MODEL ROCKETRY

October 1969
50¢

The Journal of Miniature Astronautics
Incorporating THE MODEL ROCKETEER

Drag and Stability of
CONICAL MODEL ROCKETS

ODDBALL: THE SHAM-ROC

RADIO CONTROL B/G

BUILD THE SCORPIO

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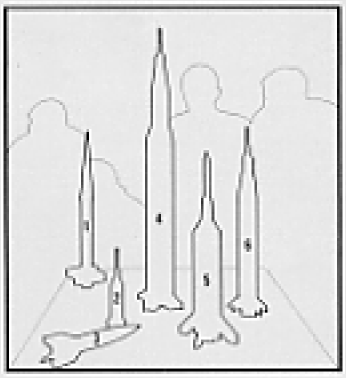

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Model Rocketry

Volume II, No. 1
October 1969

Editor and Publisher George J. Flynn
Managing Editor Gordon K. Mandell
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Distribution Manager Thomas T. Milkie
Technical Correspondent George J. Caporaso

Cover Photo

This month's cover photo shows the liftoff of a radio-controlled boost/glider built by Doug Malewicki (right) at the Eleventh National Model Rocket Championships (August 11-15, U.S.A.F. Academy, Colorado Springs). The concluding instalment of Doug's three-part series on R/C B/G begins on page 33.

From the Editor

The first issue of **Model Rocketry** was published just one year ago, in October of 1968. The initial motivation for the magazine came about when we became convinced that our growing hobby required more and better communication among the modelers than could be provided by a few pages in a model aircraft magazine. Virtually no opportunity existed for the model rocketeer to communicate his technical developments, unusual designs, or various opinions concerning the field to his fellow hobbyists. Other hobby magazines, for the most part, were disinterested in advances being made in the model rocket field. We were convinced that model rocketeers deserved and would respond to something better: to a magazine of their own.

Your response, by numerous letters, phone calls, and personal conversations over the past year has most eloquently affirmed the need for a publication written *by* and *for* model rocketeers alone. It has been nothing short of tremendous. You have made it possible for us to expand from our original format of 32 pages and a two-color cover to our present 48-page issue with a four-color cover. You have written articles, contributed your club news and letters, and *supported* the magazine by encouraging manufacturers to advertise, by mentioning to them that you've seen their ads when they do advertise, by requesting your hobby shop or newsstand to make **Model Rocketry**

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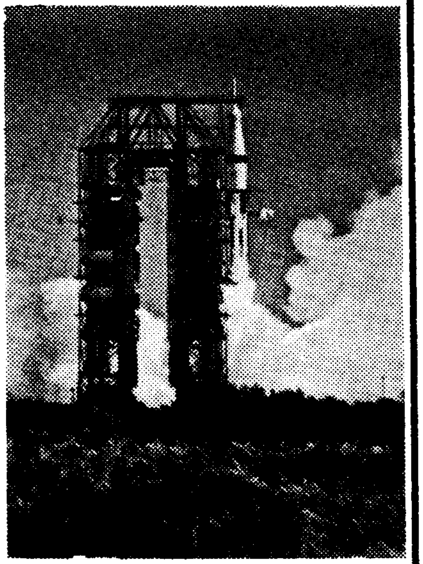

This magnificent photograph of a most historic moment in the history of spaceflight was obtained by **Model Rocketry** editor George Flynn from an advance position not accessible to most Kennedy Space Center visitors. Showing the moment of liftoff, this 7 by 8 inch full-color print will make an inspiring addition to the album of any space enthusiast.

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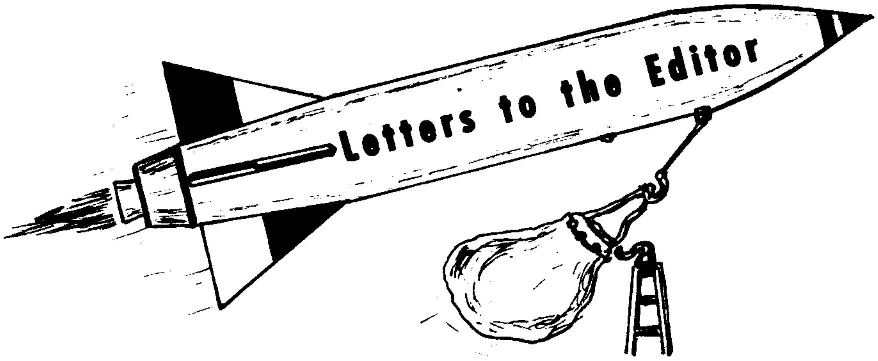

Letters to the Editor

Misfire Alley

After reading *The Old Rocketeer* in the July issue, our club tried the Misfire Alley system. It worked wonderfully! We launched almost twice as many rockets as we used to during the same length of time. It also sparked some new enthusiasm into the members because now a launching isn't a long, drawn out process like it used to be.

Our club has recently tried the NAR Drag Race Competition. We found it to be quite fun and it takes a lot of skill to design a winning rocket. Any of you other clubs tried this out?

Eric Max NAR No. 10207
Fairmont Estates Model Rocketry Society
Fairfax, Virginia

Technical Notes

I have just finished reading the August, 1969 issue af your magazine and have some comments.

I read with particular interest George Caporaso's *Technical Notes* and am in complete agreement with him. We definitely do need model rocket theorists and experimenters. There are so many holes in the framework of model rocket theory that highly original research can be done by anyone who wants to put out the time and the effort, whether or not he has any knowledge at all of higher mathematics. I have been listing for myself possible areas of research which I intend to soon tackle. So far I have thought of 26 – that is, 26 *areas* of endeavor, each probably containing dozens of questions itself, with more areas for investigation that will develop as each question is answered.

Maybe these topics have been investigated before; yet, if so, I have not read of such studies. And this points out the main problem of model rocketry – no-one knows what anyone else is doing – lack of communication. For instance, until NAR sent to its members the R & D Guide, I had never seen information from an R & D project. Certainly there are more publishable technical reports which have resulted from NARAM R & D competitions than those few available from NAR Technical Services. Why aren't they made readily available? I recently attended my first regional competition and was amazed at how the contestants learned from each other. I hardly believe the interest of some of the modelers with techniques our club brought to the meet – techniques which, to us, are as old as rocketry itself.

Model Rocketry could be the literary analogue of George's *National Technical Congress on Model Rocketry* until the real thing comes along. Even then, **Model Rocketry** could publish the results of such a meeting. Yet for two reasons, I find his dream may have difficulty in quickly becoming a reality.

First, it seems that model rocketeers do not like to publish. After G. Harry Stine's series of Countdown articles in **American Aircraft Modeler** was discontinued, the editors asked for articles by other modelers.

I think that no more than five were published in the next year. Let's hope that now since the center of rocketry literature has moved from an aircraft magazine (in which most rocketeers probably felt as alienated as myself) to a periodical which will totally concentrate on model rocketry, that most rocketeers will be motivated to write – if not an article, at least a letter. I think this kind of participation will mean the difference between MR's success or failure.

Second, most rocketeers, it seems, are afraid of the technical aspects, the research and experimental aspects, of model rocketry. I have no figures, but I would guess that at least half a million Americans have built and flown rockets. How many are members of NAR? About one or two percent? We have enough trouble encouraging experienced modelers to join our local club, let alone some monstrosity (in their minds) like NAR. the national organization to them (and even our small club) represents a kind of complexity, a formalism against which they rebel. They think that rocketry is merely the dynamic counterpart of building static models. these rocketeers fly just for sport: no competition, no technical aspects, They regard the hobby merely as a one person activity, like archery or golf.

This is bad enough. But George's *Notes* even had some of *our* club members worried. They complained he was suggesting taking the fun and sport out of model rocketry and substituting the technical aspects – "for eggheads only." When people who should have already accepted the experimental frontiers of model rocketry as matter-of-fact doubt that the sport facets can stand up to the technical facets,the futility of believing in rapid acceptance of these regional technical meetings on a large scale becomes apparent.

Jeff McConnell
Bellefontaine, Ohio

June Issue

Recently I purchased a copy of your magazine in a nearby hobby shop. It was great! I didn't know that such a magazine exisited, and I'm extremely happy to have a magazine such as yours available.

I enjoyed the entire magazine (June 1969) immensely. I especially enjoyed the reports on *Model Rockery Down Under* and the *IQSY Tomahawk*, a model which I am going to build shortly. I hope that in the future your magazine will continue it's excellent form. Thank You.

Patrick S. Maio
River Vale, New Jersey

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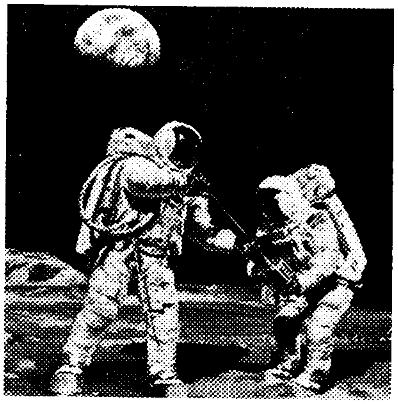

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THE PERFORMANCE OF CONICAL MODEL ROCKETS

An Experimental Investigation

by Gary W. Schwede

PROBLEM

This project explores the suitability of the conical configuration for subsonic astrodynamic vehicles. Conclusions drawn apply to subsonic vehicles or to supersonic vehicles while their velocity is subsonic. This research could prove very useful in model rocketry, full-scale rocketry (sounding and military rockets), and ordnance research.

APPROACH

My approach to the problem consisted of these steps:

1. Research of available material for pertinent data and observations.
2. Design and construction of suitable test vehicles and support equipment.
3. Testing of the vehicles under flight conditions.
4. Photography of the flights and measurement of flight parameters for use in performance, stability, drag properties, etc.
5. Careful observation of the photography of the flights for use in determination of in-flight motions and time values.
6. Reduction of data to useful form using standard aerodynamic and physical mathematical relationships.
7. Use of data to support conclusions to indicate possible usefulness of this configuration.

TESTING

During the period from December, 1968 through March, 1969, five conical test vehicles, the Apex series of model rockets, were designed, constructed, and tested. These vehicles, along with the support equipment, will be described in the "Apparatus" section of this report.

Support equipment included the following items:

1. Launcher and launch control panel.
2. An 8mm motion picture camera.
3. An elevation angle tracker.
4. Miscellaneous parts such as parachutes, wadding, ignitors, ballast weights, etc.

To date, 15 launchings of conical rocket vehicles have been successfully accomplished in this project. Ten of these launches were filmed in 4:1 slow motion, and all were tracked for elevation angle readings. A flight records table is included.

APPARATUS

1. Test vehicles–the Apex series of model rockets.

The Apex series presently consists of these vehicles: Apex 1a(1), Apex 1a(2), Apex 2, and Apex 3.

In order to standardize as much as possible the testing and results, all test vehicles of the Apex series have these common characteristics:

1. Length 16.68 in. (42.3 cm.)
2. base diameter 3.34 in. (8.3 cm.)
3. frontal area (body) 8.74 in^2. (56.4 cm^2.)
4. weight

airframe + ballast	61 gm.
engine	16 gm.
parachute & wadding	5 gm.
total	82 gm.

Apex 1 is a conical configuration subsonic rocket with a length/diameter ratio of 5:1. Its body shroud and nose cone form a right circular conical solid whose regularity is marred significantly only by the slight protuberance of the launching lug.

Apex 1a(1) and 1a(2) are of the same design. Damage to the original vehicle (1a(1)) after recovery system failure resulted in the necessity of construction of an identical model for future use. The Apex 1a configuration is identical to Apex 1 except that the 1a version posseses four swept fins with subsonic airfoils mounted equiangularly on the rear of the vehicle. The purpose of Apex 1a is to test the net effect of fins on this configuration.

Apex 2 is, again, identical to Apex 1 except that the center section of the body shroud has been removed to allow high pressure air from the surface of the vehicle to flow internally to the rear of the vehicle to relieve, in part, the low pressure in this area and the resulting turbulence. It was also hoped that this would relieve any possible thrust reduction due to the Krushnik effect.

Apex 3 is a *practical* application of the conical design for payload research. Powered by larger engines than the test vehicles, it also weighs considerably less. The recovery system occupies usually-wasted space in the rear of the rocket. This leaves a very large payload compartment. The Apex 3 is capable of carrying payloads of up to 6 ounces and can attain an altitude of about 1,000 feet.

Propulsion is supplied by prepackaged, commercial model rocket engines which are both safe and very consistent in thrust. The NAR types A 8-3, B 6-4, and C 6-5 engines manufactured by Estes Industries, Inc. of Penrose, Colorado, and the NAR types B3-4, C4-4, D4-6, and D6-6, manufactured by Flight Systems, Inc. of Louisville, Colorado are the engines for which the Apex series rockets were designed.

These vehicles are *new, original designs.* I know of no others which resemble them to any great degree.

All the rockets were finished with enamel paints with emphasis on ease of tracking and roll rate determination. The finishes are not exceptionally smooth, and do not lower the drag coefficients of the rockets abnormally.

2. Launcher, launch control, and ignition system.

The launching apparatus used is of my design and construction. The launcher is adjustable to provide a vertical trajectory from any reasonable terrain. The control system provides continuity checks both at the control unit and at the ignitor connections. The unit has a built-in safety-disconnect feature and ignites the rocket electrically from a distance of 25 feet.

3. Camera and projection apparatus.

The camera I used is a Bell and Howell 172 8mm magazine camera. I exposed Kodachrome II film at 64 frames/second. This gives a 4:1 slow-motion record of each flight, which proves very useful in obtaining accurate time records with the aid of a stopwatch. In order to eliminate time errors, I filmed the stopwatch for 5 seconds at 64 frames/second. I obtained a time reading of 20 seconds, which confirmed the accuracy of camera and projector speeds.

4. Elevation angle tracker.

This is a commercial kit tracker which has an accuracy of ±1 degree. Computations done on single flights are usually accurate to within 10%. However, all test flights were repeated several times, and average values were found which should be accurate to within 5%.

DATA AND EXPERIMENTAL RESULTS

Pertinent Weather Data

WIND: 0–1 mph; ELEVATION: 6391 ft.

Date	flight no.s	temp. °F (ave.)
Dec. 16, 1968	1–4	26
Feb. 23, 1969	5–7	32
Mar. 5, 1969	8–10	30
Mar. 16, 1969	11–15	35

Tracking and trajectory information is given below in the launch record sheets.

Photographic results

A. Flight times obtained from the films are recorded in the launch record sheets below.

B. Motion analysis of filmed flights

Flight no.	Remarks
1	Apex 1 is aerodynamically stable; flight veered west about 10 degrees.
2	Tail oscillates in approx. 10 degree arc under thrust. Film incomplete.
3	Unstable – impact about 75 feet east of launcher.
4	Vertical flight path. Oscillation 3X during thrust. Roll 5X; 0.7 sec./roll. Oscillation damped out during coast.
5	Possible veer to north.
6	Vertical trajectory. 2 slow, 5 - degree oscillations during thrusting.
7	Coasted south. One slow, 5 - degree oscillation during thrust.
8	Coasted south. Wind gust or tip-off suspected. 2 slow rolls.
9	Straight, vertical shot.
10	Straight, vertical shot.

DATA REDUCTION

Formulas

Tracked altitude: $A = 500 \tan \alpha$

Maximum Altitude:

$$A_{max} = \frac{1}{g}\,\frac{W_1-\frac{1}{2}W_p}{C_D A \frac{1}{2}\rho}\ \ln\cosh\left\{g\sqrt{\left(\frac{F_{ave}}{W_1-\frac{1}{2}W_p}-1\right)\frac{C_D A\frac{1}{2}\rho}{W_1-\frac{1}{2}W_p}}\,t_b\right\}$$

$$+\frac{1}{2g}\,\frac{W_1-\frac{1}{2}W_p}{C_D A \frac{1}{2}\rho}\ \ln\left\{1+\left(\frac{W_1-\frac{1}{2}W_p}{W_1-W_p}\right)\left(\frac{F_{ave}}{W_1-\frac{1}{2}W_p}-1\right)\tan h^2\left[g\sqrt{\left(\frac{F_{ave}}{W_1-\frac{1}{2}W_p}-1\right)\frac{C_D A\frac{1}{2}\rho}{W_1-\frac{1}{2}W_p}}\,t_b\right]\right\}$$

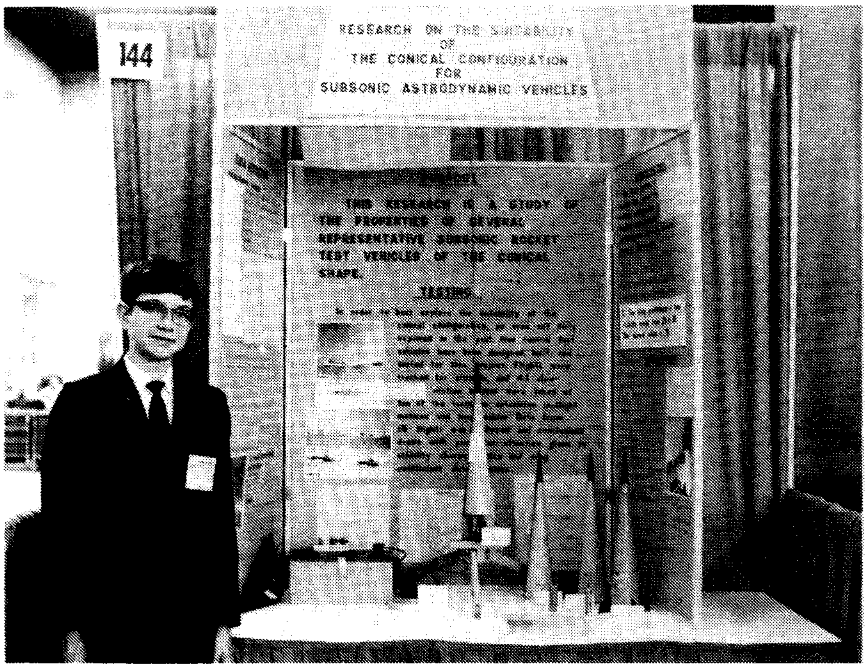
Coast Time:

$$t_c = \frac{1}{g}\sqrt{\frac{W_1-\frac{1}{2}W_p}{C_D A\frac{1}{2}\rho}}\ \tan^{-1}\left\{\sqrt{\left(\frac{W_1-\frac{1}{2}W_p}{W_1-W_p}\right)\left(\frac{F_{ave}}{W_1-\frac{1}{2}W_p}-1\right)}\tanh\left[g\sqrt{\left(\frac{F_{ave}}{W_1-\frac{1}{2}W_p}-1\right)\frac{C_D A\frac{1}{2}\rho}{W_1-\frac{1}{2}W_p}}\,t_b\right]\right\}$$

Needless to say, the last two formulas are extremely difficult to work by hand. Fortunately, data graphs computed from a very wide variety of values for the variables W_1, W_p, F, C_DA, t_b, and ρ have been prepared by use of a Univac 1107 thin-film memory computer, and are to be found in Centuri Engineering Company's Technical Information Report TIR - 100.

Also, the correction factor for atmospheric density (%) is found by use of the graph of this factor in the report.

General formula for computing aerodynamic drag: $D = C_D A \frac{1}{2}\rho V^2$



Gary Schwede, of Robertson High School, Las Vegas, New Mexico, with his project as exhibited at the 1969 State Science Fair in Socorro. Placing among the top projects in Senior Physics, he went on to win the Junior Academy competition with his project report.

2. Calculations

Numerical calculation done by slide rule.

A. Altitude

flight	alt.
1	---
2	182
3	---
4	182
5	---
6	233
7	---
8	---
9	212
10	212
11	182
12	182
13	234
14	---
15	234

Note: Only the final drag coefficient graph is available for flights 1–4, since these were made with A.8-3 engines and a smaller liftoff weight. These flights were analysed using TR-10 report available from Estes Industries, Inc. Results as to drag coefficient are comparable to those obtained from later flights, as may be seen from the graph. Graphs are available from the author.

The data graphs I used are available in these forms:

Maximum altitude: altitude as a function of weight for specific values of C_DA.

Coast time: time as a function of weight for specific values of C_DA. For more details, see technical information report TIR-100, listed in the bibliography.

I translated the graphic information into a more easily usable form by using specific values of C_D and the known values for A, the resulting points are interpolated in a smooth curve for altitude or time as a function of drag coefficient. Plotting experimental data, on the graphs, reading the values, and correcting for atmospheric density (ρ) gives the actual value for drag coefficient, an important factor affecting rocket performance.

Corrections for Atmospheric Density ($\%\rho$)

Feb. 23, 1969	$\%\rho = .85$
Mar. 5, 1969	$\%\rho = .85$
Mar. 16, 1969	$\%\rho = .84$

Actual $C_D = \%\ \rho$ (C_D from graph), C_D values ±.04

Apex 1 and 1a (nf) uncorrected: .29 actual $C_D = .29$, $(\%\rho) = .29(.84) \approx .24$

Apex 1a uncorrected: .35, actual $C_D = .35$, $(\%\rho) = .35(.85) \approx .30$

Apex 2 uncorrected: .47 , actual $C_D = .47$, $(\%\rho) = .47(.84) \approx .39$

CONCLUSIONS and APPLICATIONS

The Apex series of rockets has shown that the conical configuration is certainly feasible and probably advantageous in many respects. Though my work was primarily intended as a research endeavor, the qualities of the cone shape lend themselves well to speculation as to practical applications.

1. General conclusions.

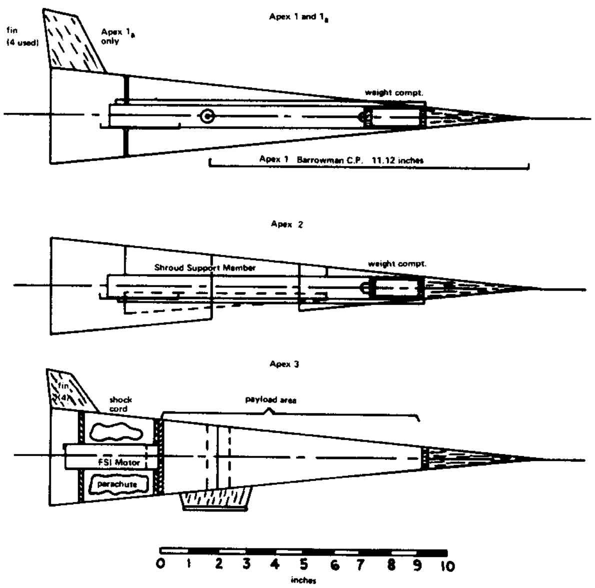
A. The conical shape has inherent stability not possessed by the conventional rocket shape. Without fins, the cone's center of pressure (computed by the Barrowman method) is located at a point 2/3 of the body length aft of the tip of the nose cone.

FLIGHT RECORDS SHEET

(f under remarks indicates the flight was filmed)

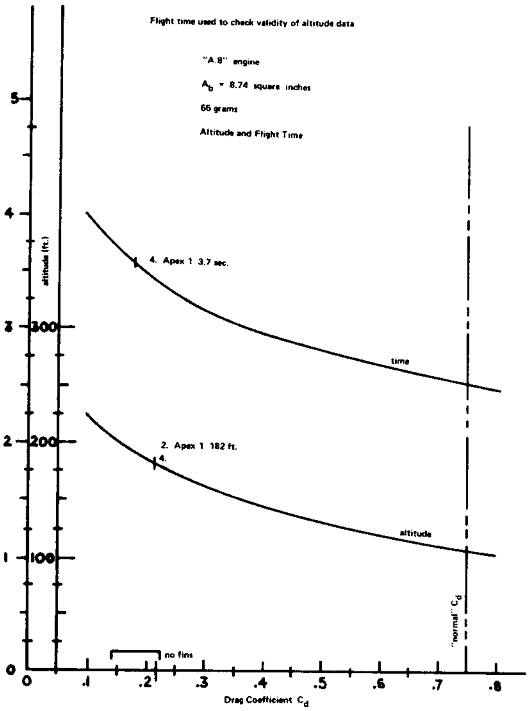
Flight No.	Date	Vehicle	Engine	Tracking°	Time	Data Acceptable?	Remarks
1	Dec. 16, 1969	Apex 1	A.8-3	17	---	no	f, veered west, stable, wt 65 gm
2	Dec. 16, 1968	Apex 1	A.8-3	20	---	yes	f, not complete, vertical
3	Dec. 16, 1968	Apex 1	A.8-3	--	---	no	f, unstable
4	Dec. 16, 1968	Apex 1	A.8-3	20	3.5	yes	f, vertical
5	Feb. 23, 1969	Apex 1	B 6-4	24	---	no	f, traj. doubtful, friction? wt 82 gm
6	Feb. 23, 1969	Apex 1a(nf)	B 6-4	25	4.0	yes	f, good traj.
7	Feb. 23, 1969	Apex 1a(nf)	B 6-4	22	---	no	f, veered south
8	Mar. 5, 1969	Apex 1	B 6-4	--	---	no	f, veered south
9	Mar. 5, 1969	Apex 1af	B 6-4	23	3.5	yes	f, vertical traj.
10	Mar. 5, 1969	Apex 1af	B 6-4	23	3.5	yes	f, vertical traj.
11	Mar. 16, 1969	Apex 2	B 6-4	20	3.4	yes	vertical
12	Mar. 16, 1969	Apex 2	B 6-4	20	3.4	yes	vertical
13	Mar. 16, 1969	Apex 1	B 6-4	25	4.0	yes	vertical
14	Mar. 16, 1969	Apex 1af	B 6-4	20	---	no	veered north, body demolished
15	Mar. 16, 1969	Apex 1	B 6-4	25	---	yes	vertical

VEHICLE DIAGRAMS

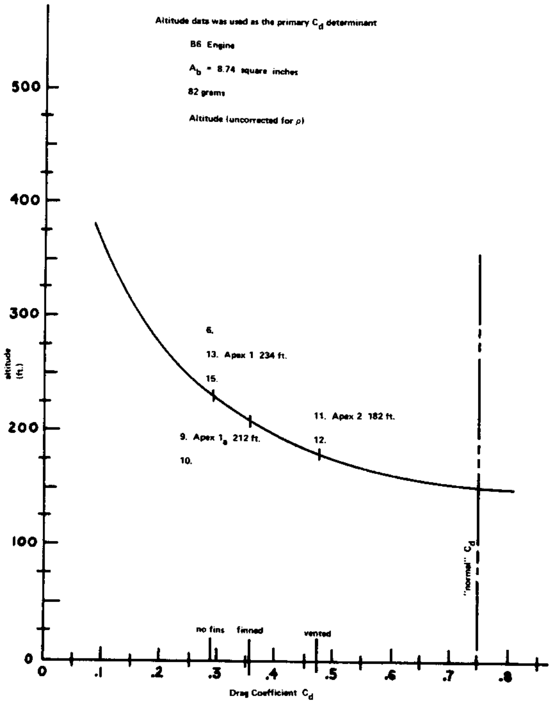


Design Constants:
length = 16.68 inches
base diameter = 3.34 inches
(length/diameter) = 5/1

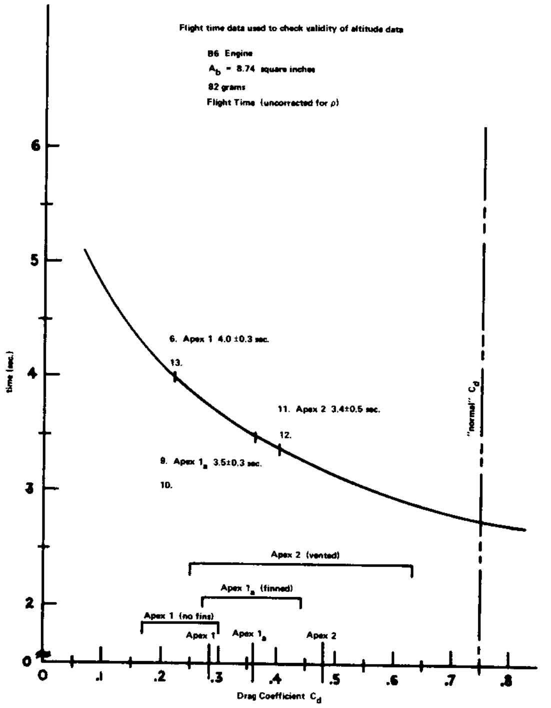
C_d GRAPH: FLIGHTS 1-4



C_d GRAPH: FLIGHTS 5-15



C_d GRAPH: FLIGHTS 5-15



When considered without fins, the conventional rocket has its center of pressure located somewhere *on the nose cone.* This inherent stability is a real advantage of the conical configuration, and makes it possible, in many cases, to obtain a safe margin of stability without the use of fins.

B. The conical shape is a high-strength configuration for rockets. The test vehicles survived many minor disasters and mishaps (dropping onto workshop floor, etc.) which would have severely damaged or completely demolished conventionally shaped rockets. This I know from much past experience.

C. The drag coefficient of the conical test vehicles was from one-third to one-half that of the typical model rocket. This drastic reduction in drag is due, in large part, to the shape of the vehicles tested, not to their exterior finish. Even the addition of fins still leaves a very low drag coefficient value. This low drag is an inherent characteristic of the conical design. This is the most surprising, advantageous, and important general conclusion of this project.

2. Specific conclusions.

Apex 1, $C_D = .24 \pm .04$. Stability–adequate.

Note: The accepted average figure for C_D of model rockets is .75! Apex 1 is the most efficient design aerodynamically of the entire series of test vehicles. However, weight distribution in this rocket is more critical than in Apex 1a, which has fins.

Apex 1a, $C_D = .30 \pm .04$. Stability–excellent.

Apex 1a is the median design in drag coefficient and performance; however, its stability is very exceptional, and this advantage lends itself to many practical applications.

Apex 2, $C_D = .39 \pm .04$. Stability–adequate.

Apex 2's performance proved rather disappointing. Rather than being the most efficient design, it has a higher drag coefficient than even the finned Apex 1a. I now conclude that, though a small amount of the base drag and turbulence may be relieved by the internal venting of this design, the increase in total wetted surface area and resulting friction drag grossly overbalanced this reduction. This, however, does not prove conclusively that venting will not reduce drag on any vehicle. It simply disproves drag reduction for this particular rocket.

Happily, the vented configuration is not a very practical one anyway, as it is very wasteful of internal space.

3. Applications and the Future

Apex 3: Apex 3 proves the conical configuration to be a very good payload carrier design for model rockets. Probably, such a design would be advantageous for professional rocketry and ordnance applications also.

Another chief advantage of the cone shape is its large internal payload area. Obviously, this quality and the low characteristic drag coefficient make the conical configuration very deserving of study for many applications. It is the sincere hope of the researcher that this work and these conclusions will be well utilized in the future.

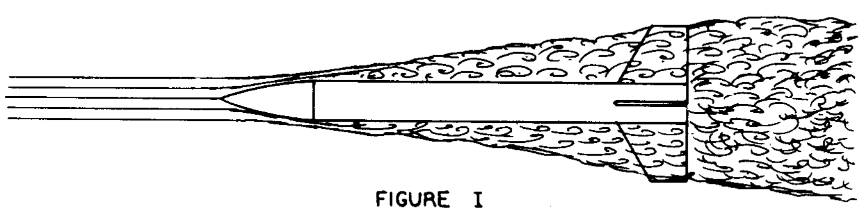


FIGURE I

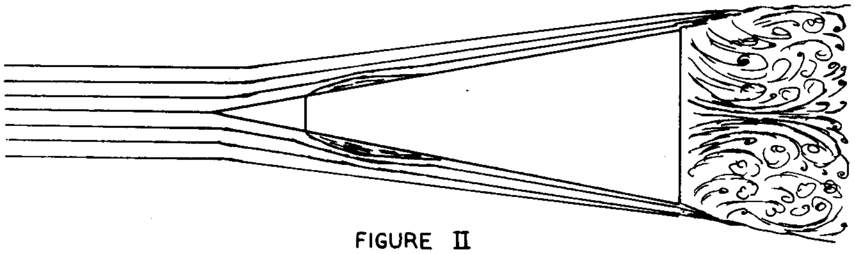


FIGURE II

Explanation of Low Drag Coefficient

One of the main goals of this general study of the properties of conical rocket vehicles was the establishment of valid average aerodynamic drag coefficient (C_D) values for the test vehicles. These values are an important index to performance capabilities.

The unusually low values obtained experimentally seem, on first inspection, to contradict the long-accepted assertion that the cone shape is a very inefficient one for subsonic vehicles. However, a deeper observation of the nature of airflow on conical vehicles and the nature of drag gives rise to a plausible explanation for the low C_D values.

The general drag equation

$$D = C_D A \tfrac{1}{2} \rho V^2$$

contains two variables affected by the vehicle shape and size. These are C_D, the average aerodynamic drag coefficient, and A, the frontal area of the vehicle. The large frontal area is the major disadvantage of the cone shape, and leads, in many cases, to its inefficiency.

However, the large value for A is, to a degree, compensated for by the low average C_D value. C_D is determined by shape and surface smoothness. In a normal model rocket, the boundary layer becomes turbulent, in nearly all cases,before or at the nose cone-body tube joint. This leads to a wide turbulent wake and large resultant energy losses. The turbulent layer is a major factor in the relatively high C_D value (typical average C_D for normal model rocket: .75) for rockets built of a cylindrical body-plus-nosecone arrangement. Figure I illustrates this flow. Fins usually necessary on a cylindrical-body rocket certainly add significant amounts of drag, also.

The conical rocket, in contrast, has a much lower C_D value. Apex 1, for example, has a value of $.24 \pm .04$. I theorize that, since airflow around a cone in flight is accelerated and (by Bernoulli's principle) its pressure is therefore lowered, the boundary layer around a cone tends strongly toward the laminar state. Laminar airflow approaches the state of the frictionless "perfect fluid" theory more closely than turbulent flow, and produces much less viscous drag. This phenomenon may very well explain the extremely low flow drag coefficient values found for conical vehicles.

The nosecone-body shroud joint and the launch lug on a conical model rocket of the type used almost undoubtedly "tripped" the airflow from a laminar to a turbulent state. However, it is theoretically quite possible, and on the basis of experimental results quite probable, that this turbulent boundary layer flow was at some point reconverted into a laminar flow by the above-mentioned conditions. Figure II represents the theorized flow about a conical rocket vehicle.

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Astroscale Data

NIKE-SMOKE

NASA METEROLOGICAL ROCKET

by G. Harry Stine

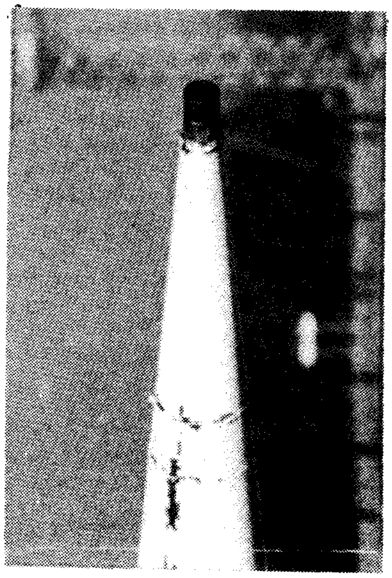
The Nike-Smoke sounding rocket is a single-stage solid propellant rocketsonde used by NASA to determine wind velocities up to an altitude of 75,000 feet above sea level. The propulsion unit is a standard Nike M-5 solid propellant rocket motor. Four cast and wrought magnesium fins are attached to the aft end of the motor casing. The payload is approximately 10 gallons or 144 pounds of titanium tetrachloride ($TiCl_4$) contained with a 10-degree conical nose cone fabricated of 341 stainless steel. Upon ejection of the $TiCl_4$ into the atmosphere during the flight of the Nike-Smoke rocketsonde, chlorides are formed which combine with the water vapor in the air to form droplets of hydrocloric acid (HCl). This reaction results in a persistent and reflective white trail which is photographed by two cameras approximately 10 to 12 miles from the launch site and 90 degrees apart in Azimuth. Wind profiles are obtained by photographic triangulation techniques utilizing time-lapse photographs of the smoke trail from the two cameras. The Nike-Smoke is usually launched from a modified Nike SAM launcher.

The Nike-Smoke program was initiated by and was under the direction of NASA Langley Research Center, Va. The Nike M-5 rocket motor was chosen because it offered the total impulse and thrust necessary to carry the required payload of $TiCl_4$ to the altitudes desired and because of its ready availability. Literally thousands of M-5 motors were manufactured for the Nike anti-aircraft missile deployment program. One M-5 was used to boost the original Nike-Ajax, while a cluster of 4 M-5's were used as a booster for the Nike-Hercules.

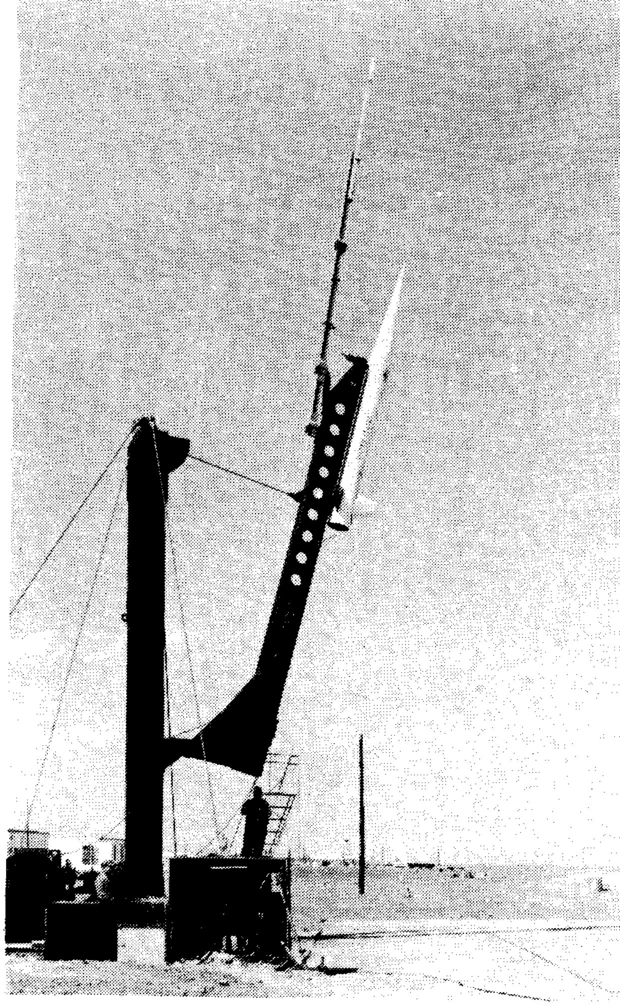
During the period from May 1962 to May 1963, 55 Nike-Smoke vehicles were flown from Cape Kennedy to investigate upper wind profiles. All Cape Kennedy rounds in this series were launched at an elevation of 80 degrees on an azimuth of 60 degrees true. Fifty-three percent of the vehicles fell within a radius of one nautical mile of the desired impact point.

During the period from July 1963 to January 1965, approximately 70 Nike-Smoke vehicles were launched from NASA Wallops Station, Virginia. Launch elevation was 80 degrees on an azimuth of 100 degrees true.

During the development phase of the Nike-Smoke project, the Project Manager was Harold B. Tolefson, and the engineers involved in the project included Charles M. Dozier, Robert M. Henry, and Robert W. Miller.



Detail of Nike-Smoke nose section shows the inlet port detail. Note that the pipe is painted black.



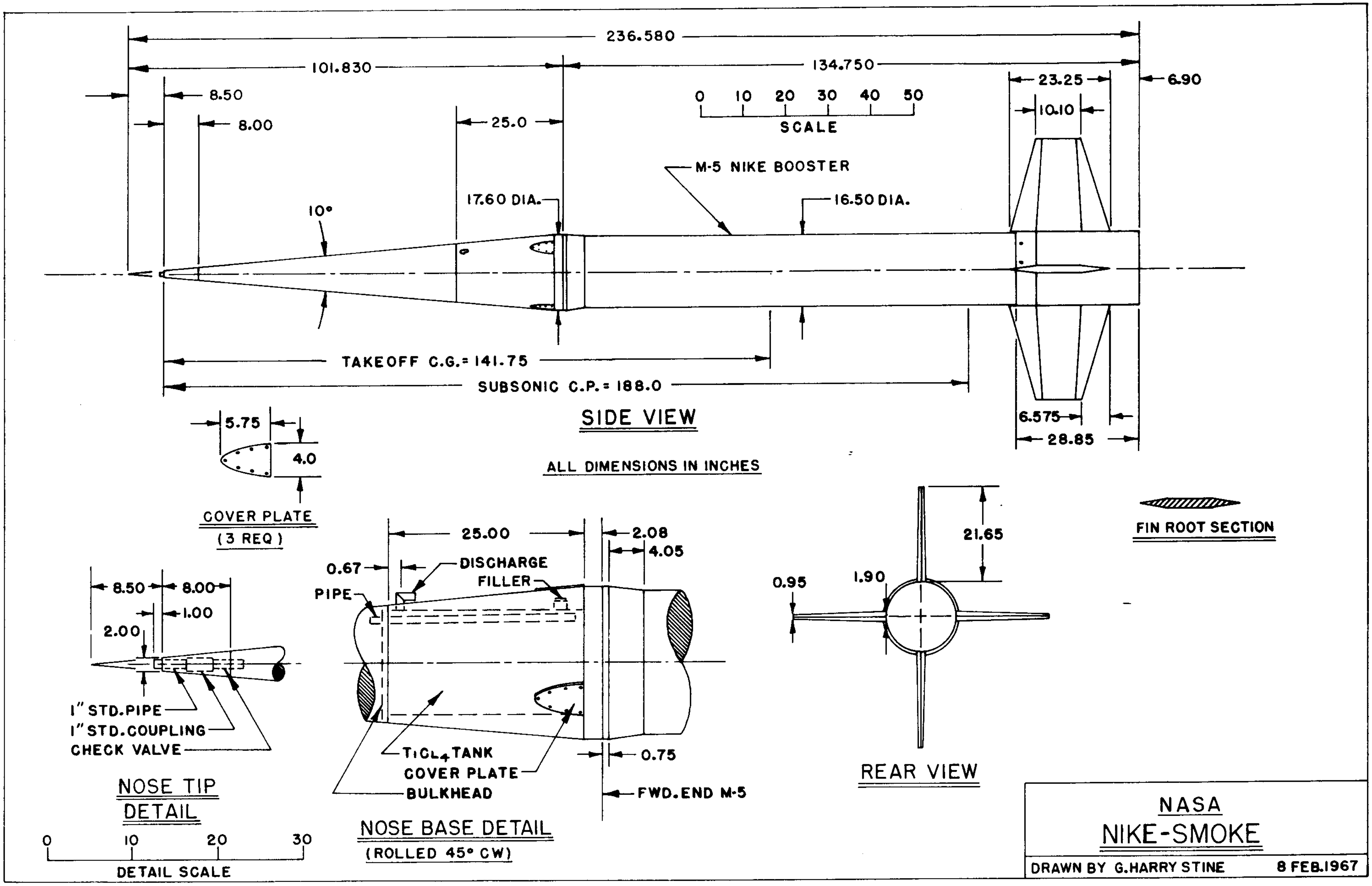
Nike-Smoke vehicles proved themselves to be an inexpensive and reliable method of determining upper wind profiles. Hundreds of them were launched during the 1960 decade from Wallops Station for meteorological purposes.

The components of the Nike-Smoke are assembled and then checked for alignment and CG position. This is normally done in a horizontal position inside an explosives assembly area. The vehicle is then placed horizontally on a standard Nike-Ajax launcher or upon a boom or rail launcher. Both types of launchers have been used at NASA Wallops Station, although rounds flown at other locations have used the standard Nike rail launcher.

Approximately 10 gallons of $TiCl_4$ are loaded into the canister inside the nose cone through one of the removable nose base hatches. The vehicle is then "buttoned-up" and the launcher is raised to the proper elevation.

A standard zero-delay M-24 electrical igniter fires the Nike-Smoke on ground command.

During thrusting while the vehicle is being subjected to high positive longitudinal acceleration forces, the $TiCl_4$ liquid is forced against the aft end of the canister. Thus, the chemical surface is about one inch from the forward plate of the canister. Air is forced into the forward part of the nose cone through a one-inch pipe and a check valve – whose purpose is to later prevent



NASA
NIKE-SMOKE
DRAWN BY G.HARRY STINE 8 FEB.1967

Nike Smoke test round (above) is prepared for launching from the Cape Kennedy sounding rocket site. Note the azimuth adjustment employing a semi-circular track system.(NASA Photo L-65-4760)

pressurizing air from escaping through the nose pipe – and thus enters the chemical canister through the pressurizing pipe. It then bubbles through the $TiCl_4$ and flows out through a discharge orifice on the side of the nose cone. This orifice is approximately 5/16-inch in diameter. A small amount of $TiCl_4$ is also expelled during vehicle acceleration.

Upon burnout of the M-5 motor, the vehicle experiences negative longitudinal acceleration caused by aerodynamic drag. This forces the chemical against the canister's forward plate. The aerodynamic ram pressure that has entered the nose cone through the forward nose pipe then squirts the chemical out through the discharge orifice until the supply of $TiCl_4$ is exhausted. The check valve in the nose tip traps air in the upper portion of the nose cone and, as the Nike-Smoke ascends into the thinner upper air, this reservoir of air pressure inside the nose cone continues to expel the chemical. The discharge orifice size is calculated to expel the $TiCl_4$ at such a rate that it becomes exhausted shortly after the Nike-Smoke reaches apogee.

The entire Nike-Smoke vehicle is allowed to impact in the ocean with no attempt being made to separate or recover any part of the vehicle.

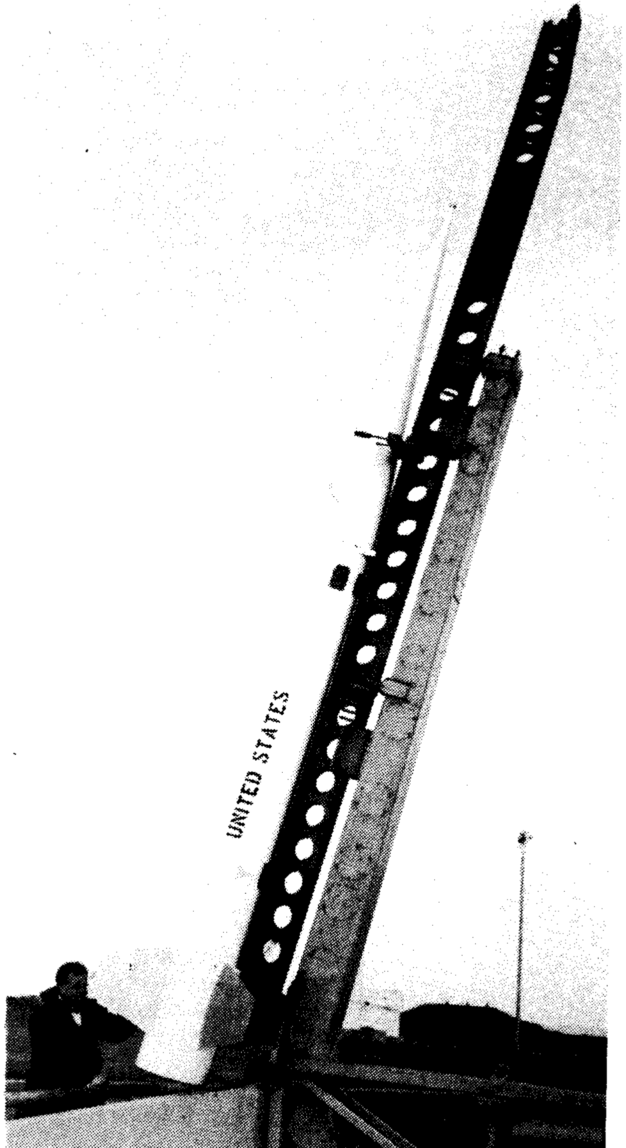
Photographs are made by two trajectory cameras at six second intervals for a period of five minutes. These photographs are studied by photogrammetric data reduction techniques. They provide data on wind speed, wind direction, and wind shear at altitudes up to 75,000 feet.

Weights:

Gross (takeoff): 1560.7 lb.
Propellant: 764 lb.
Burnout: 796.7 lb.
Payload: 144.0 lb.
M-5 Nike Booster assembly: 431 lb.
Fins: 69.2 lb.
Nose cone assembly: 152.5 lb.

Performance:

Burnout time: 3.5 seconds
Burnout altitude: 6294 feet
Burnout acceleration: 47.2 g
80 degree launch angle
Apogee: 75,200 feet
Apogee time: 65 seconds
Splash time: 147 seconds
Splash range: 56,500 feet.



Nike-Smoke (right) shown on a standard Nike-Ajax launcher assembly in 1964. (NASA Photo L-64-3401)

An early Nike-Smoke being inspected before launching in 1962. (NASA Photo L-62-663)

Civil Air Patrol Adopts Model Rocket Program

The Civil Air Patrol has established model rocketry as an authorized activity in its cadet program. Model rocketry will be used to "supplement and enrich aerospace education" of the cadets.

Only "model rockets" constructed of paper, plastic, balsa wood or any other non-metallic products are approved for use by CAP members. Commercially made solid propellant model rocket engines are the only type approved for CAP members. Amateur rocketry, "in which metallic airframes and homemade propellants are used . . . is extremely dangerous and not to be practiced in Civil Air Patrol model rocketry activities." (CAP manual 50-20)

The purpose of this new program is to acquaint CAP cadets with the importance of rocketry, increase their knowledge in the aerospace sciences, arouse interest in aerospace careers that require a knowledge of rocketry, and employ an interest in model rocketry to enrich the total development of CAP cadets.

A six week model rocket program, with one meeting and one laboratory session each week, is suggested as an initial activity. This program provides a classroom period for instruction in the basic skills of model rocketry. It culminates in the construction and firing of a single stage model rocket. Cadets in the program also construct a launching system and tracking devices. Beyond the six week introductory program, cadets are urged to continue developing model rocket skills using the **Handbook of Model Rocketry** as a basic text.

The CAP model rocket program will be conducted in accordance with the safety procedures and rules outlined in the *United States Model Rocket Sporting Code* of the National Association of Rocketry. Each CAP squadron conducting the model rocket program is encouraged by the CAP manual to establish an NAR section. CAP units would then enter into competitive meets with other NAR sections on an area, regional, and national level.

MPC Retains Stine as Consultant

Model Products Corporation of Mt. Clemens, Michigan has announced that they have acquired the consulting services of G. Harry Stine for design and technical advice in the field of model rocketry.

Stine, a founder and past president of the National Association of Rocketry, will assist M.P.C. in the design of model rocket products. A well-known international authority on both full-scale and model aeronautics, Stine's consulting role with M.P.C. will allow him to continue work as Chairman of the Rocketry Subcommittee of the Federation Aeronautique Internationale and as chairman of the NAR's Liason Committee.

The author of the comprehensive **Handbook of Model Rocketry**, Stine is also consultant for launch vehicles to the National Air and Space Museum of the Smithsonian Institution, a science advisor to CBS news, and a consultant to the Institute for the Future.

In securing Stine's exclusive consulting services, M.P.C. has obtained the valuable experience of over a decade of model rocket activity.

M.P.C.'s new model rocket consultant is also a fellow of the Explorers Club and the British Interplanetary Society, and Associate Fellow of the American Institute of Aeronautics and Astronautics, a member of the New York Academy of Sciences, and a member of the Pyrotechnics Committee of the National Fire Protection Association. His **Handbook of Model Rocketry** won the coveted Carnegie Library Foundation's 1967 award for the best technical book of the year.

NEWS NOTES

International Records Set

The Federation Aeronautic International has been informed that five participants at NARAM-11 intend to file for international model rocket performance records on the basis of flights at that meet. The records are in the FAI catagories of Single Payload, Sparrow Boost Glider Duration, Parachute Duration, Open Payload, and Swift Boost Glider Duration.

Tammy Benson of the MARS Section filed for the Swift Boost Glider Duration record with a flight of 143 seconds.

Sven Englund of the YMCA Space Pioneers acheived an altitude of 296 meters, a record in the Single Payload catagory.

Eleanor Stine, also of the YMCA Space Pioneers, filed for the Sparrow Boost Glider Duration record with a flight of 120 seconds.

Jess Medina of Seattle Washington filed for the Parachute Duration record with his flight of 209 seconds.

The Ball-Hagedorn Team (Douglas Ball and Robert Hagedorn, both from Manesfield, Ohio) filed for the Open payload record with a flight to 603 meters.

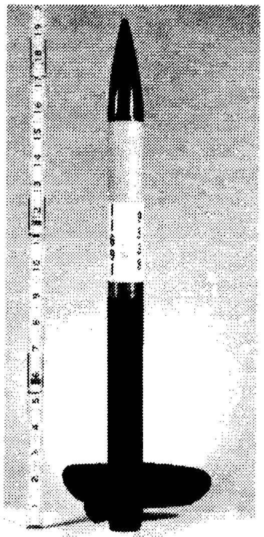


Photo by Vic Day

Shown above is the Ball-Hagedorn Team Open Payload entry at NARAM-11. Application has been made for an international record for its flight to 603 meters.

COMING NEXT MONTH: PLANS FOR THE RECORD SETTING BALL–HAGEDORN PAYLOADER.....

Technical Notes

by George Caporaso

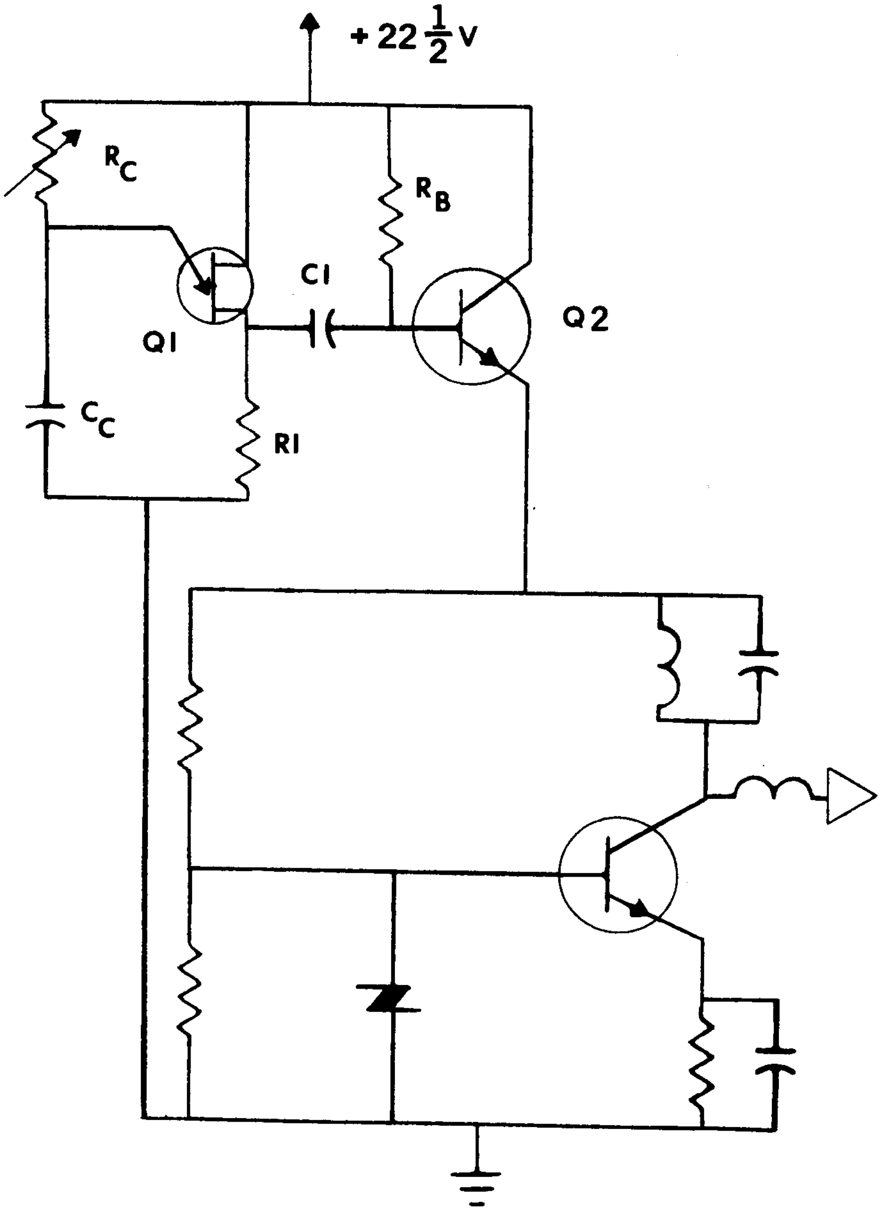
This month we will discuss some points about model rocket transmitters and sensors. The series of articles by Richard Fox on transmitters and sensors has provided model rocketeers with the first comprehensive set of plans for a reliable transmitter that is both inexpensive and reasonably small. Fox's design was the foundation, the first step, the breakthrough. It is now up to the rest of the modelers interested in this problem to further refine his designs and invent new and more useful sensors.

The present transmitter (of Fox) has 5 transistors, one citizen's band crystal, 2 r.f. chokes and a handful of small capacitors and resistors plus a sensor and a 22½ volt battery. Most of the resistors in the circuit can be of the ¼ watt type and the capacitors used can be very tiny tantalum components. The chokes used in the circuit can either be purchased or wound to a very small size.

A major problem in reducing the size of the present Foxmitter is that of reducing the number of transistors. As mentioned in Fox's May article in **Model Rocketry**, the unijunction transistor acts in conjunction with the sensor and a capacitor as a relaxation oscillator. The output of that oscillator is fed into a three stage Darlington amplifier which controls the flow of current to the transmitter stage.

In this circuit, only about 12 volts appears the transmitting stage, the other 10½ being dropped across the collector-emitter junctions of the Darlington transistors and across the base 2-emitter junction of the unijunction transistor. This voltage is pure waste! Something should be done either to utilize that wasted voltage (and power) in the collector-emitter junctions or sythesize a network that can operate at 12 volts.

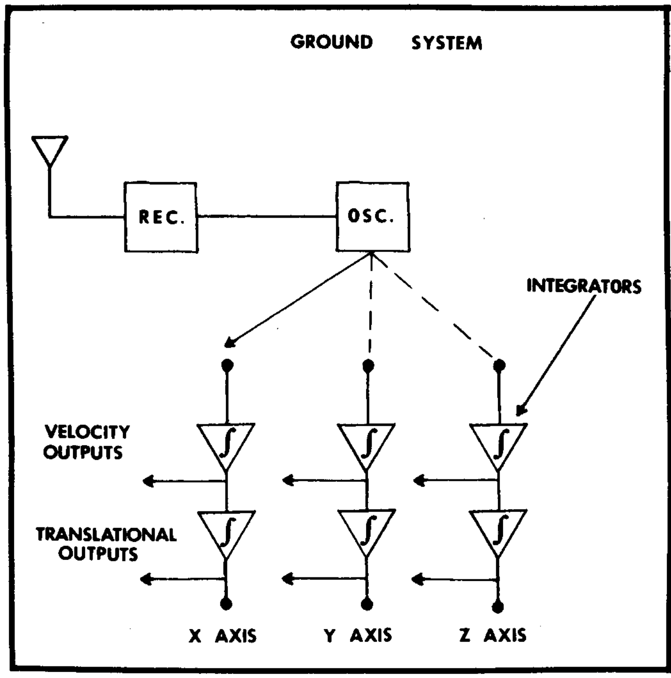
As mentioned previously Fox's transmitter uses a three-stage Darlington as a current amplifier. The author has found, however, that since the current requirement of the transmitting stage is so low (on the order of 12 ma.), the Darlington stage can be replaced by a single 2N697 emitter follower stage as is shown in the accompanying diagram. The unijunction transistor relaxation oscillator was also modified to a somewhat more simple circuit as shown in the schematic. With the 2.2 microfarad charging capacitor a charging resistor R_c of at least 2.5 kohms must be used to insure oscillation. The larger the beta of the 2N697, the better because of the lower loading of the base 1 resistor that will result.

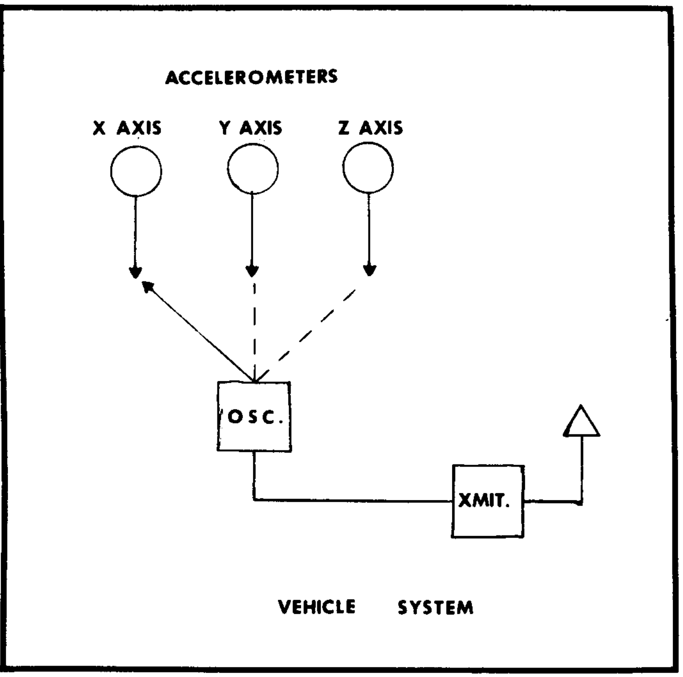


PARTS LIST FOR MODIFIED TRANSMITTER

R_c – Sensor resistor, at least 2.5k
R_1 – 100 ohm, ½ watt
R_b – 100k, ¼ watt
C_c – 2.2 ufd., electrolytic (negative terminal to ground)
C_1 – 1.0 ufd., electrolytic tantalum
Q_1 – 2N490 Ge unijunction transistor
Q_2 – 2N697 NPN transistor

NOTE: All unmarked components are identical to the transmitting section of the Foxmitter.





Typical betas for the 2N697 range from 20-60 presenting an input impedance (to the emitter follower) of from 20 kohms to about 33 kohms. The sensor oscillator will still function, however, at a beta of 10 with a loading impedance of about 10 kohms.

Once the above mentioned modifications have been made, the Foxmitter will have two less resistors and one less capacitor. It's not a "great leap for mankind" type of miniaturization, but it's a start.

Once the hoped-for improvements in the transmitter have been forthcoming all sorts of hairy things will come creeping out of people's minds for innovations and more sophisticated sensors.

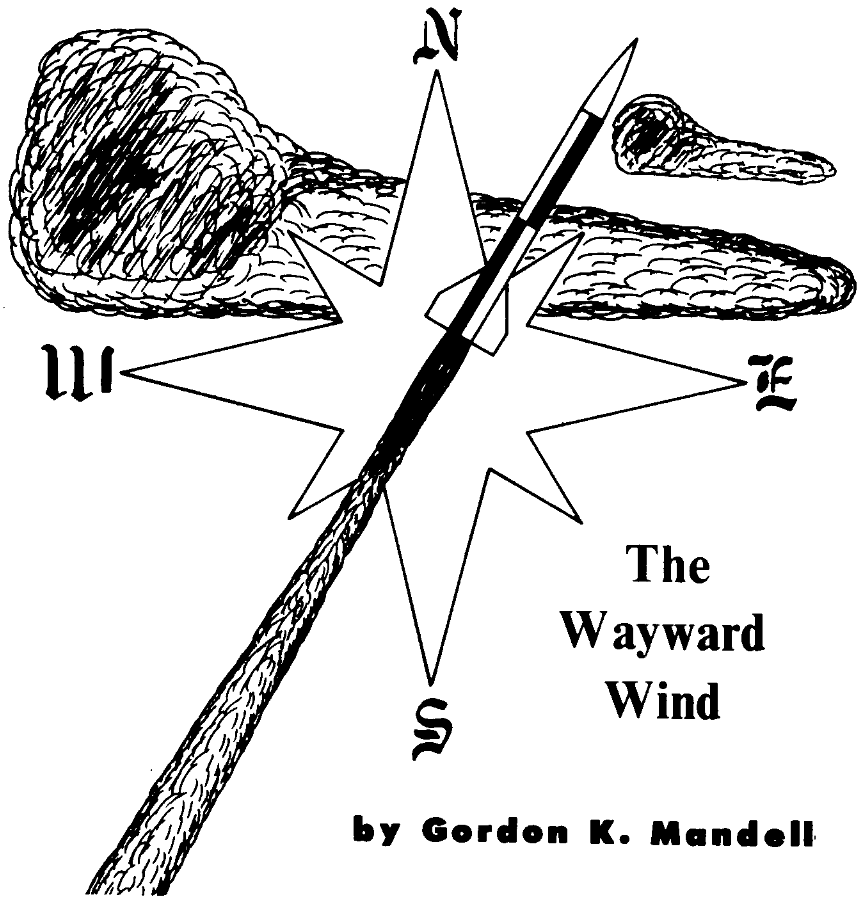
For instance, an absolutely lovely but complicated creature would be a transponder module. Essentially, the transponder must have a receiver to accept pulses from the ground and a trigger mechanism that performs two functions: it must temporarily shut down the receiver and simultaneously send a pulse to the transmitter. The transmitted pulse will reach the ground where the time-delay between the original ground-originated trigger pulse and the returned pulse can be measured by either a time-gate circuit or a triggered-sweep oscilloscope. The transponder's receiver is temporarily shut down so that it won't pick up its own transmitted signal, a situation that might result in catastrophic oscillation of the transponder. The transponder will require a 27Mc. receiver stage as well as some micrologic circuits to perform the triggering and receiver shutdown and turn-on. With today's microcircuit stockpile such a device would not be too large to be impractical.

Another, even more intriguing possibility, is a multiple-axis accelerometer telemetry system. Professional, manned spacecraft use a three-axis accelerometer system which is capable of measuring the acceleration along the x, y, or z axis very accurately. The acceleration signals are then integrated by the spacecraft's computers to give the velocity of the vehicle along the same three axes. The velocities can again be integrated to yield the distances travelled along the three axes.

An accelerometer module that could produce acceleration information (voltages) for two or three axes would be highly useful. The signals could be rather easily integrated on the ground by simple operational amplifier circuits to provide instantaneous data on all three components of acceleration, velocity, and distance (translation). In this manner, the precise location of the vehicle with respect to the launch area could be determined. The sophistication of the equipment required on the ground will be somewhat greater than the also complicated and sophisticated accelerometer module.

Dick Fox has already presented plans for an accelerometer. These must be further refined to the point where the accelerometer circuits *have outputs proportional to the accelerations.* The accuracy must be greatly improved. An additional feature for the successful operation of the module is also needed; that of sending three channels of data. As has been proposed by a recent correspondent of Gordon Mandell's, an oscillator can be constructed that will alternately switch rapidly back and forth from the transmitter to each of the three channel inputs. The three channels can similarly be re-separated on the ground by an identical switching oscillator and then fed to three circuits with two ganged integrators. The concept of the system is perhaps made a bit more transparent by the block diagram accompanying the text.

Today, no area of technology is advancing more rapidly than the field of electronics. The Foxmitter has now provided an opening for model rocketeers. We will now be able to utilize the advances in electronics to build highly sophisticated payloads, telemetering and control systems, and range determination systems. Start designing . . . or the transmitter may very well be known as the Foxmitter for evermore!



The Wayward Wind

by Gordon K. Mandell

DRAGBRAKES REVISITED

Another one of those things people seem to be perpetually re-inventing in model rocketry is the dragbrake—a form of recovery system that relies on rigid vanes or plates deployed into the airstream by various devices actuated at engine ejection. The rocket is not destabilized, nor is its nosecone separated from its body, but the dragbrakes increase its frontal area sufficiently to cause it to fall to earth slowly, nose first but in a controlled manner, thus meeting the requirements of safety and reusability which define a satisfactory model rocket recovery system.

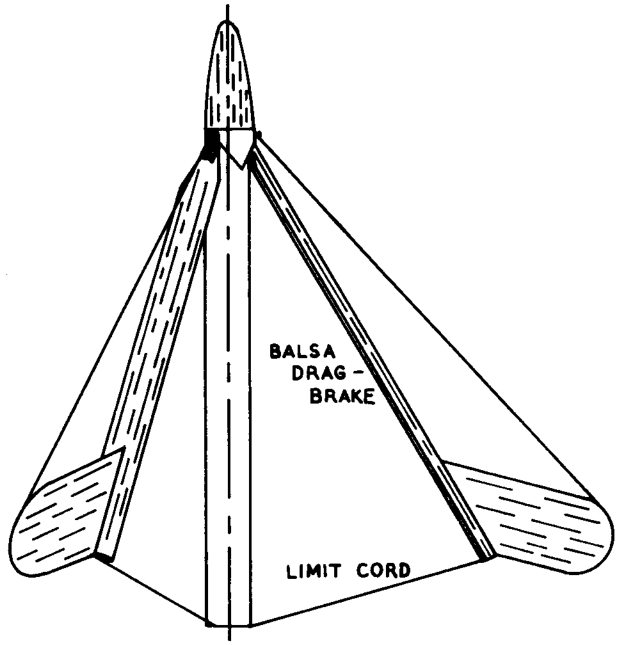
Dragbrakes, of course, are neither new nor peculiar to model rocketry. They have been in use on full-sized airplanes since before the Second World War (those of you who are aviation history buffs will no doubt recall the famous films of dragbrake-equipped Stukas blitzing Rotterdam, as well as those of split-flapped SBD's destroying the naval might of the Japanese Empire). Model rockets have used such devices in various forms since late in 1962, and the variety of configurations developed since that date has been considerable.

It may well be that there were some researchers who, even before then, had done some work along these lines, but faulty communication (as always) takes its toll and we must declare their names and accomplishments lost in the mists of time. . .to me, at least. The first dragbrake recovery system I can recall with any clarity is the one developed by Mitchell Pines, NAR No3933 (now an engineering undergraduate at Pitt University) during the winter of 1962-1963. As I remember it, the first fully-successful rocket to use the system looked a lot like Figure 1. The brakes themselves were made of curved strips of 1/32-inch balsa hinged at the nose with pieces of gauze, paper, or in later models, model aircraft silk. Actuation was provided by lengths of bungee cord (the kind used on boost-gliders for raising elevons), one length running from each of three corresponding fins, mounted in the center of its corresponding dragbrake. The purpose of mounting the fins on the brakes this way was to provide enough of a moment arm through which the bungee cord tension could act to permit a successful deployment against the force of the airstream. Some early versions of this design had failed to deploy their brakes when the fins were mounted directly on the body tube and the bungee cord was simply tensioned parallel to the body and fastened to the rear of the brake.

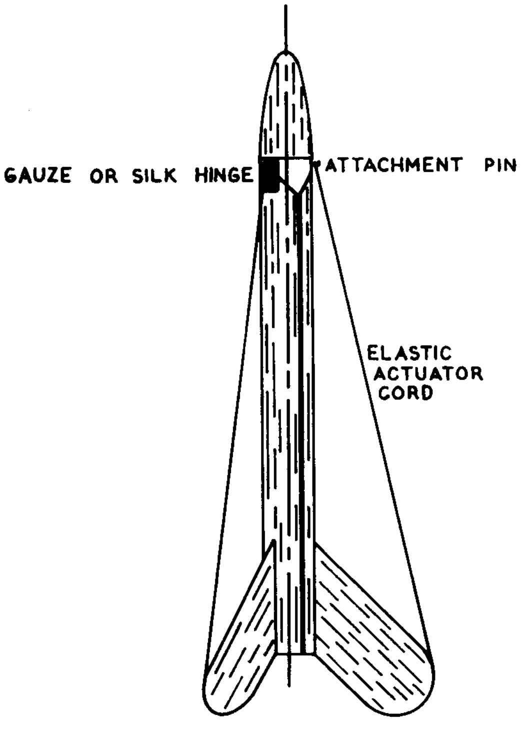
A short length of string was attached to the rear of each dragbrake to hold it in the stowed position during boost. This was accomplished by wedging the string between the engine casing and the body when inserting the engine. The brakes would be released for deployment when the ejection charge blew the engine casing out the back of the body tube, freeing the ends of the strings. No complications arose from the necessity to eject the casing, as at that time NAR regulations permitted an engine casing to be expelled from its airframe without any kind of a recovery device attached. There was in fact little or no danger involved in this practice, so long as the ejected casing was not larger than one of the 18 x 70 millimeter types. I was hit by falling casings on several occasions and, although you *could* feel it and it was a startling experience, it didn't really hurt. With the coming into common use of larger engine sizes, however, it was necessary for NAR to adopt some quantitative rule with regard to the permissible ballistic coefficient of an ejected object. The result was the present "10 sq. cm. per gram" recovery rule (paragraph 3.5 of the 1967 U.S. Model Rocket Sporting Code), which would require some modification of the Pines dragbrake system were it to be designed today.

In its final form (spring, 1963) the vehicle of Figure 1 was in fact reasonably reliable and successful in operation. Some difficulty was experienced with partial or skewed deployment of the brakes, and the vehicle sometimes had a tendency to descend tail-first with its dragbrakes trailing in the airstream behind the nose like the ribs of a broken umbrella. This last difficulty could be corrected by installing "limit lines", similar to the retaining strings, between the rear of the body tube and the dragbrake trailing edges so as to prohibit brake deployment beyond a certain point. In practically every flight, however, the brake system succeeded in slowing down the vehicle sufficiently so that no damage was sustained on landing. Mitch Pines's dragbrakes, whether or not they were the first in the hobby, represented very nearly the complete state of development of that class of brakes which are deployed from stowed positions on the body tube and which, therefore, are known as "body brakes".

There exists a second class of dragbrakes whose possibilities do not appear to have been explored: those types which are deployed from the fins, or into which the fins are transformed at ejection, and so are called "fin brakes". One possible configuration of fin brakes is shown in Figure 2, featuring split flaps at the trailing edges of the fins. The engine casing is fitted with a collar containing notches which retain the fin trailing edges in streamlined configuration during upward flight. The collar is expelled with the engine at flight apex, releasing the flaps to be deployed by the action of the bungee cords anchored at rudder-like appendages near the fin tips. The



DESCENT:
BRAKES EXTENDED



ASCENT:
BRAKES RETRACTED

Figure 1. The Pines body-mounted dragbrake system of 1963. During ascent (below) the brakes are held in the retracted position by using the engine casing to pinch the limit cords against the inside of the body tube. When the engine is ejected at flight apex (above) the cords are released and the brakes extend. Although illustrated in a nose-up position, the rocket actually falls slowly to earth with its nose pointed down.

frontal area of the rocket is thus increased by a large factor, and it falls slowly to earth. If you build one of these, you will have to remember to use a body tube large enough to allow a streamer or parachute to be wrapped around the engine, unless you devise some rearward-ejecting parachute system. Recovery of the casing is necessary both for conformance with NAR safety regulations and for retrieval of the engine collar.

I want to emphasize here that the fin-brake category does *not* include fins whose configuration is changed at ejection to induce a *spinning* of the rocket on the way down, thereby slowing it. It is true that these devices are dissipative in nature, but they do not function by direct dissipation of the translational kinetic energy of the falling model. Instead, they transform energy of *translation* into energy of *rotation* by spinning the rocket and *then* dissipate the energy of *rotation* by means of roll damping. Consequently, this class of recovery devices, which should be properly called "spin brakes", is distinct from the dragbrake category.

I said such systems *should* be called spin brakes and this, unfortunately, is precisely correct; at present, various physically misleading names such as 'helicopter fins', 'autogyro fins', or 'gyroglider recovery' are applied to them. Helicopters and autogyros are powered devices and are thus immediately disqualified from the category. The *blades* of a helicopter are powered in rotation and spin in a direction tending to lift the machine into the air, not in the direction a pinwheel, a turbine, or a windmilling airplane propeller does. What's more–and few people know this, or believe it until they see it–*so do the blades of an autogyro or gyroglider.* Although the rotors of the latter two machines are not powered, they travel through the air nearly edgewise, so the forces which spin them arise from the airfoil behavior of the blade cross section. Since the pressure distribution of an airfoil at small angles of attack is characterized by a "suction peak" near the leading edge, the blades are pulled forward through the air in the direction which causes them to generate lift; that is, in the *same* direction they would turn if driven by an engine. This phenomenon, called "autorotation", is the basis of operation of all autogyros and gyrogliders and is the principle which permits helicopters to land safely by means of an autorotative glide when their engines have failed. The rocket with roll-braking fins, on the other hand, rotates in the same direction as a turbine wheel does, extracting energy from an airstream which is traveling nearly "head on"; that is, parallel to the axis of rotation. Figure 3 illustrates the difference between autorotation and spin braking.

Body-mounted dragbrakes and spin-brake systems have often appeared on the model rocket flying field. Fin-brake

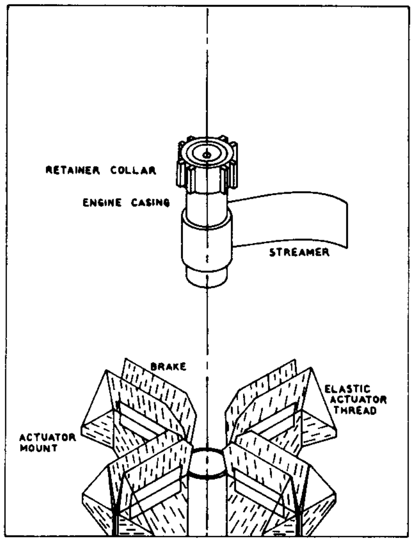


Figure 2. One possible type of fin-brake system, using elastic thread to actuate split flaps at the fin trailing edge.

systems, on the other hand, are vanishingly rare. All are basically curiosities; none offer any special or compelling technological advantages. Why bother with them, then? The answer is simply this: it is one of the attractive features of a hobby (indeed, an essential part of its definition) that the only sources of motivation needed to engage in it are those of challenge and enjoyment. The goal need not necessarily be precise, technical optimization. It's tough and it's fun to design workable dragbrake and spinbrake recovery systems–and as long as we do things for precisely these reasons model rocketry will continue to thrive.

The above was just one of many examples of inventions, ideas, and concepts that have been rediscovered time and again throughout the history of model rocketry at a shameful waste of talent and brainpower–a waste that could have been avoided if an effective forum for the presentation of such developments had been available.

Model Rocketry *provides such a forum in* The Wayward Wind. . . *so why break your back duplicating somebody else's work? Send that pet theory, idea, design, gadget, etc., to me in care of* The Wayward Wind, Model Rocketry, *Box 214, Boston, Massachusetts 02123. If we don't know about it, you've got a clear go-ahead for further development. If we do, you'll avoid repeating something that's already been done and be able to pick up where the last man left off if development is not yet complete or go on to something else if it is. Don't be secretive, or the value of your work may be lost forever. . . or you may not get credit for it when it finally comes to light. Contribute something to your hobby; be a useful member of its R & D community. Let us hear from you.*

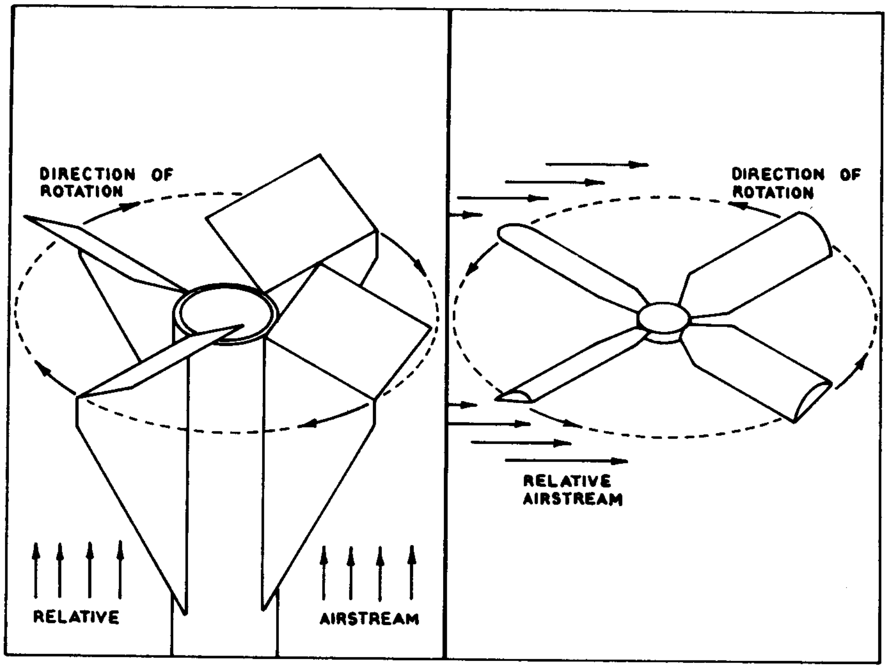
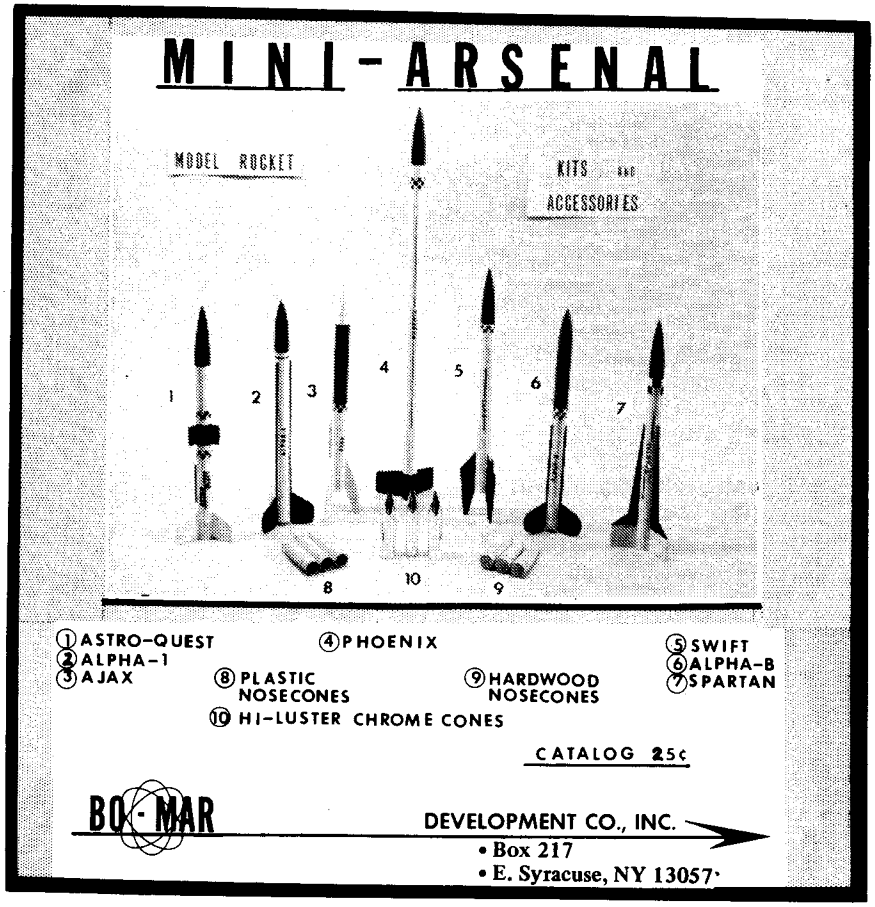


Figure 3. Illustration of the difference between spin-braking as used on model rockets and autorotation, the basis of operation of autogyros and gyrogliders. In the spin-braked rocket (left) the relative airflow is virtually perpendicular to the plane of rotation. In the autogyro rotor (right) the relative airstream is nearly in the plane of rotation; the blades rotate in the opposite direction from the rocket even though the surfaces, as viewed from comparable positions, are inclined in the same direction. Unlike the rocket, the autogyro rotor actually produces aerodynamic lift.



Build the ACHILLES-X Fin Test Vehicle

by Michael Mabon

The Achilles-X was designed to test different fin shapes simply, inexpensively, and reliably.

This design represents the "perfect equation" for fin testing. The weight and shape of the recovery unit stay the same. The weight of the BT-20M's will stay the same also. The only thing that changes is the weight and shape of the fin you are testing. (Just remember to use the same type of engine for each flight.)

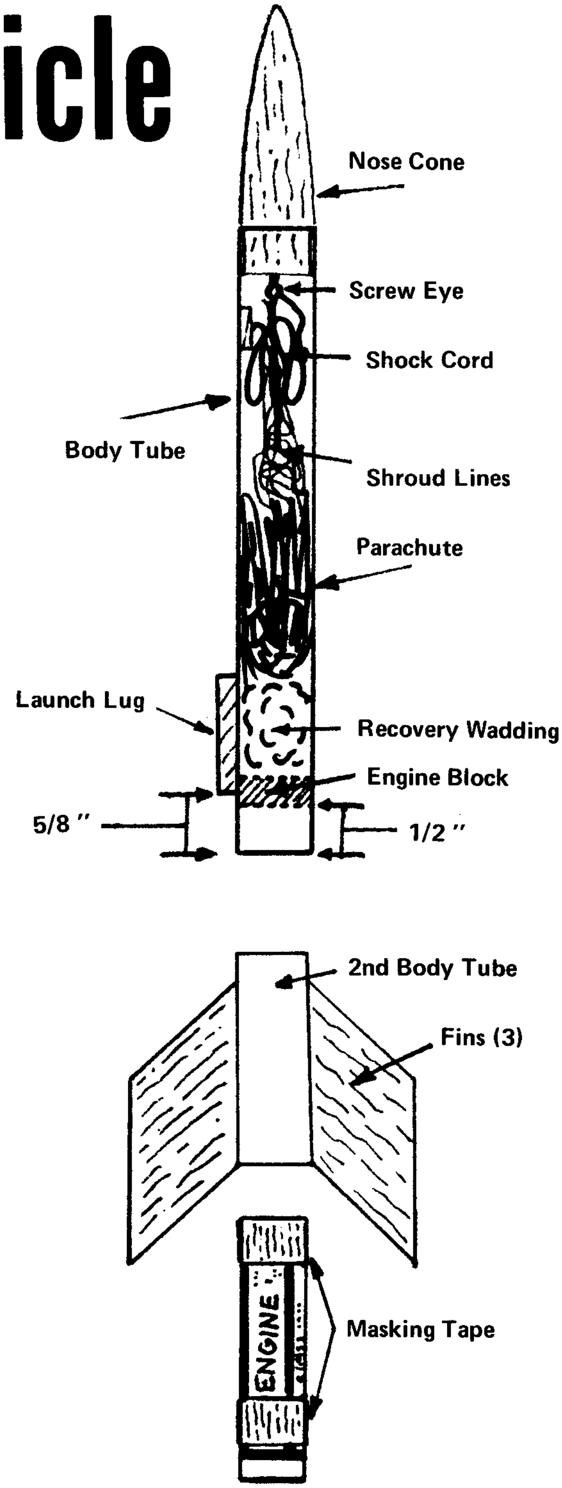
The design is very inexpensive, making it available to almost any rocketeer who wants to carry out such a program. After the initial cost of building the Achilles-X (including the recovery unit and one fin unit), the only additional costs would be for engines, fin stock, and BT-20M's, depending on the number of fin shapes you wanted to test.

The rocket is held together with the engine. Apply tape to the engine as shown to form a *tight* friction fit.

Be sure to test it for stability before you fly it. If not stable, change fin shape but don't add nose cone weights . . . that would introduce extraneous factors into the experiments and ruin the validity of the data.

PARTS LIST (All parts Estes)

Nose cone	651-BNC-20N
Body tube	651-BT-20D
Body tube	651-BT-20M
Launch lug	691-LL-2A
Parachute	651-PK-12
Shock cord	671-SC-1
Screw eye	651-SE-2
Engine block	651-EB-20A
Fins	651-BFS-20
Recovery wadding	651-RP-1A

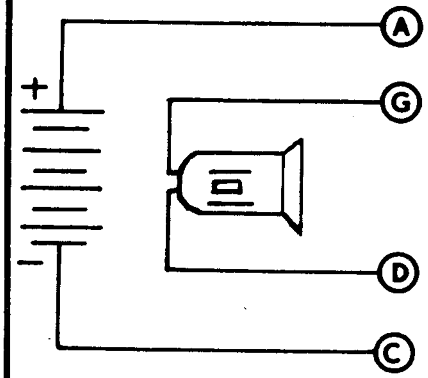


ACHILLES—X
½ Actual size

ADD A MICROPHONE TO YOUR FOXMITTER

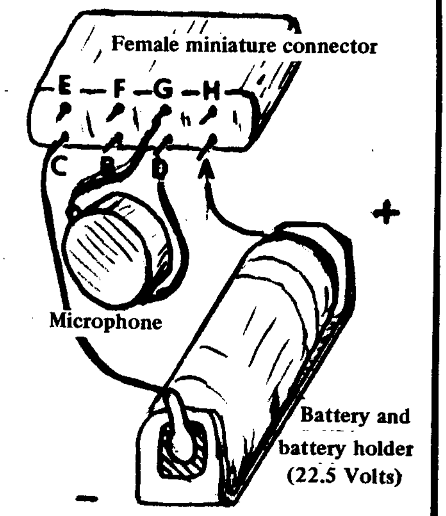
by Richard Q. Fox

FIGURE 1
SCHEMATIC



Microphone module

FIGURE 2
WIRING DIAGRAM



Parts List

M1	Microphone (crystal earphone)	Lafayette no. 99H2551
B1	22.5 volt Battery	Burgess Y15
	Battery Holder	Lafayette no. 34H5005
	Plug (Ultraminiature R/C Connector)	Lafayette no. 99H9091

This article is the sixth installment in a series on a 100 m.w. transmitter for use with model rockets. This installment describes a microphone module for the transmitter, which allows reception, on the ground, of sounds generated inside the payload capsule of a model rocket in flight. The signals picked up by the microphone may be used to obtain an exact measurement of the engine thrust duration, the time delay, and the moment of ejection. In addition, it might be possible to use the microphone to study the air passing by the rocket. Some attempts have been made to correlate the sounds recorded from the microphone with the velocity of the air passing the payload section, but the results of this experiment are still uncertain.

Construction

The construction of the microphone module follows the pattern established in the construction of the other modules for the transmitter. The transmitter must be modified as described in the August issue in order to work with this module.The microphone used should be a small crystal earphone of the type imported from Japan. Parts placement is not critical to operation; however the length of the wire connecting the microphone to the module plug should be kept as short as possible. In some cases, the builder may find he has to change the length of the antenna in order to obtain full strength transmitter output when using the microphone module.

Use

The microphone module and transmitter should be placed in the payload capsule of the rocket with the battery closest to the nose cone, and the microphone closest to the rear of the rocket. This arrangement will prevent the microphone from being crushed if the parachute should malfunction. The signals transmitted from a microphone-carrying-rocket sound like air rushing past a tube. These sounds are not too much different from the normal static generated by a cheap walkie-talkie which is not picking up any signal at all. The result of this similarity is that it is sometimes difficult to identify the sounds generated during flight. After listening a few times to a tape recording of the sounds transmitted during the flight, it usually becomes possible to identify all of the main events.

The microphone is sufficiently sensitive to pick up most of the sounds generated during a flight, however do not expect too much of it. It certainly will not detect the heartbeat of an animal in flight.

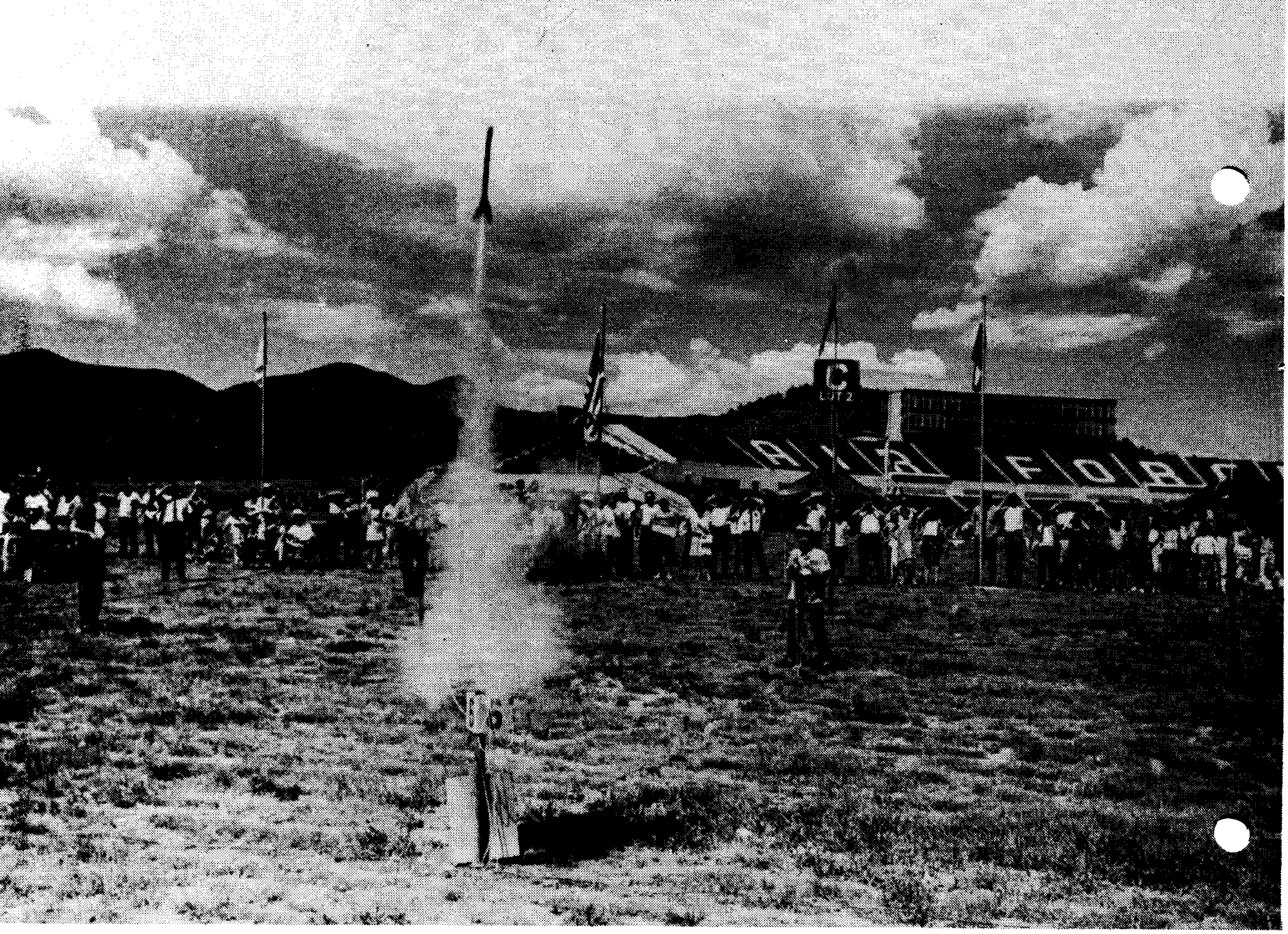
Next month's article will cover some of the comments received from users of the transmitter.

ACCELEROMETER PARTS

The correct PARTS LIST for the accelerometer module described in the August issue of Model Rocketry was accidently omitted. The correct parts are as follows:

L_o	Miller 9003 RF coil (adjustable) 0.570 to 2.80 mh
C_a	100 pf capacitor
C_b	3.0 μf capacitor
B_1	22½ volt battery, Burgess Y15

All parts available from Burstein-Applebee, 3199 Mercier Street, Kansas City, MO 64111.



All Photos by George Flynn

1969 National Model Rocket Championships

NARAM-11

August 11 through 15, 1969

USAF Academy

Over 100 Modelers Participate in Biggest Nationals Ever Held

What happens when your local supermarket loses your order for 14 dozen small eggs? Well, if you're Contest Director, egg-loft is scheduled as the first event, and the 11th National Model Rocket Championships is scheduled to open the next day, you get out your BT-60 tube, walk into the Safeway refrigerator, and hand select those eggs that fit from the three cases of medium eggs they have in stock. That's exactly what Bill Roe, Contest Director for NARAM-11, found himself doing less than 18 hours before the meet was scheduled to open.

A public demonstration launch was scheduled for Saturday, August 6th, in a Colorado Springs shopping center. The local merchants even got together and bought some space in the newspaper to advertise the demonstration. An Estes team headed by Education Director Robert Cannon arrived on the scene to conduct the launch. A crowd gathered. The first rocket went up...and came down, right on the roof of one of the stores. The plan was to launch the rocket, recover it, and re-use it later in the afternoon. The stores, however, kept getting in the way, and recovery was difficult. After an hour of launching, only two of the eight Big Berthas remained, and everyone decided to call it a day.

The contestants began arriving on Saturday. Since there was no central housing facility, they were lodged in about 25 motels lining the main road 4 miles from the U. S. Air Force Academy – site of NARAM-11. Some modelers arrived fully prepared, others still had work to do on their rockets. The long drive from Ohio allowed one rocketeer to sand the airfoil on his egglofter fins. Another needed some motel stationery to put the finishing touches on his R&D Report. Most of those in contention for national titles took things seriously: Coming to the meet, Col. Howard Kuhn of the MARS Section held first place in the Senior division. When he arrived in Colorado Springs, he drove out to the academy to inspect the launch site. Then he sought out the Contest Director for information on local fields where he could "get in a little last minute flying."

The launch site, a parking field behind the Air Force Academy's Falcon Stadium, was clear on three sides but bounded by woods to the east. A 15 position modified "Misfire Alley" system - dubbed the "Cape System" - was employed. This system, designed and built by Estes Industries, permitted the contestant to launch his own rocket but allowed the firing officer to retain positive control over the activation of the pad. Using the Estes Sequence Countdown and Rapid Launch System (ESCARLS), the firing officer could select any one of the 15 pads and begin a pre-programmed countdown at T-10 seconds. ESCARLS automatically counted down the final ten seconds, indicating the time remaining on a visual display board, and activated power to the pad for a two second interval beggining at T-0. If the contestant's rocket was not fired within the two second "launch window," he had to recycle his rocket and again receive a range clearance.

Col. James Lannon of the Air Force Academy officially welcomed the NAR and the contestants to the Academy grounds, and NARAM-11 got underway as he fired the first rocket - a Saturn V. Vern Estes took his position at the control panel, and the range was opened for processing Pee Wee Payload and Eggloft entries. Both events were flown simultaneously.

The first competition rocket off the pad was a Pee Wee Payloader built by the Bell-Hagedorn team of Mansfield, Ohio. Unfortunately, it was disqualified for failing to deploy a recovery device. Tracking, on the first day, was with the old Peak City Section six-power elbow scope trackers. They were still in good condition after several years without mainance or use. Most of the tracking teams, however, were not experienced at tracking through a magnifying scope, so a great number of tracks were lost.No tracks closed during the entire day in Senior Division Eggloft, and Norman Wood, Jr. of the Titan Section took first in the Leader Division with the only tracked rocket in that age group, turning in a respectable 433 meters. In Junior Eggloft, the tracking was better: At least three tracks closed, allowing first, second, and third place awards. Phil Gust took first with 427 meters.

Complete contest results begin on page 42.

Ed Pearson (center) and Contest Director Bill Roe (right) select eggs in a Colorado Springs supermarket. Two hours and three crates of eggs later, seven dozen eggs had been selected for use in the Egg Loft event.

Fortunately, the Annapolis Association of Rocketry carried their "open sight" trackers accross the country from Maryland. These were quickly pressed into service. In Pee Wee Payload – an altitude event employing no more than 5 newton seconds total impulse to lift a rocket carying a 3/4 inch diameter, one ounce, lead weight – the tracking was much improved.

Michael Coxen of the NARCAS Section employed a breech launcher. Art Chapman of NARHAMS used a stainless steel launch tower, consisting of three 36 inch stainless steel rods fastened to a flat base plate, to eliminate launch lug drag. The best altitude in Pee Wee Payload was turned in by Dr. Gerry Gregorek of the Columbus Association for the Advancement of Rocketry. Flying a rocket constructed by his late son Dave, the Gregorek team entry flew to 382 meters. Sven Englund of the YMCA Space Pioneers took first in the Junior Division with 296 meters, and Richard Sternbach of the Fairchester Section took first in the Leader Division with 208 meters.

The range was opened for Tuesday's events – Scale and Predicted Altitude – at 8 AM. Scale is judged both on adherance to the scale of the actual rocket and on flight performance of the model. In some cases, modelers have chosen to underpower their scale birds in order to return them safely in case of a failure. This was not the case this year, when many of the models were powered with clusters or high impulse FSI engines. Saturn models were popular, but good scale versions of sounding rockets and tactical rockets were also in evidence. Scott Layne of the Saturn Model Rocket Section took first place in Junior Scale with a highly detailed Little Joe II. Talley Guill of the Fairchester Section won in the Leader Division. Howard Kuhn of the MARS Section flew his D-Region Tomahawk (which had already taken first place in scale at ECRM and WAMARVA) to first place in Senior Scale.

Mark Wargo of the Pascack Valley Section prepares his scale entry, a model of a NASA test vehicle employed in the Earth testing of a Mars landing vehicle. The prototype is presently on display at the Smithsonian Institution.

Bruce Blackistone of the NARHAMS makes final adjustments to his Disaster 15B. The Sparrow boost/glider took first place in the Leader division with 73 seconds.

Predicted Altitude -- an event in which the contestant declares, prior to flight, the altitude he expects his rocket to attain, and is judged on the percentage difference between the predicted and tracked altitudes -- caused some problems for rocketeers not experienced in flying at the 6000 foot elevation of the NARAM-11 field. Predictions based on flights at the rocketeers' home fields were not valid for Colorado Springs unless corrected for the lower air density of the launch site. The difference in air density should cause the rocket's altitude to increase by as much as 20% over that at sea level. For most, Predicted Altitude was reduced to a guessing game, but the winners did suprisingly well. Charles Zettek, Jr. of the Greater Boston Model Rocket Society took first place in the Leader Division with an amazing 0.6%. In Junior, Michael Coxen's 1.0% was good enough for a first place. The Seniors weren't "guessing" nearly as well as the younger contestants. First place in that division went to the team of NAR Trustee L.H. Butterworth and his wife Mildred with 3.0%.

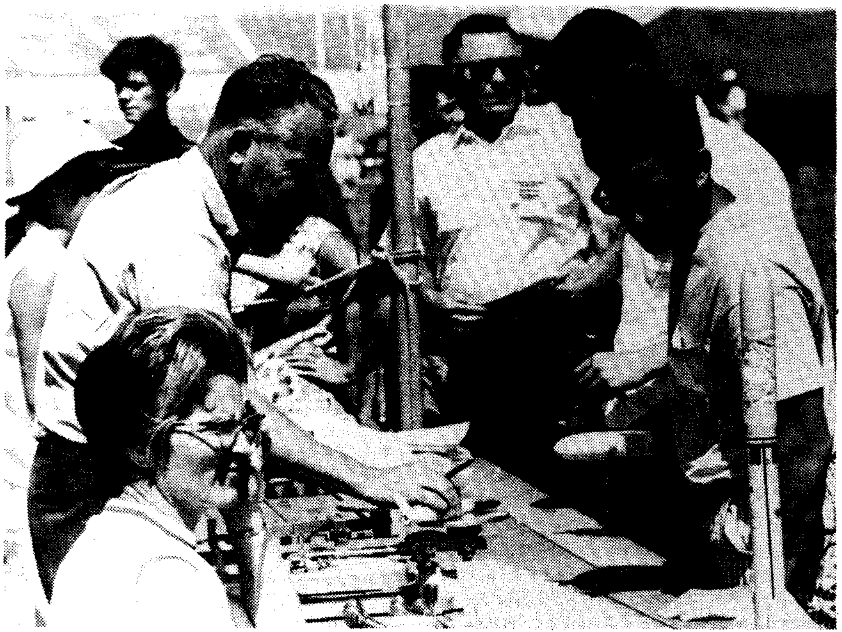
After Tuesday's flying events, the contestants were taken on a tour of the Air Force Academy.

At midnight Sunday, the NARHAMS group had climbed a 300 foot cliff overlooking the motel row where all the rocketeers were staying. They managed to get past an angry dog (fortunately tied), several barbed wire fences, and other obstacles, and planted their flag on the highest peak around. No one, they were sure, but another rocketeer would be crazy enough to climb a 300 foot cliff just to remove a flag. But at midnight on Tuesday, NARHAMS were seen once again heading through the barbed wire, on their way to the top of the cliff. Another flag was planted .....and again it dissappeared! No clues, but NARHAMS is suspicious it was the same Pascack Valley rocketeers who threw NARHAMS member Bruce Blackistone into the motel pool that arranged the dissappearance of their flag.

As the Air Force bus made its way down the road early Wednesday morning to pick up the contestants, a light rain began. The weather looked threatening all through breakfast. Anxious to get their flights off before the rain returned, the contestants were in line for processing Swift B/Gs and Scale Altitude rockets as soon as the range opened at 8AM.

Howard Kuhn of the MARS Section flew his Scale Altitude rocket to 1021 meters (over 3,000 feet) for first place in the Senior Division. Jim Stevenson, also of MARS, took first in the Leader Division with 878 meters. Guppy from the Annapolis Association of Rocketry took first place in the Junior Division with 976 meters.

MARS Section rocketeers also took firsts in both Junior and Leader Swift B/G. Tammy Benson placed first in the Junior



Shirley and Al Lindgren of the Pascack Valley Section check in rockets for Egg Loft and PeeWee Payload events.

Division with 2 minutes 23 seconds. Jim Stevenson, flying a Manta, took first in the Leader Division with 1 minute 51 seconds. The rain began just as Tom Pastrick, who had been helping as range crew all morning, was preparing for his second flight; but his 1 minute 56 seconds took first in the Senior Division.

On Wednesday afternoon the Air Force Academy opened its Aeronautics and Astronautics facilities to tours for the contestants. Of particular interest was a subsonic wind tunnel with a large cross section. Academy Cadets have used the tunnel for projects including the determination of drag coefficients for model rockets. A thrust stand was set up to accept model rocket engines, and the thrust time curve of an Estes engine was obtained.

On Thursday Open Payload, an event feared by several meet officials, was flown. The object is to carry 4 ounces of lead weight (4 standard one ounce payload weights) to the highest possible altitude. Engine power is limited to 80 newton seconds. Since the event had never been flown at a national meet, or anywhere else that the contest officials were aware of, they feared the possibility of payload separation from the parachute and having 4 MRVs fall from 1500 feet into the spectator area. Each rocket was subjected to a rigid safety inspection before being asigned to a pad. Since the contestants had never flown the event before, the "usual" winners did not place. Kevin Dolan of the Steel City Section took first in the junior division with a flight of 515 meters. Gary Crowell took first in Leader with 492 meters. The Ball-Hagedorn Team, with the only "closed track" in the Senior Division, took first with 603 meters. With the exception of one or two cluster birds, the contestants flew Open Payload with the powerful FSI D,E,and F class engines. Despite the fears, there were no "incidents" in the entire Open Payload event. The rocketeers certainly demonstrated their ability to handle both the large engines and the 4 ounces of lead weight in the nose.

Flying his home-designed Disaster 15B, Bruce Blackistone took first in the leader division of Sparrow B/G with 1 minute 13 seconds. Bruce Schaeffer placed first in the Junior Division with 2 minutes 32 seconds, not the longest flight observed, but certainly the longest recovered. With the wind blowing towards the close woods to the East, most good B/G flights went unreturned. G. Harry Stine flew his FlatCat to 1 minute 20 seconds to take first place in the Senior Division. Two novel boost/gliders were seen in this event. Karl Feldmann, of the Pascack Valley Section, flew an all styrofoam B/G for 35.7 seconds. Richard Sternback's boost/glider was a Rogallo Wing carried aloft by a standard rocket. The Rogallo Wing was deployed at ejection and returned to earth as a glider.

Just as Thursday's events were drawing to a close, the rain came down. Contest cards, flags, the PA System, ESCARLS, Tom Pastrick's Sparrow B/G, and most of the range crew got soaked in a effort to keep everyting from scattering. The contestants ran for the buses, and a tour of the Estes Industries plant in Penrose (less than 50 miles from the Academy).

The rocketeers had been invited to tour the new Estes facility, open less than two years. The expansion from one small building, visible in the distance, and now used only for kit packaging, to a complex of

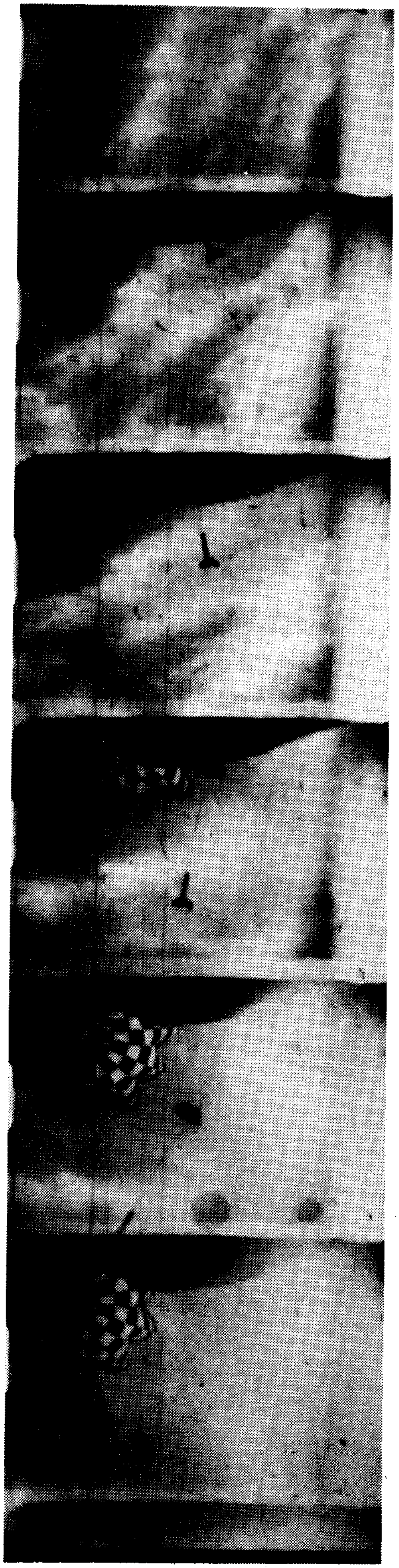


Photo by Michael Dorffler

Parachute deployment as seen from the Estes CINEROC (see page 24).

about 20 buildings which could be seen from the parking lot gave the rocketeers an impression of the growing size of the model rocket hobby. The day ended with a chicken dinner at the Royal Gorge, a scenic canyon area near the Penrose plant.

The range opened at 7AM on Friday, the final day of NARAM-11, to allow time in the afternoon for the awards banquet. Parachute Duration and the Research and Development presentations were on the schedule. The wind was again blowing to the East, and carrying all the good PD flights past the woods and out of range of the recovery teams. The best returned time was 3 minutes 29 seconds turned in by Jess Medina, a Senior from Seattle, Washington. Sven Englund, of the YMCA Space Pioneers, took first in the Junior Division with 2 minutes 40 seconds. In the Leader Division, Art Chapman placed first with a duration of 2 minutes 6 seconds.

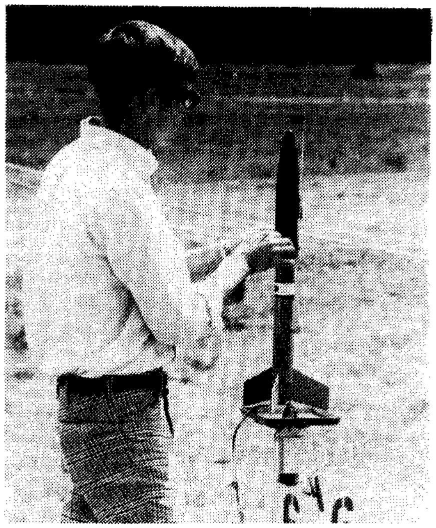
However, the wind was not the only factor hampering the return of PD birds.

Manufacturers Display New Model Ro

Estes CINEROC Movie Camera

The CINEROC, perhaps the most spectacular model rocket development since the Camroc, was publicly flight tested by Estes Industries at NARAM-11. On Monday morning, during a break in the competition flying, Mike Dorffler moved out to the pad and prepared a prototype of the first mass produced *model rocket movie camera* for launching. Vern Estes gave a brief description of the camera, which is expected to be ready for sale in early 1970, Mike turned on the CINEROC at T−5 seconds, and it lifted skyward powered by the new Estes D engine. Early Tuesday morning the black-and-white film was ready for viewing.

Since the image is reflected to the camera lens by a mirror looking down the side of the rocket, the first frames show Mike's fingers as he turns on the camera. Looking down the body you can see ignition, there's smoke from the engine, and the launch pad recedes. The rail is clearly visible, it bends as the rocket clears the top. The rocket climbs and the spectators can be seen looking up towards the sky. Still climbing, Falcon Stadium comes into view. Then the ejection charge goes off, and the carrier rocket falls away from the camera. Parachute deployment can be clearly seen, and the camera looks up at its own chute for the remainder of the film.



Mike Dorffler turns on the Estes CINEROC at T -5 seconds in a NARAM-11 demonstration. The carrier vehicle is powered by an Estes D engine.

Designed by Mike Dorffler, the CINEROC weighs about 3 ounces and uses a specially designed cassette of Super Eight black and white Tri-X film. (No high speed color films are as yet available in Super Eight size.) The lens, a 10mm focal length f16 plastic lens, produced acceptably sharp images when enlarged single frames from the film were inspected. Its depth of field is from about 6 inches to infinity, allowing allowing both the rocketeer's fingers turning on the camera and the ground viewed from 1000 feet to be in focus. Employing a 1/200 of a second shutter speed, the CINEROC shoots 26 frames per second. At its widest the camera is 1.75 inches in diameter. The rear section mounts in a BT-60 body tube.

The combination of a fast shutter speed and the rearward view allows the advanced rocketeer to study ignition, staging, stability, and parachute opening. Frames of the test films shot at the Estes plant clearly show the opening of the carrier rocket parachute, and allow the shock of the rocket body to be assessed. Other sequences show quick motions of the vehicle presumably caused by wind gusts, and the bending of the launch rod at liftoff due to the weight of the vehicle.

No price for the camera has yet been released but it is expected to sell for less than $20. An announcement will be made when Estes is ready to take orders for the CINEROC.

Also flown by Estes in the demonstration flights was the unusual Mars Lander. This incredible four legged vehicle takes off in upward flight, deploys its parachute, and lands on its feet (sometimes . . . if the wind isn't too strong). It features pre-cut, highly detailed body panels and operating landing gear. A four color decal is supplied with the kit. The rocket weighs 3 ounces and stands 12 inches tall. The landing gear span is 13.2 inches. The Mars Lander, now available from Estes, is priced at $4.75.

High-Powered FSI Birds

After seeing his engines capture every place in the Open Payload event, George Roos of Flight Systems used his demonstration flights to show off these high power engines to those rocketeers still not convinced of their value. Everything from the A4-4 to the F100-8 was flown in one or another of the FSI rockets. One three stager employed a D6-0 in the first stage, a D4-0 in the second stage, and a D4-8 in the upper stage. It weathercocked during second stage burn, and was last seen, still climbing, flying in the direction of Colorado Springs.

A two-stage F100 rocket was employed in an attempt to break the sound barrier. The rocket, designed and built by Al Fox, used a 35 pound peak thrust F100-0 first stage engine and a F100-8 upper stage engine. Second stage burnout occurred about 1 second after ignition, after expending 100 newton-seconds of impulse. The rocket held together, and by the FSI calculations broke the sound barrier.

A novel "impulse engine" was also flown by FSI. The E5-pulse engine employs five seperate propellant grains in a single casing. When flown it gives the appearance and sound of a five stage rocket. No decision yet from George Roos as to whether the impulse engine will be marketed.

Four new kits have been introduced since the last catalog. The Orbit, a 480mm long rocket designed to be flown with any engine from the B3-4 to the F7-6, employs a streamer for recovery from high altitudes. Weighing only 54 grams (without engine), the Orbit was designed to make maximum use fo the lifting capability of F7-6 long thrusting engine. the kit is priced at $2.90.

The OSO is a sounding rocket designed to carry heavy experimental payloads to high altitudes. Employing a 146mm long payload section, the OSO was designed for use with the F100 engine. Liftoff weight (without engine or payload) is 99 grams. The OSO is priced at $4.00.

The Micro is a high performance beginners kit. Like all FSI kits, it employs pre-cut plywood fins. Recommended for use with the A4-4, B3-4, C4-4, or D4-6 engines, the

(Continued on page 47)

NAR Trustee Robert Atwood's rocket made a nice flight and landed in the clearing just short of the woods. As he was walking towards the rocket, Atwood saw a young boy wearing a green sweater and with a cast on his left arm come running out of the woods. He picked up Atwood's rocket, stuffed it into a sack he was carrying, and darted back into the woods. Atwood gave chase, but it was fruitless. There was a road just on the other side of the woods, and he arrived at the road just in time to see the boy jump on his bike and race off down the road.

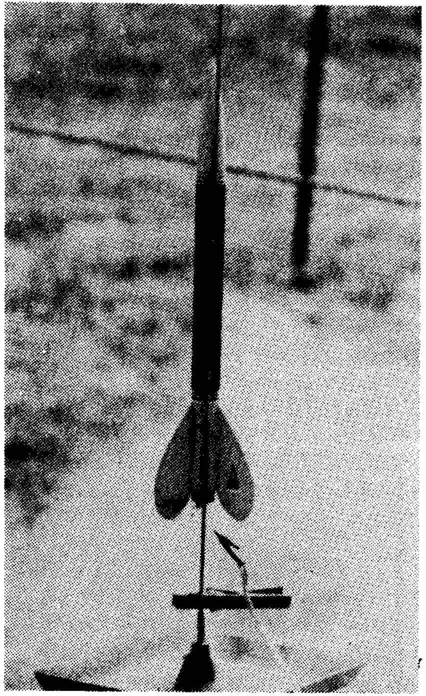
Atwood returned from the chase in time to act as MC for the R&D presentations, which began at 10AM inside Falcon Stadium. The authors of the three top projects in each age group were invited to give oral presentations of their reports to the judges and interested contestants Senior Research and Development was exceptionally good thisyear. Any of the top three projects could easily have been awarded first place.

ket Products at NARAM-11 Launching

SAI Flies the Mini-Bat

Space Age Industries introduced their new Mini-Bat B/G to the contestants at NARAM-11. This easy-to-assemble glider turns in consistent 30 plus second flights with an A engine. The Mini-Bat is a beginner's booster glider kit, requiring only very simple trimming to turn in acceptable flights. It will perform well with a B engine, and one was flown at NARAM-11 with an FSI D. Available in hobby shops next month, the Mini-Bat will retail for $1.50.

Bryan Thompson's NAR record holding Tempus Fugit, now available in kit form from Space Age Industries, was also demonstrated. Employing small, swept-back fins, this design, when properly constructed and finished, is capable of superb altitude performance. Designed for high performance, it's an ideal rocket for the beginner who is interested in competition flying. The Tempus Fugit sells for $1.50 in kit form.



The new Space Age Industries kit of Bryant Thompson's record- setting altitude rocket was flown in the manufacturers' demonstration.

MPC Enters Rocket Field

Under the banner "MPC is happening," Model Products Corporation introduced a line of six model rocket kits. Their products will be available at hobby shops across the country this month. In their *ASTROLINE* molded plastic flourescent fin assemblies, silver colored plastic nose cones and stage couplers are employed for ease in construction. The Redstone-Maveric , a 16.2 inch model weighing 1.7 ounces, is available complete with decals and recovery chute for $1.50. The Moon-Go, employing a one-piece, clipped-plastic fin section, stands 21.3 inches tall. Its weight is 2.5 ounces (without engine). Priced at $2.00, the Moon-Go also comes complete with decals and recovery devices.

The *MACH-10* Series is the new MPC competition line. Rockets in this series employ standard balsa cones and fins, and are designed for use in competition events. The Flare Patriot, employing streamer and parachute recovery stands 18.5 inches tall and weighs 1.3 ounces. TheFlare Patriot has a 2¾ inch long payload section, and is priced at $2.00. The Lambda Payloader, a 15.5 inch tall rocket, has a 4 inch long clear plastic payload section. Complete with decals, it retails for $1.50. The Theta-Cajun, a 21 inch long rocket, is designed to carry a large parachute for use in duration events. Weighing 1.3 ounces, this rocket sells for $2.00. The Icarus, a 15 inch long model weighing 1.0 ounces, sells for $1.50.

Model rocket parts from MPC will also be available across the nation in hobby stores. A flourescent orange plastic clipped delta fin section which slips on a 25mm diameter body tube retails for 50 cents. For the 20mm body tube, a delta fin section, also molded in flourescent orange plasted, is priced at 50 cents. Silver colored plastic nose cones to fit 20mm, 25mm, and 30mm body tubes have also been introduced. The 20mm cone is priced at 50 cents; the others are priced at 75 cents. White molded plastic body tube couplers in 30mm/30mm, 25mm/25mm, 30mm/25mm, 25mm/20mm, and 30mm/20mm sizes are also available with the first two priced at 25 cents each and the last three selling for 50 cents each.

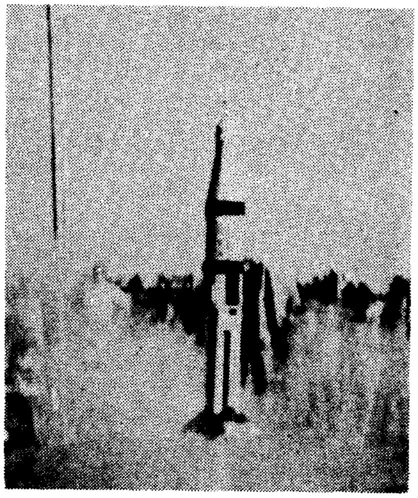
Centuri Flies Scale Line

Centuri Engineering used their demonstration flights to show off the line of 1/100 scale Apollo vehicles. The escape tower on the Apollo spacecraft is molded plastic for ease in construction. A corrugated plastic body skin is included with all the kits to reduce finishing difficulty. Pre-shaped fins, removable display engine nozzle assemblies, plastic parachutes, and historical data booklets are included with each kit.

The Little Joe II, standing 10.5 inches tall and 1.58 inches in diameter, is priced at $3.00. The Saturn 1B, weighing 4.7 ounces, stands 26.8 inches tall. It can be flown with two A8-3, B6-4, or C6-5 engines. The price is $8.95. The Saturn 5 kit, complete with three parachutes, sells for $15.95. It stands 43.6 inches tall, with a body diameter of 3.96 inches.

Displayed at NARAM-11 and now ready for delivery is the Centuri Swift B/G kit. This 16 inch wing span, pop-pod glider weighs 1.1 ounces at liftoff. The Swift is priced at $1.95.

Also flown at NARAM-11 was the Point. A conical rocket, employing its own airframe as a "parachute," the Point stand 8.1 inches tall and has a base diameter of 3.9 inches. It weighs 0.55 ounces at liftoff. Unusual demonstration flights can be obtained with this $1.50 kit.



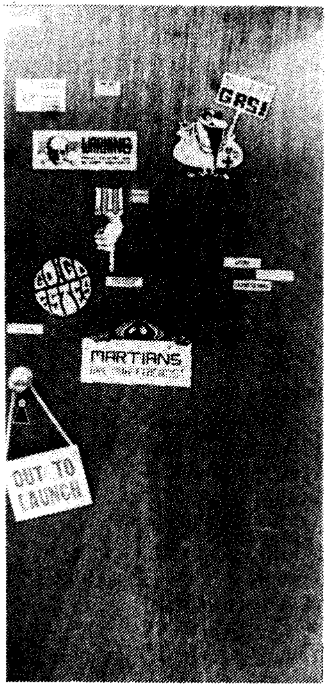
Centuri Saturn IB.

Penrose Town

To the tune of "Galveston"

(with regrets to everyone)

NARAM-11 contestants were taken on a tour of the Estes Industries plant in Penrose, Colorado on Thursday August 14th. For reasons of safety and security most of the Estes production facilities were not included in the tour. Since most of the company executives had spent the day participating in NARAM-11 events at the USAF Academy, their offices, a part of the standard plant tour, were closed. Thus the beginning of the tour was a quick look at the closed doors of Estes employees. The artist's door, shown at right, proved particularly interesting. A dinner at the Royal Gorge followed the plant tour. The events inspired NARHAMS member Bruce Blackistone to write the following song................................



Penrose Town
Oh, Penrose Town
That's the place we had a tour in
And we saw 'most every door in
The biggest industry
That's found in Penrose Town.

See the door
Oh, see the door
What, oh what's behind the door there?
There could be a great big hole in the floor there
But we'll never know
'Cause this is all they'll show.

What ever happened to good old Mable?
Perhaps she's hidden under the table
But all that we can see
Is the place where she used to be -

Royal Gorge
Oh, Royal Gorge
As we walked over, how it was raining.
When Vern stepped out the sun was shining
And made us stop and think
On the brink of Royal Gorge.

The 15 minute time period allotted for presentation and questions however, defeated the purpose of the event by not giving the contestants a chance to adequately explain their developments to the interested rocketeers. The Air Force officers who judged the event, had plenty of time to read and study the reports; but the other contestants, who could have put some of these developments into common use, had only an hour to examine the reports in the judging tent. Evening sessions, with the R&D contestants giving oral presentations of their reports to the other contestants, had been suggested prior to the meet, however lack of central housing ruled this out.

First place in the Senior Division went to Capt. Forrest Mims for his development of a ram-air guidance system for model rockets. Capt. Mims , whose major interest in model rocketry is as a research tool, attended NARAM-ll to compete only in R&D. His project, which was completed during a tour of duty in Vietnam, involved measurement of the deflection force occurring when air is allowed to enter the rocket through a hole in the nose cone and exit through a port in one side. Applying this force to the nose of the vehicle causes the rocket to be deflected from a vertical trajectory. By selecting one of several exit ports around the perimeter of the nose cone, the rocket can be guided in flight. Capt. Mims hopes to use this system, coupled with a light sensor, to home his guided rocket in on a light bulb suspended from a balloon at night. This final test would prove the effectiveness of his system.

Second place in Senior R&D went to Douglas Malewicki, who also came to Colorado Springs specifically for this event (though he arrived early enough on Thursday to also participate in Sparrow B/G). This year's "Malewicki Report" filled an entire table, and one judge was overheard asking "Which one of the reports does he want us to judge?" The report reduced to graphical form the thermal-independent behavior of a boost glider. It allows a rocketeer to predict the flight duration of his boost glider from basic, measurable parameters of the glider and a specified initial height above the ground. Glide speeds can also be determined, and the effects on glide duration due to temperature and launch altitude variations can be take into

NARAM-11 CONTESTANTS

Any NARAM-11 contestant who did not return his copy of the survey distributed in the registration packet is requested to fill out the questionaire and return it to James Pantalos, 1191 Shanley Drive, Columbus, Ohio 43229 as soon as possible. A high return rate is necessary to insure validity of the survey.

account. The glider duration graph he presented is also valid for predicting parachute durations. (Malewicki's full report will be presented in a three part series beginning in the December issue of Model Rocketry.)

Third place went to the T&S Aerospace team – Cal Tracy and Pat Stakem from Cumberland, Maryland – for their reduction of model rocket altitude prediction to a computer program.

Two interesting sociological studies were submitted in Senior R&D. The Guernsey Team – Carl Guernsey, Sr. and Francis Guernsey – analyzed *The Academic Profile of the Junior Model Rocketeer.* Their purpose was to evaluate the effectiveness of model rocketry as a teaching tool. James Pantalos, who teaches at Ohio State University, distributed a survey to the contestants on the first day of the meet. His purpose was to discover the variables influencing the selection of model rocketry as a hobby. Unfortunately, many of the rocketeers were too busy preparing their rockets to reply to the questionaire. Complete results await the contestants returning the survey forms by mail. These two reports, as well as several other R&D presentations in the Leader and Junior Divisions, indicate that model rocketry has advanced to the point that contributions to our understanding of the field can be made by people interested in areas other than aerospace engineering.

In the Leader Division, J. Talley Guill took first place with a report on an *Integrated Technique for Boost Glider Design.* Assuming that the flight performance of a B/G can be predicted by the CG location, he used a computer to designate the required CG balance point for both the boost and glide phases for several different wing configurations. Gliders were then built according to the computer specifications, and test flown to confirm the validity of the results.

Charles Andres, of the Berwick Academy Model Rocket Society, took second with his project to reduce all available model rocket performance equations to computerized form. He presently has programs to determine the CG, CP, Altitude, and Drag for rockets of any standard configuration. He is still working on an overall program to predict the performance of any single-stage model rocket. (A bimonthly column presenting his computer programs begins in this issue of Model Rocketry.)

Mark Evans of Apollo-NASA took third place with his design of a new launch system requiring only 3 volts from small lantern batteries to insure reliable ignition. The system, employing a Glo-Plug to ignite Jetex fuse which in turn ignites the engine, was successful 65 out of 75 times during his test series. The purpose of the system is to reduce the battery weight and cost, and achieve a higher degree of ignition reliability.

In the Junior Division, Scott Layne's project on engine testing took first. He designed and built an engine test stand, and then used it to evaluate the performance of several hundred engines. He then arrived at values for the deviation in performance from the published specifications for most engines currently available. His project, costing about $700, consumed about 60 hours per month for ten months.

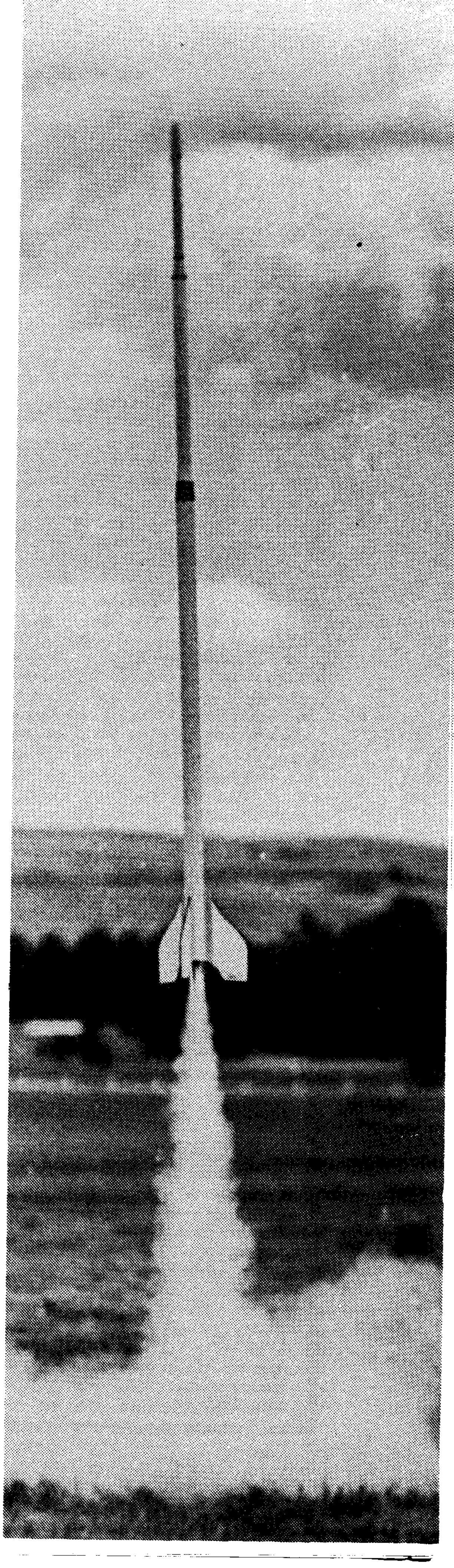
Tom McKim's investigation on *The Effect of Spin Stabalization on the Altitude of Payload Carrying Rockets* took second place. He constructed a series of rockets, identical in all respects except that the spin-fins were canted at angles of 0°, 5°, 10°, 15°, and 20°. His results showed, as expected, that spin-fins employed on sport rockets reduce their altitude. However, he found that on payload carrying models spin-fins are beneficial. In answer to Bob Atwood's question about the design of his payload model at NARAM-11, Tom admitted that it had used standard fins since he did not have enough time to test fly a spin-fin version before the nationals.

Third place went to Gary Lindgren of the Pascack Valley Section for his work in proving the feasibility of large model rockets powered by clusters of small engines. Gary demonstrated an 8 foot tall model, powered by three C6-3 engines. Fired from an 8 foot launch rod, the rocket had flown successfully once before. Liftoff was perfect in the demonstration flight, but the ejection charge failed to blow out the parachute, and the rocket crashed just outside of the spectator area. No damage was done, since the rocket weighed only 10 ounces (without engines).

Following the R&D presentations, the contestants returned to the flying field to view a series of manufacturer's demonstration flights. Estes, Centuri, MPC, FSI, and Space Age Industries participated in the demonstration.

At the awards banquet, immediately following the demonstration flights, trophies and ribbons were presented to the winners in all events. National Championship trophies were presented to the top point scorer in each age group for the contest year. In the Junior Division Scott Layne of the Southland YMCA Section was first. Mark Evans of Houston's Apollo-NASA Section was the top point scorer in the Leader Division. Howard Kuhn of the MARS Section was named Senior National Champion.

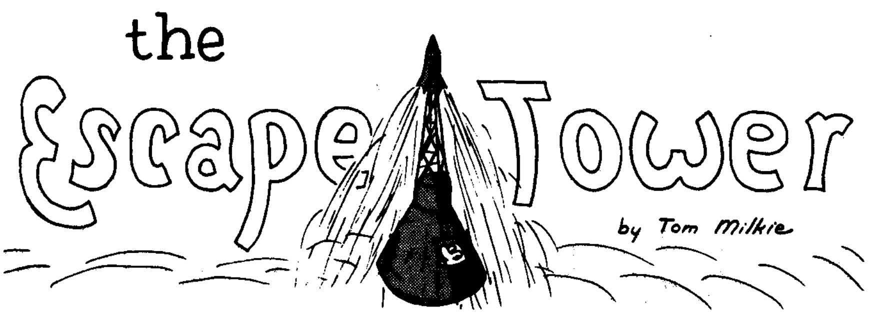
As NARAM-11 broke up, NAR President Ellsworth Beetch announced an October 1 deadline on submission of proposals for a NARAM-12 site. The contestants, exhausted from the week's events, began drawing up plans for next year's rockets.



Gary Lindgren's eight-foot rocket ponderously lifts off the pad in an R&D demonstration. ⟶

the Escape Tower

by Tom Milkie



Hang on to your safety interlocks, rocketeers, and get set for model rocket madness. This column is coming to you straight from my wastebasket. I will attempt to present some of the wilder ideas in model rocketry. Some of the best ideas of model rocketeers start out at bull sessions and midnights on the drawing board. Really wild ideas lead to other ideas, and somewhere along the line a useful new development comes out. So, from scratch pad or launch pad, I hope to get the oddball rolling.

All you mad-roc-nuts out there who have ever thought about that 10 engine cluster can throw in your garbage too. Just launch all ideas (and photos or sketches) to me, and we'll see what burns.

A few readers have already remarked on my previous rocket designs in this mag, which have been slightly *different*. I always have trouble when I take my collection of crock-rocs out to the pad. There is always some little ½A kid who looks over my Dragstab (October, 1968 **Model Rocketry**) and says, *What's it do?* The thing is it doesn't have to do anything! The fact that it is different from every 3-finned-body tube-nose cone rocket is enough. A new idea can sometimes find a useful application, at any rate it looks keen.

A lot of my previous ideas seem to be along the line of anti-balsa fins (Dragstab–no fins, Stygion–cardboard fins, Zeta–tissue fins). Well, here is another!

Those who have read my article in the January, 1969 issue on rocket stability (*A Problem in Stability*), and I hope everyone by now knows that *a rocket is not neccessarily stable if the center of gravity is behind the engine!* The engine thrusts along the centerline of the rocket, gravity, if it can be considered in a free-falling rocket, acts through the rocket center of gravity (CG), where the engine is makes no difference, there is no center of thrust (CT?), and if anyone tells me otherwise again, I will shoot him with a Mini-max powered Astron Sprite!

After screaming my head off on this point, my conscience began to bother me. *Well, smarty, what about that rocket with no fins you launched back in 61?* My conscience bothered me so much that I have since built 3 models of the same design, and I can assure you, none of them has a CT.

The model, appropriately called the Sham-roc, was built with a BT-20 size tube, no fins, and 2 wires running down the sides with a bend outwards to avoid the engine exhaust. The ends of the wires were weighted down with coils of solder to bring the CG, with a loaded engine in place, to just behind the engine. The rocket is small and heavy, so I recommend building only the light version shown.

I believe the only flights that the first version made were with some old A's, and the flights were fast and straight up. No powered loops–so it must be stable. Bad guys one, Good guys nothing. The rocket was either lost or the pieces went into other rockets. (Maybe I was short on solder.)

Years later the design was recreated and this time put through a few tests. 1/2 A engine–no powered loops, but it flips as soon as power quits (as a CG-CT stabilized rocket should, say the Bad guys). Bad guys two, Good guys nothing.

A engine–flight same. B engine–flight same. B 3-5 engine–flight same. Bad guys five, Good guys nothing. With a C engine inserted in the rocket the added weight of the extra propellant moves the CG this time to about 1 centimeter in front of the nozzle. The Bad guys claim that the rocket will thus fly unstably. Sure enough, it does three loops during powered flight. It really looks bad for the Good guys.

Could the added solder on the legs cause enough fin effect for stabilization? A ray of hope! A few wild tricks with the Barrowman equations and a "swing test" (a la Estes) convinced me that that was no cause for stability.

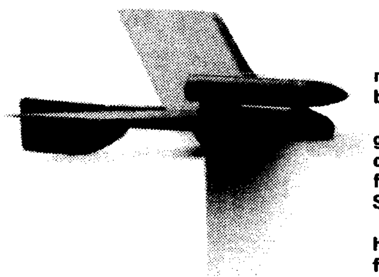
And then it hit me (the answer, not the rocket). The time of flight of the Sham-roc was actually quite small. Its heavy weight also kept it on the launch rod for a long part of its powered flight. Maybe the Sham-roc really *is unstable* and in the short time of power doesn't have time to flip or loop. The wire legs create a high moment of inertia. (In other words it would flip very slowly if there was only a small force disturbing it.) Since the rocket is very small, there would be only very small forces attempting to flip the rocket. Before the rocket can go into a loop, the fuel would have been expended, and the Sham-roc would flip wildly, yet fly straight up in unpowered flight. The longer duration thrust of the C engine allowed the Sham-roc to go into a flip before the fuel was expended, and thus caused it to loop.

This is still just a theory, and actual calculations are beyond me. (Just how much disturbing force is caused by thrust variations? launch lug drag? etc.) Maybe someone can figure this out; if so, please keep me informed.

To construct the Sham-roc IV cut a length of small sized body tube as shown and glue in an engine block. Glue on the foot supports (made from 1/8 inch thick balsa), and when dry, sew the static line to the rear of a support, as close to the rear as possible. This will provide a softer landing.

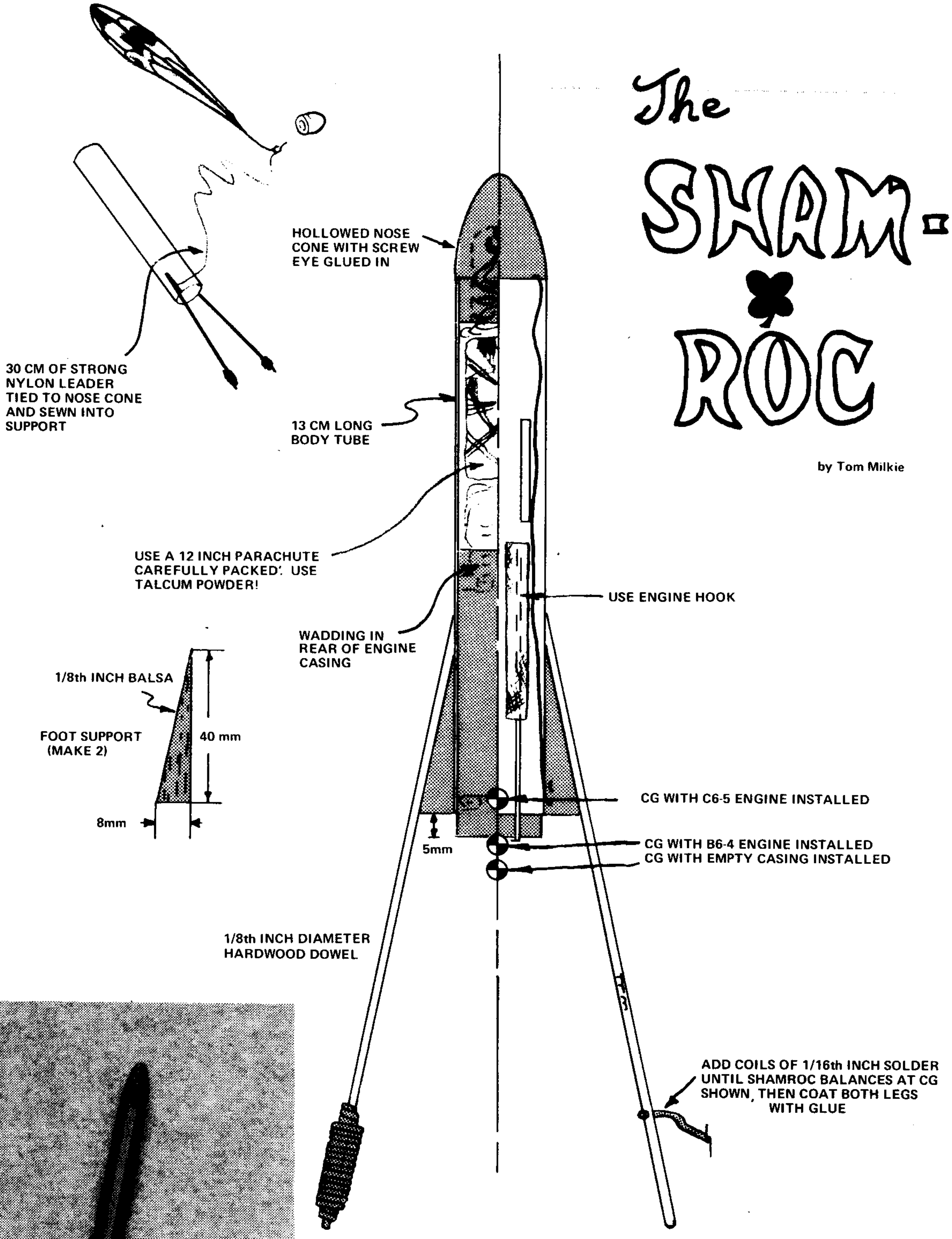
Attach the recovery system as shown. The parachute quarters are rather cramped, but a chute is a must. Wadding can be pushed down the engine casing to provide more room. Glue the dowel feet onto the supports and add the solder as shown. Keep the center of gravity (with a loaded engine in place) just to the rear of the engine.

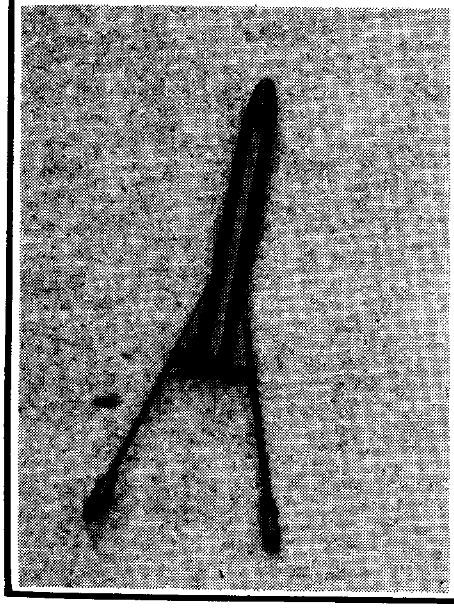
Well, that is about enough for no-finned wonders . . . hmmm, I wonder how I could build a flying scale LEM? . . .



The SHAM-ROC

by Tom Milkie





Automatic Computation for Rocketeers

by Charles Andres

This column is the first in a series of bimonthly articles on programming a computer to calculate various mathematical programs associated with model rocketry. In this issue, I shall discuss the Barrowman Method for finding the center of pressure for a rocket, pertaining to simple rockets, as well as the fundamentals of programming computers. In future issues, I will illustrate programs showing how to find a rocket's theoretical altitude, finding two and three stage rocket altitudes, finding the center of pressure for complicated rocket structures, and how to find the center of gravity and drag coefficient. There will also be a general timesaver program which will compute any variety of the above according to the programmers wishes. In addition, a program for computing the dynamic parameters as well as several tests for dynamic stability will follow.

An Introduction to Computer Programming

All of the programs are written in FORTRAN IV, which is one of the more widely used computer languages, and can be used with the IBM 360 computer. Many high schools, small colleges, and businesses also own remote terminals which are hooked into a larger institution's IBM 360 computers on a time-sharing basis. Since FORTRAN IV is often used with these terminals, especially the 2740, 1050, and 2260, operation instructions will follow. (All of the programs in this series were written using a 2740 terminal. Thus, all of the commands and instructions will be considered limited to this model. According to the RAX User's Manual, the 1050 and 2260 are both quite similar, so most of the information here should be able to cover operation of these terminal models as well.)

Each program in this series is supplemented with a flow chart, test data and results, a test rocket, and an explanation of the program. All of the information included should be sufficient enough so that any rocketeer who can identify the keys on a typewriter can type in and use the program. However, if the reader wishes to learn the ins and outs of computer language other than this brief going over, he is advised to consult a number of books on the subject, and see any local computer programmer who will probably be able to increase his basic knowledge of the machine. A suggestion of titles includes **A Guide to FORTRAN Programming**, and **A Guide to FORTRAN IV Programming** both by D.D. McCracken and published by John Wiley and Sons, 1961, 1965 respectively.

A computer program may look exceedingly complex at first glance, but is actually quite simple when broken down into the primary steps. Fundamentally, the first part of the program instructs the computer to accept the forthcoming program, the second part reads in the necessary variables, the third part explains what is to be done in mathematical statements translated into FORTRAN, and the next instructs the machine how to print out the solutions. After this, the "go to" and "stop" statements are given, followed by the data. This is where the variables which vary from rocket to rocket are typed in, and where the computer program attains its unique versatility.

The program illustrated in Fig. 1 will be mentioned in the following text to show the general workings of a computer program of this type. After the fundamentals have been explained, it will be shown why the program was written the way that it was, and what it can accomplish. Following this will be a flow chart with an explanation and test data with the rocket configuration from which it was taken.

The computer paper at the terminal may be anywhere from 80 to 120 spaces wide, but all program lines are confined to limits of 72 spaces. (Answers and computer typeouts are allowed up to 80 spaces) If for some reason the line of information is longer than this limit, it can be continued on the line below it provided that a 1 be typed in before the second successive line, a 2 before the third successive line, etc. up to 9. Therefore, any given line can be up to 720 spaces long, and some lines, such as format lines, are indeed that long. (Examples of this appear in Fig. 1.)

The first line in a program of this type is /job go. This tells the machine to begin work to accept the program which is following. (All commands to the computer are typed in small letters, all responses are issued in capital letters) Any direct command is preceded by a slash mark (/).

The second line of the program is /ftc. This statement will cause the program to *compile* but no extra tasks such as deck, cross reference maps of listings will be produced. (These terms refer to other auxiliary information which can be typed out, but is unnecessary in our work, and shall be ignored.)

After the /ftc statement, one can type in "C" followed by any message one wants to write. Of the more common uses of this feature are: identification of the program, date of programming, a dictionary of variables, etc. As many lines as are necessary can be added here as long as they are preceeded by "C". (C stands for comment.) These lines are retyped out when the program is displayed in its entirety.

The REAL statement on the list defines several variables as real numbers. In the FORTRAN language, any variable can have any combination of letters up to five, but if the variable has a first letter of J,K,L,M,N, or O, it will be assumed that these numbers are integers unless they are defined otherwise. Since dimensions and measurements are very rarely even integers, any variable beginning with these letters, J–O, must be defined as real numbers. Since it is easier to consider all variables as real numbers, I have defined those that would otherwise be integers only, as real numbers. An integer would then be written as 3.00. It is always a good idea to keep all of this program's variables in the real number system.

The next statement is the READ statement. This is the line which assigns a variable name to the data entered. Thus, if the variable in a program were x, y, and z, one would say: READ X,Y,Z and type in under data 3, 4, and 5, if x=3, y=4, and z=5. This order is always maintained. Do not worry about placing variables in alphabetical order, however, this is not necessary. The READ statement is always preceeded by a statement number. The number is typed in immediately. The tab button is then pushed to move the carriage over 7 spaces. *It is imperative that no statements other than /commands and statement numbers start earlier than column 7.* The space is left for statement numbers (1–5th columns) and column 6 is reserved for the continuation code. As I mentioned earlier, when one has a line longer than 72 characters, it must be continued on the line below with a 1 after it. However, the 1 must be in column 6.

Before the variables are listed in the order that they will be typed in, the following information must be included. After the word READ, either 1 or 5, preferably 5, separated by a comma, followed by the *FORMAT statement number* must be typed in. These two numbers are enclosed by parentheses. After this, if and only if the DIMENSION statement has been included, one must type in: (i123(j),j=1,8), followed by the variable list. The reason for these measures can be found in any basic computer book, but are too extensive to go into here. Incidentally, one can develop DIMENSION statements to his own needs if the 32 space format is insufficient. There are several other uses for DIMENSION statements, but they are not relavent to our discussion here.

The FORMAT statement must also be preceeded by a statement number. Any number up to 9999 will do, but remenber never to use a statement number more than once in defining a statement in any single program. (They also need not be in any particular order.) The FORMAT statement has the job of setting up the format for which the data will be typed in. Just remember that one is still limited to 72 spaces across. Format statements are written as thus: If you have an F7.3 format, this means that 7 spaces are allowed for each bit of data, including the decimal point, and there are three digits to the right of the decimal point. Thus, any dimension or value up to 999.999 can be typed in under this format type. In addition, any number smaller than this can be typed in as long as the decimal point is properly placed with respect to the other data bits. (ie. 6.78 is interpreted to be 006.780) Most likely, there will be more than one bit of data per line, so it is convenient to list several variables under the same format on one line. This is done by placing the number of bits per line before the format code. Thus, a 10F7.3 code would have data typed in as such:

```
XX.XXX  XX.XXX  XX.XXX  XX.XXX
XX.XXX  XX.XXX  XX.XXX  XX.XXX
XX.XXX XX.XXX
```

(blanks between data fields are for algebraic sign).
with decimal points separated by six spaces, ten of them per row. It is very common to require more than ten variables, so several rows are utilized and typed in thus: FORMAT(10F7.3/10F7.3/10F7.3) (Three rows of ten bits of data per row, 7 spaces in each bit.) Again, if one includes the DIMENSION statement, he must add the DIMENSION code 8A4 before the first format bit. (see fig. 1; first format statement)

Now, after all of the preliminaries have been taken care of, the program gets down to business. Most of the statements in this portion of the program are simply mathematical equations translated into FORTRAN. The Mathematical Operations are translated as illustrated below:

Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponentiation	**
Roots	sqrt
Tangent	tan
Arctangent	atan

Other mathematical operations are possible, and will be explained in future issues. As an example of the conversion from the standard math form to FORTRAN, compare the following standard math form with the adjacent FORTRAN line.

$$\text{CNAF} = \frac{12\left(\frac{s}{D}\right)^2}{\sqrt{1+\left(\frac{2l}{a+b}\right)^2}}$$

C N A F = (1 2 * (S / D) * * 2) / 1+sqrt((2*L/A+B)**2)

The one conditional statement I have in this program portion is the 'if' statement. This statement is absolutely necessary when a variable of zero is given, but if it is not always zero. The 'if' statement is read as follows: IF(X)12,23,35 This means that if the variable ,X, is less than zero. the

Figure 1

```
M.0072 BEGIN ACTIVITY

/input
/insert rocket(1234) M.0073 ACTION IN PROGRESS
M.0070 ACTION COMPLETE
/display M.0073 ACTION IN PROGRESS
/JOB GO
/FTC NAME=ROCKET
C          BARROWMAN CALCULATION OF CENTER OF PRESSURE
           DIMENSION I123(8)
           REAL KTB,M,L,L1,L2,L3,L4,N
99         READ(5,10)(I123(J),J=1,8),N,S,L1,A,B,R,M,XF1,L,L3,D,D1,D2,
          1XCS1,L4,D22,D12,XCB1,L2
10         FORMAT(8A4/10F7.3/9F7.3)
           XN=.6666*L
           XN1=.466*L3
           CNACS=2*((D2/D)**2-(D1/D)**2)
           IF(L4)95,98,97
98         XCS=0
           GO TO 96
97         XCS=XCS1+(L4/3)*(1+(1-D1/D2)/(1-(D1/D2)**2))
96         CNACB=2*((D22/D)**2-(D12/D)**2)
           IF(L2)95,94,93
94         XCB=0
           GO TO 92
93         XCB=XCB1+(L2/3)*(1+(1-D12/D22)/(1-(D12/D22)**2))
92         CNAF=(N*4*(S/D)**2)/(1+SQRT(1+(2*L1/(A+B))**2))
           KTB=1+.5*R/(.5*R+S)
           CNATB=KTB*CNAF
           XF=XF1+M*(A+2*B)/(3*(A+B))+(A+B-A*B/(A+B))/6
           CNA=2+CNACS+CNACB+CNATB
           X=(2*(XN+XN1)+CNACS*XCS+CNACB*XCB+CNATB*XF)/CNA
           WRITE(3,11)(I123(J),J=1,8),XN,XN1,CNACS,XCS,CNACB,XCB,
          1N,CNAF,XF,CNA,X
11         FORMAT('NAME ',8A4/' FORCE ON NOSECONE-CONICAL=',F7.3,
          1' OGIVE=',F7.3/' CONICAL SHOULDER (IF ANY)-FORCE=',F7.3,
          2' C. OF P.=',F7.3/' CONICAL BOATTAIL (IF ANY)-FORCE=',F7.3,
          3'C. OF P.=',F7.3/' FINS-NUMBER=',F3.1,' FORCE=',F7.3,
          4'C. OF P.=',F7.3/' TOTAL ROCKET-FORCE=',F7.3,'C. OF P.=',
          5F7.3/' C. OF P. DISTANCES MEASURED FROM TIP OF NOSECONE.')
           GO TO 99
95         STOP 7734
           END
/DATA
AEROBEE 300
 3.0   1.50  1.59  2.25  1.20   .976  1.05  18.275  1.30  0.0
  .541  .541  .976  6.40  1.00  0.0   0.0   0.0   0.0
M.0070 ACTION COMPLETE
/end runM.0073 ACTION IN PROGRESS
END OF COMPILATION  ROCKET
NAME AEROBEE 300
FORCE ON NOSECONE-CONICAL= 0.867  OGIVE= 0.0
CONICAL SHOULDER (IF ANY)-FORCE= 4.509  C. OF P.= 6.948
CONICAL BOATTAIL (IF ANY)-FORCE= 0.0   C. OF P.= 0.0
FINS-NUMBER=3  FORCE= 39.089  C. OF P.= 19.191
TOTAL ROCKET   FORCE= 55.194 C. OF P.= 17.527
C. OF P. DISTANCES MEASURED FROM NOSECONE.
```

computer should go to statement 12. If the variable X is equal to zero, it should proceed to statement 23. And if X is greater than zero, the computer should go to statement 35 and follow instructions there. Because the variables are very seldom of negative values, statement 12 is often a STOP statement. If the machine reaches this statement, it should treat it as a dead end. The numbers referred to are statement numbers, and thus, any statement directly connected to an 'if' statement must have a statement number.

A typical example of the usefulness of the 'if' statement is exemplified by the rocket with or without a conical shoulder. If the rocket has a shoulder, a number of additional calculations must be made to account for it. Since this requires division by a variable, either a value for the conical shoulder must be typed in, or the computer will divide by zero, a mathematical impossibility, and therefore, refuse to compile. Therefore, the 'if' statement solves this dilemma. A typical example is shown below.

```
            IF(L2) 95,94,93

   94       XCB=O
            GO TO 92
   93       XCB=XCB1+(L2/3)*(1+
       (1-D12/D22)/(1-D12/D22)**2))
  92       CNAF=(N*4*(S/D)**2)/
       (1+SQRT(1+(2*L1/(A+B))**2))
  95       STOP 7734
```

What this is saying is that if L2 is less than zero, go to 95. Statement 95 is a STOP' If L2 equals zero, go to 94. Statement 94 says that XCB = 0, and therefore is skipped. Further directions say GO TO 92 which skips statement 93. If L2 is greater than zero, go to 93, and proceed to compute a value for XCB. As one may have gathered, the 'if' statement has other uses as it acts very much as a switch in the program. Also, only one stop is needed per program. All 'if' statements can be referred through it. It is usually located at the base of the program after the last 'Go To' statement. Incidentally, if you divide by zero by accident, you answer will look something like this:

```
M.0055 JOB ENDED DUE TO INTER-
RUPT CAUSED BY FLT-PNT DIVCHECK
PSW=FF25000F8
```

After all of the mathematical steps have been typed in, the computer must be told to write out the solutions desired. This is done in two steps. The first is the WRITE statement, where WRITE is typed in followed by either 3,2, or 6 (preferably 6) comma, followed by the *write format statement number*, set off in parentheses. As before, if there is a DIMENSION statement, add (i123(j),j=1,8) and then add the names of all of the solutions which are to be typed out in the order in which they are to be typed. (Data can be read out also, as well as intermediate answers if this is desired.) Just remember that the variables are printed out in the order specified here.

The write format statement can be the most complex line of all because it can be as fancy or as simple as the operator wishes. The simplest it can be is a repeat of the data format statement, and the answers will come out just as the data went in. However, it is much more convenient and attractive to take the time to make a more complex statement so that each solution can be identified easily. A typical format is given in the program in Fig. 1. For an idea of what the answers for this format look like, take a look at what follows END OF COMPILATION ROCKET. There are two or three rules one must follow in writing a format statement. After typing in the format statement number and FORMAT, place the rest of the statement in parentheses. Any message, identification of data, etc. can be typed in as long as it is enclosed in apostrophes ('). Also every format code must be set off by commas. However, several types of format codes may be used. Remember that 8A4 is the DIMENSION statement code for the one given, and FX.Y is the format for the other format codes. (X being the number of spaces in answer, Y being the number of digits right of the decimal point.)

The 'Go To' statement must follow the format statement, and must say GO TO XX, XX being the READ statement number. This keeps the computer compiling through the program until it reaches an answer. As explained before, the stop statement follows. Any four digit number can follow this command. Add *end* after this, and /DATA.

It is a good idea not to insert data at this time. Run the program through once to test for mistakes. If you receive END OF COMPILATION XXXXXX, you may proceed to test the program with test data. If you get FORTRAN DIAGNOSTIC MESSAGES, there is a mistake in your typing, and you will be told where and what it is, although not always in no uncertain terms. No matter what occurs, give the /save command and follow it by saving the program under any name you like, as long as the name is six letters long or less followed by a lock code like this:

```
/save rocket(1234)
```

This will save the program for future use. Anytime you want to use it, follow this procedure:

```
M.0076 BEGIN ACTIVITY
/input
/insert rocket M.0073 ACTION IN
PROGRESS
M.0070 ACTION COMPLETE
```

Then type out the data for your program as illustrated.

If for any reason you want to purge the program, write /purge rocket(1234) The program cannot be purged unless a lock number identical to the /save lock number is given. The program can be used without it however.

When you type /end run, the computer will digest all of the information given it and should compile. An answer will be received in about ten seconds time or less. If you type in two or more sets of data the computer will retype the answer format as many times as required. Do not hesitate to run several rockets at once. The extra delay is not noticeable.

In case of a mistake in the program, follow the following procedure:

/update rocket (1234)

/change 45,45 (If one line, 45, is to be changed)

/change 45 (If lines are to be inserted between 45 and 46)

/change 45,52 (If lines 45 thru 52 are to be changed)

The numbers refer to the line numbers given in a display and in fortran diagnostic messages. They always look like this: L.0001 (line 1), and precede each line in a display. Always change lines in progressive order (ie. Do not change statement 1 after changing statement 34; at least not in the same update.)

Other commands of the computer which the reader will find handy include following: /input precedes any work done which pertains to following orders except displays and updates directly on the memory file. /end is put at the end of all work to get back to the BEGIN ACTIVITY MESSAGE. the /id followed by the individual terminal's indentification number is the only response to the sign on message. Make sure that this is explained by frequent users of the terminal if you are a beginner. /cancel means that one can stop whatever one is doing and get back to the BEGIN ACTIVITY message. (If you are in the middle of a program and must stop, /end will give you a chance to save the work./cancel will erase all work all the way back to the last BEGIN ACTIVITY message. /off will turn the machine off, usually with a good-bye message. /display will give you a look at your program.

Computers will not accept every character on the keyboard. With the 2740/360 combination, and many others, these are the only legal characters:

A–Z	Alphabetic Characters
0–9	Digital Characters
/	Slash
*	Asterisk
.	Period
,	Comma
()	Parentheses
-	Hyphen
+	Plus Sign
$	Dollar Sign
_	Underline
¢	Cent Sign (Used as a backspace on output)
'	Apostrophe
&	Ampersand
=	Equal Sign

The Radio Controlled Boost/Glider

Part III

by

Douglas Malewicki

Photo by George Flynn

Doug Malewicki adjusts his R/C B/G in preparation for a launch.

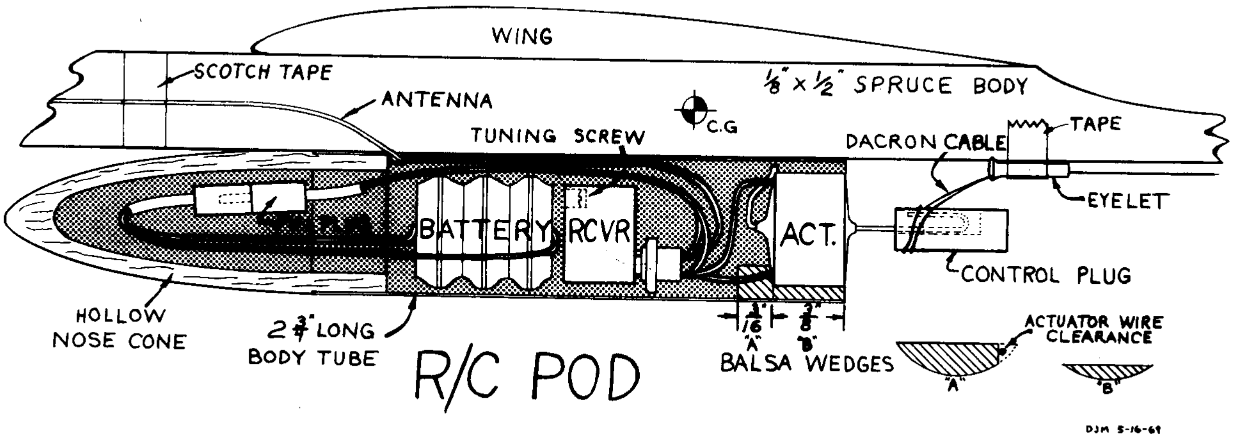
STEP 3–MODIFYING THE POP–POD BOOST GLIDER FOR RADIO CONTROL

Once the basic glider has been adequately flight tested to verify boost stability, pod separation, transition, and good glide we can safely proceed to modify it for radio control operation.

Build the Radio Control Pod

Cut a 2.75 inch length of body tube (Estes BT-20 or Centuri no. 7) and prepare the balsa wedges "A" and "B" shown in the R/C POD drawing. The purpose of wedge "B" is both to align the actuator and to give it a tight (though removable) friction fit in the body tube. Wedge "A" merely prevents the actuator from sliding forward. Wedge "B" will generally have to be sized by trial and error with the actuator inside the tube to obtain the proper friction fit. Wedge "A" only requires that enough clearance be available for the Bentert receiver cube to slide through when inserting the R/C system from the rear. When you are satisfied with wedges "A" and "B", glue them together. When dry, glue this sub-assembly inside the tube.

Next the R/C POD nose cone (an Estes BNC-20B or Centuri BC-70) should be split along its grain with a sharp X-acto knife. Each half should be hollowed (an X-acto U-gouge is great for this job) and then glued back together. As you can see from the R/C



R/C POD

POD drawing, the hollow nose provides the necessary room for storing the Deans Pin Plug. Note that the nose should also be a tight friction fit. Ejection of the nose cone is not a criterion in this application.

The Rudder

Cut the "movable" rudder surface out of 1/32 inch plywood. After sanding, use a straight pin to "drill" three hinge holes in alignment with the "fixed" rudder holes. Also cut a 1/32 inch wide slit in the rudder to accept the rudder horn. Make the rudder horn and glue it perpendicular to the rudder.

Rudder hinges that are almost frictionless are made by using one filament of dacron and looping it twice in a figure eight through each pair of fixed and movable rudder hinge holes. Tie the ends in a knot and apply a minute drop of glue to prevent any slipping.

An AFT GUIDE TUBE for the dacron control cables should be glued and scotch taped to the bottom of the body just forward of the fixed rudder. (One of the Deans plug plastic sleeves or an eyelet will do for this guide.)

Electrical System Assembly

1. Prepare the Actuator.

First bend the actuator's torque rod as shown in the R/C POD drawing. Next file down the other end of the rod (which acts as a limiter for the arcing motion) so it will be able to oscillate back and forth without rubbing against the inside of the body tube. Lastly cut, strip, and tin the yellow actuator wires for attachment to the receiver's ceramic pin plug.

2. Prepare the Receiver

Refer to the WIRING DIAGRAM and note that the notch in the receiver's ceramic pin plug is lined up with the red dot painted on the receiver cube. Remove this plug and carefully grip it in a vise in preparation for soldering leads to the various terminals. All soldering should be done with a low wattage pencil type iron rather than a high wattage gun.

First solder a 27 inch length of hookup wire to the ANTENNA terminal. Then solder a 2.5 inch length of BLACK hookup wire to serve as the BATTERY NEGATIVE (–) lead. Next twist the stripped end of a 2.5 inch long RED wire (the BATTERY POSITIVE (+) lead) together with the stripped end of the lower actuator lead and solder this as a single connection to the terminal shown. Lastly solder the remaining actuator lead to the remaining terminal. Note that if the actuator leads are backwards, no pulsing will occur. I've made this mistake myself and found that the system growls audibly in protest once the battery is connected.

3. Prepare the NICAD Battery

Solder a 2 inch length of RED hookup wire to the battery's positive (+) lug (the same side that says 50 mah). Then solder a 3 inch long BLACK wire to the opposite lug. Next EPOXY the lugs and wires on both sides so they won't flex and break with use. At this time also EPOXY the wired connection on the receiver's ceramic pin plug.

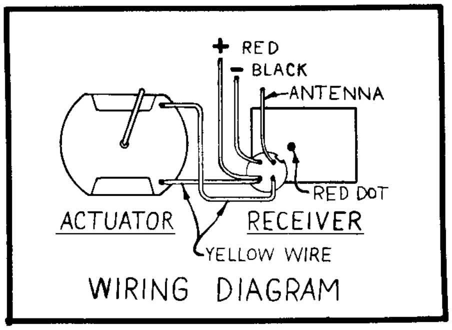
4. Prepare the Deans Pin Plug Connector

We only want a 2 pin connector so cut the plug and solder both the battery *and* receiver leads as per package instructions. Note that the Deans plug also serves as our ON-OFF switch.

5. Check Equipment Operation

Connect the battery to the receiver (red to red and black to black) and turn on the transmitter. Work the transmitter control both left, right, and neutral to familiarize yourself with how proportional pulsing works.

Note that I used DYMO tape labels to mark left, right, idle current, full current, on and off on the transmitter case. The transmitter also came with a 9 volt spring contact battery case which used 6 pencells. This was modified for two large 2N6 9 volt drycells (in parallel) with more positive acting snap on contacts.



Mounting the R/C POD

Verify that the location of the glide center-of-gravity (CG) has been marked on the body and *then* remove all clay nose ballast. Insert the receiver and actuator in the body tube with the antenna dangling out the back. Insert, but do not connect the battery in front of the body tube, and attach the nose cone.

Next find and mark the exact location of the R/C POD along the spruce body which will duplicate the glide CG. Scotch tape is useful here–also keep in mind that the antenna should be wrapped around the nose and taped lightly in place along the body to duplicate its effect on center-of-gravity.

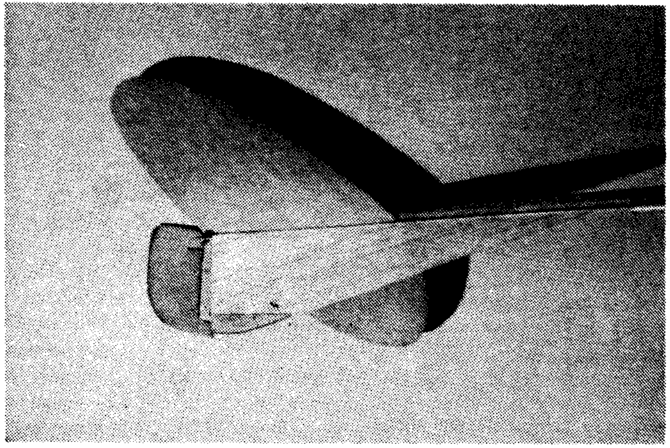
Remove all the R/C gear and nose cone from the R/C POD body tube and then glue this tube to the spruce body. Be careful that the alignment of the "A" and "B" wedges is correct. When dry, add a fillet of glue to the joints.

Next make a 1/8 inch hole in the body tube next to the glue joint for the antenna lead. This hole should be far enough aft so as not to interfere with insertion of the nose cone shoulder (see R/C POD Drawing).

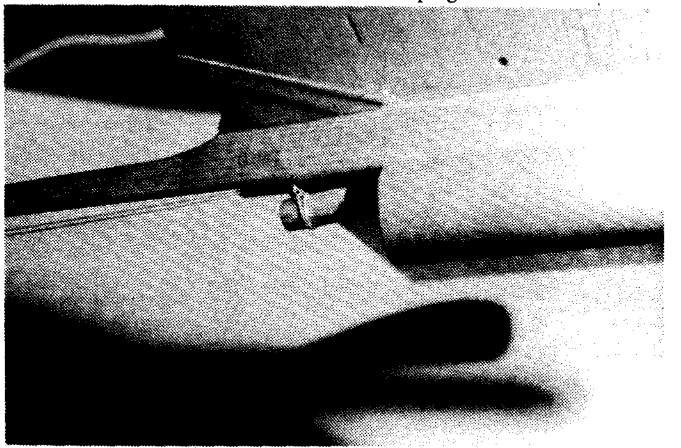
Finally, re-install the receiver and actuator in the R/C POD. Feed the antenna out through the 1/8 inch hole, wrap it around the spruce body nose notch and then back to the tail using additional pieces of scotch tape at the mid-body and tail to hold the antenna in place.

Prepare the Control Plug

The control plug is the novel feature of



The moveable rudder is made from 1/32nd inch plywood. The rudder control line is attached to a small horn on the side.



The control plug converts the rotational movement of the actuator to a linear movement of the control lines.

this system which allows for easy quick switching of the radio control equipment from one glider to the next. A piece of 1/4 by 1/4 inch hard balsa scrap from the wing leading edge should be sanded to a circular 1/4 inch diameter cross-section. A 1/2 inch length of this balsa "dowel" is used for the control plug. Next carefully slot the plug so that it will slide tightly over the actuator torque rod as shown in the R/C POD drawing. Note that the slot is somewhat offset from the center of the plug so that the plug's centerline *will coincide* with the actuator centerline when installed.

The Control Cable Eyelet

A location along the bottom of the body must be selected for the eyelet so that the control cables (which will be wrapped around and glued to the control plug) will pull at about a 45 degree angle (see R/C POD Drawing). The reason for this is because there will be too much friction if the cables must be pulled at right angles through the eyelet. You will have to slightly notch the body to make room for the rim of the eyelet. Then glue and scotch tape the eyelet in place.

Attaching the Dacron Control Cables

A two filament length of dacron should be wrapped around and the bottom strands glued to the control plug. When dry, feed the cables through the eyelet and then through the aft guide tube. *The cable which pulls the actuator from its idle current (off) position goes to the left rudder horn.*

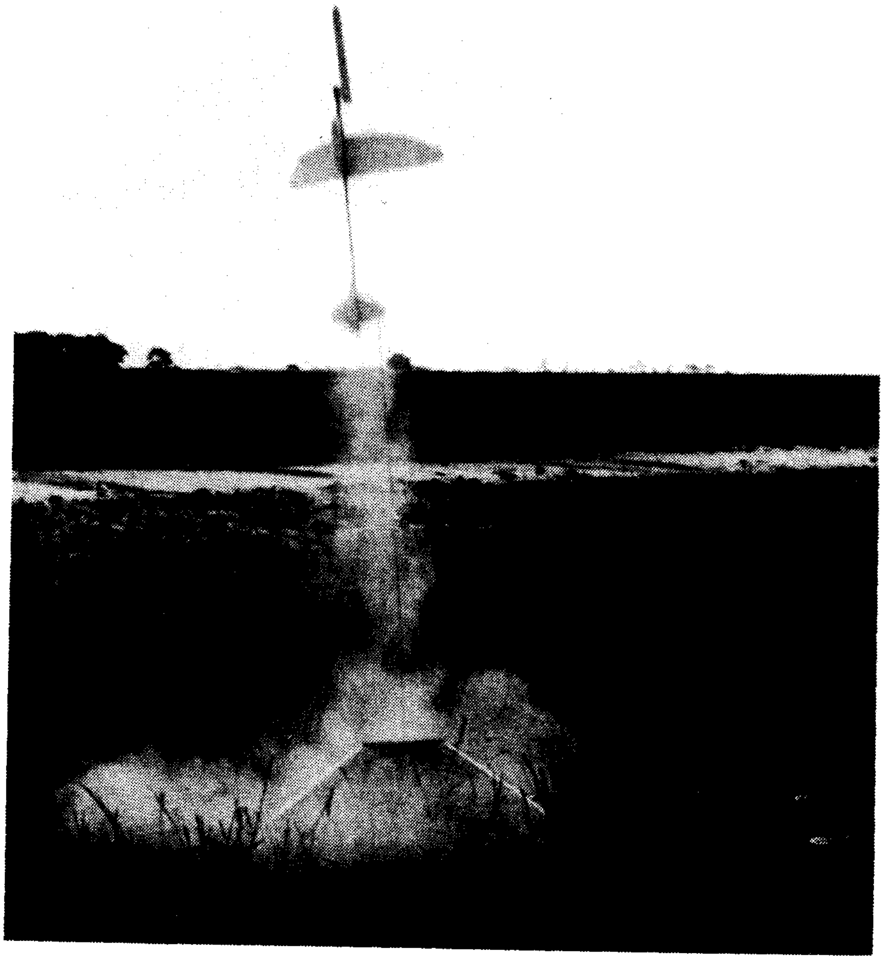
Use a slip knot to tie each cable to its rudder horn. With the transmitter and receiver turned on, adjust both knots so that the pulsing rudder deflects an equal amount on both sides of neutral. Note that the control cables should not be so tight as to prevent the *actuator* from reaching its full left or full right limits.

When properly adjusted, tighten these knots and apply a drop of glue to each–be sure to continually check the pulsing adjustment as the glue dries.

FLYING THE RADIO CONTROL BOOST GLIDER

Prior to a first flight you will have to check that the glider will pick up steering commands at an adequate range. With the transmitter turned on, steering level set to neutral, and the antenna fully extended you should be able to obtain good rudder pulsing at a range of about one block. If you can't, the receiver turning screw should be adjusted (with a plastic non-conducting tool) until you pick up the signal.

At present all flights must be conducted using B4-2 engines in order to have ejection occur while still climbing. The A5-2 engine recommended for test flying the basic pop-pod glider will already be on its way down at ejection time (due to the extra radio equipment weight being carried) and a death dive will result. As explained earlier, the same problem exists with C6-5's, even though the peak altitude would be considerably higher. I have not as yet personally verified this, but past experience tells me to be patient and let somebody else find out whether or not enough altitude remains to successfully pull out. A stronger, more positive acting rudder would surely help. C6-3's, on the other hand, would eliminate the problem.



Liftoff! (Photo by Doug Malewicki)

Prepare the parachute, wadding, and engine; then slide the pin pod on the launch rod and attach the micro-clip leads as before. The pod support tape on the launch rod will have to be slightly higher up than with the non R/C glider so that the movable rudder will clear the base.

Plug the Nicad batteries to the receiver and make one last operational check before sliding the batteries inside the R/C POD and inserting the nose cone. Turn the transmitter control lever to the left rudder position (IDLE CURRENT) in order to minimize battery drain and then hook the glider to the pod. Just before starting your countdown, turn the control lever back to neutral. *Leave* the rudder pulsing about the neutral point *throughout* the boost and transition-to-glide phases. Note that the wiggling of the rocket that you'll be expecting to occur during boost due to the pulsing rudder *never* appears. It goes straight up like the rudder wasn't even there!

Once the bird is in a steady glide you can steer it as desired. Keep in mind that it does not respond instantly to commands. A slight lag occurs before the small control forces we are dealing with can have any effect on the glider's motion *and* not neutralizing the controls once you can see a turn has been established may result in far too tight of a turn. A spiral dive can then develop and then even full opposite rudder may not be enough to pull it out in time. This isn't really as bad as it sounds–I just want to emphasize gentleness on the controls until you develop a reasonable feel for the response characteristics.

Lastly, if there is any wind try to keep the glider somewhat upwind of the launch site. Keeping track of where the pop-pod went requires eyes in the back of your head *or* a friend. Good luck, have fun, and don't forget to disconnect the receiver batteries as soon as possible after the glider lands!

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

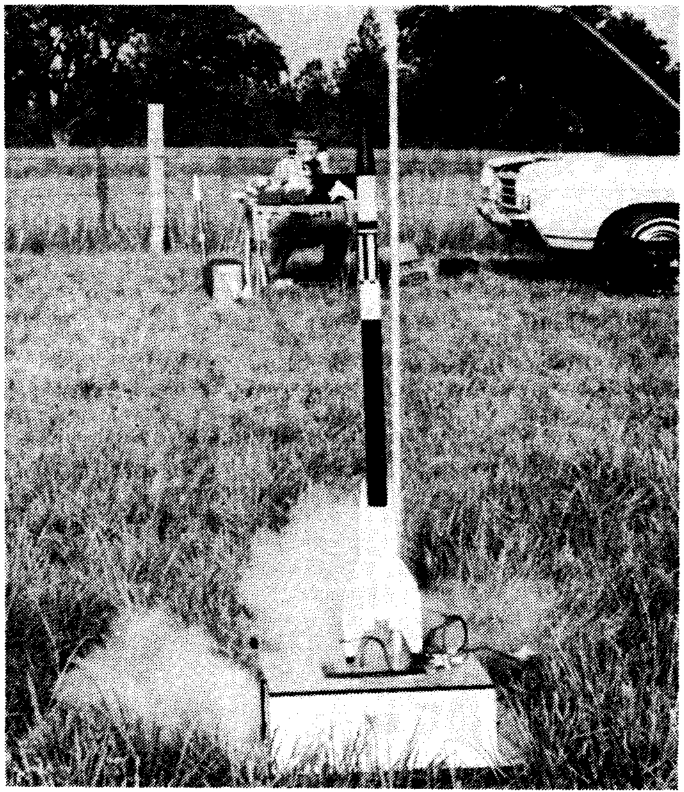
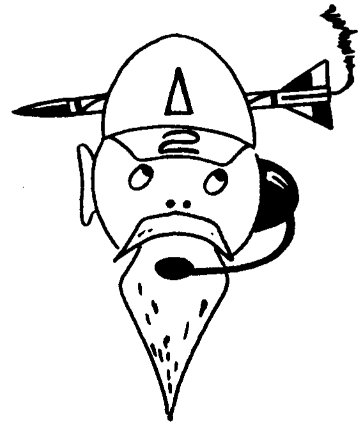


Photo by Mike Dombrowski

A summer launch at the Ellenwood, Georgia club : note the firing system and field telephones.

The Waynesburg, Pennsylvania Association of Rocketry setting up for a Lions Club lecture-demonstration.

Photo by Chris Wunder



The Old Rocketeer

by G. Harry Stine NAR#2

Elsewhere in this magazine, you will find complete results, photographic coverage, and general reportage relating to the Eleventh National Model Rocket Championships–known familiarly to NAR members as NARAM-11–held in August at the Air Force Academy. Since this was the first year in which Model Rocketry magazine existed to fully cover the meet, I found myself in the very envious position of being able to forego the reporter's hat that I wore for a decade when reporting previous NARAM's for another modelling magazine. For once, I was able to rear back and have a long look at things. And what I propose to do herein is to offer something more than reportage; you might call it an editorial whack at what I saw and how I evaluated it.

First of all, I gotta hand it to Bill Roe, a guy who doesn't know how to quit. Bill is NAR no. 13, flew in NARAM-1, was Contest Director of NARAM-2, was CD in all but fact and recognition for NARAM-3 and NARAM-4, and held the brutal position of Chairman of the NAR Contest Board up through NARAM-6. Why he ever wanted to get back in the can of worms with us for NARAM-11 is a moot question; the fact is that he did it and pulled off a real jolly job. I hope that he's with us for many more years.

Next, my old white hat is off to the model rocketeers who proved beyond a shadow of a doubt that they could handle high impulse model rockets safely and with aplomb. To my knowledge, the Open Payload category had never been flown previous to NARAM-11. But it was indeed flown at NARAM-11 and flown well. There were a few modrockers who did not know how to handle that much power, but they were small in number and their birds were stopped by very strict safety checking . . . mostly. (Every NARAM has its hair-curler, and NARAM-11 had a couple in the form of unstable long duration models that thrashed around in the air over the launch area whilst everyone proceeded to dig foxholes in record times . . .) Egg Lofters also showed the proper use of high-impulse model rocket engines. I think that most model rocketeers can now handle this big stuff, even though the Europeans are somewhat aghast at it.

We saw a significant trend in scale models away from scratch-built scalers to kit scalers. In some respects, this is good because it means that the kits are opening up the scale modelling events to more model rocketeers who might not otherwise tackle the scale categories because they are not expert scratch builders. Most scale models in the "pure scale" event did very well, and there was no repeat of past NARAM performances wherein scalers were underpowered–deliberately or accidently–so that they just cleared the launch rods. At NARAM-11, the scale birds got off and got up there, thus providing much more realism.

Boost gliding was excellent this year, and if we keep it up we may someday equal the performances already being turned in by Europeans and by non-rocketeer hand-launched glider aeroplane types. This year, you had to do more than just get the danged thing to glide in order to win; you had to turn in a flight of more than 60 seconds to be in the running at all. There were some excellent B/G flights. Keep it up, gang. Your work is improving.

But R&D was frankly quite disappointing. Perhaps this competition category should not be flown at a NARAM but held all by itself during the non-flying winter months at regional conventions. In any event, R&D showed an appalling lack of literature searching, of practicality, and of general quality. Too many times, model rocketeers and often R&D judges are enthralled by some obstruse problem or by the amount of time and money they can manage to spend on a given project. Look, fellas, we are not running R&D projects on government contracts; time and money spent are really quite secondary to the results. I hope that future R&D competitions will profit from the improved communications of model rocketry exemplified by this magazine and by some of the departments in this magazine such as Mandell's "Wayward Wind."

It's also just as possible that we need to break down the R&D competitions into additional age divisions based upon scholastic level. Let's face it: a 12-year-old model rocketeer doesn't stand very much of a chance against a 16-year-old model rocketeer competing in Junior Division R&D . . . no matter how bright the younger contestant is.

Since I am both griping and tossing kudoes at the same time, let me herewith turn loose a horrendus blast of pure ridicule: Everybody seems to gripe about the NAR pink book, yet very few people seem to have read it! Literally, the results of NARAM-11 might have been quite different and a few trophies might have ended up in other hands if both judges and contestants had simply read the darned rules, much less studied them at all. Some people are still flying out of the 1964 Edition of the rules and have not bothered to change the program patch plugs in their computer-like brains to shift over to the 1967 Edition. Personally, having spent many long hours helping to put together the current pink book (and I occasionally goof on it, myself), I can feel little or no sympathy for those raucous voices raising unmitigated Cain about the current rules. Look, before you criticize them, read them. And before you yell about changing them, try flying with them. The rules are like any other system: they will work reasonably well in the majority of situations unless and until some idiot starts "improving" them here and there by little changes. Such little changes are usually made without any consideration whatsoever of the logical consequences of such minor changes. The 1967 pink book was put together by Pinky Guill, Tally Guill, Al Kirchner, Tommy Thompson, Bill Barnitz, Jim Kukowski, and a couple of other people including myself who have not only been flying in competition but who have also had the dubious honor of being a contest director in a national or regional meet . . . or both. The new Contest Board has a real job on their hands, and I do not envy them. But they are still in a much better position than the Rules Subcommittee in 1967: the current Contest Board at least has some feedback, good or bad, on which to proceed, while the old one did not.

Buddy, if you had to write the pink book, I would advise you in advance to have a complete phisical and psychological checkup; it will help the doctors put you back into your previous shape once you have finished your job.

Enuf of that.

NARAM-11 showed that model rocketry is truly a national sport now. There were entries from over 30 states. Trophies and ribbons are scattered all over the United States now. It is no longer a local or regional thing. There are good model rocketeers everywhere. There are good NAR Sections everywhere. No region of the USA has a monopoly on model rocketry or on affairs of the NAR. As a result of this, we may finally be able to tackle the rest of the world starting with the First World Championships in Model Rocketry in Yugoslavia in September 1970.

NARAM-11also showed–if such a thing hadn't been amply proven before this–that the Leader members of the NAR between 17 and 21 years old have the savvy, the intelligence, and the capability to run things right along with the adults. And why not? Actually, this is what many of us adults in the NAR have been working for. Granted, there is still much to be learned by some Leader members in the area of diplomacy, tact and political maneuvering . . . but the mechanisms for teaching this sort of thing have also been set up and working. Never mind what they are. I should blow the underground plans of the Establishment? (Leader member, please do not forget also that you are the Establishment of tomorrow!)

We still have some serious technical problems within model rocketry that show no signs of being solved at this time, but perhaps NARAM-11 will have angered enough people to get some work started. The major one that needs work is altitude determination . . . not "tracking," because the use of that term necessarily limits the possible solutions to that problem as well as creating a problem set. There is too much human error in the present alt-azimuth theodolite system. I say that it is human error because I go out and track myself to try and define the problem. One of the biggest problems is possible loss of face by tracking personnel. By this I mean that it is easier for a tracker to report in a "guesstimate" set of angles than it is for him to report a true "track lost." Reporting a "track lost" angers other model rocketeers and possibly threatens the tracker with ego problems . . . such as jokes about being blind, etc. So some trackers are apparently reporting in guess-angles rather than admitting a track lost.

Now, friends, what is a solution to the altitude determination problem? First, it must be defined. The problem is altitude determination, not tracking or optics or baselines or calibrations. The solution is to come up with a system that will determine the true altitude achieved by a model rocket above its launching site within an acceptable set of limits–say, plus-or-minus 10% as a starter–said system not to add enough weight to the model to make any difference at all and preferably no weight at all–said system capable of being built and maintained for something less than 1% of the GNP and preferably less than $100 as a starting round number–said system capable of being automatic or at least operated by a young model rocketeer with a minimum amount of training and experience and preferably no advanced knowledge of the technology involved–said system also being capable of operating and doing its job on about 95% of the models launched regardless of altitude achieved or sky conditions or previous conditions of servitude.

There is a solution. I do not know what it is right now. If I did know, I would build it and tell you about it.

Model rocketry is a very Edisonian hobby. By this, I refer to the famous saying attributed to Thomas Alva Edison: "There must be a better way to do this job. Find it!" Let's start being Edisonian about the altitude determination system.

The return of the National Meet to Colorado and the U.S. Air Force Academy proved something else. It proved that we have come a long way since the last time NARAM models flew in the skies of Colorado. It often requires the perspective of time to see how far we have come. We have progressed . . . in spite of the contentions of some who are viewing from a short-term outlook. We have a truly national hobby with good competition from both the sporting and commercial point of view. We have built up momentum and it looks as if model rocketry is really here to stay. Model rocketry is "reproducing itself" in the sense that young men are coming up through the ranks ready, willing and eager to take over. We've achieved an outstanding safety record and maintained it, something else that would have been hard to believe years ago in spite of all our safety codes and emphasis.

The year 1969 A.D. was not only the year that men landed on the Moon. It will also be looked upon as the year model rocketry really made the grade all the way around. Like our manned lunar landing program, model rocketry has fully and completely achieved its original goals. Like our manned space flight program, it also has future goals and won't stop here. We are just beginning to see these new goals. We can't yet quite put them down and define them in a few well chosen words . . . but they are there nonetheless.

And we all seem to be heading in the same direction in a kind of semi-coordinated Brownian Movement. Sounds like great fun . . . and it will be . . .

q & a

Exactly what is ment by the following? *Most launches are probably made at a fixed azimuth to avoid the inefficiencies of dog-legging. Hence, walking-back the ground trace of the initial orbit on successive flights, when keyed to particular classes of launch vehicles is important to finding the launch site*

This was taken from the July 1969 issue on page 4, second paragraph, first column. After reading it I was totally confused. However, the rest of the article was interesting, and enjoyable reading.

Kenneth Semproch
Garfield Heiths, Ohio

"Azimuth" means the direction (that is, the compass heading) of the horizontal component of a launch vehicle's velocity over the surface of the earth. To launch at a fixed azimuth means to keep this compass heading constant during the boost to orbit. To dogleg means to change the heading while the rockets are thrusting. Once the spaceship is in orbit and the engines are shut off, the ship has an orbit whose plane lies at a fixed angle to the earth's equator. If no doglegging has been done this plane's intersection with the surface of the earth includes the point from which the rocket was launched. To walk back the ground trace means to follow the earth back around the earth from the point at which you first see the spaceship. Now if several spaceships are launched from the same base, and none of them dogleg, but at least two have different inclinations to the equator, the ground traces will intersect in a point – and that is the point from which the rockets were launched. When the author of the paragraph in question refers to the "inefficiencies of doglegging", he means that a rocket must waste a lot of fuel to change its azimuth, and hence its final orbit plane, during boost.

GKM

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

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

International Report

Japanese Activity

by Ritsuri Honda

A comprehensive model rocket program is being established in Japan under the careful supervision of the Japan Model Association.

Apollo 11 attracted public attention not only as a journalistic topic of the adventure by "Columbus" of the 20th century but also as a huge achievement of science here in Japan, too. Right after the Apollo 10 experiment was completed, all the information media including newspapers, radio, magazines, TV, etc. began building up anticipation for this rocket launching by giving special articles and programs about the Lunar exploration in various forms. Electrical appliance manufacturers do not have sufficient quantities in stock of the color TV as a result of their advertisement "Let's watch Apollo 11 on color TV." And on the very day of the landing, due to the "Apollo shock", the exchange of the stock market, the number of people in the streets and the movement of traffic recorded the minimum of this year.

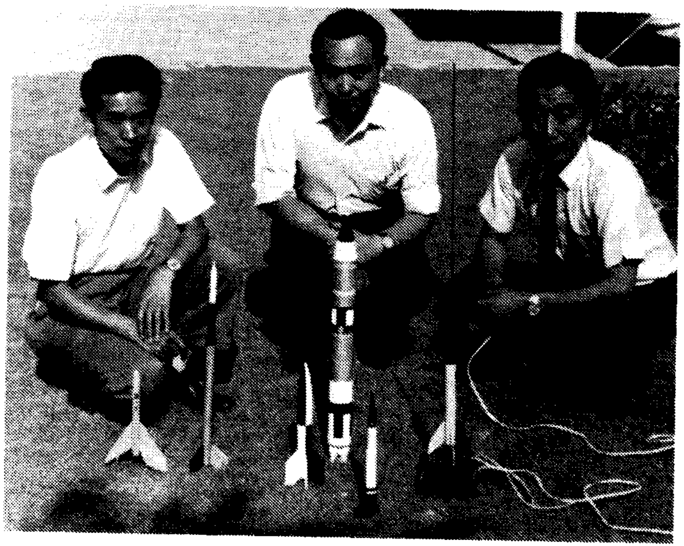
Thus space exploration fever is at its peak, and so is model rocketry. But this enthusiasm is producing some difficulties, for example, primary school boys build small small rockets using pencil caps and firework powder and wound themselves.

Our Subcommittee of Model Rocketry of JMA's first and greatest concern should be safety regulation. Of course we have never had any accidents with the *model* rockets which meet FAI rules, but we regard perfect safety as a necessity.

Therefore, our dominant opinion is that model rocketry must be under JMA control. That is, (1) the launching sites must be designated by JMA, (2) practice and experiments, whether launching or ground test, must be attended by a JMA model rocketry instructor, (3) engines with fuel must be designated by JMA, (4) for launching, the engines with fuel must be distributed by the JMA instructor, who will confirm the persons and the number of engines with fuel, (5) all engines with fuel including used engines after recovery or ground test and unlaunched engines with fuel must be returned to the instructor, (6) all launching and firing experiments not at designated places and/or not guided by JMA instructors will be prohibited, (7) JMA will decline all responsibility for engines with fuel i) not distributed by an authorized instructor, ii) without an indicated designation, iii) placed outside of the designated site, (8) a JMA Model Rocket Instructor is defined as one who holds a certificate issued by JMA and the Ministry of Education after passing the final examination like those given in the Free Flight, Control Line, and RC categories.

The safety regulations must meet the legal requirements of the National Public Safety Commission and of the Fire Division, especially on the method of storage. Rocket modelers in Japan, therefore, are to build rockets but are not to have engines with fuel on hand, except by the designated place attended by the authorized instructor. Engines with fuel will not be placed on the market but will be controlled completely by JMA. We do not have any Japan-made engines with fuel yet. We are assuming a cautious attitude in production, storage and distribution of the engines with fuel.

We are especially interested in scale model rockets for which Mr. Harry Stine proposed the FAI rules. We have several plans of full-size rockets of the United States drawn and sent us by him, and we are collecting Japanese sounding rocket plans, several of which were sent to him. But we don't have the data on their color scheme at hand; they will be published when we get them.



Advisory Committee to the Model Rocketry in JMA. Kazuhiro Mihara (left), Chief Designer of the OS Engine, is the holder of the Japanese control line speed championship. Author Ritsuri Honda (center), and Yasuo Tominaga complete the guiding Committee.

Yuji Oki, Chairman of the RC Subcommittee of the JMA, is about to ignite for launching at the Japan RC Nationals. This demonstration was very effective as a diversion for the people who were a little bored by the repetitive performances of RC planes.

Reader Design Page

The SCORPIO

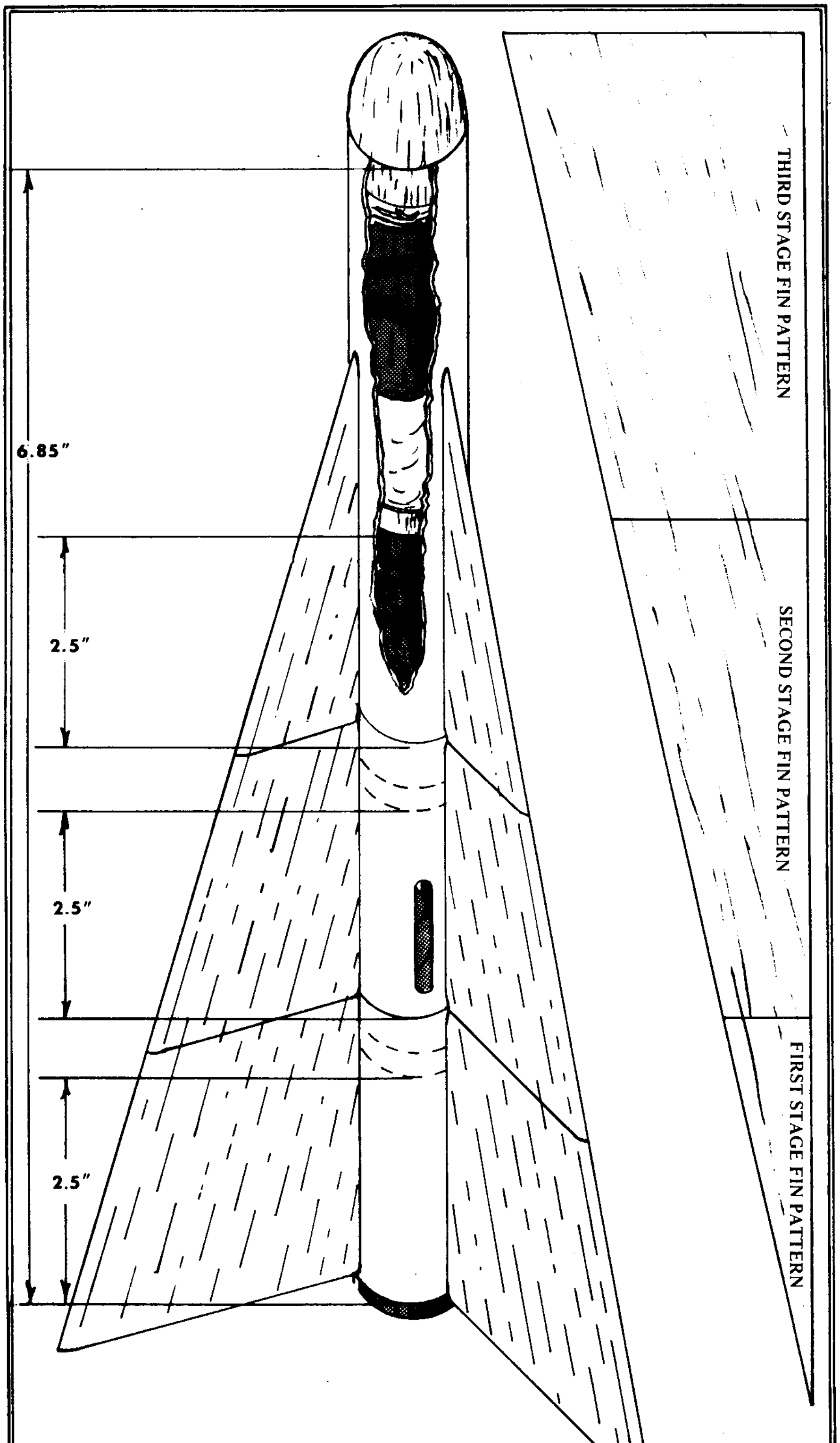
The Scorpio by Michael Reid of Clinton, Iowa, is this month's reader design winner. Mike says it is a very reliable high altitude vehicle, and high altitude it is! Since it is very light and 3 stages high, be certain to use only small engines. The top stage should have a long delay ejection charge engine.

PARTS LIST

nose cone	BNC-20A
body tube	BT-20
engine blocks (3)	EB-20B
parachute (or streamer))	
shock cord	
screw eye	
stage couplers (2)	JT-20C
Fins (3)	1/16th inch stock

Each month Model Rocketry *will award a $5.00 prize for the best original rocket design submitted by a reader during the preceeding month. To be eligible for this prize, entries 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



THE MODEL ROCKETEER

NATIONAL ASSOCIATION OF ROCKETRY, 1239 Vermont Avenue, N.W., Washington D.C. 20005

1969 Contest Year: Final Tally

1969 NATIONAL CHAMPIONS

JUNIOR DIVISION

National Champion	Scott Layne
Reserve Champion	Ellie Stine

LEADER DIVISION

National Champion	Mark Evans
Reserve Champion	James Stevenson

SENIOR DIVISION

National Champion	Howard Kuhn
Reserve Champion	G. Harry Stine

CHAMPIONSHIP TEAM

Ball-Hagedorn Team

NATIONAL CHAMPIONSHIP SECTION

MARS Section

TEAM STANDINGS

1st	Ball-Hagedorn	1082 points
2nd	Sipes Team	913 points
3rd	Gregorek Team	646 points
4th	Butterworth Team	500 points
5th	Beetch Team	344 points

INDIVIDUAL STANDINGS

JUNIOR		
1st	Scott Layne	1174 points
2nd	Ellie Stine	1125 points
3rd	Alan Stolzenberg	1032 points
4th	Robert Sievers	992 points
5th	Sven Englund	990 points
LEADER		
1st	Mark Evans	1793 points
2nd	James Stevenson	1508 points
3rd	J. Talley Guill	1120 points
4th	Michael Poss	1021 points
5th	Bruce Blackistone	717 points
SENIOR		
1st	Howard Kuhn	1523 points
2nd	G. Harry Stine	1372 points
3rd	Karl Feldmann	745 points
4th	Douglas Malewicki	480 points
5th	A. W. Guill	430 points

SECTION STANDINGS

1st	MARS	9344 points
2nd	Apollo-NASA	9285 points
3rd	YMCA Space Pioneers	6886 points
4th	NARHAMS	5035 points
5th	Southland YMCA	4436 points
6th	Fairchester	4413 points
7th	Pascack Valley	4310 points
8th	Columbus Association for the Advancement of Rocketry	3939 points
9th	Steel City	2911 points
10th	WCMRS Titan	2413 points

SPECIAL AWARDS

DISTINGUISHED SERVICE	Bendix Field Engineering Corp.
DISTINGUISHED SERVICE	James Kukowski
GOOD SPORTSMANSHIP	Thomas Pastrick
GREGOREK AWARD	Jay Harris
NEWSLETTER AWARD	NARHAMS (ZOG-43)

NARAM-11
Event Results

EGGLOFT

JUNIOR		
1st	Phil Gust	427 meters
2nd	Ellie Stine	303 meters
3rd	Richard Malecki	60 meters
LEADER		
1st	Norman Wood, Jr.	433 meters
	(No other closed tracks)	
SENIOR		
	(No closed tracks)	

PEE WEE PAYLOAD

JUNIOR		
1st	Sven Englund	296 meters
2nd	Steven Lehnhard	280 meters
3rd	Phil Gust	234 meters
LEADER		
1st	Richard Sternbach	208 meters

2nd	Charles Russell	184 meters
3rd	Bruce Blackistone	180 meters
SENIOR		
1st	Gregorek Team	382 meters
2nd	A. W. Guill	180 meters
3rd	James Pantalos	174 meters

SCALE

JUNIOR		
1st	Scott Layne	935 points
2nd	Guy Cavallo	840 points
3rd	George Pantalos	820 points
LEADER		
1st	J. Talley Guill	760 points
2nd	Charles Russell	690 points
3rd	James Stevenson	680 points
SENIOR		
1st	Howard Kuhn	840 points
2nd	Orbits Team	790 points
3rd	Bryant Thompson	695 points

PREDICTED ALTITUDE

JUNIOR		
1st	Michael Coxen	1.0%
2nd	Chris Regan	5.1%
	George Vella	5.1%
3rd	Dwight Booth	5.7%
LEADER		
1st	Charles Zettek, Jr.	0.6%
2nd	Michael Poss	1.1%
3rd	Charles Andres	7.4%
SENIOR		
1st	Butterworth Team	3.0%
2nd	Ball-Hagedorn Team	5.7%
3rd	Guernsey Team	6.1%

SWIFT B/G

JUNIOR		
1st	Tammy Benson	143 seconds
2nd	Jay Harris	121 seconds
3rd	Guy Cavallo	119 seconds
LEADER		
1st	James Stevenson	111 seconds
2nd	Kenneth Longenecker	87 seconds
3rd	David Newill	79 seconds
SENIOR		
1st	Thomas Pastrick	116 seconds
2nd	Butterworth Team	95 seconds
3rd	James Pantalos	92 seconds

CLASS I SCALE ALTITUDE

JUNIOR		
1st	Guppy	976 meters
2nd	John Albert	961 meters
3rd	Brian Dolezal	891 meters
LEADER		
1st	James Stevenson	878 meters
2nd	Alan Malizia	785 meters
3rd	Joe Baxter	772 meters
	Mark Evans	772 meters
SENIOR		
1st	Howard Kuhn	1021 meters
2nd	G. Harry Stine	978 meters
3rd	Ball-Hagedorn Team	873 meters

OPEN PAYLOAD

JUNIOR		
1st	Kevin Dolan	515 meters
2nd	Phil Gust	482 meters
3rd	Larry Caminite	477 meters
LEADER		
1st	Gary Crowell	492 meters
2nd	Greg Scinto	401 meters
3rd	Joe Baxter	400 meters
SENIOR		
1st	Ball-Hagedorn Team	603 meters
	(No other closed tracks)	

SPARROW B/G

JUNIOR		
1st	Bruce Schaefer	152 seconds
2nd	Ellie Stine	120 seconds
3rd	James Kerley	96 seconds
LEADER		
1st	Bruce Blackistone	73 seconds
2nd	Norman Wood, Jr.	67 seconds
3rd	David Newill	65 seconds
SENIOR		
1st	G. Harry Stine	80 seconds
2nd	Charles Andres	72 seconds
3rd	Butterworth Team	71 seconds
	Douglas Malewicki	71 secon

CLASS I PARACHUTE DURATION

JUNIOR		
1st	Sven Englund	160 seconds
2nd	Steve Frashier	159 seconds
3rd	Vincent Jahn, Jr.	153 seconds
LEADER		
1st	Arthur Chapman	126 seconds
2nd	Michael Poss	121 seconds
3rd	Norman Wood, Jr.	112 seconds
SENIOR		
1st	Jess Medina	209 seconds
2nd	James Pantalos	194 seconds
3rd	Bryant Thompson	172 seconds

RESEARCH AND DEVELOPMENT

JUNIOR	
1st	Scott Layne
2nd	Tom McKim
3rd	Gary Lindgren
LEADER	
1st	J. Talley Guill
2nd	Charles Andres
3rd	Mark Evans
SENIOR	
1st	Capt. Forrest Mims
2nd	Douglas Malewicki
3rd	T&S Aerospace Team

TRUSTEES MEET

The trustees met in open session on the evening of August 13th, at the USAF Academy. NAR President Elsworth Beetch presided, and trustees Bryant Thompson, G. Harry Stine, A. W. Guill, L. H. Butterworth, John Worth, Robert Atwood, and honorary trustee William Roe attended.

G. H. Stine, Chairman of the Liason Committee, reported on FAI activities. Sparrow B/G, Scale, and Scale Altitude rules consistent with the present Sporting Code have been adopted by the FAI. Events for the 1970 World Championship Meet have been selected. Parachute Duration, Scale, Sparrow B/G, and Swift B/G will be flown. The United States has been invited to participate in the September 1969 Yugoslav National Model Rocket Championship Meet, to observe and advise on international preparation. Stine will attend.

Stine reported that the HIAA requested that NAR Standards and Testing establish standards and undertake the evaluation of kits and parts as well as engines. The NAR agreed. Estes Industries has donated a strain gauge suitable for testing engines through C class to the NAR for use in testing. Stine resigned his position as Chairman of the Standards and Testing committee to assume a consulting position with a manufacturer. Dr. Gerry Gregorek, a Professor of Aeronautics at Ohio State University, was named to succeed him.

In view of rising insurance and operating costs, it was necessary to raise the annual NAR membership dues by $1.00 for each member. This increase is expected to allow the NAR to remain self-sufficient and continue to provide all members services.

A committee consisting of A W. Guill, Robert Atwood, and William Rich was formed to study the long term growth of the NAR. Their purpose is to provide projected membership curves for the next 36 months, and to evaluate the long-term funding and manpower needs of the organization.

Robert Atwood, Director of Section Activities, reported that as of August 7th, 1969 there were 68 chartered NAR Sections in the country. The 3685 members is an all time high for this time of year, and of these over 30% are in organized Sections (up from 18% last year). With continued enthuiastic efforts on the part of the Regional Directors of Section Activities, the 1970 goals are 110 chartered Sections and 5500 NAR members.

Dr. Gerald Gregorek was selected to serve the remainder of the term of the late Dr. Willey Ley as a trustee.

LAC ELECTIONS

Elections to the Leader Administrative Council were held during NARAM-11. All Leader and Senior members in attendance received ballots. Those Leader members elected were:

Jay Apt, 40 Woodland Road, Pittsburgh, PA 15232
Robert Mullane, 34 Sixth Street, Harrison, NJ 07029
Joe Persio, PO Box 123, Cheshire, Conn. 06410
Michael Poss, 7855 Naylor Ave., Los Angeles, CA
Elaine Sadowski, 1824 Wharton St., Pittsburgh, PA 15203
Greg Scinto, 17 Hillside Ave., Stamford, Conn.
Gary Spriggs, 4123 Twin Towers, Morgantown, W. VA 26506

Elections were for a one year term.

IF I WROTE THE PINK BOOK.....

At the request of the Trustees, the LAC has been collecting suggestions for revising the Pink Book since April. Richard Sipes, new NAR Contest and Records Committee appointee, will use these suggestions when he revises the present Pink Book (the 1967 edition), which he hopes to do this winter so it can be used in the 1970-71 contest year.

This month we present a number of suggestions that have come in to the LAC on the subject of Research and Development rules.

A popular new suggestion seems to be that all R&D judges at all meets be NAR members; and that an even balance between all the sciences and engineering be sought. Many of those who flew at NARAM-11 have suggested that it be mandatory that the top five – not just the top three – contestants in each division make oral presentations complete with a mandatory question and answer period. Several people would also like to see longer presentation periods than the 15 minutes now customary at the NARAM, possibly with the time coming from unused evenings.

At this year's nats, a discussion on the range produced the following idea: all scale and R&D judges should be *licensed* at the beginning of the contest year (or could apply any time during the year for later judging). They would have to demonstrate a knowledge of all the pertinant Pink Book regulations and be NAR members in good standing. A simple proceedure like this, involving a written quiz similar in style to the AMA judge license form, could go a long way towards eliminating the arbitrariness and non-uniformity in these two important areas of competition.

The past two years have seen an increasing number of R&D projects utilizing model rockets as tools in examining another area of scientific interest. The division between these projects and reports involving theoretical or experimental rocket flight dynamics using the model rocket as the central area for investigation has become pronounced in the last two contest seasons. As a result, many of those who favor broad-ranging projects have been asking for a clear statement of the disqualification rules that prohibits judges with an engineering leaning from ruling tha projects using rockets as research tools don't fall within the R&D standards.

More new ideas on competition next month; but remember: since the Pink Book is being revised this winter, you do write the Pink Book. So send all your suggestions (by November 15th) to:

Pink Book Revision
40 Woodland Road
Pittsburgh, Pennsylvania 15232

WHITMAN WIND TUNNEL

The wind tunnel at Walt Whitman High School in Bethesda, Maryland, is considered by many to be the finest wind tunnel built specifically for model rocket applications. The wind tunnel project was initiated in the fall of 1965 by the Whitman Aerospace Research Society for the purpose of providing a useful tool for aerodynamics research to the members and as an educational aid to the school. Under the direction of Richard Langley, former society president, the 24 members designed and built the tunnel with the valuable technical assistance of Mr. Norman Fresh, Head of the Subsonic Branch at the Naval Ship Research and Development Center (formerly David Taylor Model Basin) in Potomac, Maryland.

The wind tunnel, valued at nearly $1000 excluding labor, was funded by loans and grants from the Student Government Association, Montgomery County Board of Education, Parent-Teachers Association, and the Washington Academy of Sciences. Many savings were realized by the club through purchasing of wholesale and surplus materials.

After considerable discussion and intensive research by the members, the final design of the tunnel was arrived at in December 1965. A closed-circuit configuration was chosen over an open-circuit design because of the higher efficiency obtainable. The tunnel was constructed in the school's Industrial Arts shop and in the basement of the school, where the tunnel is now installed.

The tunnel is 19 feet long and can be detached into five sections for mobility. The structure consists of a 2x4 wooden frame covered with masonite panels. A series of expansion and contraction cones is used to maintain high efficiency and minimize air turbulence. In each of the four corners is installed a set of 18 curved galvanized steel vanes which guide the air around the corners smoothly. In the settling chamber is a honeycomb of 119 milk cartons which straighten out the air before it reaches the test section. The test section measures 15x20x42 inches and is equipped with large plexiglas observation windows. The test section was designed to accomodate boost-gliders and large class F birds as well as smaller models.

The source of wind is a 28 inch diameter wooden propellor belt-driven by a 10-horsepower, 3-phase electric motor. A clutch is provided to reduce the starting torque on the motor. Though the members originally predicted a wind velocity of about 150 mph, due to air friction and other losses the actual speed is only about 50 mph. The speed has been found to be sufficient for most testing purposes.

After the basic structure was completed in May 1966 it was then necessary to design and build some test instruments before any actual research could be conducted. A pitot static tube and mechanical drag balance were designed by Mark Mercer (1966-67 society president) for use in his Westinghouse and NAR research projects, Mark's efforts earned a first place trophy in the Research and Development event at NARAM-9. The pitot-static tube is used to measure the air velocity in the test section by comparing the "head" pressure on the front of the small tube to "static" or atmospheric pressure and then displaying the difference on a U-tube manometer. The drag balance operates by comparing the drag force of the model to the weight force of a hanging mass. The instrument is quite critical to balance and time-consuming but does provide accurate results. Some effort has been made to develop an electronic drag instrument using strain guages to detect the force, but no adequate designs have been encountered. Mark Mercer has also done some work on a stability instrument which plots angle of attack against time.

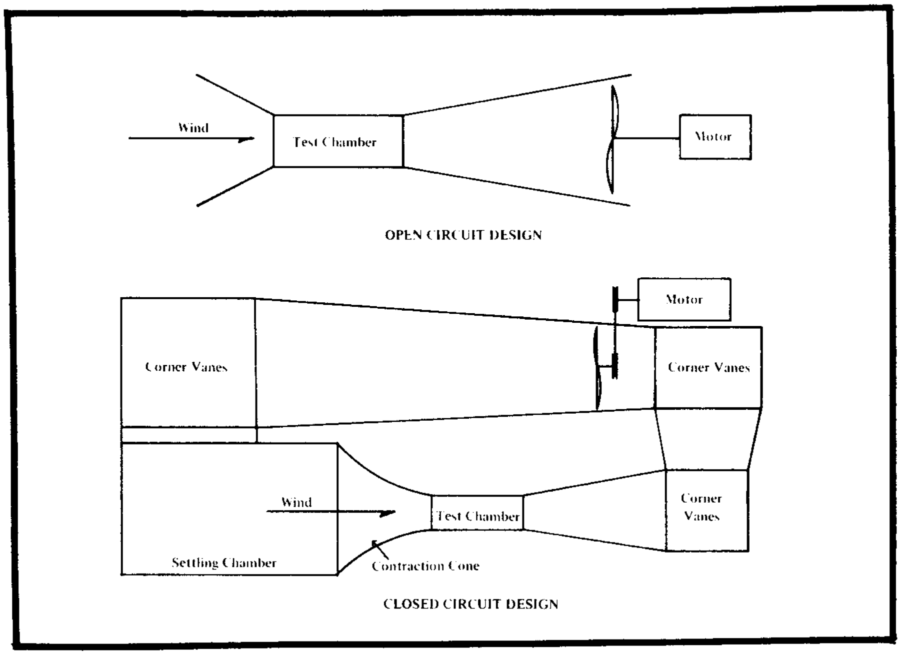
After the completion of the drag instrument, Mark Mercer took drag measurements on his own test models and also some special test models provided by Centuri Engineering Company. The results of some of these tests have been published in Douglas Malewicki's TIR-100 technical report published by Centuri. The remainder of Mark's tests were submitted as an R&D entry at NARAM-10 where it was awarded a first place.

In addition to Mark's testing, the wind tunnel has been demonstrated to the high school Physics and Chemistry students during the past two years. Recently there has been a marked decrease in student interest in the tunnel and the society's membership has dwindled to near-extinction. Rapid turnover of membership has always plagued the society but an attempt is being made to gain the interest of incoming sophomores in the school. Hopefully, some renewed interest in the tunnel will be able to provide modellers with additional information on the designs of their models.

—Carl Kratzer

Photo by Maurice Langley

The test chamber of the Walt Whitman High School Wind Tunnel is shown during construction.



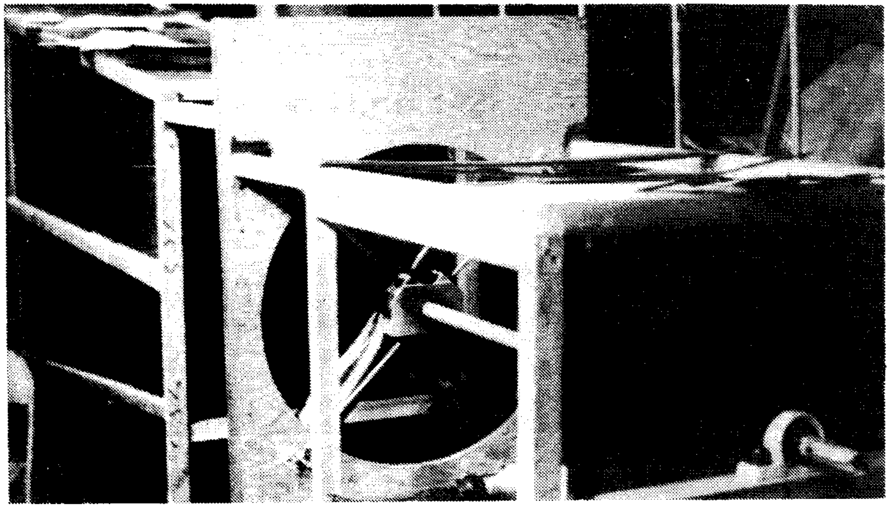


Photo by Mark Mercer

Drive section of the Whitman Wind Tunnel during construction.

★★★★★★★★ Join the National Association of Rocketry ★★★★★★★★

The National Association of Rocketry is the nation's original and largest nonprofessional rocket society. Founded in 1957, the Association has grown to include among its membership the cream of America's model rocketry community -- the most ardent sport flyers, the most skilled competitors, the most creative and highly qualified researchers.

The NAR offers a complete program of competition rocketry and is the only rocketry organization affiliated with the National Aeronautic Association, United States representative to the Federation Aeronautique Internationale. Only NAR members can establish or surpass officially recognized United States and World model rocket performance records.

Flight liability insurance of up to $100,000 coverage is automatic with each individual Association membership. Because of NAR's excellent safety record the premium on this coverage is so low ($0.50) that it is included as part of a member's annual dues. Any group of members desiring to fly or compete as a club may form a chartered Section of the Association, and such Sections are eligible for special insurance coverage under a $300,000 policy that protects the model builder, the Section, and the owner of the flying field -- a great help in obtaining flying sites. Extensive aid and instructional literature are available from NAR Headquarters to groups wishing to become chartered Sections.

The extensive resources of NAR Technical Services, including rocket plans, technical literature, and technical reports of the NAR Standards and Testing Committee, are available *at cost* to NAR members only. *The Model Rocketeer*, the official newsletter of the Association, appears each month in **Model Rocketry** magazine, and each Association member receives a subscription to **Model Rocketry** as part of his membership privileges. As an NAR member you receive *automatically* a full 48 pages of rocketry news, features, designs, and technical information each month, written *by* and *for* model rocketeers exclusively.

And -- last, but certainly not least -- NAR is the model rocketeer's spokesman in matters of legality and government or industry support for the hobby. Innumerable times in the past the NAR has saved the hobby from disastrous over-regulation by misguided and ill-informed public officials, and Association members have been instrumental in the passage of special permissive model rocket legislation in several states where the hobby had previously been restricted by obsolete pyrotechnics codes.

Competition, insurance, **Model Rocketry** magazine, membership services, legislative aid and advice -- you get them *all* with membership in the NAR. Doesn't it make sense to be a member of the most highly respected and the only internationally recognized association of its kind in America? Be a part of the nation's rocketry elite....fly with the best....join the NAR today!

APPLICATION FOR MEMBERSHIP

Memberships expire Dec. 31, each year

(Please print or type)

Name: ______________________ Age: ________

Street: ______________________

City: __________ State: ________ Zip Code: ________ (Required)

Membership fee is total of Basic Fee for age category, plus Magazine Subscription Fee of 25¢ for for each month remaining in membership year.

Grade of Membership (check one): Basic Fees:

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If I am accepted for membership in the National Association of Rocketry, I pledge to observe and follow the NAR Safety Code. I am aware that a reported violation of the NAR Safety Code may lead to the revocation of my membership rights. I also agree to abide by the By-Laws and the Standards and Regulations of the NAR.

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(**Club Notes** continued)
Laboratory School have completed a summer program on rocketry. Included in the program was the construction and firing of several model rockets. Joanne White, a Southern University graduate, directed the rocket program for 24 students. She became interested in rocketry while serving as a teacher of dependents of American servicemen in Italy.

Thomas Stetler, a sixth grade teacher in Memorial School, is in his seventh year as haed of the Rocket Club in Medford Township, New Jersey. Stetler donated his spare time to keep the Rocket Club going all year. All sixth grade students are invited to join. Many of the boys and girls who join in the sixth grade continue in the club through eighth grade.

July 22nd and 23rd saw the Zenith NAR Section (Mankato, Minnesota) conducting a demonstration launch at the Cosmos Space Festival, Willmar Minnesota County Fair. Combining with a NASA space exploration display, Zenith, home section of NAR President Ellsworth Beetch, attracted nearly a thousand spectators during the two days of launching, displays, and talks.

Fifth graders at Frank G. Lindsey School in Westchester, New York have recently been experimenting with model rockets. Nance Latorre and Libby Tangen, both students, recently told **The Reporter Dispatch**: "To finish off our unit about rockets, we are building and launching our own rockets. These usually go from 2,000 to 3,000 feet high and return by a parachute recovery system. If these flights prove successful," the girls added, "we might even design a rocket of our own."

"Our first attempts at construction," teacher Allan Dampf explained, "were from kits that included all parts and instructions. We learned from our early attempts that the rockets must be constructed very carefully and that all surfaces must be smooth to reduce friction. The fins, too, must be fastened securely to the body at proper angles to give complete stability during the 'powered' phase of flight. Once we learned these basic facts, we were ready to tackle a larger, more complicated design. We started with a multi-stage rocket and got practice in reducing friction in the stage couplers. Our next venture led us to grouping and igniting three engines at the same time. Our final experiment afforded us experience in building and launching a rocket glider."

In future months, the group plans to continue their experiments by launching insects in the payload section, to determine the effects upon them of thrust and stress. A two-stage Camroc carrier is also scheduled for future launching.

Results from the July 27th Metro Denver Rocket Association Contest are reported in the lastest edition of *Misfire.* In Class I Parachute Duration Joe Johnson took first place with 108.5 seconds flying an FSI Micro powered by an A4-4 engine. Pete Quinn took second place with 102 seconds flying an Alpha. Gus Hall, flying an FSI Micro powered by an A4-4 engine, had one of the longest flights in Parachute Duration ever observed on the MDRA Hogback Range. His bird was visible for 8 minutes and 44 seconds through 7x50 binoculars before disappearing into the distance.In Pee Wee Payload, David Adameck placed first with his X-Ray. No altitude was reported. Vic Cross, Contest Director and *Misfire* editor, reports that workmanship on the models has improved quite a bit since the last MDRA contest.

Photo by George Flynn

NARHAMS members Art Chapman and Bruce Blackistone (right) plant flag on a cliff overlooking the motel area during NARAM-11.

The Pascack Valley Section has tentatively scheduled a regional meet for October 19, 1969. The meet, open to all NAR members in the states of New Jersey, New York, Connecticut, and Massachusetts, will include Egg Lofting, Design Efficiency, Scale, Swift B/G, and Parachute Spot Landing. Al Lindgren will be Contest Director for the meet.

The baseball field at McMullen Elementary School in Londonville, Ohio, recently became the launch site for students in Mrs. Celestia Harbour's 6th grade class. On the last two days of school in June, Mrs. Harbour's class gathered at the field to fire rockets which they had constructed earlier in class.

MARS-4 (Mid-Atlantic Regional Shoot), a regional meet for NAR members in the Mid-Atlantic area, is scheduled for October 25 and 26. Sponsored by the Star Spangled Banner Section, no further information was available at press time.

ZOG-43, the NARHAMS section newsletter and winner of this year's NAR Newsletter Award, was the first to report results of NARAM-11.Andy Elliott *ZOG-43* editor, was on the telephone each morning to NARHAMS members on the scene in Colorado. They provided him with day-to-day information on the progress of the nationals. *ZOG-43* was in the mail to all NARHAMS members and other NAR sections only 4 days after NARAM-11 closed.

Students in the science enrichment program at the New Windsor School, Newburgh, New York gathered at the Kobolt Airport in Wallkill to test their models. The model rockets flown by instructor John Mataraza and his 35 young students were built from Estes kits as part of their summer school study of astronautics. After flying their rockets from the Walkill Airport, each of the students was taken on a brief airplane ride.

St. Augustine's School in Franklin Park, New Jersey has begun a model rocket program. Under the direction of Edward

Photo by Andy Elliott

Howard Galloway, advisor to the NAR Star Spangled Banner Section in Baltimore, and his wife Dottie invited their Section and the nearby NARHAMS Section to a picnic at their house on the Severn river on August 23. Nearly 30 people enjoyed a thoroughly relaxing early afternoon until NAR Trustee Jim Barrowman attacked a row boat piloted by Ole' Ed Pearson and Bruce Blackistone. Responding with true NARHAMS loyalty, Bob Singer and Andy Elliott counter attacked with their radio controlled surfboards. After lunch and a spirited session of Oddjob-type frisbee, the action returned to the river front until the mosquitos invaded at dusk. The day was capped by a songfest led by Blackistone.

Brady, a science teacher at St. Augustine, a group of scientific-minded boys got together to launch their first rocket –– a Big Bertha.

Results are in from the Metro Denver Rocket Association's April 20th Altitude Competition. As reported in the *MDRA Misfire*, Peter Quinn took first place with 1150 ft. flying an Alpha; Bill Meine took second flying a Drifter; and Jim Meine took third with a rocket of his own design. All rockets were powered by C6-5 engines.

The Metro Denver Rocket Association recently presented their MDRA Outstanding Member award to Gene Killan. He had been Vice-President and Contest Director of the MDRA. For the past year Gene, who recently graduated from Colorado University, has assisted the club in various activities. He is leaving the club to accept a job in aircraft design with the Boeing Aircraft Company in Seattle, Washington.

On May 21st, Robert Cannon, Educational Director of Estes Industries, addressed a group of 4th, 5th, and 6th grade students at the Shaw Heights Elementary School near Denver, Colorado. Over 200 students attended the discussion which was followed by a demonstration firing.

(From the *MDRA Misfire*)

A group of Kendall Park, New Jersey high school students, under the supervision of Postmaster Raymond South, have been giving demonstration launchings in several of the township's public schools. Their program is partially funded under the federal Program for the Advancement of Creative Education. Launchings have been conducted at the Cambridge and Greenbrook schools, and the group is investigating future launchings at other sites.

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

(FSI continued)

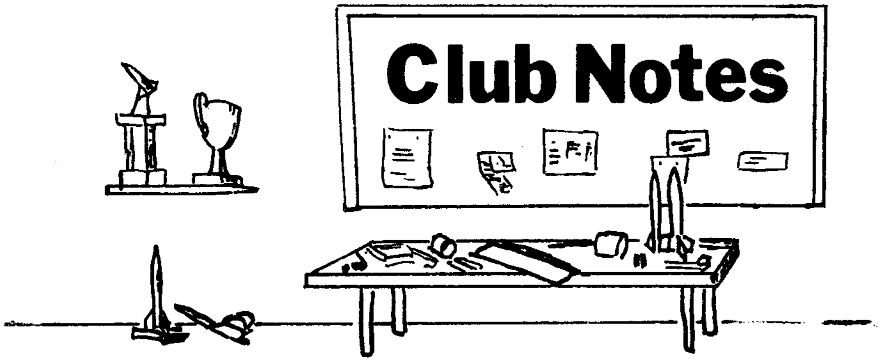
Micro is priced at $1.79 complete with two A4-4 engines or $1.40 without engines.

The Sprint, featuring a large upper body tube with a transition to a smaller engine tube at the rear, is designed to carry a large parachute aloft for use in duration events. It stands 337mm high, and is 30mm in diameter. Takeoff weight without the engine is 55 grams. The price is $2.25.

The new FSI catalog listing nose cones, body tubes, pre-cut fins, couplers, igniters, parachutes, etc., as well as the engines and kits was distributed at NARAM-11. Copies of the catalog are available from FSI, Box 145M, Louisville, Colorado 80027.

(From the Editor continued)

available to other rocketeers, and by introducing your friends to this publication. Model Rocketry is *your* magazine. With this kind of continued support from *all* of our readers, Model Rocketry will continue to grow and to provide the communications medium which has been so sadly lacking in our hobby for the past eleven years.



Club Notes

One hundred fifty boys and girls participated in a model rocket summer academic enrichment program at Comprehensive High School in Springfield, Massachusetts. John Dumont, Joan Coach, and Mrs. Teresa Wilson, all science teachers in the Chicopee school system, supervised launching activities which closed out the program.

The Winter Park Aeronautics and Space Society would like to hear from any interested modelers in the Winter Park, Florida area. They can contact Harold L. Downing, 2840 Cady Way, Winter Park, Florida 32789, or call 671-3136. WPASS's invitation is open not only to people in the Orlando/Winter Park area, but to modelers in Union Park, Maitland, Altimonte Springs, and Apopka. WPASS has a 4 rod launcher, adult supervision, and access to a gigantic launching field.

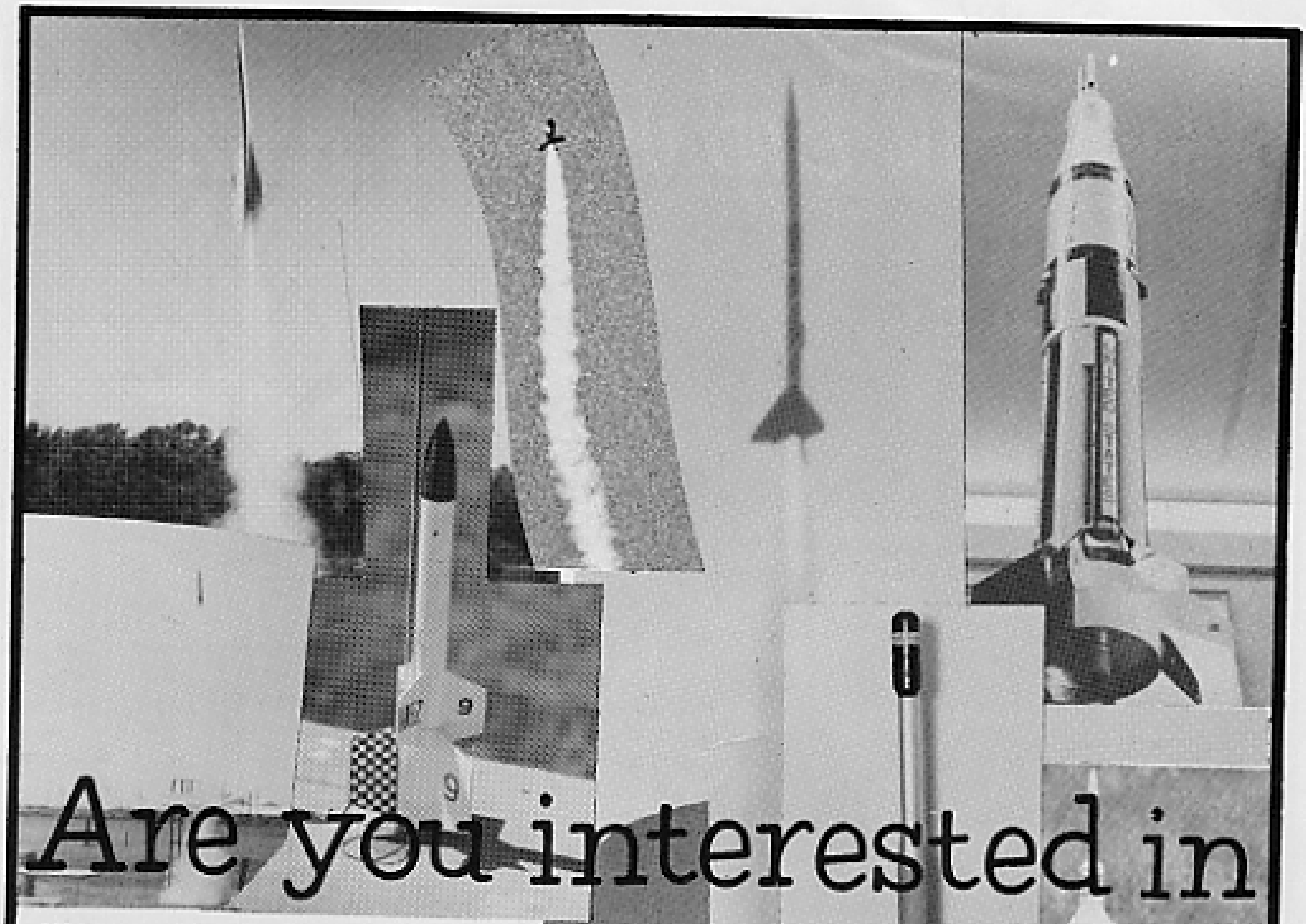
The Annapolis Association of Rocketry has produced the first issue of its new newsletter–*The Voyager*. Scheduled for monthly publication, if the "volunteers" maintain their enthusiasm, the three page newsletter was printed by offset.

The Nicolet High School Rocket Club would like to get together with other southwestern Wisconsin clubs for a contest. Interested clubs should contact Jeff Nickels, 8033 N. Regent Road, Milwaukee, Wisconsin 53217 or at 352-9044.

Shown here is a member of the SPAD Inner Council of Robeson Aerospace prior to the successful "shakedown" launch of a conical shaped model rocket. The vehicle picture is F-powered and later reports indicate this unusual rocket club plans their own "Safeguard" system. They have embarked upon an AMR (anti-model rocket) program. Success is dubious, but murky details seem to include some sort of unique launching, a RMFD, Rapid Maneuverable Fire Deployment. This technique was developed by W.T. Sellers, Jr. of Lumberton, North Carolina.

A group of fifth, sixth, and seventh grade students at the Southern University

(Continued on page 47.)



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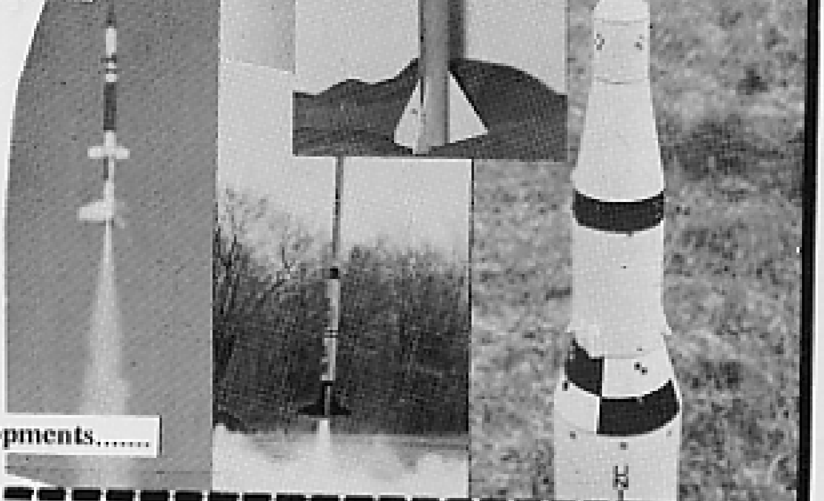

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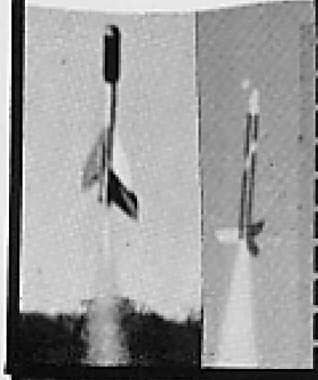

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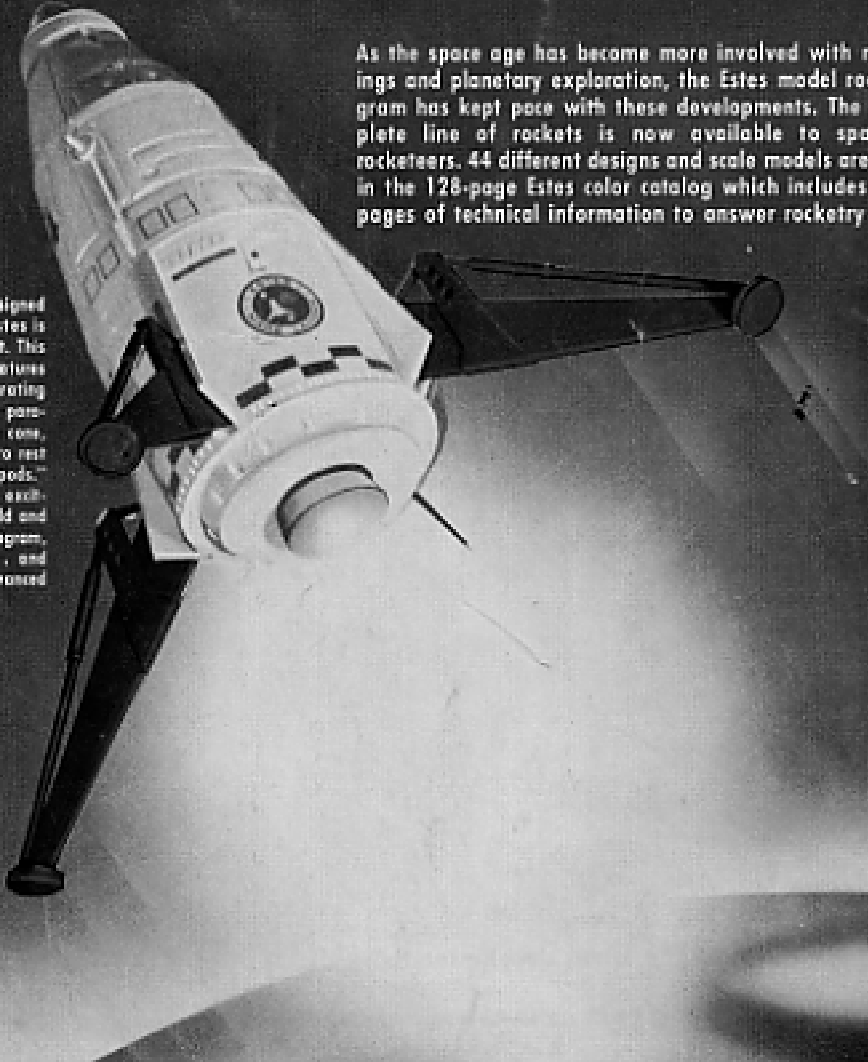

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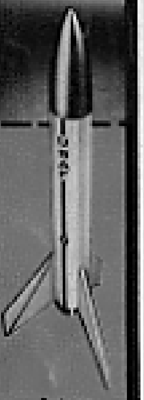

Astron Alpha