MARCH 1972

MODEL ROCKETEER

OFFICIAL JOURNAL OF THE NATIONAL ASSOCIATION OF ROCKETRY

Vol. XIV No. 2

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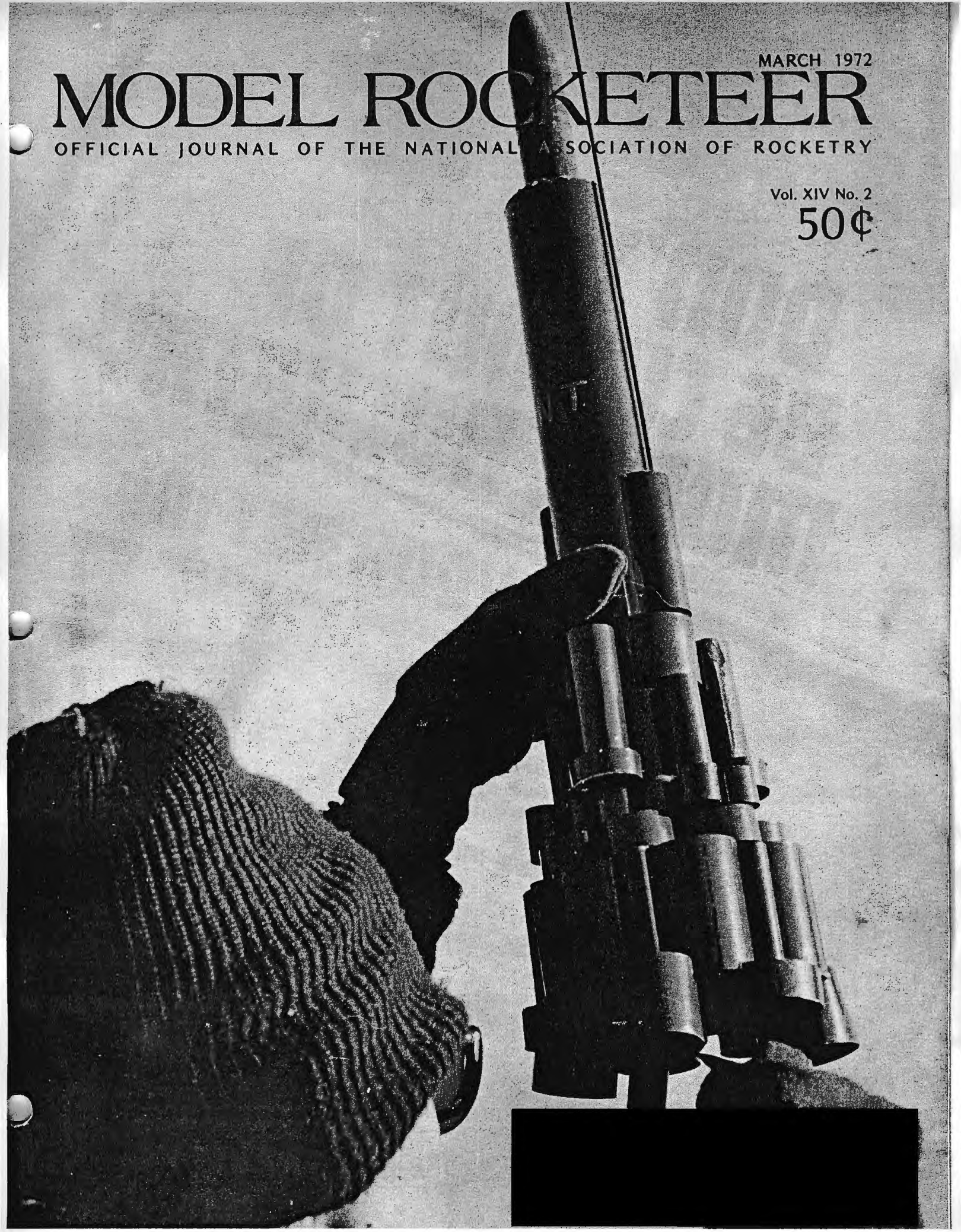

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Vol. XIV No. 2

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Cover Photo: At Tannenbaum-1, Doug Plummer prepares to launch his ZNT Christmas Tree.
(photo by Bob Mullane)

CONTENTS

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EDITOR'S NOOK

On March 16, 1926, Dr. Robert H. Goddard launched the world's first liquid fuel rocket. This gasoline and liquid oxygen-powered rocket reached an altitude of 41 feet, and landed 2.5 seconds later and 184 feet away in an Auburn, Massachusetts cabbage patch.

As a boy, Goddard read the works of H.G. Wells and Jules Verne, and it was while still a boy that he first dreamed of flying in space and going to the moon. For many years, he held fast to his dreams, even though he was ridiculed by the press and, in 1929, forbidden to conduct further launches in Massachusetts by the State Fire Marshal. But it is to Robert Goddard that we must give credit for the development of modern rocketry. March 16 has been designated as Goddard Day, and on this day we should remember the work of this quiet, solitary man.

Elaine Sadowski

Send questions, ideas and gripes about NAR (don't forget about the "Loudly from a Broken Soapbox" and "If I Wrote the Pink Book" columns!) to:

Robert Mullane
NAR in Action Editor
34 Sixth Street
Harrison, New Jersey 07029

Send technical articles and plans to:
Patrick Stakem
Technical Editor
1001 Rockville Pike, Apt. 625
Rockville, Maryland 20852

Section news goes, of course, to:
Charles M. Gordon
NAR Section News
192 Charolotte Drive, Apt. 2
Laurel, Maryland 20810

Any other articles, photographs, cartoons, ideas, etc. go to:
Elaine Sadowski
Model Rocketeer Editor
1824 Wharton Street
Pittsburgh, Pennsylvania 15203

IMPORTANT NOTICE

The number of member complaints concerning non-receipt of the December 1971 and January 1972 issues of *Model Rocketry Magazine* has exceeded NAR Headquarters' capability to respond with even a form letter. For those who have yet to receive either or both issues here are the FACTS:

- Both months NAR sent the publisher of MRm a mailing tape containing the names and addresses of all members. Upon receipt of the tape the publisher invoiced NAR for magazines and postage according to the number of names on the tape.
- For the December issue the publisher invoiced NAR for 5542 copies of the magazine on October 28, 1971 indicating that he had received the mailing tape by that date and that it included all members. The invoice was paid by NAR check No. 421 on November 18, 1971.
- For the January issue the invoice for 5641 copies was dated December 8, 1971. The invoice was paid by check No. 424 on December 15, 1971. As of this date (January 21, 1972) there is no evidence that any NAR member has received the January issue.

These are the FACTS. It is suggested that members with complaints or questions concerning non-receipt of MRm contact the publisher directly—NAR Headquarters does not have the answer.

A final word. The publisher of *MODEL ROCKETEER* reaffirms that your copy will arrive each month on schedule and if it doesn't you know where you can go—straight to NAR Headquarters.

NAR NEWS

NARAM-14 Events Announced

NARAM-14 will be held in Seattle, Washington, on August 6-11, 1972, at the Boeing Space Center, and will be hosted by the South Seattle Rocket Society. The site is within fifteen minutes of the Jet Inn, and the hotel is within five minutes of the Seattle-Tacoma International Airport. No campground is available.

The following events are scheduled: Scale, Class 2 Parachute Duration, Design Efficiency, Open Spot Landing, Sparrow Rocket Glider, Pigeon Eggloft, Swift Boost/Glide, and Research and Development. R&D will have a weighting factor of 5 for this meet.

NAR members interested in attending NARAM-14 must send a postcard not later than April 10, 1972, to:

NARAM-14 Contest Director
Jess S. Medina
15824 43rd Avenue South
Seattle, Washington 98188

Cards should contain your name, address (with Zip Code), NAR number, and NAR section (if any).

Trustees Meeting Held in Pittsburgh

The NAR Board of Trustees met in Pittsburgh, Pennsylvania on January 15, 1972. Among the more important topics discussed were the following:

The appointment of Bob Mullane as Publications Committee Chairman; the appointment of Lindsay Audin as Chairman of the newly-formed Events Commission, a committee with the job of organizing and coordinating conventions, symposiums, etc.; the appointment of Ed Pearson to the chair of the Education Committee; the announcement that persons under 21 can now file for FAI records for $5.00, instead of $25.00; the creation of NAR-manufacturer liaisons, with financial affairs to be handled by Norm Ward and other matters by Jim Barrowman.

Details of the meeting will appear in the minutes, to be published in a future issue.

LAC Resumes Wanted

The Leader Administrative Council is accepting resumes from NAR leader members wishing to run for the 1972-1973 LAC. The resumes should be *100 words or less* and should include the candidate's past activities in the NAR. The deadline for the submission of resumes is March 18, 1972. They will be published along with a ballot in a future issue of *Model Rocketeer*. Resumes should be sent to:

Miss Connie Stine
127 Bickford Lane
New Canaan, Connecticut 06840

The LAC reserves the right to edit the resumes for length.

All leader members are invited to run for the LAC and to participate in its projects.

NAR International Team Selection Committee Named

The committee charged with selecting the U.S. team to be sent to the World Model Rocket Championships has been appointed. The ten voting members are Jon Randolph, Jim Worthen, Al Lindgren, Bruce Shay, Brian Dolezal, Gary Lindgren, Dottie Galloway, Charles Andres, Bob Mullane, and George Pantalos (Chairman). G. Harry Stine is serving as the non-voting committee advisor. The committee will use the criteria outlined in the February *Model Rocketeer* to choose a three-person team plus one alternate for each of the three events to be held at the meet.

Section Activities Reports

According to Bob Atwood, NAR's Director of Section Activities, NAR membership stood at 5,165 people at the end of 1971, and there were 128 sections. Mr. Atwood estimates that 50% of our members are in sections, a substantial gain over last year's figure of 37%.

The Publications Committee Reports

by Lindsay Audin,
Publications Committee Chairman

In the past year, the Publications Committee has had three major projects in the works:

1). finishing the *Section Manual*—it was decided to go ahead with a four chapter manual covering newsletters, publicity, demonstrations and exhibits, and equipment. These chapters are completed and are in preparation for printing. Completion date is (we hope) the Pittsburgh Convention.

2). publication of the first LAC Scale Pak—nearly completed, a LAC project involving preparing 100% scale plans; i.e., plans that would, by themselves, be sufficient scale data for NAR Scale events. The first plan is the IQSY Tomahawk. The second may be the UK Skylark. Scale data for the launchers are also included. The first Pak should be finished by the Pittsburgh Convention, and the second by NARAM-14.

3). distribution of the first slide-tape show—completed at this time is one copy of "Introduction to Model Rocketry" on 35 mm. slides (there are 36 slides) and on a cassette (or reel-to-reel) tape; running time is about 20 minutes. A few touch-ups on the slides and tape need to be made, but the basic job is completed. New copies will be made as soon as my tape recorder is repaired. Help is needed (and hereby requested) for work on new slide-tape shows. Work was to have started on a Boost/Glide program, but our volunteer disappeared. What is primarily needed is a format with script and *lots of slides of gliders*. A script is partially completed, but I need a "star"—that is, a main character to narrate and demonstrate gliders. A good working knowledge of gliders and residence in the Northeast are required. It is impossible to key slides, tape, and script by proxy; it must be done when our crew and the "star" can meet together for a weekend. Thus, anyone within 250 miles of New York City is asked to come forward on this or any other interesting topic.

The first copy of "Introduction to Model Rocketry" was previewed at NARAM-13, and much good feedback was received. A tape of Dr. Gregorek's talk on aerodynamics was also made, and an attempt to correlate his slides with it is planned for the near future.

Aid on any of the above projects is appreciated (and has proven to be much fun for participants). Volunteers may express their interest by writing to the Publications Committee at:

Bob Mullane
34 Sixth Street
Harrison, New Jersey 07029

NAR in ACTION!

Everything You Always Wanted to Know About NAR Insurance

by Bob Mullane

Q: What is the insurance company's name and policy number?

A: General Accident Assurance Corporation (Philadelphia). The policy number is GLA 398-2158.

Q: If all section members are insured, why is section insurance necessary?

A: Many rocket section members and officers do not realize that their section as a group may be sued in the event of claims from an accident. The accident can occur at the section flying site, meeting site, or section contest. It can be caused by a section member, spectator, or anyone participating in the section activity.

If the section is sued as a group, individual NAR member insurance does not protect the section. Furthermore, individual member insurance has only protected members against model rocket accidents. Other types of accidents for which the section may be liable are not covered even if all section members are NAR members. Therefore, section insurance is necessary to protect the section as a group against liability from flying as well as nonflying accidents.

Q: What activities are covered by my NAR Insurance?

A: Your individual membership insurance protects you from any claim resulting from an accident while building or flying model rockets. Section insurance covers all NAR section activities (including meetings) and accidents at a meet or launch which are not directly caused by a rocket. For example, if a spectator falls in a hole while watching a meet, your section (but not your individual) insurance covers any injury.

Q: Who is covered by my insurance?

A: NAR insurance is "liability" coverage. This means that you are protected against a claim of injury or damage from a person you hurt or whose property you damaged with your rocket. You are not covered if you hurt yourself or damage your own property—only if you hurt or damage the property of someone else (either a NAR member or a nonmember).

Section insurance protects the section, its officers, and the owner of the flying or meeting site where the accident occurs.

Q: What is the maximum amount for which I am protected?

A: You, the section, and the flying or meeting site owner are each protected against claims up to $300,000. Larger amounts are available upon request.

Q: What does this $100 deductible mean?

A: If you damage the property of another NAR member, you must pay the first $100 of the damage. So, if an accident damages $100 or less of another NAR member's property, you will not receive any payment from NAR insurance; you must pay in full yourself. This does not apply in the case of bodily injury to anyone (member or nonmember), or property damage to a nonmember—in those cases, the insurance covers the entire amount of the claim (and covers claims for less than $100).

Q: Someone told me that this is "excess" insurance, is that true? And what does that mean?

A: Yes, NAR insurance is in "excess" of any other applicable insurance which you may own. This means that if you have a personal insurance policy for $1,000 which is applicable to this accident, then NAR will pay only the amount of a claim which is over $1,000. In this case, if someone made a claim against you for $1,200; your own insurance would pay $1,000 and NAR insurance would pay $200.

Q: What about legal fees?

A: NAR insurance covers all costs of investigating claims and any legal expenses involved in settling the claim.

Q: What if an accident is caused by improper use of a rocket?

A: NAR insurance does NOT cover any accident which occurs from any operation of model rockets which does not comply with NAR regulations and any applicable federal, state, or local regulations. In other words, if you are violating the NAR Safety Code or any NAR regulations or any applicable law and an accident occurs, you will NOT be able to collect NAR insurance. (Next time you're thinking of "just bending the law a bit" consider the consequences of an accident for which you will NOT be able to get coverage from NAR.)

Q: What do I do if an accident occurs?

A: The member who caused the accident must file a claim as soon as possible. You should obtain the time, place, and details of the accident, as well as the names and addresses of anyone who was injured or whose property was damaged and the names and addresses of any witnesses to the accident. Immediately contact NAR Headquarters for filing procedures and a claim form. (NAR HQ Phone: (703) 536-4299)

Q: What can I do to prevent an accident?

A: Just what NAR members have always done: continue following all NAR regulations and especially the safety code. They were designed to prevent accidents and have done a very good job (with the cooperation of you, the NAR member) to date.

express your opinion on by-laws

By Manning Butterworth

NAR-By-Laws

ARTICLE III, Membership

Section 1: The membership of the Association will be comprised of citizens of the U.S.A. and of organized groups of U.S. citizens.

Section 2: The membership of the Association shall comprise six (6) classes, namely, (a) Senior Membership, (b) Leader Membership, (c) Junior Membership, (d) Honorary Membership, (e) Manufacturer Membership, and (f) Corporate Supporting Membership.

Section 3: Senior members shall be those persons over 21 years of age who are interested in the sciences of rocketry, astronautics or their allied fields.

Section 4: Leader members shall be those persons who are at least seventeen (17) years of age but who are under 21 years of age, who are interested in the sciences of rocketry, astronautics or their allied fields.

Section 5: Junior members shall be those persons under 17 years of age who are interested in the sciences of rocketry, astronautics or their allied fields.

Section 6: Honorary members shall be those persons who, by their contribution to the sciences of rocketry, astronautics or their allied fields, or by their interest in or aid to the Association, shall be deemed eligible for such membership by a vote of the Board of Trustees.

Section 7: Manufacturer members shall be limited to those firms who manufacture, produce, distribute, or sell model rocket engines, kits, parts, components, accessories, and/or equipment.

Section 8: Corporate Supporting members shall be limited to those firms or organizations who are interested or involved in rocketry, astronautics or their allied fields, including the educational aspects thereof.

Section 9: A person or organization having expressed his (its) desire for membership shall become a member of the appropriate class upon satisfaction of the Membership Committee as to his (its) sincerity of purpose and good reputation, upon affixing his (its) name to a statement pledging to observe and abide by the Safety Code of the Association in all non-professional rocket work, and upon payment of dues required by these By-Laws.

Section 10: Members of all classes shall be entitled to attend all business and other meetings of the Association. However, as later provided herein, only voting members of the Association need be formally notified of meetings. In addition, all classes of members shall be entitled to participate in the rights and privileges of the Association except as expressly provided herein.

Section 11: Voting on all matters related to the business of the Association shall be restricted to Senior, Leader, and Honorary Members of the Association as well as a single vote from each Manufacturer Member and each Corporate Supporting Member. There shall be no vote by proxy, but vote may be cast by mail subject to provisions made elsewhere in these By-Laws.

Section 12: For conduct prejudicial to the objectives, reputation or property of the Association, or for failure to observe and abide by the Safety Code of the Association in all non-professional rocket work, a member of any class may be censured, suspended or expelled by a two-thirds vote of the Board of Trustees present and voting at a meeting, provided notice of the charges against him and of the time and place of the meeting at which they are to be presented be published and distributed to him by mail not less than five (5) days prior to such meeting, and provided he be given the opportunity to be heard in his own defense. Any member of any class charged with violation of the Safety Code of the Association shall be automatically suspended from membership until the meeting of the Board of Trustees at which his case is to be decided, providing the time of suspension is not longer than one (1) year from the date of suspension until the date of hearing. No person, once having been admitted in good faith as a member of the Association, shall be denied the right to continued membership except for the above reasons and through the above procedure, or except for non-payment of dues.

The above is Article III as it appears now in the By-Laws. The By-Laws Revision Committee is presently considering the following changes in the article.

Change Article III, Section 1 to read:

The membership of the Association will be comprised of (a) citizens of the United States regardless of where they may be residing, (b) organized groups of U.S. citizens, (c) citizens of other nations who may be residing in the U.S., and (d) citizens of other nations that do not yet possess an organized model rocket club affiliated with the respective FAI-member national aero club.

Justification: This would permit military service personnel, embassy personnel, exchange students, etc., to become members, as well as exchange students and other foreign nationals residing in this country, including visiting professors, educators, and other professional people. Refer also to G. Harry Stine's proposed amendment to the By-Laws and its rationale (*Model Rocketeer*, August, 1971) for a discussion of part (d) above.

The Committee is also considering allowing for one-day memberships. These should be of especial interest to section advisors, who have probably at one time or another conducted sport launches involving non-NAR members. A one-day membership could provide insurance coverage for all participants, and could perhaps facilitate the recruiting of new club members.

Please send your "votes" or comments on the changes discussed above or on other parts of Article III to the By-Laws Revision Committee member nearest you or to the Chairman. The members are Manning Butterworth (Chairman), Room 315, 5540 Hyde Park Boulevard., Chicago, Illinois 60637; Douglas Ball, 415 Houck House, 61 Curl Drive, Ohio State University, Columbus, Ohio 43210; William D. Boggs, 730 East Dartmouth Street, Gladstone, Oregon 97027; A. W. Guill, 32 Gerdes Road, New Canaan, Connecticut 06840; and, just appointed to replace Ben Russell, who will be devoting full time to regional Contest Board operations, Harold Mayes, 712 S. Kansas Avenue, Olathe, Kansas 66061. Although the votes are not official, they will help in the preparation of a final draft of the proposed amendments.

BOOSTERS

These members have given a financial boost to NAR.
Why not join this growing list?

Alan Cohen
Ed Pearson
Hank Beckmeyer
Stephen Lane
Joshua Arzt
Alan Bilger
Jacques A.P. Adnet
William G. Ould
Dale Greene
Henry C. Smith
Robert N. Turner
Cary Wadell
John R. Huerkamp
Jane K. Hopkins
Greg A. Lyzenga
Wayne Hendricks
Alan N. Williams
Steve Tzoutzourakis
Richard A. Prew
James Bosse
Mark Roode
Marc Graynor
Douglas Helsing
Robin Shearin
Robert Morstadt
Kevin Harris

TECHNICAL FEATURE

On Optical Tracking Systems

by
Manning Butterworth, NAR 213

Manning Butterworth is currently working towards a doctor's degree in Astrophysics at the University of Chicago. He was graduated from Northwestern University in 1969 and received his master's degree in Astrophysics at the University of Chicago in 1971. Manning joined the NAR in 1958 (it was called the Model Missile Association then) and has been a member of the Zenith section since late 1962. His other hobbies include science fiction, classical music, and computer programming.

This paper consists of two parts; in the first we describe how to establish a tracking geometry, and in the second we show how to optimize that geometry. Familiarity with the basic ideas relating to an optical tracking facility as described in the NAR Technical Report No. 3 will be helpful to the reader in understanding what follows, especially the second part; however ordinary range experience will suffice to enable the reader to utilize the results of this paper.

Figure 1 depicts what we call here a tracking geometry. All data reduction systems, such as quickie boards, computer printouts, and 3D–boards, which use the azimuth and elevation angles from two trackers, assume the tracking geometry of Figure 1. The significance of this geometry is that altitude determinations can be made regardless of non-vertical flight paths or the lay of the land. Unfortunately the latter capability is not presently exploited and this has led to the popular, though false, impression that the tracking stations and launch area must all be at the same elevation. Thus, the baseline at NARAM-11 was re-established in a more level arrangement when the original arrangement failed to yield any closed tracks. The fault, however, was not in the locations of the trackers but in the way they were calibrated. The resulting tracking geometry was not that of Figure 1 so, of course, the tracks didn't close! Unhappily this was not so obvious at the time.

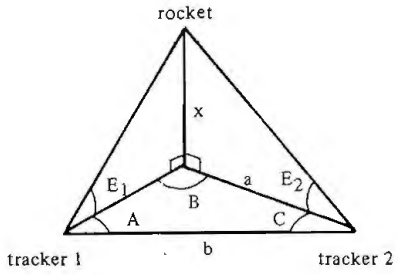

Figure 1

According to the *U. S. Model Rocket Sporting Code* tracking "theodolites must be equipped with both azimuth and elevation axes at right angles to each other". However, to establish the tracking geometry of Figure 1 more than this is required. The elevation must be adjusted to read zero when the optical axis or line of sight is at a right angle to the azimuth axis (the azimuth axis is vertical if the tracker is level). This is a permanent adjustment and can be done in the home. There are a number of ways to make the adjustment and the best will depend on the particular design of tracker. One method is to use a bubble level on the base of the theodolite to level the whole tracker; a second bubble level is placed on some flat part of the open sight or telescope to insure that the line of sight is perfectly horizontal. The elevation dial or pointer is then adjusted to show zero.

We will now give a procedure for calibrating the trackers which will result in establishing the tracking geometry of Figure 1.

Step 1. Lay out a baseline so that each tracker can see the other and the launch area. It is not necessary for the trackers and launch area to be at the same elevation.

Step 2. Sight each tracker on the other and adjust the azimuth to read zero.

Step 3. Adjust the legs of the theodolite so that the other tracker is at zero elevation. Do not touch the elevation dial or pointer to do this.

Step 4. Sight on some fixed point at the launch area such as a flag a few feet off the ground and adjust the legs of the tracker so that the elevation reads zero when looking at the flag. Again, do not touch the elevation dial or pointer.

Step 5. Sight again on the other tracker to check that it still has zero elevation. If step 4 has upset this, adjust the legs so that the elevation reads zero again. Repeat steps 4 and 5 until both the launch area and the opposite tracker show zero elevation.

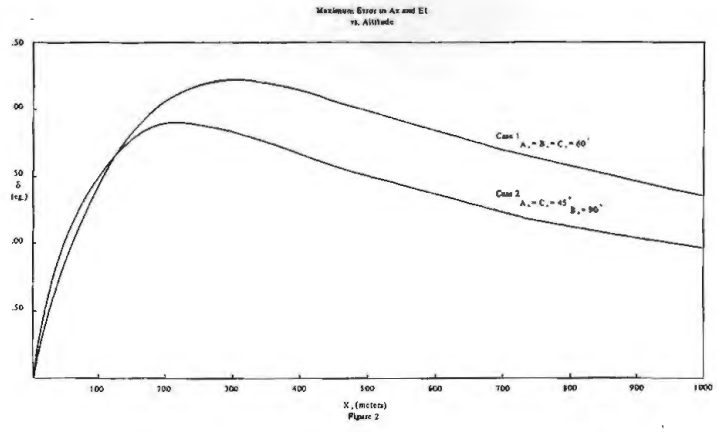

Figure 2

The trackers are now calibrated. Note nothing has been said in Steps 1 through 5 about using a bubble level or plumb bob. If your trackers use a plumb bob to determine the elevation, the plumb bob should be replaced by a fixed pointer.

We now discuss the optimization of the tracking geometry of Figure 1. In the manner described in Technical Report No. 3 we obtain from Figure 1 the altitudes measured by tracker number 1

$$(1)\quad X_1 = \frac{b \sin C \tan E_1}{\sin (A + C)},$$

and by tracker number 2

$$(2)\quad X_2 = \frac{b \sin A \tan E_2}{\sin (A + C)}.$$

There are five measured quantities which appear in equations (1) and (2): the baseline, b, and the azimuth and elevation from tracking stations 1 and 2. The accuracy of X_1 and X_2 is determined by the errors which may be present in any of these five quantities.

We study the effect of such errors by replacing each measured quantity in the above equations with the sum of the true value of each quantity plus a small error term. Let a subscript zero denote the true value of a quantity and the corresponding small Greek letter the error. Thus,

$$b = b_0 + \beta;\ A = A_0 + \alpha;\ C = C_0 + \gamma;$$

$$E_1 = E_{10} + \epsilon_1;\ E_2 = E_{20} + \epsilon_2;\ X_1 = X_0 + \chi_1;$$

$$X_2 = X_0 + \chi_2.$$

Substituting these definitions in equations (1) and (2), we expand the result and keep only terms up to the first order in the error parameters. After considerable simplification we obtain the following equations

$$(3)\quad X_1 = X_0\left\{1 + \left[\gamma \cot C_0 + \frac{\beta}{b_0} - (\alpha + \gamma)\cot\ (A_0 + C_0) + \frac{2\epsilon_1}{\sin (2E_{10})}\right]\right\},$$

and

$$(4)\quad X_2 = X_0\left\{1 + \left[\alpha \cot A_0 + \frac{\beta}{b_0} - (\alpha + \gamma)\cot\ (A_0 + C_0) + \frac{2\epsilon_2}{\sin (2E_{20})}\right]\right\}.$$

From equations (3) and (4) and the definitions of χ_1 and χ_2 we have

$$(5)\quad \chi_1 = X_0\left[\gamma \cot C_0 + \frac{\beta}{b_0} - (\alpha + \gamma)\cot\ (A_0 + C_0) + \frac{2\epsilon_1}{\sin (2E_{10})}\right]$$

and

$$(6)\quad \chi_2 = X_0\left[\alpha \cot A_0 + \frac{\beta}{b_0} - (\alpha + \gamma)\cot\ (A_0 + C_0) + \frac{2\epsilon_2}{\sin (2E_{20})}\right]$$

We will use these equations to investigate the effect of errors first, on the chances for a track to close and second, on the accuracy of the tracking.

The average measured altitude is

$$(7)\quad \bar{X} = \frac{X_1 + X_2}{2}.$$

In order for the track to close each altitude must be within 10 per cent of $\bar{X}$, that is, we require

$$(8)\quad \left|\frac{X_1 - \bar{X}}{\bar{X}}\right| \leq .1 \text{ and } \left|\frac{X_2 - \bar{X}}{\bar{X}}\right| \leq .1.$$

Using the definitions of X_1 and X_2 in terms of χ_1 and χ_2 in equation (7) and inequalities (8), we get, again to first order in the errors,

$$(9)\quad \left|\frac{X_1 - \bar{X}}{\bar{X}}\right| = \left|\frac{X_2 - \bar{X}}{\bar{X}}\right| \approx \left|\frac{\chi_1 - \chi_2}{2X_0}\right|$$

The condition for a closed track is

$$(10)\quad \left|\frac{\chi_1 - \chi_2}{2X_0}\right| \leq .1.$$

Using equations (5) and (6) this condition becomes

$$(11)\quad \tfrac{1}{2}\left|\gamma \cot C_0 - \alpha \cot A_0 + 2\left(\frac{\epsilon_1}{\sin (2E_{10})} - \frac{\epsilon_2}{\sin (2E_{20})}\right)\right| \leq .1.$$

From the behavior of the cotangent function we note that the errors α and γ are much magnified as A_0 and C_0 approach zero. This means that the worst possible place to put the trackers is on a line which runs through the launch area. This condition can also arise if the rockets weathercock sufficiently to end their flight directly over the line between the two trackers.

We also note that errors in elevation are magnified by values of E_{10} and E_{20} near zero or near 90 degrees. Finally we see that the error in the baseline, β, has no effect on whether tracks close or not. Thus, small azimuth or elevation angles or very large elevation angles should be avoided.

The plots in Figure 2 present a more detailed picture. Both plots were obtained assuming the worst possible case, that is, no cancellation among the errors, and for convenience we have taken $|\alpha| = |\gamma| = |\epsilon_1| = |\epsilon_2| \leq \delta$.
The value δ is the maximum error which will still yield a closed track. We see that the tracking geometry in Case 1, ($A_0 = B_0 = C_0 = 60$ degrees,) is clearly superior to that in Case 2, ($A_0 = C_0 = 45$ degrees and $B_0 = 90$ degrees).

Only at altitudes too low to be interesting does the latter offer any advantage. The largest permissible errors for Case 1 occur for altitudes equal to the baseline and are about 2 1/4 degrees for b_0 = 300 meters. At 900 meters δ has decreased to about 1 1/2 degrees in Case 1 and about 1 degree in Case 2.

Case 2 is typical of the geometry used with open sight trackers since the shorter distance to the launch area makes the rockets and their smoke trails easier to see. When used for events such as Design Efficiency, Predicted Altitude, Pee Wee Payload, or Robin Eggloft which typically yield altitudes around 200 - 300 meters, as high as 95 per cent closed tracks can be achieved with the geometry in Case 2 under conditions of good visibility. This is so simply because these altitudes fall in the range of the largest permissible errors. The high achievable tracking rate shows that the errors are usually much smaller than the maximum.

Case 1 is typical of a system using trackers equipped with telescopes and tracking is usually done on the rocket since the greater distance and the magnification greatly decrease the contrast of the smoke trail against the sky. Tracking rates of 60 per cent are considered good with this type of system. Although Case 1 is inherently superior, it performs more poorly in practice; the reasons are that telescopes must be used to see the model, but their field of view is so small that if a model is momentarily lost from view, it often cannot be relocated, and that the greater line of sight distance from tracker to rocket means the model is simply harder to see through the haze, dust, smog, etc..

We now use equations (5) and (6) to examine the accuracy of a tracking system. The quantity which measures the accuracy is

$$(12)\quad \Delta = \frac{\left|\bar{X} - X_0\right|}{X_0}.$$

From equation (7) and the definitions of χ_1 and χ_2 this is

$$(13)\quad \Delta = \frac{\left|\chi_1 + \chi_2\right|}{2X_0},$$

which upon using equations (5) and (6) is just

$$(14)\quad \Delta = \tfrac{1}{2}\left|\alpha \cot A_0 + \gamma \cot C_0 + 2\frac{\beta}{b_0} - 2(\alpha + \gamma)\cot\ (A_0 + C_0) + 2\left(\frac{\epsilon_1}{\sin (2E_{10})} + \frac{\epsilon_2}{\sin (2E_{20})}\right)\right|$$

Since the signs of the errors are arbitrary, the basic differences of Δ from the left hand side of inequality (11) are the third and fourth terms in the absolute value sign. The third term shows that if the baseline is off by so many per cent, so is the altitude; all altitudes are affected in exactly the same way however, so that the relative places in a contest could not be changed by such an error. The fourth term will fluctuate from flight to flight but will vanish whenever $\cot (A_0 + C_0) = 0$, that is, for $A_0 + C_0 = 90$ degrees. Assuming $A_0 = C_0$, then $A_0 = C_0 = 45$ degrees and we have Case 2.

Thus, despite the drawback of having a smaller tolerance for errors, the geometry of Case 2 is capable of yielding high tracking rates at least for altitudes around 300 meters and it has the advantage of being inherently more accurate than the geometry of Case 1. Its suitability for much higher altitudes will have to be demonstrated in practice.

In this paper we have given a detailed procedure for calibrating a tracking system which is independent of whether the land is flat or not, and we have examined the geometry of such a system both from the point of view of its likelihood to yield closed tracks and its accuracy.

CONTEST Calendar

February 27, 1972—Pottstown, Pennsylvania. Name: Fat Chance World Record Trials I. Host: Missile Minders 133. Events: Class 0, 1, 2, 3, 4 Altitude, Class 0, 1, 2, 3 Parachute Duration, All B/G events, All classes of Streamer Duration, All R/G events, Design Efficiency, Pee Wee Payload, Single Payload. Contact: Carl J. Warner, 665 Woodland Avenue, Pottstown, Pennsylvania 19464. Telephone: (215) 323-4296.

March 4-5, 1972—Sulphur Springs, Texas. Name: Texas State Championship. Open to all NAR members. Host: Sulphur River Section 206. Events: Class O Altitude, Single Payload, Class I Drag Efficiency, Class I Parachute Duration, Eagle Boost/Glider, Pigeon Eggloft, and Open Spot Landing. Contact: Danny Miller, 804 Gilmer Street, Sulphur Springs, Texas 75482.

March 5, 1972—Concord, Massachusetts. Name: NERFSec II. Host: New England Rocketry Federation 236. Events: Scale, Super Scale, Hawk R/G, Gnat B/G, Open Spot Landing. Contact: Patrick Griffith, Legion B, Milford, Massachusetts 01757; telephone (617) 473-7654.

March 26, 1972—Houston, Texas. Name: AP-4. Host: Apollo-NASA 103. Events: Quadrathon, Plastic Model. Open Spot Land, Scale, Pigeon Eggloft, Class O P.D., Class I S.D. Contact: B. S. Russell, 14155 Labrador Ave., Apt. 96, Houston, Texas 77047.

April 8, 1972—Taylor Ridge, Illinois. Name: HAWK-72-1. Host: Black Hawk 110. Events: Hornet Boost/Glider, Class O Streamer Duration, Drag Race, Class O Parachute Duration, Streamer Spot Landing, Scale. Contact: Glenn A. Scherer, Jr., 1427 7th Avenue, Rock Island, Illinois 61201.

April 23, 1972—Houston, Texas. Section Meet. Name: 72-AP-5. Host: Apollo-NASA 103. Events: Quadrathon, Scale, Sparrow B/G, Sparrow R/G, Open Spot Land, Contact: B. S. Russell, 14155 Labrador Avenue, Apt. 96, Houston, Texas 77047.

April 23, 1972—Manassas, Virginia. Name: NOVAAR-4. Host: Northern Virginia Association of Rocketry 205. Events: Hornet Boost/Glide, Hornet Rocket/Glider, Sparrow Rocket/Glider, Swift Boost/Glider, Class O Parachute Duration, and Design Efficiency. Contact: Randy Thompson, 10814 First Street, Fairfax, Virginia 22030.

May 14, 1972—Fairfax, Virginia. Name: Washington Area Record Trials (WART-1). Host: Northern Virginia Association of Rocketry 205. Events: Records in any class of timing event may be attempted. Competition events: Condor B/G, Swift R/G, Class O P.D., Class 2 S.D. Trophies and ribbons will be awarded to winners. Meet fee (to cover cost of trophies and ribbons) is $2.50. Contact: Randy Thompson, 10814 First Street, Fairfax, Virginia 22030.

May 28, 1972—Houston, Texas. Section Meet. Name: 72-AP-6. Host: Apollo-NASA 103. Events: Plastic Model, Hawk B/G, Scale, Robin Eggloft, Pee Wee Payload, Open S.L., Predicted Altitude. Contact: B.S. Russell, 14155 Labrador Ave., Apt. 96, Houston, Texas 77047.

June 17-18, 1972—Davenport, Iowa. Name: MAR '72 (Mid-America Regional '72). Host: Hawkeye Section 178. Events: Predicted Altitude, Pee Wee Payload, Robin Eggloft, Scale, R&D, Hornet Boost/Glide, Swift Boost/Glider, Class O Parachute Dureation, and Open Spot Landing. Contact: Dan Leckington, 2018 Marquette Street, Davenport, Iowa 52804.

Conventions, Exhibitions, Seminars

March 17, 18, 19, 1972—Pittsburgh, Pennsylvania. Name: Pittsburgh Spring Model Rocketry Convention. Hosts: Steel City 157 and Three Rivers Section 172. Lectures, movies, discussions: R & D, Model Rocketry Programs in the School and Community, Model Rocket Photography, Construction Techniques, Model Rocket Instrumentation, CINEROC, Plastic Models, Variable Geometry Boost/Gliders, Scale Modeling, Basic Boost/Gliders, Parasite Boost/Gliders, Model Rocket Clubs, Rocket Gliders, Club Newsletters. Contact: Elaine Sadowski, 1824 Wharton Street, Pittsburgh, Pennsylvania 15203.

May 27-June 4, 1972—Dulles Airport, Washington, D.C. Name: Transpo '72. Transportation exhibition including the latest technological advancements in equipment and systems in the entire transportation field.

June 1972—Toronto Canada. Toronto Regional. Open meet and seminars sponsored by the Canadian Rocket Society. Competitions and presentation of the Diamond Award in Rocketry. Science teachers and their students especially invited. Contact: CRS, Adelaide St., P.O. Box 396, Toronto 1, Ontario, Canada.

July 7-9, 1972—Montreal Canada. Third National Canadian Model Rocket Conference. Convention and competition open to all model rocketeers from Canada and the United States. Events: Discussion Groups, contests in Scale, Condor B/G, Sparrow B/G, Hawk R/G, Open Spot Landing, and Class O PD. Contact: Canadian Conference 1972, c/o Steven J. Kushneryk, 7800 des Erables Ave., Montreal 329, Quebec, Canada.

R&D summaries

"Canard Boost/Gliders"
William Clugston, NAR 15879, 8114 Blairton Road, Springfield, Virginia 22152
**Second Place*

The objectives of this project are to set design standards for the canard boost/glider and to encourage the use of this neglected design. There is no reason the canard should be ignored, for it has flight characteristics second to none among the delta wing boost/gliders. The canard design has also shown versatility in the field of payload boost/gliders, a field I plan to investigate next with the Vampire 4, which has a four foot wing span.

One of the major problems with canard gliders is their tendency to do loops during the boost phase. To overcome this, movable elevons that are in a neutral position during boost, but which drop down to produce lift in the canards during glide. The canards then bring the main wing to an angle of attack to produce lift. The other, still tentative result I have obtained is a ratio between the canard wing and main wing areas. The ratio of main wing to canard is 8/1 and 2/1 for rocket gliders and payload gliders, respectively. I have also investigated airfoil shape, and have discovered that the main wing airfoil should be symmetrical in shape.

The canard shares the same straight-up boost characteristics that the rest of the delta-wing boost/gliders have. The canard design has good glide stability. The canards, in addition to acting as control surfaces, can also act to help replace a wing. In one of my experimental flights, the right wing left the glider, but a reasonably good time for a rocket/glider was obtained. The only real stability problem encountered in either the boost or the glide phase was spinning during boost. This problem can be corrected by using a rudder that has an area that is one-ninth that of the wing. The main wing of the glider used in the experiments is built-up and silk covered, similar to a model airplane wing.

See next month's MODEL ROCKETEER for additional award-winning summaries.

Coming next month . . .

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The New Pink Book
A Preview

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1107 Waverly Road
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Contest Board Chairman
Judy Barrowman
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Seabrook, Maryland 20801

State Heads

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1551 S.W. 38th Avenue
Fort Lauderdale, Florida 33312

Virginia
Roland Gabeler
5105 W. Franklin Street
Richmond, Virginia 23226

Georgia
Richard Malecki
Georgia Tech Box 33698
Altanta, Georgia 30332

Alabama

None

Arkansas

None

Delaware*

256 Explorer Rocket Association
Martin Smith
2418 Marilyn Drive
Wilmington, Delaware 19803

116 Gemini Model Rocket Society
James Insinga
5 Lehigh Road
Cooper Farm
Wilmington, Delaware 19803

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208 South Walnut Street
Milford, Delaware 19963

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1107 Waverly Road
Fort Lauderdale, Florida 33312

247 Gold Coast Model Rocket Assn.
Lynn Fletcher
1975 Northwest 36th Street
Miami, Florida 33142

270 Greater Jacksonville Rocket Club
Ernest L. Rowland Jr.
345 East Forsyth
Jacksonville, Florida 32202

266 Tampa Area Rocket Association
John Markham
1466 Hunter Lane
Clearwater, Florida 33516

Georgia

128 Metro Atlanta Society for Educational Rocketry (MASER)
Willard Arbour, Jr.
2320 Shasta Way Northeast
Atlanta, Georgia 30345

Kentucky

None

Louisiana

284 ARK-LA-TEX Model Rocketry Club
Mark Knox, Jr.
1117 James Street
Bossier City, Louisiana 71010

Maryland

102 Annapolis Association of Rocketry
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54 Decatur Avenue
Annapolis, Maryland 221403

106 Belair Association of Model Rocketry
Robert Seufert
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248 Harford Area Space Modelers (HASM)
Bertram Grollman
RD 1, Box 55A
Darlington, Maryland 21034

120 Laurel Area Rocket Society
Raymond Werre
313 Old Line Avenue
Laurel, Maryland 20810

131 Major General Holgren Toftoy Memorial Section
Guy M. Norlin
1623 Old Joppa Road
Joppa, Maryland 21085

130 Metropolitan Area Rocket Society (M.A.R.S.)
Peggy Sipes
5012 60th Avenue
Hyattsville, Maryland 20781

139 NARHAMS
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146 Randallstown Rocket Society
Walter Moon
3702 Woodspring Court
Randallstown, Maryland 21133

171 Robert Goddard Model Rocket Research Society
Douglas Dotson
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Seabrook, Maryland 20801

150 Rockville Rocketeers
Jim Philmon
5111 Crossfield Court
Rockville, Maryland 20852

244 Scorpius Rocket Club
Ronald F. Hillard
2311 Richie Road
Forestville, Maryland 20028

204 Southern Maryland Area Rocket Team (SMART)
Ralph Sweck
R.R. 1, Box 580
Accokeek, Maryland 20607

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

163 Wheaton Rocket Association
Kevin Harris
12402 Stretton Lane
Bowie, Maryland 20715

Mississippi

None

North Carolina

275 Goldsboro Starlancers
Roderick Wright
CMR 3271
S-J AFB
Goldsboro, North Carolina 27530

225 Hornets Nest Model Rocket Club
Richard J. Toner
5012 Valley Stream Road
Charlotte, North Carolina 28209

Puerto Rico

None

South Carolina

226 Model Rocket Association of Augusta, Georgia
MRA c/o Hobby House
603 Georgia Avenue
North Augusta, South Carolina 29841

Tennessee

235 Memphis University School Model Rocket Society
Morris Jones
4288 Charleswood Road
Memphis, Tennessee 38117

Virginia

205 Northern Virginia Association of Rocketry
Paul Shelton
3968 Oak Street
Fairfax, Virginia 22030

203 Vikings Rocketry Society
c/o Roland Gabeler
5105 West Franklin
Richmond, Virginia 23226

Virgin Islands

None

Washington, D.C.

149 Rock Creek Section
Marjorie Townsend
3529 Tilden Street, Northwest
Washington,D.C. 20008

West Virginia

None

*Delaware was included in last month's Northeast Section Directory in error.

SECTION NEWS

by Charles Gordon

A new section has been formed in Fort Wayne, Indiana, called the Summit City Aerospace Modelers (SCAM). Persons interested in joining this section should contact: Charles Humphries, 5101 DeRome Dr. E., Ft. Wayne, Indiana 46805.

Congratulations also to the SCAM Section on the publication of Volume 1, Number 1 of their newsletter, "PRANG MANTA".

A drop in attendance at section affairs with the coming of winter is a problem many sections face when it gets too cold and wet to launch. Alan Jones, Vice President of the Hawkeye Section (No. 178) in Davenport, Iowa, reports on how his section is trying to alleviate this problem by holding a series of educational workshops on physics, boost glider design and construction techniques, tracking and data reduction, altitude competition, and many other topics. These are improving winter attendance as well as making for better modelers in the section.

Club History: The Point Place Model Rocket Club of Toledo, Ohio

This model rocket club was formed on April 20, 1970, by three men from the Point Place Area of Toledo, Roy Bailey, Bill Kuehling, and Ted Warren. These men, along with Roy's wife Barbara, were the club's first officers. John Carle joined this group as Events Technical Advisor to complete the Board.

The young club's development was spurred along by the sponsorship of Les and Ron Haddad, proprietors of The Hobby Shop, a model supply store in Point Place. Les and Ron became members and have been most generous with their financial support and guidance in organizational matters.

The original group built much of the equipment necessary to conduct flying events, such as two launch racks which have a combined capacity for twelve rockets, an electrically controlled firing panel, and tracking scopes for measuring the altitude of rockets in competitive events. Other equipment was added throughout the year, notably a telephone system used to communicate with the trackers. This was built by Dick Notestine, who was one of the club's early members.

Model rocketry is a hobby that can be enjoyed by youngsters and adults, girls and boys, men and women, and all of these are represented in the club's current membership of approximately fifty.

Besides being a fun organization, the Point Place Model Rocket Club teaches skills in the use of tools and materials for the construction and finishing of models. The club has seen that this hobby can be educational and very rewarding, as evidenced by a young man from Toledo who was recently awarded a college scholarship for work performed while associated with model rocketry.

Tannenbaum-1

by Dave Klouser

Photos by Bob Mullane

On the night of December 28, rocketeers from Massachusetts, New York, New Jersey, Pennsylvania, Georgia, and Maryland converged on the Howard Johnson's Motel of Phillipsburg, N.J., for Tannenbaum-1. At this two-day regional sponsored by the Phillipsburg Area Rocket Club Condor Boost/Glide and Rocket Glider, Roc Eggloft, Sparrow Boost/Glide and Rocket Glider, Robin Eggloft, Class 2 Streamer Duration, and Class 2 Parachute Duration were flown along with several unofficial events like Scale Christmas Tree, Class 5 Parachute Duration, D Engine Feather Boost/Glide, and Ornamental Ping Pong Spot Landing. The weather was clear and a bit cold that night, but the forecast was for wind and rain.

Contest Coordinator Dave Klouser opens the meet with an explanation of the ground rules and the layout of the range.

At 8:00 PM, a contestant's briefing was held to lay down the ground rules for the meet. Contest Coordinator David Klouser explained that the higher engine class events would be safety checked by Guppy and Bernard Biales, and that the Scale Christmas Trees would be judged by Elaine Sadowski and Bob Mullane. He then reminded everyone that the main idea of the meet was to have fun, and most everyone listened, as was to become apparent!

After the contestant's briefing, Scale Christmas Tree was judged in Elaine's room. The entries numbered two, Stuart Zaharek's plastic Christmas tree mounted atop a rocket-like base and Doug Plummer's green Super ZNT. Halfway through the judging, a major blackout (half the lights in the room went out) resulted in the movement of the judges from the table to the bathroom, where the judging was completed. After the static judging, Stuart was ahead, but both entries had to put in a stable flight in the morning.

The next day, the range crew arrived at the field at 8:45 and began to set up. By 8:55, it became apparent that the range would not be ready in time to begin launching on schedule, so Richard Pfeiffer (PARC) began to prepare an egglofter for flight. A tilt-a-pad was borrowed, and the rocket was launched by a car battery at 9 seconds before 9:00. The flight was an omen of things to come, as it arched over and streamlined in.

Richard Pfeiffer prepared an Egglofter for flight. At 9 seconds to 9:00 a.m. it took off without warning.

The range was completed, but loose swivels further delayed launching. Doug Plummer began to load his family of ZNT's, including some two-staged models, to start the meet off right. The first ZNT worked beautifully, but the remaining ones didn't fare as well, with some even going unstable.

Finally, the racks were ready for competition flights, but with the high gusty winds and the extreme cold, many modelers were reluctant to put their models on the pad. Several PD models pointed out the wind direction and speed as they drifted along above the harvested New Jersey cornfields. A couple of outstanding rockets, such as Trip Barber's 3-1/2 minute one, disappeared while still several hundred feet in the air and several miles down range. Since both the SD and PD events were with B engines, mini-jet rockets were in abundance, and they took several places.

Designs for the Sparrow B/G event were varied but standard. Only one second separated the first and second place winners, but both

Bruce Kennedy launches the only qualified Ornamental Ping Pong Spot Lander.

gliders were up longer than they were visible to the timers. Once again, the wind had changed the strategy of the contestants, and possibly the winners.

One of the more unusual designs entered in Sparrow B/G was Bernard Biales' ejectable flex-wing. This model used plastic for the wings and tail. After several misfires using all types of igniters, he finally got the model off, but to no avail; no place determining time was turned in by the glider.

As in the SD and PD events, mini-jets were again being used in the Sparrow RG competition. It is interesting to note that there was a tie for first place between two models, one of which was a flop-wing, the other a standard glider with no moving parts. Philip Sheppard followed the example set by Bill Fileccia at NARAM-13 and used a standard glider with no moving parts while Frank Osborn used a flop-wing for his 48-second flight.

Condor Rocket Glider, flown only once before at a major contest in the Northeast (NART-2), was expected to be a very interesting event. At NART-2, only one Condor RG out of 5 worked. At Tannenbaum-1, three Condor RG's were entered, and two out of the three worked, proving that the state of the art has advanced. First up was Guppy (MITMRS) with a standard flop-wing powered by an F7-4. The boost was like a corkscrew, straight up and spiraling, and it leveled out at a good altitude and started to glide beautifully. It was timed for 160 seconds before it disappeared behind some trees down range.

Next came Bernard Biales. Once again, he had a flex-wing, but this flight would prove more interesting and fruitful than his Sparrow B/G flight. The boost was straight up, but when it arched over, the wings failed to deploy. However, to the amazement of everyone, especially Bernard, it *still* glided. As a matter of fact, it glided for 66 seconds. Unfortunately, though, he couldn't find the glider, and it was given up for lost.

Thomas Milkie, after much preparation and work on the pad, and after regluing several launch lugs, finally had his Condor RG ready to go. The countdown started, the engines ignited, and the model fell over and thrusted away, nose first in the mud.

Condor B/G, which is getting to be old hat for many rocketeers now, wasn't so old hat at this meet. Although there were two good flights in Condor RG, no one had qualified in Condor B/G by the end of the day. Peter Roos, however, really gave it a try when he flew his glider with a twin E engine clustered pod. The glider itself looked like a Swift or at most a Hawk size glider, but it proved its strength when it held up to two prangs.

Then time out was taken from the official competition flights to fly the unofficial event scheduled for that day, Scale Christmas Tree. Both of the entries were unstable, but Stuart's was stabler, so he was awarded the prize.

After lunch, the tracking scopes were set up by MITMRS members for the two egglofting events. Once again, Roc was to be flown in a regional in the Northeast. The other regional was run by Doug Plummer. It was called Germ-1, and 33% of the Estes D's exploded. Tannenbaum-1 upheld this tradition with 2 out of the 6 D13's used in eggloft exploding.

Guppy, who had just finished the bottom stage to a beautiful two-staged model the night before, had the bottom stage explode and ignite the upper stage. It went unstable and impacted in the soft mud about 200' from the launch site which did wonders for the condition of the egg!

Robert Levinson really took his chances when he flew a three-stage D13 egglofter. His luck held out, as the model went straight up into the clouds and disappeared. He never saw the 'chute open, but he had broken the law of averages.

Then Tom Milkie prepped his black-staged model for flight. The model had an interesting body design, almost like a square with rounded-off edges. The boost was absolutely beautiful—the best flight of the day in Roc. When the chute opened, however, the wind began its old tricks, and Tom started running in an attempt to recover the model. He remained long after the range had been torn down, but to no avail.

The overall results in Robin were very disappointing. The best altitude was 126 meters, far below the normal winning altitude at recent meets. The winning rocket was a two-staged model with a B in each stage, built by Robert Levinson.

After the range was closed, most of the rocketeers returned to the motel to eat. The only ones left on the flying field were the range crew, the foodstand crew, and Tom Milkie. Tom still hadn't found his egglofter!

Once again, at 8:00 PM, people gathered at the conference room to see the NARCAS movie and slides of PACT-1 and a recent Pascack Valley Christmas party. After this, Bob Mullane, who had seen a Coolight in Bamberger's and instantly fell in love with it, brought it out to show everyone. A Coolight is a plastic tube containing the two chemicals that cause fireflies to light up. When they are mixed in the tube, a fairly bright light results which lasts about 3 hours. He couldn't wait to try it out, so we got a rocket that night and taped the light on the side. It was launched from the motel lawn, and the light was visible all the way through impact, even though the parachute didn't open. The flight did prove, however, that there is a cheap, easy-to-work-with light that is bright enough for night launching available.

After the launch, everyone returned to the conference room for a paper airplane contest. Once again, as with other contests, the competition was stiff with Steve Streiker winning with a 4.5 second duration. The night ended with everyone watching an episode of the Twilight Zone, and then going to sleep to get some very needed rest.

The next day, even though there was a very cold steady rain and a slight wind, several die-hard rocketeers showed up at the launch. TO EVERYONE'S SURPRISE, BOTH TOM MILKIE AND BERNARD BIALES FOUND THEIR LOST MODELS! Fewer models were flown this day, but up to this time, there had been no qualified Condor B/G's. Guppy again brought his Condor RG to the pad, but this time it was registered as a B/G. It boosted as before, but lost most of its altitude before the wings opened and it leveled out. Due to a warping of the tail, it only turned a 27-second flight in, but it was good enough to capture first place.

In Ornamental Ping Pong Spot Landing, Bruce Kennedy won with a distance of about 50 yards, but the other entry was disqualified. Mike Angelo won Feather Boost/Glider with a beautiful flight with his Omega from NARAM-13.

After these flights, the awards were presented in a nearby barn. In all, it was a fun meet, which was the sponsor's intention, and everyone left with a new experience under his belt.

Guppy was successful with his Condor as the model turned in a 160 second flight.

Tom Milkie had the only Roc Egglofter which got a beautiful 680 meter flight.

David Klouser of Stewartsville, New Jersey, has been involved with model rocketry for over four years, and in the NAR for two. Besides model rocketry (and running meets and editing his section newsletter), Dave enjoys chess and bowling. He is a junior at Phillipsburg High School, and he plans a career in engineering.

National Association of Rocketry
MODEL ROCKET ENGINE CERTIFICATION LIST

The NAR Contest Certificate has been granted to the model rocket engines listed below:

Centuri Engineering Company

STANDARD SIZE ENGINES
(18 mm dia. x 70 mm long)

½A6-0	½A6-2	½A6-4			
A5-2	A5-4	A8-0	A8-3	A8-5	
B4-2		B6-0	B6-4	B6-6	
B14-0	B14-5	B14-7			
C6-0	C6-3	C6-5	C6-7		

ENERJET SERIES

E24-4 E24-7	E24-10	24 mm dia. x 76 mm long
F52-5 F52-8	F-52-12	29 mm dia. x 127 mm long
F67-6 F67-9	F67-14	29 mm dia. x 127 mm long

L. M. Cox Manufacturing Company

STANDARD SIZE ENGINES
(18 mm dia. x 70 mm long)

A6-0	A6-2	A6-4	A6-5		
B4-0	B4-3	B4-5	B4-6	B6-0	B6-6
C6-0	C6-2	C6-4	C6-6	C6-7	
D8-0	D8-3				

Estes Industries

STANDARD SIZE ENGINES
(18 mm dia. x 70 mm long)

¼A3-1		¼A3-2		¼A3-4
½A6-0		½A6-2		½A6-4
A5-2		A5-4		
A8-0		A8-3		A8-5
B4-2	B4-4	B4-6	B6-0	B6-2*
B6-4		B6-6		
B14-0	B14-5	B14-6	B14-7	
C6-0	C6-3	C6-5	C6-7	

SHORT SIZE ENGINES
(18 mm dia. x 44 mm long)

¼A3-1s	¼A3-2s	¼A3-4s
½A6-0s	½A6-2s	½A6-4s
A5-0s	A5-2s	A5-4s

MINI-SIZE ENGINES
(13 mm dia. x 44 mm long)

¼A3-2t	¼A3-4t	½A3-0t	½A3-2t
	½A3-4t		
A3-0t	A3-2t	A3-4t	A3-6t

"D" SIZE ENGINES
(22 mm dia. x 70 mm long)

D12-0* D12-3* D12-5* D12-7*

Flight Systems Incorporated

(21 mm dia. x 70 mm long)

B3-0		B3-4	B3-6		
C4-0	C4-2	C4-4	C4-6		
D4-0	D4-2	D4-4	D4-6	D4-8	
D6-0	D6-6	D6-8	D18-0	D18-4	D18-6

(21 mm dia. x 95 mm long)

E5-0 E5-2* E5-6

(27 mm dia. x 150 mm long)

F7-4		F7-6
F100-0	F100-4	F100-8

Model Products Corporation

STANDARD SIZE ENGINES
(18 mm dia. x 70 mm long)

A3-2	B3-3	B6-0	B6-4
C6-0	C6-4	C6-6	

MINI-SIZE ENGINES
(13 mm dia. x 57 mm long)

½A3-3m	½A3-5m	A3-0m	A3-4m	A3-6m
B3-0m	B3-5m	B3-7m		

Vashon Industries

Cold Propellant Valkyrie I and II

*Indicates New Contest Certification

The NAR Safety Certificate has been granted to the Model Rocket Engines Listed below:

Centuri Engineering Company

MINIMAX SERIES

(29 mm dia. x 120 mm long)

E15-4	E15-6	E15-8
E62-0	E62-4	E62-7

(29 mm dia. x 197 mm long)

F16-4		F16-7	
F97-0	F97-4	F97-7	F97-10

Estes Industries

The "Citation Engine" Series
(21 mm dia. x 70 mm long)

Flight Systems Incorporated

A4-4 (21 mm dia. x 70 mm long)

This Certification List, effective 31 January 1972, supersedes all previous lists.

G. M. Gregorek, Chairman
Standards & Testing Committee
National Association of Rocketry

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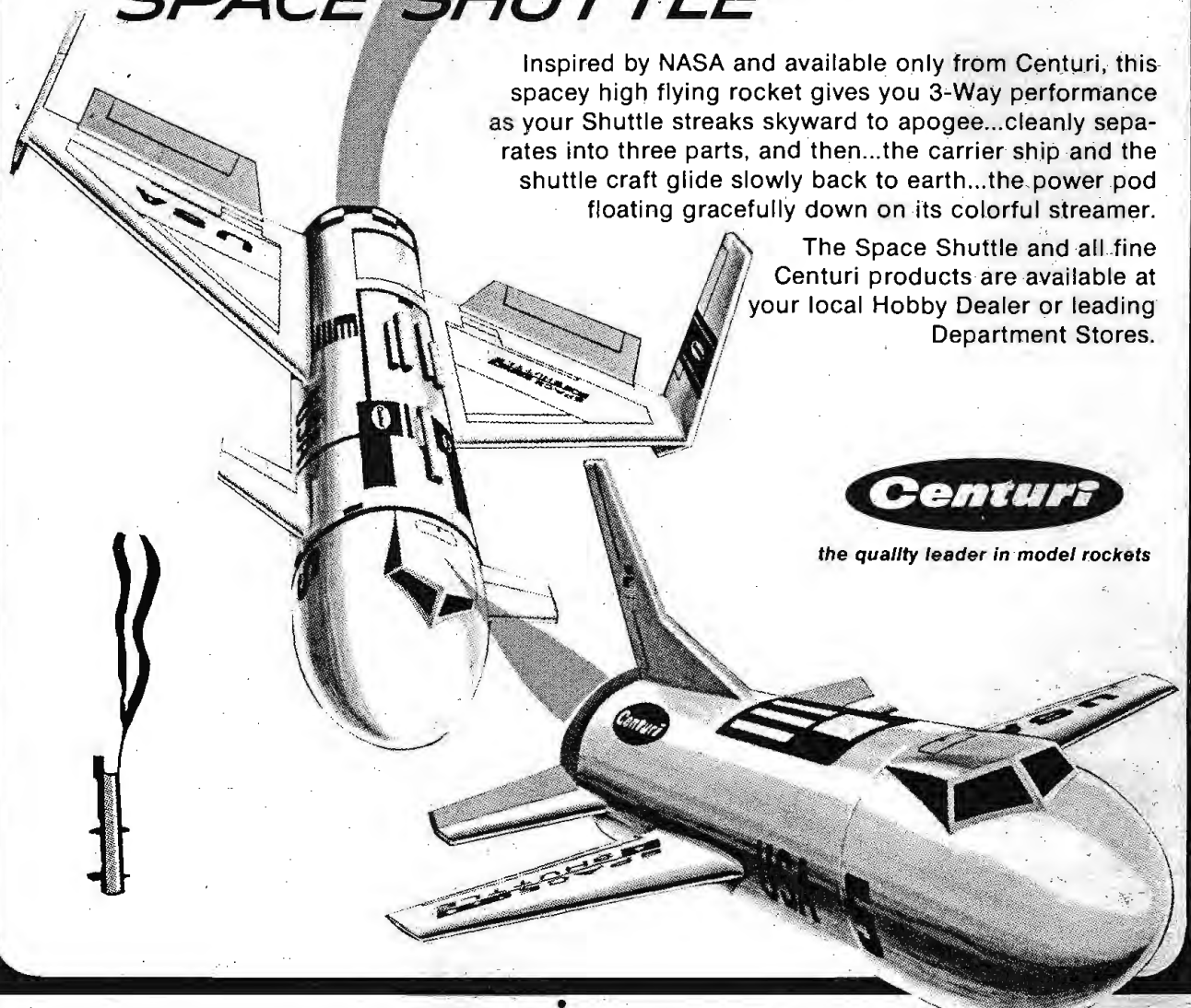

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