S.S. *New Jersey* models. Not only will these designs detract from the realism of the event, but they will also present safety problems due to their nonsymmetrical airframes.

Recently, the number of available scale model rocket kits has increased to a tolerable level. I claim possession of not less than ten different kits, all of which are readily adaptable for flight. Plastic model manufacturers have recently introduced new rocket kits to their lines as a result of the renewed interest in the space age prompted by the Apollo landing.

For this reason I would like to see the former Plastic Scale event reinstated with certain modifications. The old rules used the same point judging system used in Scale competition, causing an unjustified significance to quantity of scale data and adherence of the model to scale. It is a known fact that many plastic model kits are not true to scale as they are often scaled from photographs or inaccurate drawings. In most cases, the modeller has no way of improving the accuracy of the model; thus, he should not be penalized for such deviation from true scale. Because of this conclusion, it is evident that scale data is not so critically important. The data is necessary to verify the color scheme and special attachments characteristic of some particular flight, but extensive material is not needed. The new rules should therefore concentrate the points in the categories of construction, adaptation to flight, and flight characteristics.

I wish to conclude my remarks by saying that I would prefer to see the event eliminated completely than to permit our launching fields to become arenas for flying trash-heaps and the like.

NAR Cites Bendix for Distinguished Service

NARAM-11 Contest Director William Roe presents the NAR Distinguished Service Award to President Lester Graffis of the Bendix Field Engineering Company. Their interest in model rocket activities over the past years has made possible the continued growth of the NAR.

NEW HQ

As a result of the directive issued by the Board of Trustees at NARAM-11, the NAR has relocated its official headquarters to a new office in McLean, Virginia. Previously, the NAR had shared office space and secretarial help with the Academy of Model Aeronautics. In line with the trend to greater diversity between the two hobbies, accelerated by the changeover to *Model Rocketry*, the NAR has established its own office facilities. The new headquarters activities are maintained by former AMA head secretary, Mrs. Lou Ward. This change, not intended to alienate the two organizations, will expidite handling of NAR affairs. All future correspondance should be addressed to:

National Association of Rocketry
P. O. Box 178
McLean, Virginia 22101

ANNOUNCEMENTS

The following events are *tentatively* scheduled for the dates indicated below. Mailing addresses for sections may be found in the current section roster. Further details of these events will be printed as they become available.

Pittsburgh Convention: March 20,21, and 22 sponsored by Steel City Section.

MIT Convention: April 3,4, and 5 sponsored by MIT Model Rocket Society.

ECRM-4 Regional Meet: April 11 and 12 at Camp A. P. Hill, Bowling Green, Virginia. Sponsored by NARHAMS.

EDITOR'S NOOK

Coincident with the new year and the creation of a new headquarters, the *Model Rocketeer* is now being edited by another person, namely Carl Kratzer. Lindsay Audin, former editor of the column, has informed the Association that he can no longer continue to devote the time and effort necessary to maintain the newsletter due to other commitments. He will, however, continue to contribute material for the column from time to time.

I would certainly be negligent if I did not mention some of the more notable services Lindsay has performed for the NAR in the past. Lindsay holds the rare distinction of being one of the few remaining active members in possession of a three-figure NAR number (953). Lindsay has actively participated in competition and NAR affairs for an number of years and has served as president of the Pascack Valley Section. He has done intensive R&D work on the topic of Krushnic effect and thrust augmentation and has received several awards for his efforts. In 1966 Lindsay organized and became chairman of SCINAR, forerunner to the LAC. Since then he served as first chairman of LAC, member of NAR Publications Committee, editor of the short-lived NAR *Technical Review*, co-author of the NAR R&D Methods Guide, and finally as editor of *Model Rocketeer*. Lindsay currently holds a full-time job in Troy, New York, while completing requirements for his Bachelor's Degree at Rensselaer Polytechnic Institute. On behalf of the membership I congratulate Lindsay for a fine performance.

This issue was to be prepared jointly by Lindsay and myself; however, due to unforeseen difficulties encountered during my odyssey from Ithaca to Troy I ended up doing it myself – while studying for two major exams. A replacement for my former position as Technical Editor is being sought and will probably be announced next month. Your criticism and suggestions concerning the newsletter are quite welcome as are any materials you wish to contribute. Reiterating Lindsay's comments in the November issue I must again point out the lack of interest expressed by the general membership. As Technical Editor I mailed out a number of requests to previous national R&D winners for copies of their reports. Even with the inclusion of stamped self-addressed envelopes in some letters the return was meager. Without greater involvement and cooperation of the membership the *Model Rocketeer* will become dry and monotonous; besides, I do not savor the thought of writing the entire thing myself. Enough said? Please send your contributions via NAR Headquarters or direct to:

Model Rocketeer Editor
Carl Kratzer
320 Thurston Avenue C-31
Ithaca, New York 14850

NEW BOOK

Of particular interest to scale model buffs and historians is the recently released book entitled *German Secret Weapons* by Brian Ford. Part of a new series by Ballentine Books on the history of World War II, this paperback is abundant with choice photographs and drawings of the *A-3, A-5, V-1, V-2, Natter, Wasserfall,* and other lesser-known rockets. Most of the illustrations and historical data were taken directly from German archives. The book is interesting reading and contains information about other aspects of German weaponry. The 160 page book is priced at $1.00.

ATTENTION ALL SECTIONS

SECTION NEWS is real. Now, instead of three or four places to write with your news, there is only ONE. The official outlet for NAR News is now in the *MODEL ROCKETEER*, so send your material here. Has something happened in your section or group? If so, be sure your official news contact with NAR SECTION NEWS knows about it. If your contact knows, then I will find out.

Be sure and send all news to: NAR SECTION NEWS, c/o Charles M. Gordon, Editor, 192 Charolette Drive, Laurel, Maryland 20810. REMEMBER!!!! IF I DON'T HAVE IT - I CAN'T PRINT IT!

NAR SECTION ROSTER

(as of November 1969)

Aerospace Unlimited
Daniel Winter
8260 E. Eden Rd.
Eden, NY 14057

Anchorage Association
Jim Eshenower
2712 Kobuk Circle
Anchorage, Alaska 99504

Annapolis Association
Mrs. Ruth Anderson
Route 3, Box 98B
Annapolis, MD 21403

Apollo NASA
Gary King
13903 Barry Knoll Lane
Houston, TX 77024

Arevalos Rocket Assn.
Reinie Stolz
9463 El Valle Ave.
Fountain Valley, Calif. 92708

Beardstown RRA
Joe Hamon
Box 185, Arenzville Rd.
Beardstown, Ill. 62618

Belair Association
Robert Seufert
12400 Starlight Lane
Bowie, MD 20715

Berkeley Heights
40 River Bend Road
Berkeley Heights, NJ 07922

Berwick Academy
Charles Andres
Academy Street
South Berwick, ME 03908

Bethlehem Section
Frank Osborn
2607 Winston Rd.
Bethlehem, PA 18017

Birch Lane
Thomas Hills
2429 Temple Dr.
Davis, Calif. 95616

Black Hawk
Paul Schubert
410 18-½ Ave.
Rock Island, Ill. 61201

Braeburn Community
Ronald Finke
8403 Braesview
Houston, TX 77071

Colonial Heights
David Lippiatt
1214 Covington Rd.
Colonial Heights, VA 23834

CSAR
Dr. Gerald Gregorek
4451 Danforth Rd.
Columbus, Ohio 43299

Cosmotarians
William D. Boggs
730 E. Dartmouth St.
Gladstone, Ore. 97027

Fairchester
Jeff Guill
32 Gerdes Rd.
New Canaan, Conn. 06840

Gemini
Scott Brown
204 Delaware St.
New Castle, Del. 19720

Glen Ellyn
Scott Gordon
476 Main Street
Glen Ellyn, Ill. 60137

Goddard Jr. H.S. Club
Jim Johnson
PO Box 622
Seabrook, MD 20801

Greater Boston
Michael Listorti
71 Waverly Street
Everett, MA 02149

Greenwich Space Orbiters
Gary Goelkel
14 Innis Lane
Old Greenwich, Conn. 06870

Hobby House Model Rocketeers
Raymond Werre
313 Old Line Ave.
Laurel, MD 20810

ITROS
Mike Cummings
531 Lake St.
Crystal Lake, Ill. 60014

McDivitt Society
John F. Oswalt
35 West Minges Rd.
Battle Creek, Mich. 49017

LaSalle Section
Patrick Stakum
PO Box 1335
Cumberland, MD 21501

Loma Valley Rocket Pioneers
Don Leech
PO Box 26
Browns Valley, Calif. 95918

Long Island Rocket Society
Andrew Schecter
75-31 193rd St.
Flushing, NY 11366

Mamaroneck Larchmont
Bernie Ferrer
350 Prospect Ave.
Mamaroneck, NY 10543

Mansfield Aeronautics & Space
Doug Ball
786 Forest Drive
Mansfield, Ohio 44905

Mentor Rocket Club
H. David Rice
PO Box 265
Mentor, Ohio 44060

MASER
3643 Mill Creek Rd.
Atlanta, Georgia 30319

Metro Denver
Juanita Severe
8361 Chase Way
Arvada, Colo. 80002

MARS
Peggy Sipes
5427 85th Ave.
Apt. 101
Lanham, MD 20801

Toftoy Memorial Section
Karin Norlin
1623 Old Joppa Rd.
Joppa, MD 21085

Mini Wheels Rocketeers
Tag Powell
714 Raritan Ave.
Highland Park, NJ 08904

Missile Minders
YMCA
338 King Street
Pottstown, PA 19464

MIT Model Rocket Society
Gordon Mandell
Box 110, MIT Branch PO
Cambridge, MA 02139

Natural Science Museum
Walter E. Mueller
Natural Science Museum
10600 East Blvd.
Cleveland, Ohio 44106

Midwestern Rocket Research
Jeff Mason
7926 Kessler
Overland Park, Kansas 66204

Monroe Astronautical
Greg Howick
2424 Turk Hill Road
Victor, NY 14564

NAR Orbiters
Dana J. Schwartz
86 Tottenham Rd.
Rochester, NY 14609

NARCAS
Carl S. Guernsey
2915 Maple Road
Camp Hill, PA 17011

NARHAMS
James Barrowman
6809 97th Place
Lanham, MD 20801

New Castle Association
Tom McKim
1023 East Washington St.
New Castle, PA 16101

North Jersey Association
288 Crocker Pl.
Haworth, NJ 07641

North Shore
Jan Wolitzky
239 Normandy Rd.
Massapequa, NY 11758

Pascack Valley
Bob Mullane
34 6th Street
Harrison, NJ 07029

Queen City
Jeff Flygare
323 Parkwood Ave.
Kenmore, NY 14217

Ramrocs MR Research
Chris Gilroy
406 West Stanford
Jefferson, Iowa 50129

Randallstown
Walter Moon
3702 Woodspring Ct.
Randallstown, MD 21133

Richland Rocketeers
Ed Roberts
564 Cedar St.
Richland Center, Wis. 53581

Rocket Assn. of Norco
Greg Deems
PO Box 460
Norco, Calif. 91760

Rock Creek
Marjorie Townsend
3529 Tilden St., NW
Washington, DC 20008

Rockville Rocketeers
John Tomasello
5104 Brentford Dr.
Rockville, MD 20853

Saturn Section
Rudy Griswold
975 Gloria
El Paso, TX 79907

SMARS
Mark Davis III
208 South Walnut St.
Milford, Del. 19963

Southland
Michael Poss
7855 Naylor Ave.
Los Angeles, Calif. 90045

Star Blazer Section
Stephen Limkemann
1135 South Starr
Burlington, Iowa 52601

Star Spangled Banner
Howard Galloway
428 Ben Oaks Drive West
Severna Park, MD 21146

Steel City
Arnold Pitler
1051 N. Negley Ave.
Pittsburgh, PA 15206

St. Ignatius High
Rev. Richard Twohig, SJ
1191 West 30th St.
Cleveland, Ohio 44113

The Orbits
Tom Danvals
c/o Mr. Leslie Derkovitz
1562 Katie Ave.
Las Vegas, Nev. 89109

Three Rivers
Thomas Wallette
353 Hawthorne Rd.
Pittsburgh, PA 15214

UFO
Jeffrey Pauley
13604 Crispin Way
Rockville, MD 20853

Valley Rocket Research
Jim Haverkamp
2305 Hillside
West Des Moines, Iowa 50265

West Covina
Dane M. Boles
1444 West Garvey Ave.
West Covina, Calif. 91790

Wheaton Rocket Assn.
Jerome Trager
c/o Hobbies Unlimited
Wheaton Plaza
Wheaton, MD 20902

Wicomico Aerospace
Mitchell Christian
Rt. 4, Windham Court
Salisbury, MD 21801

Xaverian H.S. Society
Ihor Jadlickyj
7100 Shore Rd.
Brooklyn, NY 11209

YMCA Space Pioneers
G. Harry Stine
564 South Ave.
New Canaan, Conn. 06840

Zenith
Ellsworth Beetch
211 Clover Lane
Mankato, Minn. 56001

The NAR Bylaws Explained

One of the questions any NAR member is asked by people he talks to about model rocketry is about how the NAR is organized. Too often, the average model rocketeer cannot answer.

The NAR organization is no secret. The basic document of NAR organization, the bylaws, is available at a nominal cost from NAR Technical Services. However, the bylaws are only the skeleton of the organization. This skeleton is fleshed out by the policies and activities of the people who run the NAR.

Before taking a quick tour through the NAR bylaws, a word about a very important bylaw article. Article XIII deals with the sharing of earnings. In essence, this article says that the NAR is a non-profit organization. More importantly, the NAR's trustees, officers, and members cannot receive any of the NAR's earnings. Although anyone who works for the NAR may be paid, the trustees, officers, and committee chairmen are all unpaid volunteers.

The entire NAR, except for the office work, is run by volunteers – from the trustees, officers, and committees to the regional representatives, section advisors, and section officers. This is important to realize since volunteers simply cannot spend the same amount of time on NAR efforts as they could if the NAR were their regular job. As a result, the work either will not be done or must be spread out over a number of people. On a national level, having a number of people spread across the country causes a large number of problems in communications and coordination of effort. Also, volunteers genarally work when they have time and cannot always get things done as quickly as a person paid to do the job.

With the understanding that they are implemented by people who spend their free time on the NAR, it is apparant that the bylaws spell out a great deal of dedicated effort.

The bylaws begin by stating the name of the National Association of Rocketry.

The stated purpose of the NAR is quite lengthy and detailed. Basically, though, the NAR is organized to further safe rocketry, astronautics, and related sciences.

Membership in the NAR is available only to United States citizens. There are six different types of memberships: Junior, Leader, Senior, Honorary, Manufacturing, and Corporate Supporting. The first three types are familiar to us all. Honorary membership is granted to outstanding rocketeers by the Board of Trustees. Manufacturer membership is for companies who deal in model rocket equipment and supplies. Corporate supporting membership is for companies or organizations involved in rocketry, astronautics, or similar fields who wish to support the NAR and its goals. Leader, senior, and honorary members can vote at NAR business meetings. Each manufacturer or corporate member has a single vote.

While going to great lengths to protect individual rights, the bylaws provide for a procedure by which a member can be suspended from the NAR. Violation of the Safety Code is cause for immediate suspension.

The bylaws require no specific duties but give the Board of Trustees the power to set NAR dues.

The NAR must have a business meeting at least every three years. Although not required by the bylaws, NAR business meetings are usually held at a national meet. A business meeting of the NAR will probably be held at NARAM-12 next year. Twenty-five voting members are enough for a quorum at a business meeting.

The Board of Trustees is the governing body of the NAR. It consists of 13 senior or honorary NAR members. The board is elected by the NAR voting members every three years. The current board was elected at NARAM-9; the next one will be elected at NARAM-12. Board of Trustees meetings must be held at least once a year. Three trustees at a meeting is a quorum.

The NAR officers are a President, Vice President, Secretary, and Treasurer. Officers are elected by the Board of Trustees. Only trustees may be officers. New officers are elected at the board meeting immediately after the NAR business meeting at which the new board was elected.

The President is the chairman of NAR business meetings and Board of Trustees meetings. He is the official representative of the NAR and appoints all committee chairmen. The Vice-President is the back-up in case the President is unable to function. He also carries out any special assignments authorized by the President. The Secretary is the communications center of the NAR. He records all NAR business meetings and Board of Trustees meetings. He maintains the records and archives of the NAR. He is supposed to handle the NAR's correspondence. Usually, though, the NAR office and all the officers and committees do this. He keeps a list of all NAR members and sees that all voting members are notified of upcoming business meetings and Board of Trustees meetings. He takes care of the details of all NAR balloting. The Treasurer handles all the NAR's money and keeps the financial records.

Currently there is an additional officer not specifically mentioned in the bylaws. The NAR Office Manager is in charge of NAR Headquarters operations. The bylaws allow the trustees to appoint officers other than those spelled out in the bylaws.

During the year, when the trustees are unable to meet, an Executive Committee can make trustee decisions. The Executive Committee is made up of three trustees who are appointed by the the Board of Trustees. Decisions of the Executive Committee are not binding until they are ratified by the Board of Trustees at its next meeting.

Nominations for at least six Board of Trustees members are prepared by the Nominating Committee before each Board election. The Nominating Committee is made up of three senior NAR members who are appointed by the President. Nominations for the Board of Trustees can also be made by any voting member at the election meeting.

In addition to the above committees there are nine standing committees whose chairmen are appointed by the President and ratified by the Board.

The Membership Committee promotes membership in the NAR; makes sure that each new member has applied for the proper type of membership; and runs any membership drives.

The Standards and Testing Committee establishes NAR standards and tests model rocket equipment to see that it meets the standards. This committee is in charge of the Safety Code.

The Contest and Records Committee sanctions contests and certifies and records the results of all contests. It also verifies and certifies performance records set by NAR members.

The Liason Committee maintains contact with organizations with which the NAR works and coordinates activities with them.

The Section Activities Committee encourages the formation of new local NAR sections. It charters sections and maintains communications between the sections and the Board of Trustees.

The Education Committee has charge of all NAR educational programs and works with educators intrested in rocketry.

The Public Affairs Committee provides for publicity on national NAR activities and is responsible for the Model Rocketeer newsletter.

The Technical Services Committee stocks and sells NAR insignia, technical reports, scale plans, and other materials.

Money can be paid out of the NAR treasury only when specific officers authorized by the Board of Trustees have approved the expenditure. Currently, the authorized officers are the Treasurer and the NAR Office Manager.

The NAR bylaws can be amended either at a Board of Trustees meeting or at an NAR business meeting. In either case, a two-thirds majority is required for an amendment to pass. Also, if an amendment is passed by the Board of Trustees, it must be ratified by a two-thirds majority at the next NAR business meeting if it is to continue to be effective.

There are a lot of bylaw details that have not been covered in the above paragraphs, so if you are really interested, refer to the bylaws yourself.

By Jim Barrowman

SECTION NEWS

By Charles M. Gordon

Members of the Natural Science Museum Model Rocket Research Society of Cleveland held a night launching competition in October. The purpose of the meet was to launch a model rocket capable of being tracked and recovered at night. Entries were judged on basic design, appearance and finish, tracking system, propulsion system, recovery system, performance in flight, and altitude. Spectators at the meet remarked at the ingenious methods used by the entrants, which included flashing lights, steady lights, and a siren module. The top three winners were Brian Dolezal, Kenneth Semproch, and Darrell Witkoski.

******

The recently formed Three Rivers Section held an area meet against Steel City Section veterans near Pittsburgh. Final results are pending at this time.

******

NARHAMS is now printing its newsletter, **ZOG-43**, by a multilith process resulting in finer quality reproduction and a possibility of photographs.

******

The Xaverian High School Model Rocket Society of Brooklyn has issued a technical report to its members on basic boost/glider design.

******

The Fairchester Section of Stamford, Connecticut, recently published the first part of an eight-part scale drawing of the Astrobee 1500 launcher. Interested scale addicts may wish to contact the section for information.

******

Members of the Natural Science Museum Model Rocket Research Society have volunteered their time to instruct ten inner-city Cleveland sixth-graders in rocket fundamentals, using kits and workspace provided by the Museum.

******

Another section experimenting with night launchings is the West Covina Model Rocket Society in California. In their newsletter, **Nozzle News**, two simple designs for constant light sources are provided. Both are easily built by electronically inexperienced modellers and are inexpensive and readily adapted for flight. So remember, next time you see a flashing light in the sky, it might not be a UFO [unidentified flying object] but rather just another UFMR [unidentified flashing model rocket].

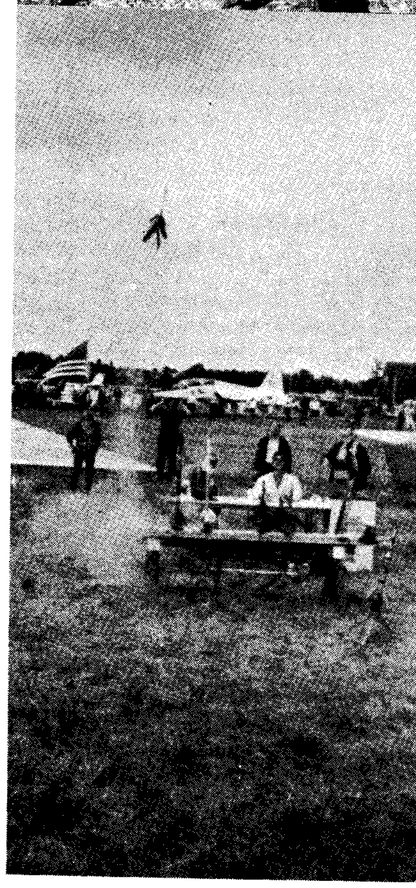
******

Guests from St. John's High School in Washington, D.C., attended and participated in the monthly range meet held by the Rock Creek Section. Much interest was shown by the guests and it is hoped that several new members will be acquired.

Congratulations to the following sections for joining the ranks of newsletter publishers: West Covina with **Nozzle News**, Bethlehem ABM with **ABM Newsletter**, Annapolis with **Voyager**, Tri-City Cosmotarians with **The Probe**, and Mamaroneck-Larchmont Rocketry Association with the **M-L R A Club News**.

******

The Cosmotarian Section of Gladstone, Oregon held a demonstration launch at the Salem/OMSI Air Fair on Labor Day, 1969. Shown below are photographs of the event.



ODDS & ENDS

On September 21, 1969, representatives of WAMARVA area sections (Washington D.C.-Maryland-Virginia) held a meeting to coordinate area activities for the coming contest year. This meeting was held to synchronize dates and places for contests and special activities. This prevents overlapping or conflict between section dates and provides greater opportunity for participation in all the various activities by NAR members in the area.

&&&&&&

MARYLAND now leads the NAR in numbers of sections. There are currently 11 sections chartered in the state.

&&&&&&

The Mini-Wheels Rocketeers Section of the NAR no longer exists. It has been replaced by the Central Model Rocket Club (of New Jersey). Expanded membership and geographical area expansion has made section reorganization necessary. Members now hail from the entire central New Jersey area. Good luck to this "new" section.

&&&&&&

The Flags Keep On Coming

Many sections throughout the NAR now have their own flags to fly at contests to show that their section is there.

At their last regular meeting in September, the Cosmotarians section of Gladstone, Oregon, chose their new flag design as a result of a contest among members of the section. The winning flag design shows the earth on a black background. In the center of the earth is a rocket with a stylized exhaust; the exhaust forming the triangle of the NAR emblem. The section's full name, Tri-City Cosmotarians, is in light blue around the outside of the earth.

We hope that all will see this flag at NARAM-12 next year.

NAR SECTION NEWS appears each month as a regular feature in the **Model Rocketeer**. *Those sections wishing to have news and/or information of their activities printed in this column should submit such material to:*

NAR Section News Editor
Charles M. Gordon
192 Charolette Drive
Laurel, Maryland 20810

HOLIDAY GREETINGS

The NAR is pleased to have you join the ranks of membership for the next twelve months and hopes you will remain active and participate to your fullest capability. Best wishes for a happy new year from:

Model Rocketeer Staff
Board of Trustees
Leader Administrative Council
Contest Board

Boost Glider Performance

Part II

by Douglas Malewicki

THE GLIDING PERFORMANCE GRAPHS EXAMPLES AND PROBLEMS

The best way to illustrate the variety of practical uses of these graphs is to work thru several example problems. After each new concept is presented along with a step-by-step detailed solution, one or more nearly identical problems are given for you to solve yourself. Answers are given at the end.

Example 1

This first example shows the basic use of figure 2 for predicting glide durations.

Assume you have a boost glider which has an aerodynamic glide factor $C_L^{3/2}/C_D$ of 5 and a wing loading W/S of 1 ounce weight per 20 square inches of wing surface area. What will be the flight duration of this glider from an altitude of 100 feet? Assume that the glider has already transitioned and is in a steady glide and that standard atmospheric conditions exist (i.e., it was launched at sea level and the temperature was 59° F).

Noting that figure 2 gives the duration per 100 feet of altitude directly for any aerodynamic glide factor and wing loading, we prodeed as follows: 1. The aerodynamic glide factor is:

$$C_L^{3/2}/C_D = 5$$

2. The wing loading is:

$$\frac{W}{S} = \frac{1 \text{ ounce}}{20 \text{ in}^2} = .05 \frac{\text{ounce}}{\text{inch}^2}$$

3. Using figure 2 we locate the proper wing loading along the bottom line and then follow it up until it intersects the glide factor = 5 line. Following this point of intersection to the left we find that the flight duration from 100 feet of altitude would be:

$$t_{100} = 25.6 \text{ seconds}$$

Note that we use the symbol t with the subscript 100 to mean the "duration in seconds for each 100 feet of altitude".

Problem 1A

Assume you have a second glider with a wing loading of 1 ounce weight per 50 square inches of wing surface area and an aerodynamic glide factor of $C_L^{3/2}/C_D = 8$. What will be the duration of this glider from an altitude of 100 feet?

Summarizing the known information we have:

1. Aerodynamic Glide Factor

$$C_L^{3/2}/C_D = 8$$

2. Wing loading

$$W/S = .02 \quad \text{ounces/inch}^2$$

which results in a

3. Flight duration per 100 feet of altitude from figure 2 of

$$t_{100} = \quad 52 \quad \text{seconds}$$

Example 2

Next we calculate durations for gliders from altitudes other than 100 feet.

If the glider of Example 1 is in a steady glide at an altitude of 450 feet above the ground, how long will it take to glide down to the ground? In example 1 we already learned that its total duration is 25.6 seconds per 100 feet of altitude. This means that it will take 25.6 seconds to lose 100 feet of altitude. Since 450 feet is 4½ times as high as 100 feet, then it will stay up 4½ times as long.

Problem 2A

If the glider of *Example 1* is 800 feet above the ground, how long will it take to glide down?

With a duration per 100 feet of altitude of 25.6 seconds we will obtain:

$$\text{Total duration} = 204.8 \text{ seconds}$$

Problem 2B

How long will the glider of *Problem 1A* take to reach the ground from an altitude of 300 feet?

Example 3

The next example shows how to account for variations in glide duration which are strictly dependent on atmospheric properties of the air.

Instead of flying the glider of Example 1 at sea level when the temperature was 59° F we now fly it from a field at an elevation of 4000 feet above sea level and at an outside air temperature of 93°. How long will this glider fly if it is already in a steady glide at an altitude of 200 feet above the surface?

We know that the duration must be modified using the air density compensation factor $\sqrt{\sigma}$. For an altitude of 4000 feet and temperature of 93° F we find from figure 4 that

$$\sqrt{\sigma} = .90$$

It is shown in the derivations that flight time varies linearly with the air density factor $\sqrt{\sigma}$. Thus, the non sea level duration is simply:

$$t_{100} \text{ at 4000 feet and } 93^\circ\text{F} = (t_{100} \text{ at sea level})(\sqrt{\sigma})$$
$$= (25.6)(.9) = 23.0 \text{ seconds}$$

To complete this example we need to find the total duration from 200 feet.

$$\text{total duration} = (\text{duration per 100 feet})\left(\frac{\text{total altitude}}{100 \text{ feet}}\right)$$

$$\boxed{\text{total duration} = 46 \text{ seconds}}$$

Problem 3A

How long will the glider of *Problem 2B* (aerodynamic glide factor = 8 and wing loading = 1 ounce/50 inch²) take to glide down from an altitude of 350 feet if launched at Denver, Colorado at an elevation of 6000 feet above sea level when the outside air temperature is 90° F?

$$t_{100} \text{ at 6000 feet and } 90^\circ \text{ F} = (t_{100} \text{ at sea level})(\sqrt{\sigma})$$

Example 4

This example goes into somewhat more detail on the actual computation of the aerodynamic glide factor and wing loading.

A glider has a wing surface area of 60 square inches and a weight of 1.2 ounces. Using a sensitive wind tunnel balance it was determined that for a stable trim condition the aerodynamic lift coefficient $C_L = .64$ and the aerodynamic drag coefficient $C_D = .08$. What will be this glider's duration from an altitude of 400 feet?

1. Compute the aerodynamic glide factor

$$\frac{C_L^{3/2}}{C_D} = \frac{C_L\sqrt{C_L}}{C_D} = 6.4$$

2. Compute the wing loading

$$\frac{W}{S} = \frac{1.2 \text{ ounces}}{60 \text{ square inches}} = .020 \frac{\text{oz}}{\text{in}^2}$$

3. Using figure 2 we find that the flight duration per 100 feet of altitude will be

$$t_{100} = 52 \text{ seconds}$$

4. Thus, from an altitude of 400 feet we will have

$$\text{total duration} = (\text{duration per 100 feet})\left(\frac{\text{total altitude}}{100 \text{ feet}}\right)$$

$$\boxed{\text{total duration} = 208 \text{ seconds}}$$

Problem 4A

Find the total duration for a glider 300 feet above the surface if it weighs 1.5 ounces, has 30 square inches of wing area, has an aerodynamic lift coefficient $C_L = 1.0$ and an aerodynamic drag coefficient of $C_D = .3$. This boost glider was launched at a field elevation of 1500 feet when the outside temperature was 86° F.

Example 5

Next, we demonstrate how to find the downward vertical component of velocity called the sink velocity and the actual forward gliding speed of the model.

Find the sink velocity and glide speed for the glider of Example 4.

1. The sink velocity in feet per second is found just to the left of the flight duration values of figure 2. Thus for

$$t_{100} = 52 \text{ seconds}$$

we see that

$$\boxed{\text{Sink Velocity} = V_S = 1.9 \text{ ft/sec}}$$

(an approximate interpolation)

Note that this could also simply be calculated by dividing 100 feet of altitude by the duration in seconds for 100 feet

$$V_S = \frac{100 \text{ ft}}{t_{100}} = \frac{100 \text{ ft}}{52 \text{ sec}}$$

$$\boxed{V_S = 1.92 \text{ ft/sec}}$$

(which is a more exact answer)

2. Glide speed

Figure 4 gives the glide speed (or forward velocity) required for the aerodynamic lift to support the weight of the glider. Thus, for a wing loading W/S of .020 ounces/inch^2 and a lift coefficient of $C_L = .64$ we obtain

$$\boxed{\text{Glide Speed} = V = 15.5 \text{ ft/sec} = 10.5 \text{ miles per hour}}$$

Problem 5A

Find the glide velocity and sink velocity for the glider of *Problem 4A*. (Note that this problem was made somewhat more complicated by not flying in a "standard sea-level atmosphere". The final sink velocity will already have accounted for the $\sqrt{\sigma}$ density correction, but the glide velocity found using figure 3 must still be divided by $\sqrt{\sigma}$ to be correct).

Example 6

This example presents a simple technique for finding the aerodynamic glide factor of any model.

Several model rocketeers are interested in experimentally determining the actual aerodynamic glide factor $C_L^{3/2}/C_D$ for their gliders, but do not have access to a wind tunnel. Using a tape measure (or theodolite) they determine that when looking out from the third story of the school building adjacent to their flying field that their eye level will be exactly 30 feet above the ground surface. Then one boy merely hand launches the glider of interest to heights greater than the observer's eye level. Those flights which transitioned to steady glide prior to descending to the 30 foot level are subsequently timed with a stop watch; the stop watch being started just as the glider descended through the 30 foot level and then stopped once the glider contacts the ground.

Flight durations of 14, 15, 15½, 14½, and 16 seconds were recorded for one glider which had a wing surface area of 40 square inches and weighed .8 ounce. The test field was at sea level and the temperature was 59° F. What was the aerodynamic glide factor $C_L^{3/2}/C_D$ for this glider?

1. First, find the average duration for a series of test flights.

$$\begin{array}{l}\text{duration time} \\ \text{for 30 feet}\end{array} = \frac{14 + 15 + 15\tfrac{1}{2} + 14\tfrac{1}{2} + 16}{5} = \frac{75}{5}$$

$$= 15 \text{ seconds}$$

2. Next, determine the duration per initial altitude of 100 feet instead of 30 feet.

$$\begin{array}{l}\text{duration per} \\ \text{100 feet}\end{array} = (\text{duration per 30 feet})\left(\frac{\text{desired altitude}}{\text{actual altitude}}\right)$$

$$= (15 \text{ sec})\left(\frac{100 \text{ ft}}{30 \text{ ft}}\right)$$

$$= (15 \text{ sec})(3.333) = 50 \text{ seconds}$$

3. Calculate the wing loading.

$$\frac{W}{S} = \frac{.8 \text{ ounce}}{40 \text{ inch}^2} = \frac{1}{50\text{th}} \text{ ounce per inch}^2 = .020 \frac{\text{oz}}{\text{in}^2}$$

4. Using figure 2 we see that in order for a wing loading of .020 to result in a flight duration per 100 foot altitude of 50 seconds that we must have:

$$\boxed{C_L^{3/2}/C_D = 6.1}$$

Problem 6A

A second boy similarly flight tests his glider which weighs 1.6 ounces and has 100 square inches of wing surface area. He obtains 30 foot flight durations of 10.4, 10.0, 9.0, 11.0, 9.6, and 10.0 seconds. What is the aerodynamic glide ratio $C_L^{3/2}/C_D$ and the sink velocity V_S?

Example 7

This example and the following problem demonstrate that the luck factor of thermals has a great influence.

The glider of *Example 6* enters a hot air thermal which is rising at 2½ feet per second just as it descends through an altitude above the ground of 40 feet. 30 seconds later the glider comes out of this thermal and continues down to the ground flying only in calm, still air. How long is the total flight duration?

1. First we need to calculate the sink velocity of the glider.

$$V_S = \frac{100 \text{ ft}}{t_{100}} = \frac{100 \text{ ft}}{50 \text{ sec}} = 2\frac{\text{ft}}{\text{sec}}$$

2. Thus, if the glider is descending through the air at a sink velocity of 2 ft/sec and the air itself is rising at 2½ ft/sec, the net difference will be the true sink velocity relative to the surface of the ground.

$$\begin{array}{l}V_S \text{ with respect} \\ \text{to the ground}\end{array} = \begin{array}{l}V_S \text{ with respect to the air} \\ + V \text{ air with respect to the ground}\end{array}$$

$$= -2.0\frac{\text{ft}}{\text{sec}} \text{ DOWN} + 2.5\frac{\text{ft}}{\text{sec}} \text{ UP}$$

$$V_S \text{ with respect to the ground} = +.5\frac{\text{ft}}{\text{sec}} \text{ UP}$$

which means the glider is rising, not descending!

3. If the glider stays in this thermal for 30 seconds, it will be at a greater altitude than before:

$$\text{increase in altitude} = (\text{upward velocity})(\text{time})$$
$$= +.5\frac{\text{ft}}{\text{sec}}(30 \text{ sec})$$
$$= 15 \text{ feet}$$

or, the glider is now at an altitude above the ground of

$$\text{new altitude} = \text{initial altitude} + \text{increase in altitude}$$
$$= 40 \text{ ft} + 15 \text{ ft}$$
$$= 55 \text{ ft}$$

4. Using the calm, still air duration per 100 ft of 50 seconds we can determine the time to reach the ground from 55 ft

$$\text{time} = (t_{100})(\frac{55 \text{ ft}}{100 \text{ ft}})$$
$$= (50 \text{ sec})(.55) = 27.5 \text{ seconds}$$

5. Thus, the total time of flight – from when the glider entered the thermal at 40 feet to when it touched down – will be

$$\text{total flight time} = \text{time spent in thermal} + \text{time to glide down in calm air}$$
$$= 30 \text{ seconds} + 27.5 \text{ seconds}$$

$$\boxed{\text{TOTAL FLIGHT TIME} = 57.5 \text{ seconds}}$$

6. It should be interesting to compare this time to the calm air time from 40 feet to see how much of an effect a thermal can have on glide performance.

$$\text{time to descend 40 feet in calm air} = (t_{100})(\frac{40 \text{ ft}}{100 \text{ ft}})$$
$$t = (50 \text{ sec})(.4) = 20 \text{ seconds}$$

This is about one third of the duration in the assumed thermal.

Problem 7A

Find the duration for the glider of *Problem 6* if it enters the same thermal of *Example 7* at the same altitude of 40 feet? Compare the duration of this glider with the thermal to the *Example 7* glider assuming it did not "catch" a thermal.

Example 8

This example shows the usefulness of figure 1 for quick evaluation of changes in the design of an existing glider.

In an attempt to improve and learn what affects the performance of his glider, a boy (who we assume does not have the information in this article) builds four variations of his original glider. His first used lighter balsa and decreased the total weight by 20% while keeping C_L, C_D, and S the same. His second has the same weight (W), wing surface area (S) and drag (C_D) as the original, but he used a cambered airfoil to produce 20% more lift (C_L) when trimmed for gliding flight. His third has the original C_L, W, and S, but he decreased aerodynamic drag (C_D) by 20% by careful sanding and finishing. His fourth glider has an increased wing surface area (S) which is 20% larger than original, but the original airfoil is used so that the non-dimensionalized Lift Coefficient (C_L) and Drag Coefficient (C_D) don't change. We also assume the total glide weight has not changed. This boy obviously has a lot of testing to do before he can conclusively say how these variations from his original design will affect flight durations.

With the information in this article we can scientifically tell him just what he can expect before he ever begins building these new models! (Note that figure 1 summarizes the basic gliding equation in a more meaningful form).

Our conclusions would be that:

a 20% decrease in Weight (W) will increase flight duration from a given altitude by 12%
a 20% increase in Lift (C_L) will increase flight duration by 31.5%
a 20% decrease in Drag (C_D) will increase flight duration by 25%, and lastly
a 20% increase in Wing Surface Area (S) will increase flight duration by 5%.

We can also conclude that the aerodynamic factors of Lift and Drag have a much more significant effect on glide duration. (Note: This problem could also have been evaluated by using the basic glide duration equation or figure 2 – but in each case would have involved more work).

Problem 8A

Same problem as above, but we want to study the effect of a 50% decrease in weight (W), a 50% decrease in drag (C_D), a 50% increase in lift (C_L), and a 50% increase in wing surface area (S).

Example 9

This example will demonstrate how the graph of figure 2 can be used to predict calm air duration times for parachute recovery rockets.

The duration equation for parachute recovery duration is:

$$\boxed{t_{100} = \frac{(\sqrt{C_D})(\sqrt{[\frac{1}{2}P]})}{(\sqrt{[W/S]})}}$$

You will note this has the same form as the glider flight duration equation except that the aerodynamic gliding factor $C_L^{3/2}/C_D$ is replaced by $\sqrt{C_D}$, the square root of the dimensionless aerodynamic drag coefficient. Thus, we can use figure 2 as before to determine durations merely by evaluating $\sqrt{C_D}$ and using it in place of $C_L^{3/2}/C_D$.

Also note that the weight (W) will be the burnout weight of the rocket rather than the liftoff weight and it, of course, must include the weight of the parachute itself.

We don't have a wing any more so instead of the reference area (S), referring to a wing, we use (S) to now refer to the parachute's total area when lying flat. Thus, for a given flat diameter (D) of a circular chute the total surface area is:

$$S = \frac{\pi(\text{Diameter})^2}{4} = .785 \ (D)^2 \text{ inches}$$

For a preliminary parachute aerodynamic drag coefficient of $C_D = 1$, we obtain $\sqrt{C_D} = \sqrt{1} = 1$. The more or less hemispherical shape that a plastic parachute assumes when fully opened varies with weight to area ratio and on the sink velocity itself. Thus, the C_D based on flat reference area also is somewhat of a variable – obviously, another area of model rocketry requiring further research!

Now we can proceed with a detailed example. In an attempt to have the largest possible parachute, a boy uses one of the very thin polyethylene bags which dry cleaning establishments wrap suits and dresses in. He finds he can make a 4 foot diameter circular chute (4 feet = 48 inches). The rocket to hold such a chute is made up of an Estes BT-60 body tube. It has a lift-off weight, with a B4-2 motor, of 2.3 ounces and a burnout weight of 2.0 ounces. The rocketeer then uses Centuri's TIR-100 to predict that the chute will eject at an altitude of 350 feet, 3.2 seconds after liftoff.

Assuming that the chute opens fully without losing any altitude predict its total flight duration in calm standard day air.

1. Parachute flat surface area:

$$S = \frac{\pi}{4}(48 \text{ inch})^2 = .785\ (48)^2 = 1808 \text{ in}^2$$

2. Weight-to-surface area ratio:

$$\frac{W}{S} = \frac{20 \text{ ounces}}{1808 \text{ inch}^2} = .0011 \frac{\text{ounces}}{\text{inch}^2}$$

3. Instead of $C_L^{3/2}/C_D$, we use

$$\sqrt{C_D} = 1$$

4. From figure 2, we obtain flight duration per 100 foot of altitude:

$$t_{100} = 34.8 \text{ seconds}$$

5. Since 350 feet is 3.5 times 100 feet, the duration will also be 3.5 as long:

duration from 350 feet = (34.8 seconds)(3.5)
= 121.8 seconds

6. The total duration from liftoff will then be:

total duration = time from liftoff to ejection + parachute duration time

= 3.2 seconds + 121.8 seconds

$\boxed{\text{TOTAL DURATION = 125 SECONDS}}$

Problem 9A

Another boy decides to build a more streamlined rocket using an Estes BT-20 body tube in order to achieve more initial height. He finds that a 24" diameter "cleaner bag" parachute is the maximum he can pack inside such a small tube and still expect reliable ejection and opening. This rocket has a lift-off weight of 1.3 ounces and a burnout weight of 1.0 ounces when using a B4-2 engine. Using Centuri's TIR-100, he computes that the ejection altitude will occur at 900 feet, 7.2 seconds after liftoff.

Assuming his 24 inch chute instantly fully blossoms, determine: 1) the duration per 100 feet of altitude, 2) total duration from 900 feet altitude, 3) the total flight duration, and 4) decide whether his rocket or the previous boy's rocket of Example 9 would win a class 2 parachute contest.

ANSWERS

Problem 1A

Aerodynamic Glide Factor $C_L^{3/2}/C_D = 8$
Wing Loading W/S = .02 oz/in^2
Flight duration for 100 feet of altitude = 65 seconds

Problem 2A

Total flight duration from 800 foot altitude = 204.8 seconds

Problem 2B

Total flight duration from 300 feet = 195 seconds

Problem 3A

Air density compensation factor $\sqrt{\sigma} = .87$
Suration from 100 foot altitude = (.87)(65 seconds) = 56.6 seconds
Duration from 350 feet = 198.1 seconds

Problem 4A

Aerodynamic Glide Factor $C_L^{3/2}/C_D = 3.33$
Wing Loading W/S .050 oz/in^2
Duration from 100 foot altitude at sea level, 59°F = 17 seconds
Air density compensation factor $\sqrt{\sigma} = .95$
Duration for 100 foot altitude when flying at 1500 feet above sea level at 85°F = 16.2 seconds
Duration from 300 feet = 48.6 seconds

Problem 5A

Sink Velocity $V_S = 100\text{ft}/t_{100}$ = 6.17 feet/second
Sea level, 59°F Glide Speed V = 19.5 feet/second = 13 miles per hour
Glide speed at 1500 feet, 86°F $V/\sqrt{\sigma} = 19.5/.95 = 20.5$ feet/second

Problem 6A

Average duration from 30 feet altitude = 10 seconds
Duration per 100 feet altitude = 33.3 seconds
Wing Loading W/S = .016 ounces/inch^2
Aerodynamic Glide Factor $C_L^{3/2}/C_D = 3.7$
Sink Velocity V_S = 3 feet/second

Problem 7A

Sink velocity in thermal V_S = 3 feet/second *down*
Net velocity with respect to ground
= + 2½ ft/sec up - 3 ft/sec down
= -½ ft/sec which is still down, not up in this case, and the glider continues to descend—though much more slowly
Altitude lost after 30 seconds in the thermal is 15 feet
Altitude remaining = 40 - 15 = 25 feet
Duration for remaining altitude = 8.3 seconds
Total flight duration with thermal = 38.3 seconds
Total flight duration from 40 feet for the Example 7 glider assuming it *did not* enter a thermal = 20.0 seconds. Thus, this lower performance glider of this problem would win if it entered a thermal and the higher performance glider of Example 7 did not. However, if there were no thermals or if they both entered the same thermal, the higher performance glider would win consistently.

Problem 8A

Variable	Change	Resulting Change in Flight Duration
Weight	50% Decrease	41% Increase
Drag Coefficient	50% Decrease	100% Increase
Lift Coefficient	50% Increase	84% Increase
Wing Surface Area	50% Increase	23% Increase

Again changing the lift and the drag has the strongest influence on improving the total flight duration.

Problem 9A

Parachute surface area S = 454 in^2
Weight to area ratio W/S = .0022 ounces/in^2
Assume again that $C_D = 1$
Duration for each 100 feet of altitude = 24.5 seconds
Duration from 900 feet = 220.5 seconds
Total flight duration from liftoff = 227.7 seconds

Thus, you can see that the rocket of Problem 9A will have a longer duration than the rocket of Example 9. The conclusion is simply that having the largest possible parachute is not as important as proper optimization of the entire flight.

DEALER DIRECTORY

Statement of Ownership
Management and Circulation
(Act of October 23, 1962: Section 4369, Title 39, United States Code)

1. DATE OF FILING: October 1, 1969 2. TITLE OF PUBLICATION: Model Rocketry 3. FREQUENCY OF ISSUE: Monthly 4. LOCATION OF KNOWN OFFICE OF PUBLICATION (STREET, CITY, COUNTY, STATE; ZIP CODE): 595 Massachusetts Avenue, (Suite 208), Cambridge, Mass. 02139. 5. LOCATION OF HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS (NOT PRINTERS): 595 Massachusetts Avenue, (Suite 208), Cambridge, Mass. 02139. 6. NAMES AND ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR: PUBLISHER (NAME AND ADDRESS): George J. Flynn, 3 Ames Street, Cambridge, Mass. 02139. EDITOR (NAME AND ADDRESS): George J. Flynn, 3 Ames Street, Cambridge, Mass. 02139. MANAGING EDITOR (NAME AND ADDRESS): Gordon K. Mandell, 7 Wyndell Street, Cambridge, Mass. 02138. 7. OWNER (IF OWNED BY A CORPORATION, IT'S NAME AND ADDRESS MUST BE STATED AND ALSO IMMEDIATELY THEREUNDER THE NAMES AND ADDRESSES OF STOCKHOLDERS OWNING OR HOLDING 1 PERCENT OR MORE OF TOTAL AMOUNT OF STOCK. IF NOT OWNED BY A CORPORATION, THE NAMES AND ADDRESSES OF THE INDIVIDUAL OWNERS MUST BE GIVEN. IF OWNED BY A PARTNERSHIP OR OTHER UNINCORPORATED FIRM, ITS NAME AND ADDRESS, AS WELL AS THAT OF EACH INDIVIDUAL MUST BE GIVEN): Model Rocketry, Incorporated, 595 Massachusetts Avenue, (Suite 208), Cambridge, Mass. 02139; George J. Flynn, 3 Ames Street, Cambridge Mass. 02139; Gordon K. Mandell, 7 Wyndell Street, Cambridge, Mass. 02138; George J. Caporaso, 2278 West 6th Street, Brooklyn, New York; Thomas T. Milkie, 362 Memorial Drive, Cambridge, Mass. 02139, Mr. & Mrs. George J. Flynn Sr., 10 Mulberry Avenue, Garden City, New York, 11530; Mr. & Mrs. Robert Tufano, 2 Mulberry Avenue, Garden City, New York, 11530; Dr. & Mrs. Robert Tufano, 181 Old Court House Road, New Hyde Park, New York;; Mr. & Mrs. Eugene Flynn, 21 Elderwood Lane, Huntington, New York; Mr. & Mrs. Joseph Flynn, 1249 Greenbriar Lane, North Bellmore, New York; Mr. Mandell, 32 Truxton Road, Melville, New York; Mr. G. Harry Stine, 127 Bickford Lane, New Canaan, Conn. 06820; Mr. Bryant Thompson, 511 South Century, Rantoul, Ill. 61866. 8. KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECURITY HOLDERS OWNING OR HOLDING A 1 PERCENT OR MORE TOTAL AMOUNT OF BONDS, MORTGAGES, OR OTHER SECURITIES (IF THERE ARE NONE, SO STATE): None. 9. FOR COMPETION BY NONPROFIT ORGANIZATIONS AUTHORIZED TO MAIL AT SPECIAL RATES: Not Applicable. 10. EXTENT AND NATURE OF CIRCULATION: A. TOTAL NO. COPIES PRINTED: (AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS) 11,900; (ACTUAL NO. COPIES OF SINGLE ISSUE PUBLISHED NEAREST TO FILING DATE) 16,000; B. PAID CIRCULATION 1. SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES: (AVERAGE NO.) 6,200; (ACTUAL NO.) 9,618; 2. MAIL SUBSCRIPTIONS: (AVERAGE NO.) 1,600 (ACTUAL NO.) 5,422; C. TOTAL PAID CIRCULATION: (AVERAGE NO.) 7,800 (ACTUAL NO.) 15,040; D. FREE DISTRIBUTION (INCLUDING SAMPLES) BY MAIL, CARRIER OR OTHER MEANS (AVERAGE NO.) 600 (ACTUAL NO.) 154 F. OFFICE USE, UNACCOUNTED, SPOILED AFTER PRINTING (AVERAGE NO.) 3,500, (ACTUAL NO.) 806 G. TOTAL (SUM OF E & F SHOULD EQUAL NET PRESS RUN SHOWN IN A): (AVERAGE NO.) 11,900, (ACTUAL NO.) 16,000. I CERTIFY THAT THE STATEMENTS MADE BY ME ABOVE ARE CORRECT AND COMPLETE:

George J. Flynn
Publisher

(SIGNATURE OF EDITOR, PUBLISHER, BUSINESS MANAGER, OR OWNER)

(From the Editor, continued)

presented, The Southwestern Conference, at least from last year's experience, was more experimentally oriented. Model rocket instrumentation formed the principal topic of discussion.

Is there a need for more Conventions? The answer is an empahtic YES. Yes on two counts: first there's a need for more opportunities for discussion in any given region, and second there's a need for more geographic coverage. Many topics of interest need to be ignored at each Convention, because the two day, self-imposed, time limits the amount of discussion possible. Futhermore, many rocketeers have no opportunity to attend a Convention, since the cost of travel to the nearest one may be prohibitive. Three Conventions cannot cover the needs of an entire nation of rocketeers. Areas strong in model rocket interest, such as Maryland, Ohio, and Washington State have never had a Convention. Why? Perhaps the potential sponsors realize the quantity of work involved in organizing a successful Convention. Perhaps they would rather do other things, for example sponsor a competition. Any club interested in promoting the advancement of the hobby should, however, be willing to provide the leadership necessary to sponsor a Convention.

If there is a Convention in your area, you would do well to support it. If there's not, and if your club has the experience, interest, and leadership necessary to sponsor a successful one, organize one. You will not regret it, and the entire hobby will benefit.

(Club Notes, continued)

On October 11, the Star Sailors Model Rocket Club, of Mona Shores High School, Muskegon, Michigan, held its second launch. Forty rockets were flown, highlighted by the launching of an Estes Saturn IB. Several of the rockets exceeded an altitude of 2500 feet. Anyone in the Muskegon area interested in joining the club should contact Ed Baker, phone 798-3473.

On October 22 the Aerobee Model Rocket Club held its first official meeting at the Flatbush Boys Club, Brooklyn, New York. Kenneth Tallon was elected President; Lee McQueen was elected Vice President. The group has held its first rocket meet at its range on the shores of Geristan Inlet in Brooklyn. Anyone in the area interested in joining the group should contact Ken Tallon at the Boys Club on Saturdays at 11 am.

Jeff Parker and Brian Doane are interested in forming an NAR section in Androscoggin in Maine. Interested persons should call or write: Jeff Parker, 33 Oak Street, Mechanic Falls, Maine 04256; 345-5821.

The South Dixie Rocket Club of Louisville, Kentucky exhibited at the Kentuckian Hobby and Gift Show November 8-16 at the Kentucky Fair and Exposition Center, co-directed by Sherman and Pauline Zlotolow.

The show was the first annual show and was given primarily to stress the growing importance of hobbies and leisure-time activities. The club showed model rocketry, in terms of its activities and progress, to the people of the area, and also hoped to increase their membership.

The South Dixie Rocket Club is comprised of ten members including Alan Kelley, President; Marty Daniel, Vice President; Sally Kendrick, Secretary; Tom Hoeppner, Electronics Technician; and Doug Allgeier, Chief Rocket Designer.

Other rocketeers and clubs in the same area may contact the South Dixie club c/o Alan Kelley, 1203 Terudon Drive, Louisville, Kentucky 40214.

A group of model rocketeers in the greater St. Louis area are forming a club in hopes of becoming an NAR section. The club has already had several meetings and launchings, including two demonstration launchings. At the demonstrations, practically everything from a 'Lil Hercules to a Saturn V was flown.

The club election held recently yielded the following results: President, Randy Picolet; Vice President, Peter Wheeler; Secretary-Treasurer, John Lee; Club Advisor, Mr. Robert Funk.

John Lee is presently attempting to have model rocketry legalized in the state of Missouri. He has contacted State Representative James Conway, and they are drafting a bill.

The members all feel a lack of model rocketry activities in the St. Louis area, and would like all interested persons, especially senior and leader members of the NAR, to contact the club by writing to: Randy Picolet, 6039 Southwest Avenue, St. Louis, Mo. 63139.

The Columbus Society for the Advancement of Rocketry has recently completed two meets in October; CSAR-3, a sectional meet, and OHIO-2, an area meet with the Mansfield Aeronautical and Space Association. Both meets were highly successful, with good weather throughout both weekends.

The events for CSAR-3 were Class 1 Parachute Duration, Sparrow Boost/Glide, Plastic Model, 10 Nt.-sec. limit Eggloft, Predicted Altitude, and Scale. Luck for PD was good, with two flights over 200 seconds and one over 400! unfortunately, none of the models were found, as the wind blew them away.

OHIO-2 was held the weekend of October 18 and 19. Its events were Sparrow Boost/Glide, Predicted Altitude, 25 Nt.-sec. limit Eggloft, Plastic Model, Class O Altitude, and Super Scale. High winds played havoc with Eggloft, with many birds weathercocking and arcing directly toward one of the tracking stations, but Vikki Lundberg of MASA got off a good flight of 902 feet to win Junior Eggloft. The highlight of the Super Scale competition was the launching of a beautiful, four-foot tall, F-100 powered Tomahawk, built by the Ball-Hagedorn team from MASA.

CSAR member George Pantalos turned in a Sparrow B/G flight at OHIO-2 of 2 minutes 4 seconds, surpassing the old international record. Leading in points in the CSAR are: Dr. Gerald Gregorek, Senior, George Pantalos, Leader, and Craig Streett, Junior. The CSAR has scheduled several more meets next year: Buckeye-I, an area meet, in April, and the Midwest Model Rocket Regional (MMRR '70) in June.

A group of eigth graders in Rockville, Maryland have been running a rocket club for almost one year without a sponsor, but with the help of many willing fathers. Ken Tomasello had the idea in January 1969 and called some of his friends together to get it going. Ken's father, Mr. John Tomasello, volunteered his experience from his job at Goddard Space Flight Center to advise the club and supervise our activities. Then, Craig Wilson, now junior member of NAR, joined and his father, Mr. Craig Wilson, senior member, buildt the club a multiple launcher financed from his own pocket and a 4-speaker public address system that has proven indispensable at our demonstrations for various groups and at our first Section meet.

The officers are: Ken Tomasello, President; Jim Philmon, Vice-President; Jim Threatte, Secretary-Treasurer; Craig Wilson, Sargent-at-Arms. The Rockville rocketeers have just finished a membership drive and brought our membership up to 21, all of whom are members of the NAR. Their first Section meet (RR 1) was held on July 13 with four events: Open Spot Landing; CL1 Parachute Duration; CL1 Altitude; CL1 Predicted Altitude. The winner was Jim Threatte taking three first places and one second place.

Launchings are from the Goddard Space Flight Center's antenna test range. RR2 was held August 31, 1969. The club is open to anyone who has an interest in its objectives. Rocketeers in the Rockvelle, Maryland area interested in the club should call 946 9181 and ask for Ken.

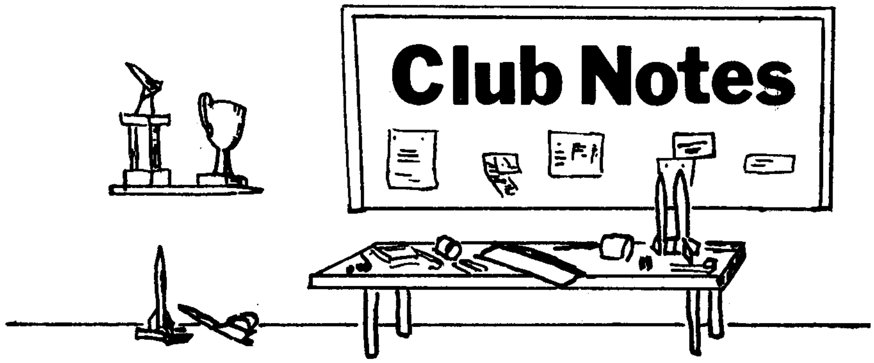
Results of the November 9 contest between Pittsburgh's Steel City and Three Rivers Sections were reported in the Three Rivers *Contrail*. Spot Landing, Eggloft, Class I Parachute Duration, Sparrow Boost/Glide, and Research and Development were flown in Senior/Leader and Junior age groups. In Junior Spot Landing, Rich Labash (TR) took first with 5' 7", and Rich Baier (TR) captured the Senior/Leader division with 60'. David Crafton (SC) placed first in Junior PD with a time of 100 seconds, while Rich Baier's 103 seconds took first in S/L. Marvin Lieberman (SC) placed first in Junior B/G with 69 seconds, while David Martin (TR) captured first in S/L with 14 seconds. Rich Labash placed first in Junior Eggloft with 350'; David Martin took the S/L prize with 1,090'. In R&D Tom Wuellette (TR) took first in S/L division, and Marvin Lieberman took first in Junior R&D. Overall, Three Rivers topped Steel City by a score of 488 points to 410 points.

The October issue of *The Voyager*, Annapolis Association newsletter, reports the club's participation in Sci-Tech '69. Sponsored by the Chamber of Commerce of Greater Annapolis, Sci-Tech was held from October 31 to November 2 at the Annapolis National Guard Armory.

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

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

"Could one of you direct me to the tracking scope?"



The North Pittsburgh Rocket Club has also formed an NAR section composed of club members who are also NAR members. The Section, called the Three Rivers Section, is presently preparing a constitution for submission to the NAR. North Pittsburgh rocketeers wanting further information on this club should contact Tom Wuellette, 353 Hawthorne Rd Pittsburgh, PA 15209.

The Western Branch YMCA in Baltimore, Maryland has formed a model rocket club. Open to boys and girls 11 years old and older, the club meets at the Johnnycake Junior High School. They launch regularly from the Catonsville Community College cross-country field.

There is an NAR section being formed in the south Seattle, Washington, area. Interested modellers should call Jess or Tony Medina, 15824 43rd Street, South Seattle, 98188. Phone CH4-1228.

The Brownsville High School Rocketry Club in Brownsville, Pennsylvania, recently staged a rocket show and competition under the sponsorship of the Brownsville Jaycees. Robert Neel, president of the Jaycees, presented the first place trophy to champion rocketeer Albert Durigon. In the individual events, Albert Durigon took first in Class O Altitude, Joe Flack took first in Class 1 Altitude, Albert Durigon took first in Class 2 Altitude, Tom Liston took first in Class 3 Altitude, David Douville took first in Parachute Duration, Jim Flack took first in Spot Landing, and Mary Hasson took first in Predicted Altitude.

Bill Roe reports that Bill Becker, Tony Gonzales, and others from Colorado Springs are working to reestablish the old Peak City Section and the Rampart Range Section. Their first launch was held on September 28, using Estes launchers. 50 people attended, and about 130 rockets were launched.

Denver's MDRA Section has been quite active according to the latest issue of their newsletter – *Misfire*. The club has presented pins to all club members who have been in the NAR more than one year. Gene Killian led the list, having been an NAR member for three years. Mel Severe and Bill Cooney have been members for two years. Vic Cross, the club photographer and *Misfire* editor, received the "Outstanding Service" award for his dedication to the club's activities.

Mel Severe reports that John Essman, NAR 43 (Yes, a two-digit NAR number!), a former member of the old Mile High Section left a note on the MDRA shanty last September. He is interested in joining Metro Denver or forming a club in Boulder, where he attends Colorado University.

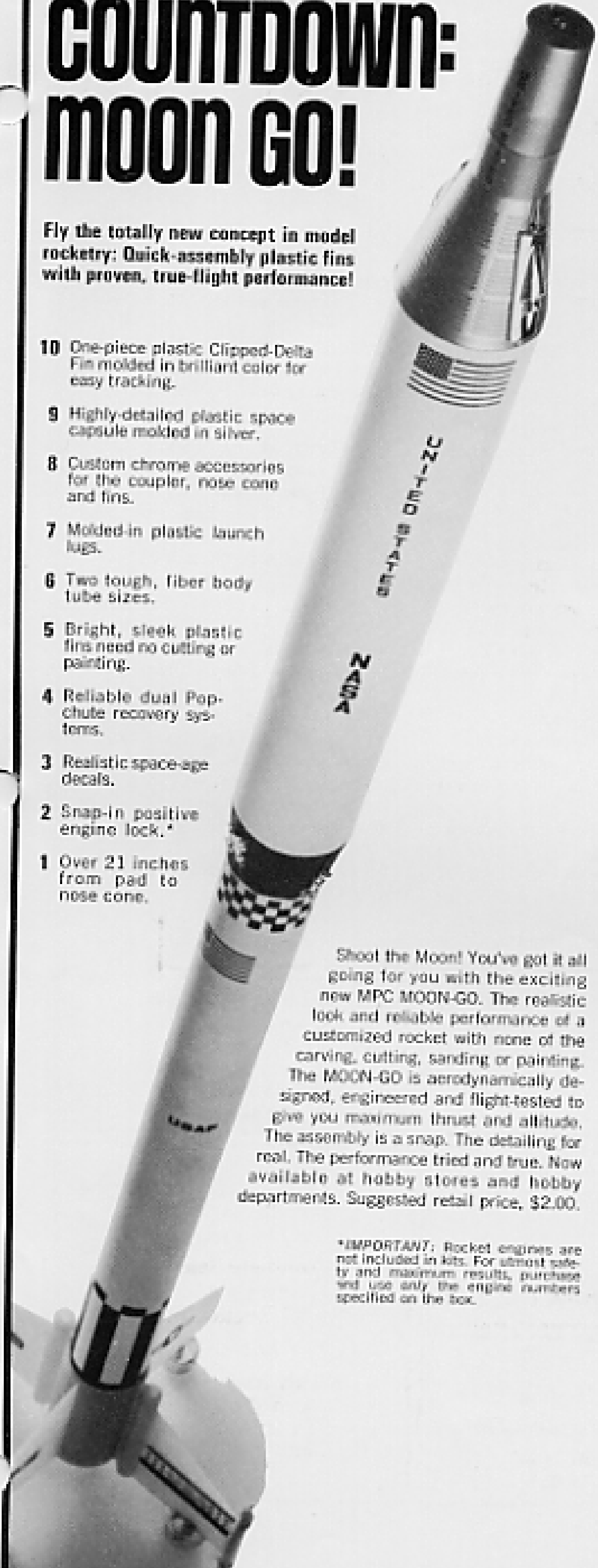
Students at the Easton Area High School, Easton, Pennsylvania have organized a model rocket club. Larry B. Kirk, a physics instructor at Easton, serves as club advisor. In their brief history, club members have launched over 200 rockets.

Wilmington Rocket Society prides itself on conducting scientific experiments in model rocketry, while at the same time introducing the hobby to youngsters who in the future will be controlling the group. Three committees separate the club into working sections. The committees are: 1) Laboratory; 2) Range Operations; 3) Library and Public Affairs.

Wilmington Rocket Society would like to correspond with any other clubs to get to know who's who. WRS, Rt. no. 1 Box 395 Wilmington, North Carolina 28401

Club Notes
Continued on page 46

COUNTDOWN: MOON GO!



Fly the totally new concept in model rocketry: Quick-assembly plastic fins with proven, true-flight performance!

10 One-piece plastic Clipped-Delta Fin molded in brilliant color for easy tracking.

9 Highly-detailed plastic space capsule molded in silver.

8 Custom chrome accessories for the coupler, nose cone and fins.

7 Molded-in plastic launch lugs.

6 Two tough, fiber body tube sizes.

5 Bright, sleek plastic fins need no cutting or painting.

4 Reliable dual Pop-chute recovery systems.

3 Realistic space-age decals.

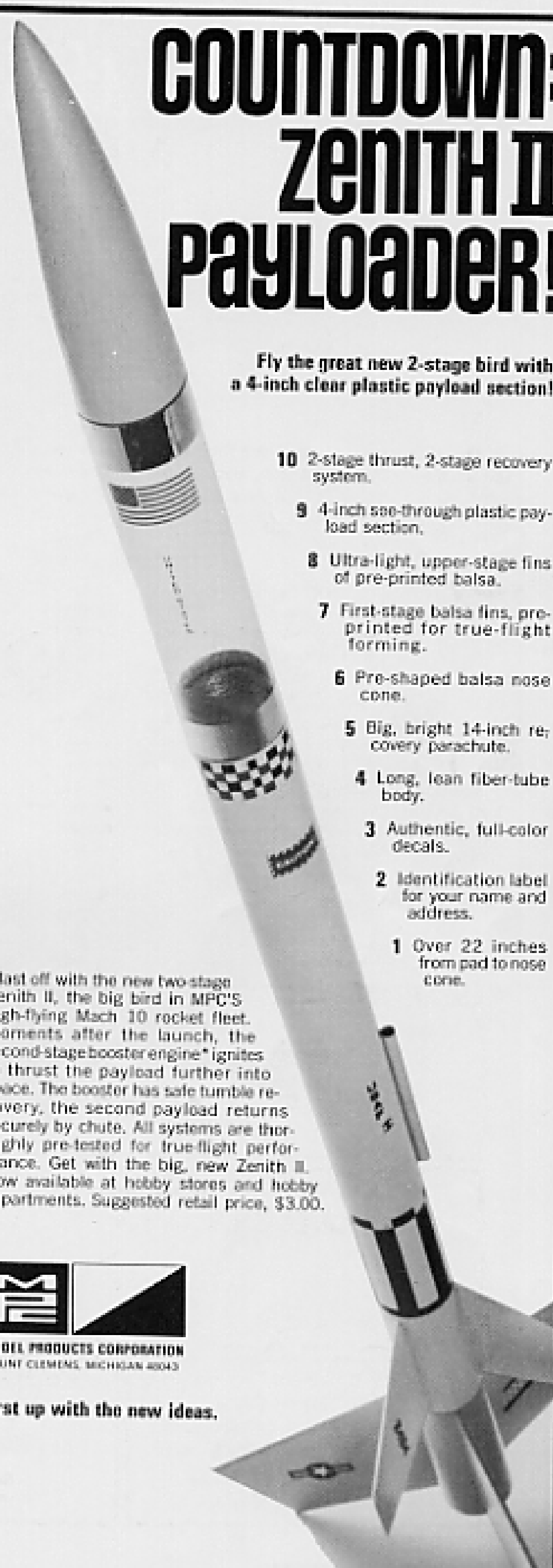
2 Snap-in positive engine lock.*

1 Over 21 inches from pad to nose cone.

Shoot the Moon! You've got it all going for you with the exciting new MPC MOON-GO. The realistic look and reliable performance of a customized rocket with none of the carving, cutting, sanding or painting. The MOON-GO is aerodynamically designed, engineered and flight-tested to give you maximum thrust and altitude. The assembly is a snap. The detailing for real. The performance tried and true. Now available at hobby stores and hobby departments. Suggested retail price, $2.00.

*IMPORTANT: Rocket engines are not included in kits. For utmost safety and maximum results, purchase and use only the engine numbers specified on the box.

COUNTDOWN: ZENITH II PAYLOADER!



Fly the great new 2-stage bird with a 4-inch clear plastic payload section!

10 2-stage thrust, 2-stage recovery system.

9 4-inch see-through plastic payload section.

8 Ultra-light, upper-stage fins of pre-printed balsa.

7 First-stage balsa fins, pre-printed for true-flight forming.

6 Pre-shaped balsa nose cone.

5 Big, bright 14-inch recovery parachute.

4 Long, lean fiber-tube body.

3 Authentic, full-color decals.

2 Identification label for your name and address.

1 Over 22 inches from pad to nose cone.

Blast off with the new two-stage Zenith II, the big bird in MPC'S high-flying Mach 10 rocket fleet. Moments after the launch, the second-stage booster engine* ignites to thrust the payload further into space. The booster has safe tumble recovery, the second payload returns securely by chute. All systems are thoroughly pre-tested for true-flight performance. Get with the big, new Zenith II. Now available at hobby stores and hobby departments. Suggested retail price, $3.00.

MODEL PRODUCTS CORPORATION
MOUNT CLEMENS, MICHIGAN 48043

First up with the new ideas.

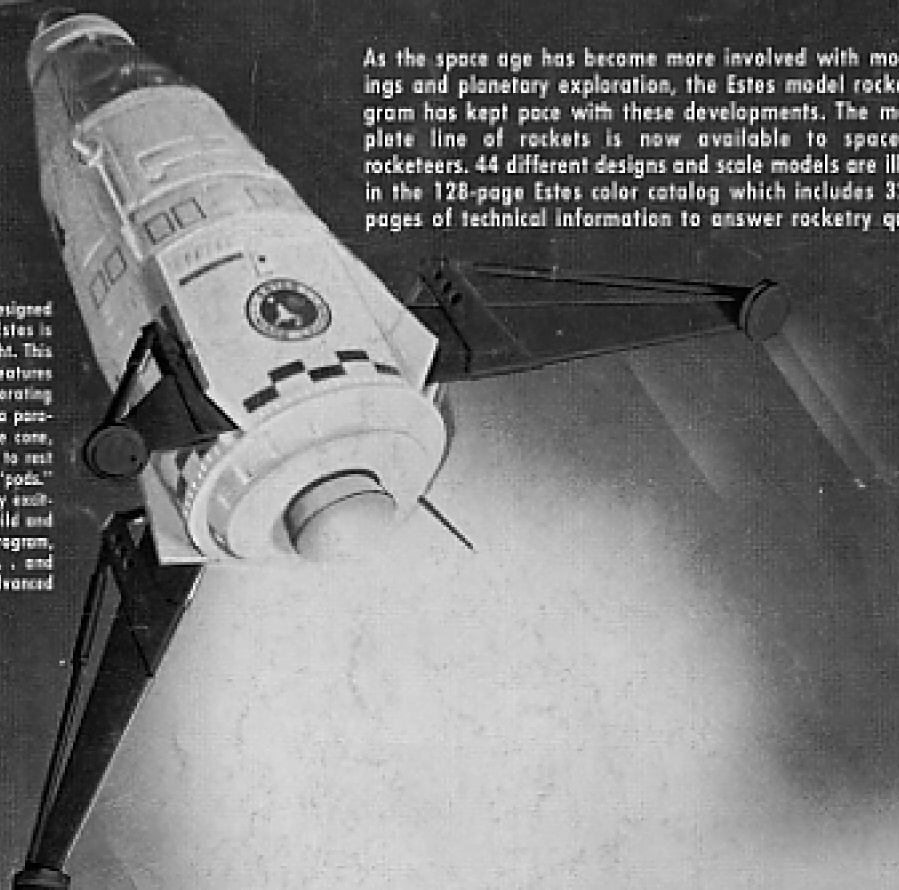
In step with the times...

ESTES MODEL ROCKETS

As the space age has become more involved with moon landings and planetary exploration, the Estes model rocketry program has kept pace with these developments. The most complete line of rockets is now available to space-minded rocketeers. 44 different designs and scale models are illustrated in the 128-page Estes color catalog which includes 32 yellow pages of technical information to answer rocketry questions.

One of the newest models designed for advanced rocketeers by Estes is the Mars Lander, shown at right. This exciting space-age design features detailed body panels and operating landing gear. At peak altitude a parachute is ejected from the nose cone, bringing the craft gently down to rest on its spring-activated landing "pods."

This is just one of the many exciting new designs by Estes to build and fly. To launch your rocketry program, order a starter kit today . . . and soon you'll be ready to fly advanced models like the Mars Lander.



MODEL ROCKETRY'S MOST COMPLETE CATALOG AND ROCKET MANUAL

LOOK FOR ESTES ROCKETS AT YOUR HOBBY STORE.
IF NOT AVAILABLE, SEND THIS COUPON.

Estes Industries, Dept. 31, Box 227, Penrose, Colo. 81240

Payment enclosed. Please send me the following:

- ☐ Starter Special #DSK-20. Includes high-flying Astron Alpha kit, 2 powerful engines, complete instructions and design manual $2.00
- ☐ #DSK-70 — Same as above plus electric launching system with batteries . . . $7.00
- ☐ Huge illustrated color catalog and design manual (free with order) . . . . 25¢

NAME . . . . ADDRESS . . . .

CITY . . . . STATE . . . . ZIP . . . .

Astron Alpha