JULY 1970

MODEL ROCKETRY

The Journal of Miniature Astronautics
Incorporating THE MODEL ROCKETEER

Astroscale Data:
KOROLEV RD-107 "VOSTOK"

$11 WIND TUNNEL
DESIGN PLANS

BUILD THE "TRIAD"
ODD-BALL DESIGN

MIT MODROC
CONVENTION
COVERAGE

EXPERIMENTAL PARACHUTE
DURATION RESULTS

BREATHING RATE
"FOXMITTER" SENSOR

"OLD ROCKETEER"
CUSTOM PLASTIC
PARTS?

CZECH COMPETITION
COVERAGE

Model Rocketry

Volume II, No. 10
July 1970

Cover Photo

This month's cover shows one of the Eggloft racks at this year's East Coast Regional Meet. The meet, held at Camp A.P. Hill, Virginia, featured a Hawk B/G "demolition" contest. Complete ECRM coverage is in this issue.

(Photo by George Flynn.)

From the Editor

For years it has been popular to fly live payloads. Most model rocketeers go through the stage of lofting a grasshopper, fish, mouse or other animal in a model rocket. Such flights generally accomplish *nothing* except, on numerous occasions, the death of the animal.

As Dr. Gerald Gregorek said to the MIT Convention, "If you launch an uninstrumented mouse, and you want to find out if he can stand the G-load of hitting it with an F100, you can just as soon grab the mouse by its tail, swing him around your head, and *throw him against the wall.*" Most, though certainly not all, flights involving live biological payloads are in fact no more *useful* than slamming the mouse against a wall or hitting him on the head with a hammer.

Recent advances in the field of model rocket telemetry, however, make it possible to undertake *serious research projects* involving the lofting of live payloads. The heartbeat and breathing rate sensors desdribed in this issue of **Model Rocketry**, coupled with the "Foxmitter" to relay data to the ground, will allow the rocketeer to undertake such projects. Biological experimentation, under the careful supervision of a trained biology or science teacher, can now be conducted by the average rocketeer.

Remember, however, that merely because you've instrumented that mouse, you don't have an excuse to throw him against a brick wall. Likewise, merely attaching the heartbeat and breathing rate sensors to your mouse does not justify igniting an F100 under him. If you are interested in the biological aspects of model rocket flight, *first* prepare a careful experimental program. Discuss your project with a science teacher. Make sure it has some value *before* you undertake it. *Unless you're going to do a useful research project, don't loft live payloads.*

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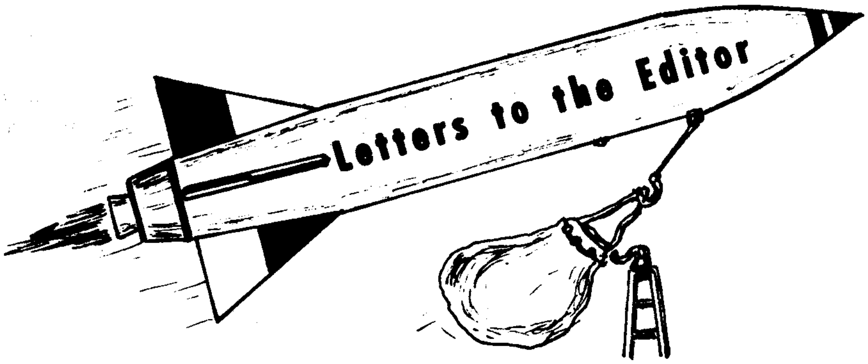
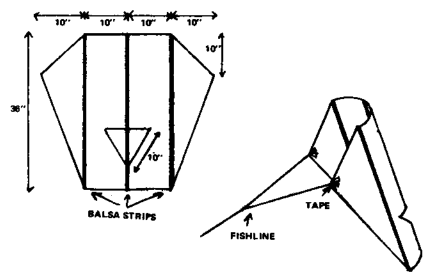


Thermal Detector

I noticed in Mr. Malewicki's article, *Drag Coefficient Measurements* **(MRm,** April '70), that he mentions the subject of thermal detectors. A few years ago I came across a very simple thermal detector in a model airplane magazine. All it amounts to is a very simple kite. It's made of very light materials so that it can fly normally in just a breath of air. When a thermal comes through the area, the kite will rise until it is flying straight above it's anchor point.

I'm afraid that it's not electronic, or even very scientific, but it works.



THERMAL DETECTOR

The thing is very simple to make, and costs maybe 25¢. First, confiscate an old plastic laundry bag and cut to the shape shown. Be sure to cut out the triangular section, this substitutes for a tail. Next, tape three 1/8" square balsa strips in the position shown. Heavier materials can be used if the kite is to be flown in any significant wind. Finally, attach the bridle as shown, with tape reenforcement at the tie points. One last important point, to reduce weight and drag, use light fishline instead of ordinary kite string.

Gary Crowell
Boise, Idaho

Exhaust Plumes

Recently I have begun working on the problem of defining model rocket exhaust plumes. My work as a propulsion engineer involves definition of plumes for large solid propellant motors and I have a number of analysis methods at my disposal. Doug Malewicki's article *Drag Coefficient Measurements* in the April issue of your magazine proved to be most interesting.

First of all, Mr. Malewicki's preliminary investigation has pointed out the possibility of two interesting effects on model rocket drag. The "laminar bucket" is known to exist and may occur on model rockets. Similarly, the use of base fairings is known to reduce drag in some cases. This is documented on page 3-20 in **Fluid Dynamic Drag** by Hoerner. Further experimentation will indicate whether or not these effects are actually taking place.

However, before everyone starts getting excited by the possibility of ultra-low drag coefficients due to plume effects, I have to throw some dark clouds on the horizon. The base fairing used to simulate the plume does not give a realistic picture. Using a method-of-characteristics solution of the near flow field and a semi-empirical solution of the far field, I made a preliminary analysis of a Series I motor plume. Although the detailed structure of the plume needs more work and experimental verification, a few features are known with a high degree of certainty. First, the supersonic core of the plume, which may be treated as a solid body, is only 0.3 – 0.4 inches in diameter. Secondly, the region in which the exhaust plume becomes subsonic and starts to mix with the air is 2 – 3 inches from the nozzle exit plane.

All of this indicates that the exhaust plume does not significantly streamline the flow in the base region. As a result, there still exists a low pressure region at the base and this causes drag. Admittedly, the situation is better than if there were no plume at all, but it isn't nearly as good as implied in the article.

Right now, I am working on a more detailed theoretical analysis of the Series I motor plume. Concurrently, an experimental program to verify the predicted plume is being planned. I hope to have the equipment ready and begin experiments by late summer. This is an area in which little work has been done and I hope to be able to make an original contribution.

Robert E. Cramer
Renton, Washington

HAD Scale

In the April issue of **MRm** the HAD Sounding Rocket scale design required a 1.49 inch diameter tube. You suggested that this tube needed to be hand wound, since no commercial tubes were available in this size. I have found that the thin layer tubes from "Bounty" paper towels have the right diameter for the job. These tubes are strong enough to withstand the power from a cluster of C's.

I hope this information will save other rocketeers some time and work.

Robert Thomas
Crawfordsville, Indiana

Canadian Regulations

Your April issue contains a letter from Barry Nicolle concerning the rules governing model rocketry in Canada. He mentions that you must be over 21 years in order to obtain a Firing License. This age has recently been lowered to 18 years. As a recent survey, we have 180 registered Firing Supervisors in Canada. I suggest that Canadian model rocketeers consult with their science teachers at school or write to the Canadian Rocket Society, P.O. Box 396, Toronto Adelaide St. PO, Toronto 1, Ontario for more information on the rules.

Hillel Diamond
Toronto, Canada

Psionic Control

G. Harry Stine's *Psionic Control of Modrocs* (MRm, April 1970) was a truly great article. It was absolutely hilarious and contained enough concentrated humor to cause even the sourest of model rocketeers to turn up his heels in laughter. But what made Mr. Stine's article so good was the fact that everything he said had the distinct possibility of being true (except possibly his explanation of the origin of the Reynold's Number).

I congratulate Mr. Stine and **Model Rocketry** for a great job, and I sincerely hope to see your magazine progress with the same standards of excellence it has always had.

Robert Hartman
Taylor, Texas

Warwick 2

I have just completed building the Warwick 2 described in the February 1970 issue of **Model Rocketry** and would like to offer a suggestion to other builders. The four 2" sections of BT-60 used as stabilizing tubes are not exactly flush to the side of the mail body tube when attached. The designer apparently intended this small space to be filled with glue, however I glued small slithers of balsa wood between the mail body tubes and the stabilizing tube on my model. This strengthens the structure and made my model almost indestructable.

In addition, the PS-20A payload section could be replaced with a PS-20C section, giving you more payload space.

Fred Sarniewicz
Elmhurst, New York

Super-Titan

While thumbing thru the March issue of **Model Rocketry** I was shocked and felt downright stupid when I saw the plans for the Super-Titan. I was attempting to build a similar second-stage ignition system, using a cluster of three D-engines for power. I spent weeks designing and building the rocket. Conventional small engines could not be used because of the tremendous weight of the battery system I was using for the upper-stage ignition.

I had almost completed the launch vehicle when the March **MRm** arrived. All hope was gone, and my dreams were reduced to mere rocket exhaust. I know rocketry must progress, but let me help it along too!

Now I'm stuck with a rocket than can lift 16 ounces, but has nothing to lift. The upper-stage ignition system described in the Super-Titan article weighs less than one ounce! Now I'm considering lofting transmitters, light flashers, and every other kind of conceivable gadget. I'd hate to see all of my designing work go up in chute wadding. What do you suggest?

Mark Miskinis, NAR 15377
Dearborn Heights, Michigan

LEM vs LM

Why does Tom Milkie continue to call the Apollo Lunar Module (LM) the "LEM" when that official designation was changed to "LM" two or more years ago? It's like calling a 747 an *aeroplane.*

I am sending a copy of your March 1970 edition to my friends in Public Affairs at Grumman Aerospace Corporation, builders of the LM. Perhaps they will come up with a scheme that makes flying a model LM more realistic. Instead of reducing the weight, for instance, they might recommend adding weight. Instead of launching the LM *upward* with the descent stage, that might make it possible to soft-land the LM after tossing it manually into the air.

Oh, well! I never said I was an engineer.

Bob Button
Torrance, California

Elliptical Fins

In several recent issues I have noticed plans for high performance rockets. In the May 1970 issue, Mr. Stine speaks of Mr. Carlisle's Mark II as "draggy." There is nothing more draggy in the velocity range in which model rockets fly than a bird with a sharp nose and squared fins.

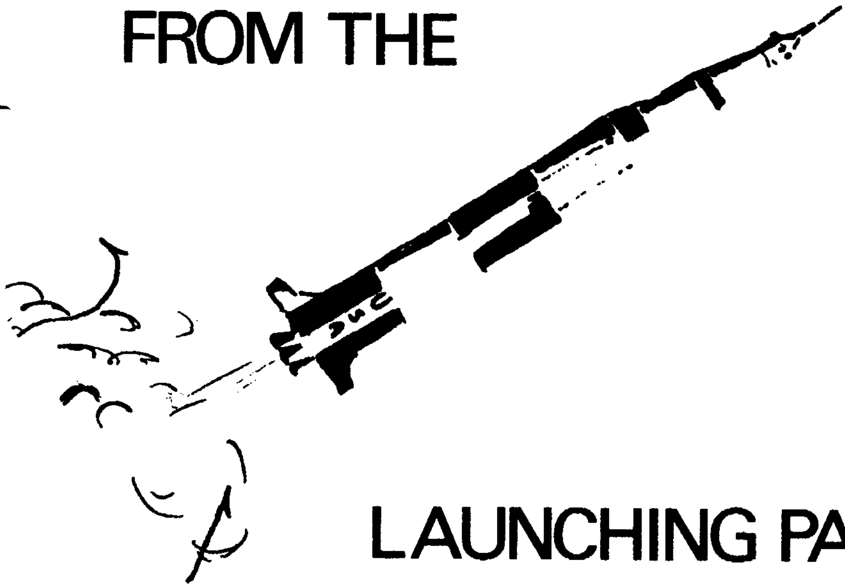
First, the fins. About 1/4 to 1/6 of a model's total drag lies in its fins. As a result of some independent wind tunnel studies of my own, I have found that the acclaimed elliptical planform fin is far superior to two other planforms (which are representative of other standard fin planforms). In some cases the drag coefficient of another planform of the same total surface area, thickness, and airfoil was as much as 34% more than that of the elliptical planform at identical wind tunnel test parameters.

Elliptical Fin Planform

Another find which may be beneficial to rocketeers building PeeWee or Single payload birds; if about 1-1½ turns of paper are taken from the *inside* of an Estes BT-30 tube, a standard NAR-FAI payload will readily fit inside it. This procedure weakens the payload section of the tube, but, with the nose cone glued in place and with the payload and nose block inserted, the tube is supported fully along its length. Although this probably has been discovered before, I thought I might make this helpful hint known to rocketeers.

Craig Streett, NAR 11943
Columbus, Ohio

FROM THE



LAUNCHING PAD

Flight Systems President George Roos has disclosed several of the products currently undergoing R&D by his company. Expressing the attitude that "model rocketry must have a purpose," To this end, Flight Systems engineers are developing a series of model rocket payloads. A light flasher, weighing only one-half ounce complete with the Cd-Zn batteries, will soon be available both assembled and in kit form. The flasher, used for night tracking, will have a one second repetition frequency.

A similar beacon, equipped with an impact activation device, will be available as a landing marker. The beacon, which lights up on impact, will allow easy recovery of night launched rockets.

Flight Systems is also developing a peak reading altimeter which will fi in their standard 21mm ID tube, weighing in the half ounce range, this device will allow ±5% altitude readings, and will be priced in the $5 range. If it works out well, this device could replace the standard lead weight in payload altitude competitions.

Already in the prototype stage is a maximum velocity indicator, which will also fit in standard payload sections. This device, which FSI expects to market at less than $5, will read maximum velocity on the way up. It is also capable of reading terminal velocity on the way down, and terminal velocity is directly relatable to the C_d of the vehicle. If successful, this device will allow rocketeers to determine the drag coefficient of their rockets without elaborate wind tunnel testing.

Also due for expansion is the already extensive Flight Systems engine line. Presently offering the only NAR certified E and F engines, FSI is now developing special engines designed for boost/glide work. These low thrust A and B engines are optimized to give a lower peak thrust, and maintain an approximately constant velocity during thrusting. Since drag goes up as the square of velocity, higher altitudes will be achieved by these B/G engines designed to accelerate the glider just fast enough to assure aerodynamic stability.

To supplement the Flight Systems line of D-engines, already including low thrust D4 and medium thrust D6 engines, will be a high thrust D16-6 engine. With a total impulse of 20 newton-seconds, the D16-6 will be ideally suited to payload lofting.

George Roos assures rocketeers that they can continue to look to FSI for leadership in all areas of model rocketry.

Clubs interested in expanding their equipment should be particularly interested in a construction article on an *anemometer* and *wind direction indicator* featured in the January 1970 issue of **R/C Modeler.** The device described by L. Jack Weirhauser indicates both wind speed and direction, quite important if you're flying boost/gliders or parachute duration models. Weirhauser's anemometer employs a freely spinning model airplane propeller rather than the more standard cup-type design to allow a single instrument to measure both speed and direction. The electronics used should cause no difficulty to the average rocketeer. Full size plans are available from R/C Modeler Magazine, Dept. R Plans Service, PO Box 487, Sierra Madre, Calif. 91024. Order plan #AWD-1, priced at $1.00.

If you have an amateur radio license, Technician Class or higher, take a look at the microminiature six meter transmitter described in the May 1970 issue of **73.** If constructed according to K1CLL's plans, the transmitter measures only 3/4" x 3/4" x 1/8", and though no weight is specified it should be quite light. Output power ranges up to 1/4 watt on the six meter band, and with a six inch antenna its been heard out to *15 miles.* Since the unit can be tone modulated, a number of standard model rocket sensors (as described in previous issues of **Model Rocketry**) can be adapted for use with this unit. Remember, *you must have a license to operate this transmitter.* However, the increase in range you can get over the operation of a 100 mw transmitter on CB, which requires no license, will certainly provide the small incentive necessary for a serious experimenter to pass the code and theory exams.

Last month's Record Trials, sponsored by Harrisburg, Pennsylvania's NARCAS Section, saw the first Condor B/G flights at a sanctioned NAR event. Almost twenty of these large boost/gliders were flown, powered by almost everything from clusters of Estes D-engines to FSI F100 and F7 engines. Everything from a Maxi-Manta, to a variable geometry B/G, to a six foot "Infinite Loop" was flown. We'll have complete coverage of the Record Trials next month.

Ace Radio Control is now the US distributor for the Bentert actuator used by Doug Malewicki in his RC B/G. Those rocketeers who have experienced difficulty in obtaining this part for his B/G, described in the August, September, and October 1969 issues of **Model Rocketry** can now obtain this item from Ace. Write to them at Box 111R, Higginsville, Mo. 64037 for price information.

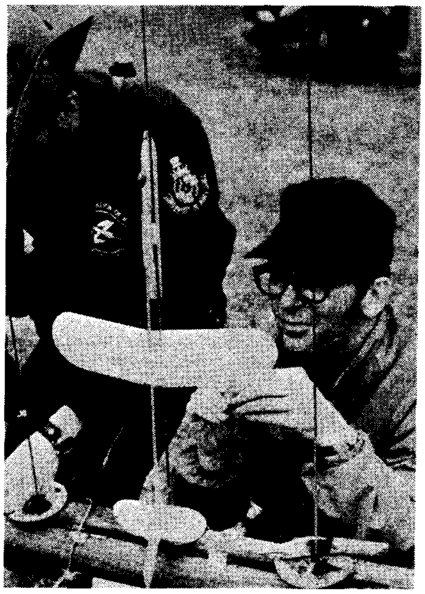
Several rocketeers are currently working on RC boost/gliders. Howard Kuhn has a Maxi-Manta which will take the new Ace Gem receiver in a pod beneath the wing. The glider has been flown under power, and the first tests with radio are expected soon. Bob Parks has been test gliding another RC B/G, but as yet it has not been flown under power. In addition, a number of the Condors flown at the NARCAS Record Trials could easily be converted to RC.

Use of radio control on B/G's will allow thermal soaring. Presently, when a B/G gets into a thermal it doesn't stay in long since the turning radius is much larger than the average thermal size. With RC equipment in the B/G however, the same thermal soaring techniques used by airplane modelers can be used. Boost/glide times of well over thirty minutes should be attained in the bigger events.

Jim Kukowski's experiments with styrofoam wing B/G's seem to be working out well. Jim had an approximately 12 inch span ready for flight at the NARCAS

Record Trials. It weighs just about the same as a standard balsa wing Hornet B/G, but the wing is thick enough to allow a reasonable airfoil to be put on. The glide speed and sink rate were both a little lower than normal designs. In some test flights the night before the trials the styrofoam wing B/G was doing over a minute with no thermals. Styrofoam and/or built-up wing B/G's seem to be the ways to go for small competition gliders.

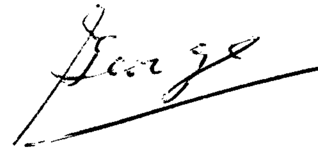
Only one styrofoam material seems to have a high enough density, and a correspondingly smooth surface, to be useful for B/G's. The material, HD-300, was just recently introduced by Dow, and is available from at least two mail order sources. Preformed, airfoiled wing sections are available from D-B Industries, Box 2835, Mansfield, Ohio 44906. High-density foam sheets, also ideal for wing sections, as well as styrofoam blocks, thin covering material, etc. are available from Lancer Industries, Box 445R, Carpinteria, CA 93013. Lancer also has available a hot-wire styrofoam cutter priced at $14.95. Write to them for a complete list of styrofoam products.



Jim Kukowski preps his styrofoam Hornet B/G for flight.

Model rocketry in Australia seems to have hit a snag in its development. According to a recent letter from Neville Fraser in Merrylands, NSW Australia, a lack of demand for parts and equipment has forced the only Australian supplier out of business. A wholesaler in Melborne continues to import Estes kits and engines, but no parts "so we will be forced back into the dark age as far as original designs, projects, etc. are concerned," Neville reports. "One of our (Australian) pyrotechnic firms is making a sample batch of motors, roughly C class, which is at least a start towards home-grown industry. The problem is that we in Australia don't have the incentive to start a hobby like model rocketry."

A great deal of the success of model rocketry in the United States comes from the attention given to our active national space program. The early satellite launchings, and more recently the manned Mercury, Gemini, and Apollo programs, have stimulated the development of the hobby in the United States. "Although we do have a large rocket range (in Australia) its workings are mainly military, and no news is made from it. With nothing to stimulate young interest, the hobby is grounded before it starts. As a matter of fact, our government, even if unintentionally, is stamping out rocketry. Officially we are not allowed to fire rockets over 300 feet. At least things can not get worse!"



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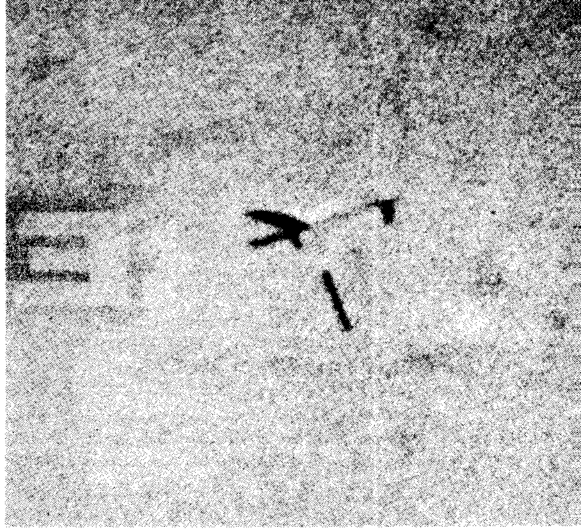
Send address changes to Change of Address, Model Rocketry, Box 214, Astor Street Station, Boston, MA 02123. Please include the address label from the last Model Rocketry you received.

Balsa dust rained from the sky at the NARHAMS' sponsored competition flown from Camp A. P. Hill.

ECRM-4



Andy Elliott's (NARHAMS) Hawk B/G drags its pod across the sky in the Hawk B/G event. With the pod attached, Andy turned in a 56 second flight.

This year's annual East Coast Regional Meet, the first major meet of the Spring for East Coast rocketeers, got underway on the afternoon of April 10th, 1970. Ninety-two rocketeers from Delaware, Pennsylvania, and Maryland gathered at Brown's Quality Court Motel, just across from U.S. Army Camp A. P. Hill – which served as the site of the competition.

Early in the evening the contestants gathered in the parking lot for a briefing by Contest Director Jim Barrowman. He warned them that, due to a recent dry spell, the grass in the launch area was unusually dry and care would have to be exercised to keep down the fire hazard. Since no building or painting was permitted in the rooms, a number of rocketeers were seen sitting on the motel steps finishing their rockets. Two B/G's were lost in the swimming pool during trimming tests conducted under the cover of darkness on the motel lawn.

The next morning everyone was out at the field early, and most of the contestants participated in removing the dry grass from the launch area. The first event on the schedule was Hawk B/G – a boost/glide event employing C engines. Many rocketeers were expected to bring only one B/G, planning to fly it in both the Hawk and Swift events, Jim Barrowman explained that the Hawk competition would be flown first "so that we'll demolish right off anyone who only brought one B/G down." Right he was! The first Hawk B/G off the pad broke apart (disintegrated would be a more appropriate term) under power. The second B/G suffered a catastrophic failure. The engine pod ripped off the third boost/glider, giving a flight duration of about 2 seconds . . . and a DQ for deploying the pod recovery system after hitting the ground.

It just kept on raining balsa dust all through the Hawk event. Eight of the first ten B/G's failed. Only two, Mike Coxen's (NARCAS) which had a beautiful flight but disappeared from sight and Charles Armiger's Estes Orbital Transport which turned in a 43 second time, held together under the C-engine's thrust. In all, well over 50% of the Hawk B/G's were DQ'ed. They were, in general built too light and too weak. Many contestants made the mistake of flying boost/gliders built for Sparrow or Swift flight at other contests. It just doesn't work!

In the Leader Division there was only one "qualified" flight. Bruce Blackistone (NARHAMS) flew a 2 foot long, canard B/G. Though his pod did not fully deploy, it moved far enough to partially activate the canards, giving him about a 1:1 glide ratio. His 14 second flight gave him first place in the Division.

Perhaps the most unusual flight of the whole meet came in the Junior Division Hawk B/G. Andy Elliott (NARHAMS), who had spent over a half-hour trimming his B/G at the motel the night before the meet, prepped it for launch. The liftoff of his modified Thermic 20 was perfect. It climbed nicely under power, but at ejection the streamer separated from the engine pod. A DQ? No, because the shock cord wrapped itself around the B/G body just forward of the wings. This would be expected to unbalance the glider, and cause a poor flight, Andy's *luck* held out, however! The pod shock cord cut through the masking tape attaching his trimming weights to the nose boom. The weights fell off, the pod dragged from the nose, and the B/G glided well. Andy turned in a 56 second flight, received a first place trophy, and renewed his confidence in *pure luck* as the dominating factor in modroc competition.

Steve Kranish (NARHAMS) displays his Hawk B/G, a tower-launched rocket containing a rogallo wing. One fin caught in the tower, demolishing the B/G.

Guppy (AAR) prepares his Swift B/G entry. It was one of the many Swift B/G to be DQ'ed.

Bruce Blackistone (NARHAMS) preps the only Leader Hawk B/G to fly successfully. The Disaster 16-B turned in a 14 second flight when the pod failed to deploy.

Several unusual B/G's were flown in the Hawk event. Steve Kranish (NARHAMS) flew a Rogollo wing glider which was lofted inside a standard rocket body. Unfortunately, one fin of the launch vehicle hung up on the tower launcher, ripping off the fin and allowing the unstable rocket to prang. The Rogallo wing itself never got a chance to deploy.

Since ECRM-4 coincided with the Apollo-13 launching from Cape Kennedy, Doug Plummer (NARCAS) prepared a Saturn-V for launching at the same moment that Apollo-13 lifted off the pad. The firing officer monitered the Apollo-13 countdown over the radio, and prepared to fire Doug's rocket at zero. At T-60 seconds the tilt-a-launcher used on the NARHAMS' pad loosened, and the Saturn-V canted to 45°. Jim Barrowman and Doug rushed out to the pad, hoping to correct things in time for the launch. "T-48 seconds," shouted the firing officer as Jim lifted the Saturn from the pad. By "T-30 seconds" the tilt-a-launcher had been removed, the pad was ready, and the rocket was again lowered on the rod. "T-20 seconds" the firing officer shouted, and Doug rushed to reconnect the firing clips. At T-10 seconds Jim and Doug ran from the pad, they turned just in time to see the Saturn-V lift off at zero — right on time.

Class O altitude followed. Against the clear blue sky, tracking was excellent with 79% of the tracks closing. The Juniors turned in some excellent flights, with all three winning altitudes going over 200 meters. Towers were used throughout, with Andy Elliott (NARHAMS), Scott Brown (Gemini), and Paul Conner (NARHAMS), first place winners in each age division, all firing from tower launchers. David Crafton (Steel City) came up with a novel tower — a coffee can filled with sand, and with three launch rods placed in the sand to guide the rocket.

HAWK BOOST/GLIDE

JUNIOR		
1st	Andy Elliott	56 sec.
2nd	Dave Lewis	52 sec.
3rd	William Dees, Jr.	48 sec.
LEADER		
1st	Bruce Blackistone	14 sec.
	(no other qualified flights)	
SENIOR		
	(no qualified flights)	

CLASS 0 ALTITUDE

JUNIOR		
1st	Andy Elliott	235 meters
2nd	Carl S. Guernsey	218 meters
3rd	Marvin Liberman	216 meters
LEADER		
1st	Scott Brown	167 meters
2nd	Bruce Blackistone	149 meters
3rd	Mark Doran	135 meters
SENIOR		
1st	Paul Conner	207 meters
2nd	Joe Bilbo	157 meters
3rd	Ed Pearson	155 meters

EGGLOFT

JUNIOR		
1st	Carl S. Guernsey	350 meters
2nd	Tom Gillman	316 meters
3rd	Dave Emerson	312 meters
LEADER		
1st	Shiela Duck	402 meters
2nd	Chuck Gordon	351 meters
	(no other closed tracks)	
SENIOR		
	(no closed tracks)	

CLASS 1 PARACHUTE DURATION

JUNIOR		
1st	William Dees, Jr.	125 sec.
2nd	Carl S. Guernsey	84 sec.
3rd	Bob Crain	64 sec.
LEADER		
1st	Shiela Duck	93 sec.
2nd	Bruce Blackistone	54 sec.
3rd	Brewer-Hammond Team	20 sec.
SENIOR		
1st	Robert Atwood	87 sec.
2nd	Carol S. Meese	81 sec.
3rd	Clovis Crummet	45 sec.

SWIFT BOOST/GLIDE

JUNIOR		
1st	Carol R. Meese	86 sec.
2nd	Scott Snyder	71 sec.
3rd	Alan Stolzenberg	64 sec.
LEADER		
1st	Bruce Blackistone	75 sec.
	(no other qualified flights)	
SENIOR		
	(no qualified flights)	

SCALE

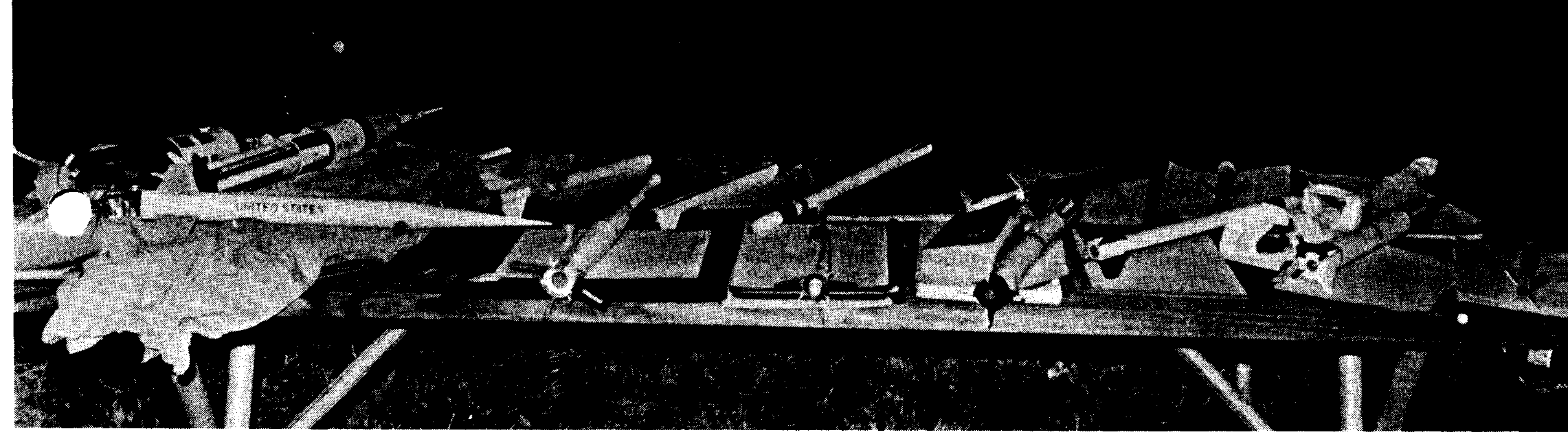
JUNIOR		
1st	Andy Elliott	Nike-Smoke, 663 pts.
2nd	Marvin Lieberman	Thor-Delta, 590 pts.
3rd	Alan Stolzenberg	Thor-Delta, 589 pts.
LEADER		
1st	Scott Brown	Honest John, 617 pts.
2nd	Guppy	IQSY Tomahawk, 594 pts.
	(no other qualified flights)	
SENIOR		
1st	George Meese, Sr.	IQSY Tomahawk, 584 pts.
2nd	Barrowman Team	D-Region Tomahawk, 560 pts.
	(no other qualified flights)	

OVERALL

JUNIOR		
1st	Andy Elliott	141 points
2nd	Carl S. Guernsey	72 points
LEADER		
1st	Bruce Blackistone	117 points
2nd	Scott Brown	96 points
SENIOR		
1st	George Meese, Sr.	93 points
2nd	Barrowman Team	54 points

SECTION STANDINGS

1st	NARHAMS	711 points
2nd	AAR	534 points
3rd	NARCAS	267 points
4th	Steel City	162 points
5th	Gemini	156 points
6th	SSB	108 points



The scale models were collected in an Army tent ajacent to the flying field. Andy Elliott's first place Nike-Smoke (front row, left), built from the Centuri kit, had additional detailing added. Numerous types of models — Little Joe, Saturn, Nike-Smoke, Tomahawk, Thor-Delta, Mercury-Redstone, Aerobee, Black Brant, and Honest John — were entered.

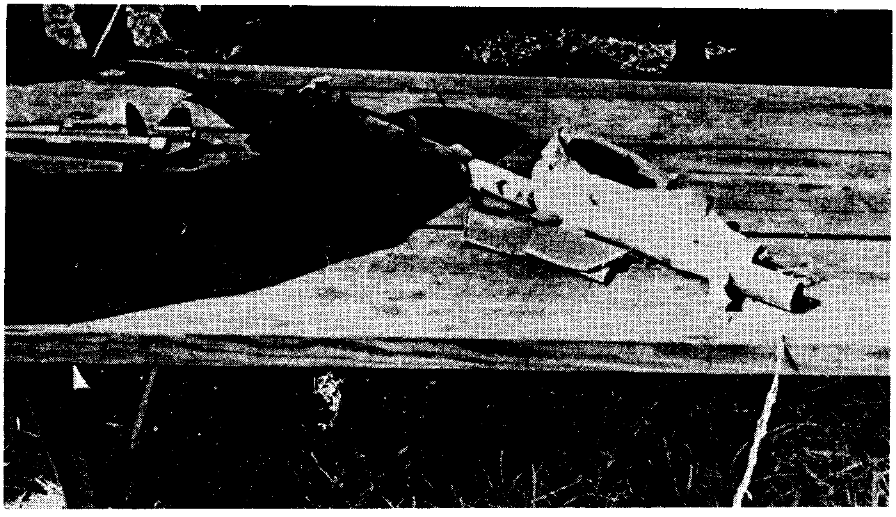
Eggloft, the only other tracking event of ECRM-4, was also flown on Saturday afternoon. A suprisingly large number of Astron Scramblers were flown in this event. D-engine vehicles also proved popular. Shiela Duck (NARHAMS) turned in the most spectacular flight, with 402 meters from a single D13 engine. Carl Guernsey (NARCAS) took first place in the Junior Division with 350 meters. Ted Coughlin (NARHAMS) provided a disaster reminiscent of the HAWK boost/gliders when his tandem/cluster C-engine egglofter exploded just after second engine ignition. The rocket completely disintegrated several hundred feet in the air. Tracking was not quite so good in Egglofting, with only 41% of the tracks closing. As a result, only four Juniors, one Leader, and no Senior tracks closed.

By Sunday morning, just in time for the PD event, the wind increased and shifted to a crosswind across the narrow leg of the rectangular field. The contestants' emphasis was on altitude rather than parachute size with many small (under 24 inch diameter) chutes being used. The best performance was turned in by Bill Dees, Jr. (AAR) with 125 seconds.

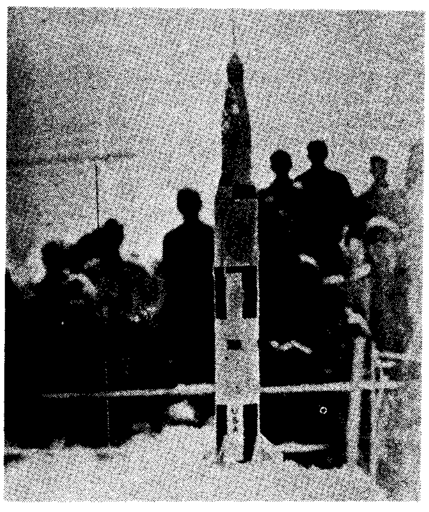
There was quite a bit of wind when the Swift B/G event got underway in the early afternoon. A number of gliders were DQ'ed for failure to separate from their pods. Some rocketeers, remembering Saturday's Hawk event, seemed intent on proving that B/G's can be torn apart even with B-engines. Overall, the times were not up to last year's performance in the same event, with Carol R. Meese's (AAR) 86 second flight topping those returned. There were, however, a number of exceptional flights which were carried away by the wind. The best flight of the Day was by Paul Conner (NARHAMS), whose B/G was still several hundred feet in the air when the timers lost it after over three minutes. Paul gave up on the recovery when the glider started drifting over the woods, and it became clear that it would land in a tree. Ted Coughlin (NARHAMS), flying another Conner design which Ted built in the early morning hours before the event, turned in an over two minute flight before the glider landed in a tree still some 40 feet in the air. He was unsuccessful in recovering the glider. Bruce Blackistone, who wandered off for lunch during the event, arrived back at the field just in time to fly his Swift B/G before the event closed. His canard wing "Valkyrie" series B/G took off just as the wind calmed down. The glider circled with about a 200 foot radius right over the launch site, and landed within 400 feet of the pad some 75 seconds later. This flight gave Bruce first place in the Leader Division with the only qualified Leader flight.

This year the scale competition was not totally dominated by the Tomahawks as was last year's ECRM. With static-scale points being awarded by Goddard's Herb Honnecker, a number of rockets were DQ'ed for failure to model a specific prototype vehicle. Black Brants and Aerobees modeled as mass production vehicles were DQ'ed. Both Steel City scale contestants — Marvin Lieberman and Alan Stolzenberg — were flying Thor-Deltas. Alan's Thor-Delta lost some flight points when a plastic fin fell off on the way up, and Marvin edged him out by *one point* for Junior second place. Andy Elliott took first place in Junior scale with a Nike-Smoke, built from a Centuri kit. Andy added additional detailing from the Astroscale article in the October 1969 issue of **Model Rocketry.** In the Senior Division George Meese's (AAR) IQSY Tomahawk edged out the Barrowman Team's D-Region Tomahawk when the Barrowman rocket was returned with only minor damage after a recovery system failure. The Barrowman rocket was saved from destruction when it impacted on the top of the judging tent.

Even with 90 contestants, ECRM ran ahead of schedule throughout, and the range was closed by 3 PM. Overall winners were Andy Elliott in the Junior Division with 141 points, Bruce Blackistone in Leader with 117 points, and George Meese, Sr. in the Senior Division with 93 points.



Ira Rosenfeld's ECRM-3 egglofter was recovered by an ECRM-4 crew. The rocket was all there, but the egg had disappeared.



In synchronization with Apollo 13 launch-Doug Plummer's Saturn-V lifts off.

AARM-1 – July 11-12, 1970, Regional Meet sponsored by the Edmonton Rocketry Club, open to all rocketeers, especially those from Alberta, Canada and neighboring areas. Events: Scale, Design Efficiency, Class I Altitude, Parachute Duration, Streamer Duration, and Swift B/G. Site: Edmonton, Canada. Contact: Denis Lufkin, CD AARM-1, 13540 – 126th Street, Edmonton 44, Alberta, Canada.

SPAM-2 – July 12, 1970, Area Meet sponsored by the New Canaan, Connecticut, YMCA Space Pioneers. Contact: YMCA Space Pioneers, 564 South Avenue, New Canaan, Conn. 06840

OCEAN SHORES INVITATIONAL – July 18-19, 1970, open to all rocketeers from the US and Canada, especially from the Northwest. Events: Hawk B/G, Single Payload, Class 1 PD, Parachute Spot Landing, Class 1 Altitude, and Egglofting. Site: Ocean Shores, Washington State. Contact: Jim Worthen, 40-28, Barberry Ct. South, Seattle, Washington 98108.

Southwest Model Rocket Conference – July 23-25, 1970, the second annual conference sponsored by the ARC-Polaris Rocket Club of Portales, New Mexico. Speakers, displays, discussion groups, and a competition will be featured. All rocketeers are invited. Site: Eastern New Mexico University. Fee: $23.00. Contact: SWMRC-MRM, PO Drawer 89, Portales, New Mexico. 88130.

PaNoWAM-1 – July 25, 26, 1970, Pacific Northwest Area Meet, sponsored by the South Seattle Rocket Society. Open to NAR members in the Northwest. Events: Class 2 Altitude, Egg Lofting, Swift B/G, Sparrow B/G, Class I PD, and Open Spot Landing. Site: Boeing/Kent Space Center. Contact: Jess Medina, 15824 43rd Ave., Seattle, Washington 98188.

NARAM-12 – August 16-21, 1970, the 12th National Model Rocket Championships, open to all NAR members. Events: Class 1 Parachute Duration, Design Efficiency, Sparrow B/G, Scale, Swift B/G, Space Systems, Egg Lofting, Open Spot Landing, R&D. Site: Astroworld, Houston, Texas. Contact: by July 6, 1970, Contest Director, Richard Sipes, 5012 60th Ave., Bladensburg, MD 20710.

New Jersey Mini-Convention – September, 1970, the one day long convention will include discussion groups, a flight session, and post flight analysis. Open to all rocketeers. Contact: Mini-Convention, c/o Bob Mullane, 34 Sixth Street, Harrison, New Jersey 07029.

TRI-SEC II – September 11-13, 1970, a regional meet for NAR members from Deleware, Maryland, Pennsylvania, New Jersey, Connecticut, and New York, sponsored by Gemini MRS. Events: Class 0 Altitude, Open Payload, Scale, Eagle B/G, and Class 1 PD. Site: Sand Pits Launch Facility, New Castle, Del. Contest Director: Scott Brown, 204 Deleware St., New Castle, Del. 19720.

MITSEC-1 – September 14, 1970, MIT Section meet open only to section members. Events: Hornet B/G (limited to ¼A engines), Class 1 Streamer Duration if included in new Pink Book (limited to ¼A engines), Class 1 Parachute Duration (limited to ½A engines). Site: MIT Briggs Field, Cambridge, Mass.

WESNAM-2 – October 4, 1970. Area meet open to NAR members from Mass., N.H., and Maine. Events: Hawk B/G, Egg Loft (20 N-sec limit), Class 2 Parachute Duration, Plastic Model (if this event is eliminated from the new "Pink Book", Streamer Spot Landing will be substituted). Site: Bridgewater, Mass. Contact: Trip Barber, MITMRS, MIT Branch PO Box 110, Cambridge, Mass. 02139.

ATTENTION
CONTEST DIRECTORS
Mail notices of your contests at least 90 days in advance for listing in Model Rocketry's "Modroc Calendar":

Modroc Calendar
Box 214
Astor Station
Boston, Mass. 02123

The Experimenter's Notebook:

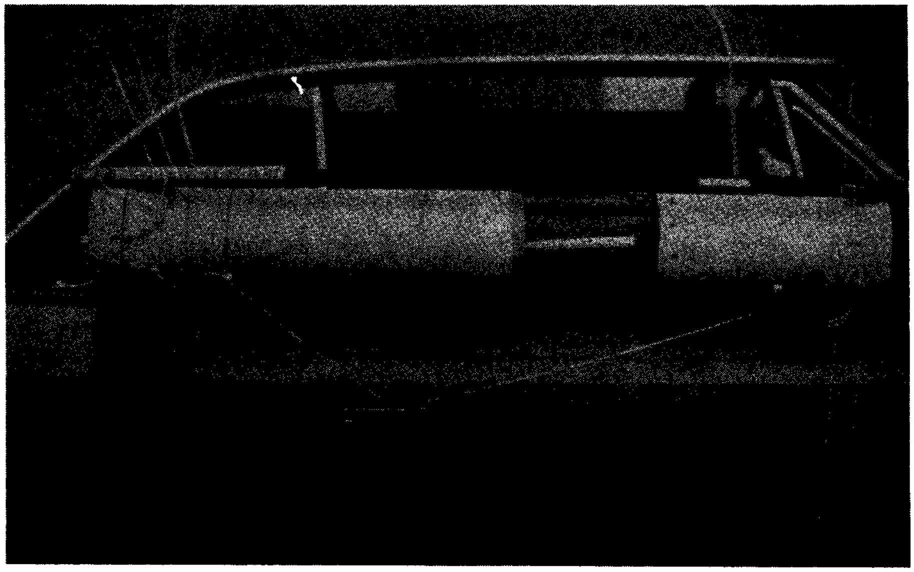
An $11 Wind Tunnel Design

by Forrest Mims

THE STRAP-ON WIND TUNNEL

Lack of a low cost wind tunnel with flow sufficiently fast and laminar to permit the taking of reliable data has posed a serious problem to scientific model rocketry. This edition of *The Experimenter's Notebook* will present an interim solution to the problem, a complete wind tunnel capable of laminar flow at velocities up to about 44 meters/second (90 mph) and costing about $12.00. The secret to the tunnel's low cost is that it is suspended from the side of a moving automobile for test runs. The technique may seem rather crude but as will be shown later can provide fairly accurate measurements as well as save the considerable amount of time and money required for construction of a conventional wind tunnel. As an historical note on the concept, scaled down versions of early aircraft were sometimes tested for aerodynamic soundness by being mounted on top of a moving automobile.

The strap-on wind tunnel is constructed from sheet metal tubing and couplers as



The strap-on wind tunnel attached to the side of a car. Note the clear plexiglas test section.

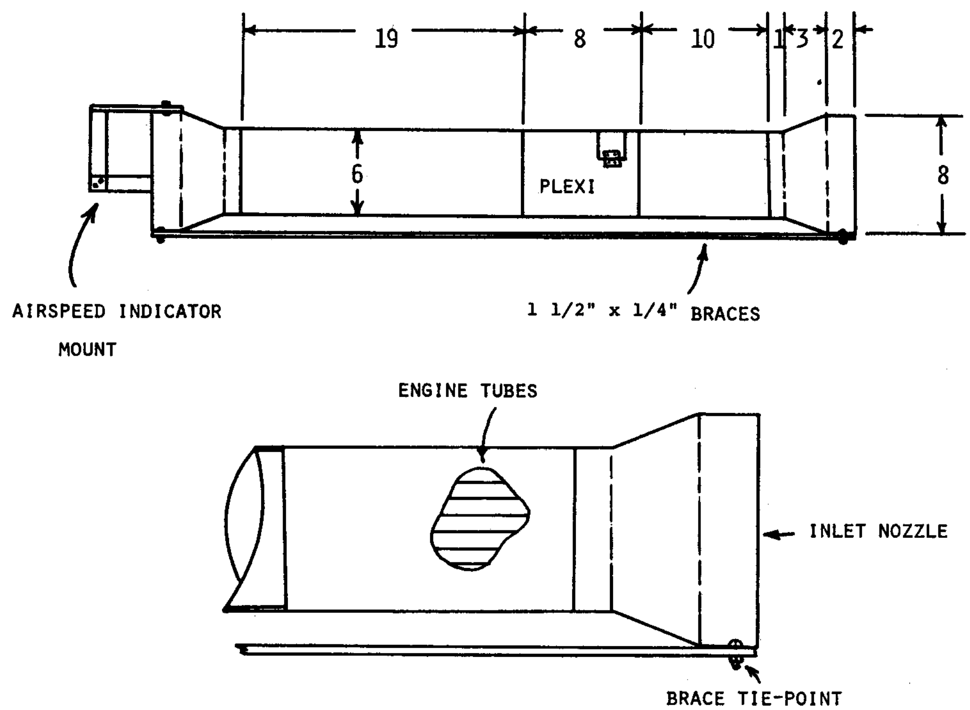


Figure 1: Construction Diagram.

shown in Figure 1. Visual access to the test model is provided by a section of plexiglass tubing. As the plexiglass tubing happens to be the most costly item on the tunnel, some experimenters may wish to discard it in favor of a small plastic covered port hole in the side of an all-metal tunnel.

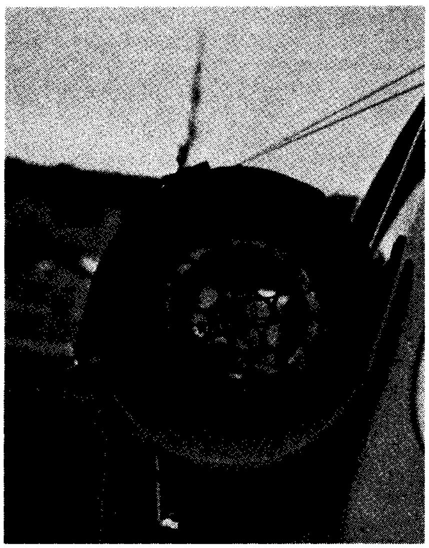
The capability which permits the tunnel velocity to exceed that of the automobile is a result of the inlet and outlet compression nozzles. The inlet nozzle causes the air entering to increase in velocity while the outlet nozzle provides an expansion region permitting the tunnel air stream to return to the ambient flow velocity before exit. The outlet nozzle is important as it greatly reduces the possibility of upstream flow resultant from the interaction of the tunnel stream with the ambient flow. A well known phenomenon in wind tunnel testing is air moving opposite to the normal flow, often a result of downstream vortices and turbulence.

If you aren't fortunate enough to buy the tubing pre-cut to proper length, you will have to use tin snips and perform the job yourself. Always make a guideline with masking tape or felt tip marker before beginning a cut. Use great care and if possible wear heavy work gloves when cutting the tubing as the freshly cut edges are extremely sharp and capable of inflicting deep cuts. When the sheet metal tubing has been cut to size, force a couper on one end of each length and force each remaining end 1-½ inch over the plexiglass tubing.

Mount the three wood braces on the tunnel to provide rigidity. Use small nuts and bolts and affix the braces to the couplers (inlet and outlet nozzles).

In order to discourage turbulence and encourage laminar flow, force sixteen or so model rocket motor mailing tubes into the tunnel mouth just aft of the inlet nozzle. The tubes will straighten the airflow and are equivalent to the baffles and air straighteners of larger professional tunnels. Use of soda straws instead of engine tubes should make the tunnel perform even better.

Several techniques for mounting test models are shown in the drawings. As the



The inlet nozzle compresses the air and thus increases its speed in the test section.

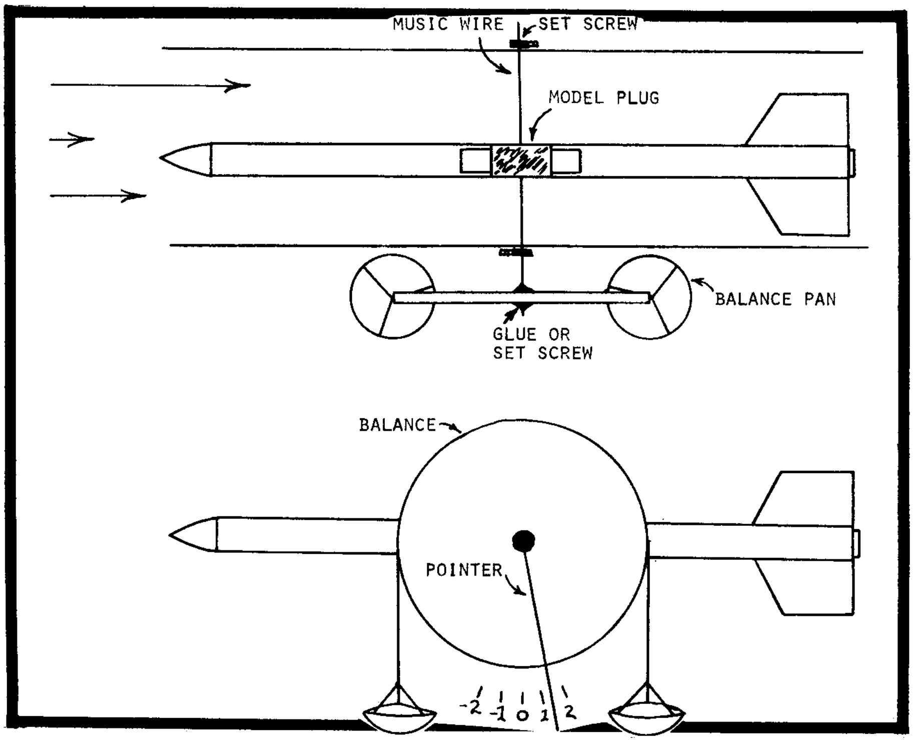


Figure 2: Suggested arrangement of the wind tunnel pan balance.

longitudinal rigidity of the test model is quite important to the gathering of reliable data, pay particular attention to good working procedures when actually installing a model. Once you have constructed your tunnel, you will have plenty of time to develop good model mounting procedures and will not doubt develop a favorite technique.

There are several methods of measuring aerodynamic assymetries and other parameters on a test model. The model you choose will depend in large part on your preference for mounting the model. I have used the tunnel in rather extensive measurements of the force produced by a ram air control guidance system (see **Model Rocketry,** February and March, 1970). Since I needed only to measure a small offset force occurring in but one direction, I chose a very simple balance system consisting of a circular wheel to which were affixed two small balance pans. During test runs, an appropriate amount of weight added to the proper balance pan caused the test model to assume a normal angle of attack and enabled a quick determination of the control mechanism force. Figure 2 shows this type of balance system schematically. Readily available weights are listed in Table 1.

Certain measurements of model rocket parameters might best be obtained by means of a sting mount and strain gauges. The sting mount is the familiar technique whereby a model is projected into the test section of a wind tunnel by means of a streamlined spike inserted into the rear of the model. Strain gauges mounted on the sting provide accurate indications of aerodynamic forces. Such a strain guage system is quite expensive. One I used in a professional tunnel cost over $10,000. Nevertheless, it might be possible for the dedicated experimenter to construct a simple version using homemade strain gauges. A future edition of *The Experimenter's Notebook* will discuss the construction of homemade strain gauges and their application to model rocketry.

Velocity in the Strap-On Wind Tunnel is measured by means of a small electric motor to which a fan blade has been attached. The motor is mounted aft of the test model (but not within the tunnel outlet nozzle). Air rushing by the fan blades spins the propeller causing a small voltage to appear at the motor commutator. In effect, the motor performs as an electrical generator. As shown in Figure 3, a volt meter attached to the motor leads permits voltages produced by the motor at various airspeeds to be recorded.

TABLE 1

Try to borrow or purchase a set of basic laboratory weights for use with the tunnel balance. If weights are not available for loan and if their cost is prohibitive, you can use the following approximate weights for new coins.

Dime — 2.2 gms.	**Penny — 3.1 gms.**
Nickle — 5.0 gms.	**Quarter — 5.7 gms.**

A length of heavy copper wire which corresponds to the weight of a nickel will yield five 1.0 gms. weight when cut into five equal lenghts.

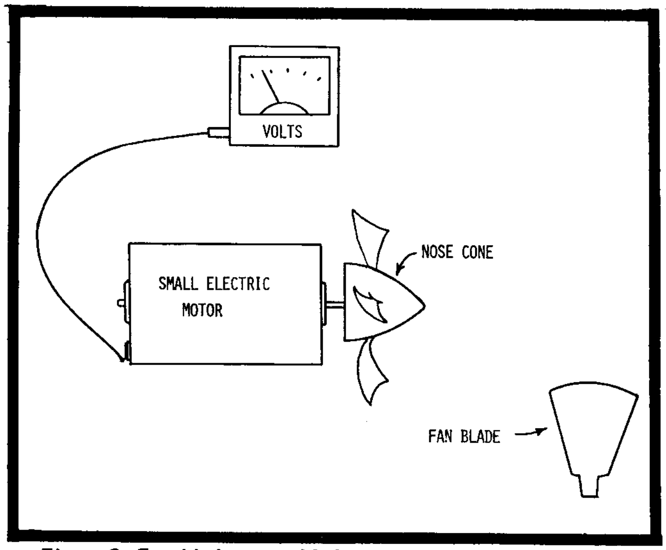


Figure 3: Fan blades are added to a small electric motor and the voltage generated when the windstream turns the shaft indicates the wind speed.

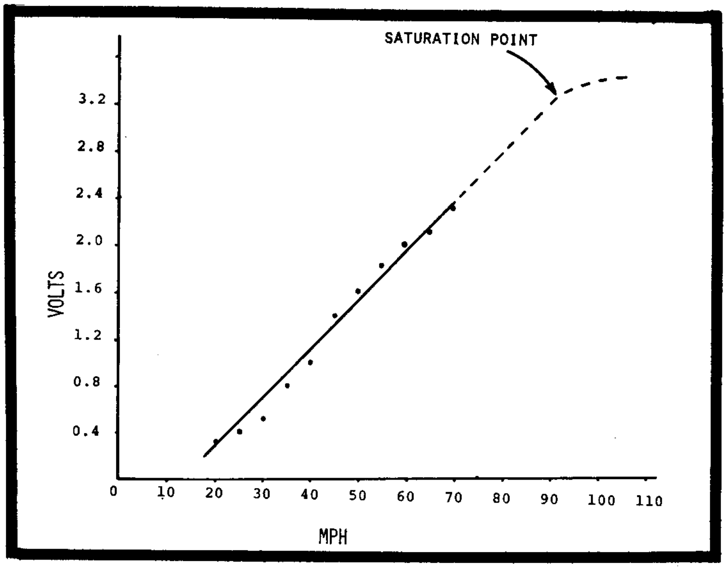


Figure 4: Typical calibration curve for the motor type wind speed indicator. It should be used only in the linear region.

Calibration of the airspeed indicator is accomplished by firmly mounting or holding the assembled unit from the side of a moving automobile. An assistant will be necessary to drive the car while you read off the voltages produced at various speeds. Naturally, for such a calibration technique to be reliable and repeatable, the ambient air should be at rest with little or no indication of a breeze. You will probably find that the motor will begin to turn when the automobile reaches a velocity of about 30 mph. Make a calibration reading every 5 or 10 mph and record them in your notebook (the good researcher keeps a good notebook). Your final calibration will appear similar to the actual one of the original Strap-On Wind Tunnel shown in Figure 4. Since the calibration curve for most motors will be fairly linear over the range of measured airstreams, it is relatively straightforward to extend the line of your curve out to a reasonable velocity (e.g. 100 mph). If your velocity indicator begins to produce a constant voltage even though the automobile velocity is increased, the motor has reached a saturation point, the calibration curve is no longer valid, and a method of operating the motor at a slower rpm (smaller fan blades perhaps) must be found. With the velocity indicator mounted in the tunnel, it will be possible to easily determine tunnel airspeed, even though it will always be faster than the automobile velocity.

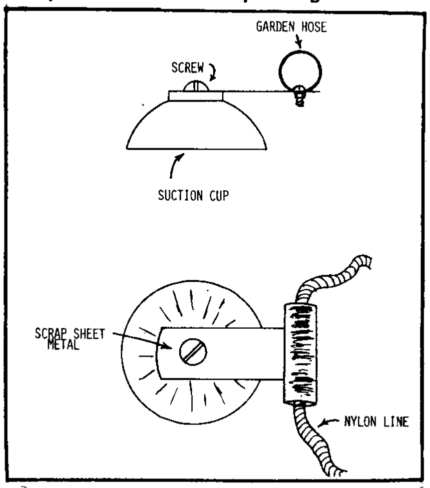


Figure 5: The wind tunnel can be fastened to the car with suction cups.

By the way, some readers may wish to try other types of velocity indicators. The pitot tube or manometer may both be utilized in the Strap-On Wind Tunnel. Your local library will have details on the operation and construction of these devices. Also, the very ancient wind displaced pendulum may be adapted for use in the tunnel. Whichever technique you use, pay good attention to calibration procedures before attempting to take actual data.

As indicated by the name, the Strap-On Wind Tunnel is suspended from the side of an automobile for test runs. Use stout nylon line and at least half a dozen suction cups to insure rigidity. Also, provide at least two fixed tie down points to insure a sturdy mount even though one or more of the suction cups fails. The nylon line is attached to the suction cups as shown in Figure 5. Short lengths of sturdy plastic tubing or discarded garden hose will prevent fraying. The tubing is bolted to rectangles of scrap sheet metal and screwed to the suction cups. (Most suction cups come with a mounting screw). The nylon line is securely tied to pairs of holes drilled into each end of the three braces. For best results, the tunnel's longitudinal axis should be parallel to the ground. Access to the model and balance is provided by the car window. As turbulent air entering the open window may hamper balance measurements, it is a good idea to cover the opening with a layer of thick transparent plastic. The plastic sheet is taped to the inside of the car along the window frame. The axle on which the model is mounted is pushed through the plastic so that measurements may be made from inside the car. If it is necessary to have frequent access to the model, cover only half of the window space with the plastic and keep the window half way closed until model access is required.

You will always need an assistant to drive the automobile when testing models in the Strap-On Wind Tunnel. Never attempt test runs unassisted as the danger to yourself and others on the road is obvious. During your first attempts to take data, you will possibly notice vibration and subsequent oscillation of the balance pan. Such vibration will hamper measurements and can be largely prevented by a better mount of the tunnel to the automobile. By the way, always provide plenty of padding between tunnel and car as the exposed tunnel will almost certainly produce scratches and nicks in the paint job.

Sheet metal tubing for the tunnel is available at air conditioning and heating shops. Plexiglass tubing can be obtained at most plastic distributors. Try a hardware store for the nylon line and suction cups.

Once you have constructed a Strap-On Wind Tunnel, you will be adequately equipped to perform fairly accurate experiments. In a comparison of data obtained from the Strap-On Wind Tunnel and the 2' X 3' US Air Force Academy wind tunnel, force measurements agreed to within 30%. This may sound like a large error factor, but as any wind tunnel engineer will say, the agreement is actually fairly good considering the drastic difference in tunnel configurations.

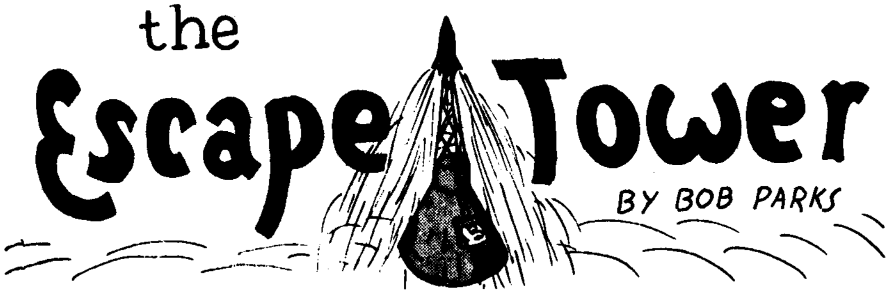
For ideas on measurements to be made in your tunnel, see past issues of **Model Rocketry** and watch future editions of *The Experimenters Notebook.*

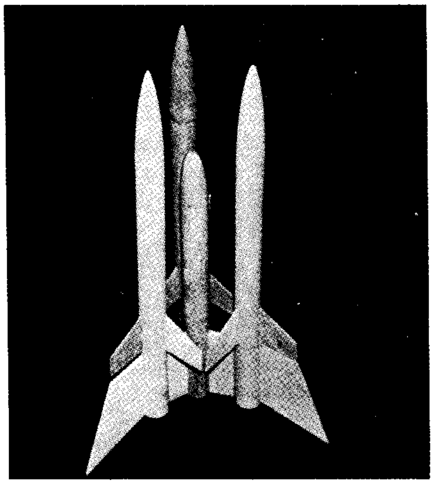
PARTS LIST

10" length – 6" diameter plexiglass tubing
30" length – 6" diameter sheet metal tubing
2 each – 6" to 8" sheet metal couplers
15 ft. – 1-½" X ¼" wood bracing
6 each – suction cups
50 ft. – Nylon Cord
16 each – Rocket Engine Mailing Tubes
1 each – Airstream velocity indicator (see text)
Misc. – Hardware

the Escape Tower

BY BOB PARKS





The Triad

FOR MIRV-LIKE FLIGHTS BUILD THE TRIAD

The Triad is an attempt to break away from the standard WOOSH, pop out a 'chute and land (and slight variations thereof) model rocket flight. Basically it consists of three complete two stage rockets, with the boosters all attached to a central sustainer. The rocket lifts off normally, however at staging it separates, with the three upper stages and the booster all continuing on divergent paths. The result is spectacular, to say the least.

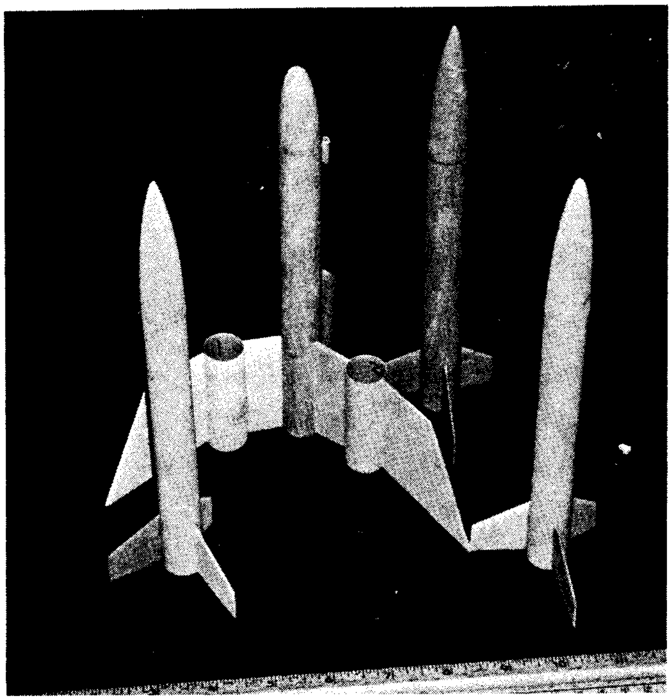
This model just kind of "happened" while I was in the process of designing a four stage sounding rocket. The size and shape of the original was pretty much determined by the spare parts that were around at the time. Since the Barrowman method does not cover the case of parallel body tubes, a guesstimate was made. As it turned out nose weights were required. Anyway, it was time for a flight test. It took about ten minutes to hook up the clip whips, and a somewhat longer time to talk someone into firing it. (It seems that no one wants to get close enough to my experimental rockets to press the button. Maybe I should get a radio control launch system.) All four engines fired, and staging occurred around 300 feet. All of the upper stage engines ignited, however one failed to separate. Both of the others went out of sight. The booster and the stuck upper stage were recovered, and one of the upper stages was located by a random search.

The rocket in the drawings is basically the same as the original. Some changes were made to improve the stability in case one of the engines fails to ignite. There is nothing unusual about the construction of the Triad, but a few comments might be helpful.

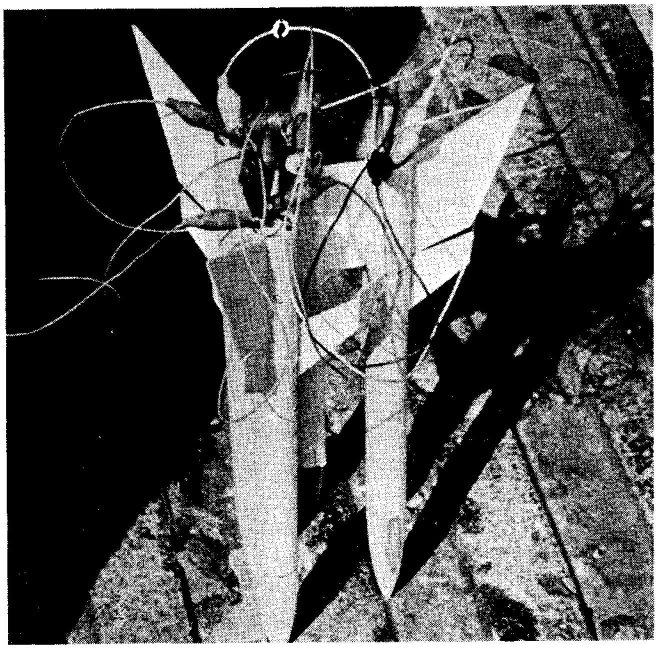
Because of the separation of the engines, there will be greater than normal loads on the fins. The standoffs should be made of at least 3/16" balsa or 3/32" plywood. The booster fins can be 1/16" ply or 3/32" balsa. Extra care should be taken to assure a good glue joint. A generous fillet should be used. One material that I have found helpful for this is Sears Filled Epoxy Cement. It is about as thick as putty, and can be shaped and smoothed while wet by dipping your finger in water and wiping it over the fillet. It can also be sanded when it hardens. The upper stage engine blocks should be positioned so that the engine sticks out about 1/2". I used a parachute on the booster and streamers on the upper stages. Use only 1/4 A and 1/2 A series III engines in the boosters and upper stages. A B4-4 or C6-5 is used in the center. Don't forget the nose weights!

Be very careful when prepping the Triad. A relay ignition system as was shown in the *Wayward Wind* (December '69) will increase the chances of ignition greatly.

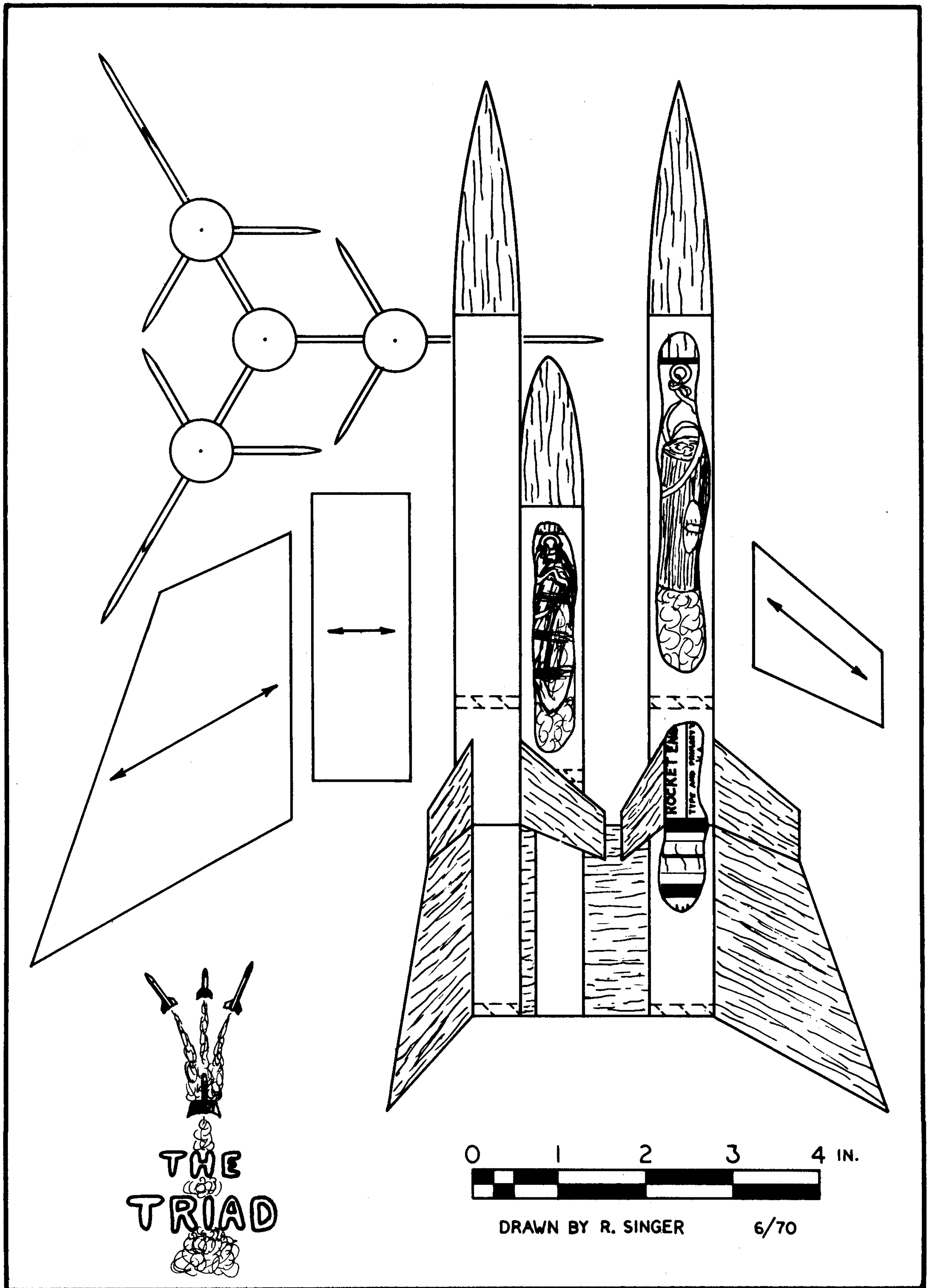
This type of a rocket might actually prove useful for something, so try experimenting. I would be interested to hear of any results. If you do make some modifications, test the model in accordance with part 14 of the new safety code (the Milkie Clause). The Triad could possibly be modified for competition. You could use MPC T-20 tube, put a payload in each section, and fly in open payload. The only problem is whether you use the sum of the altitudes or the average. And then you could fly Quadrathon in one flight. . . .

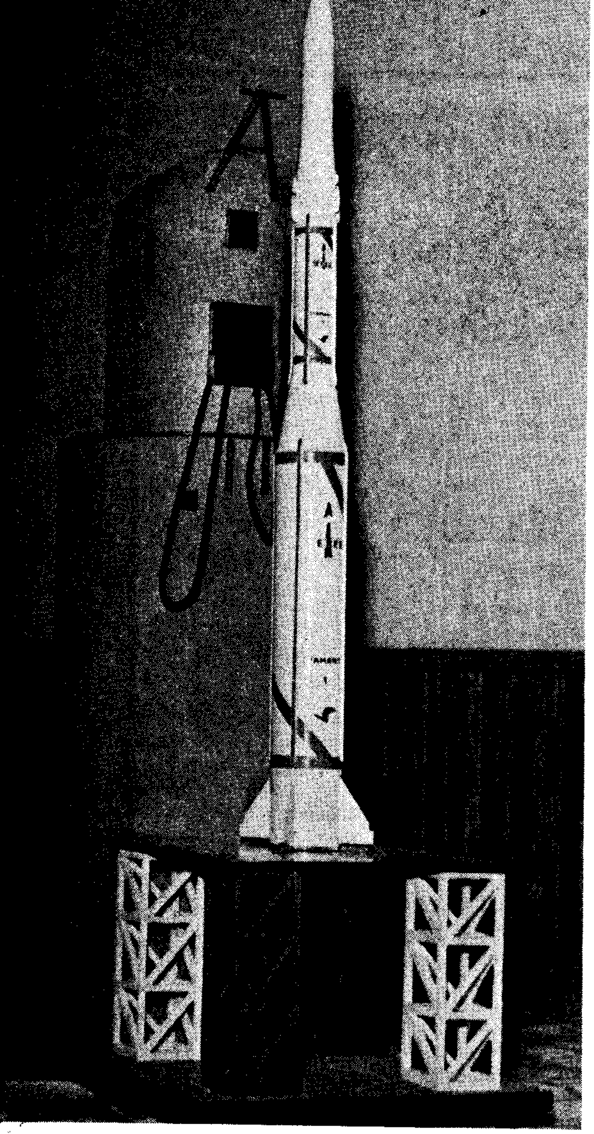


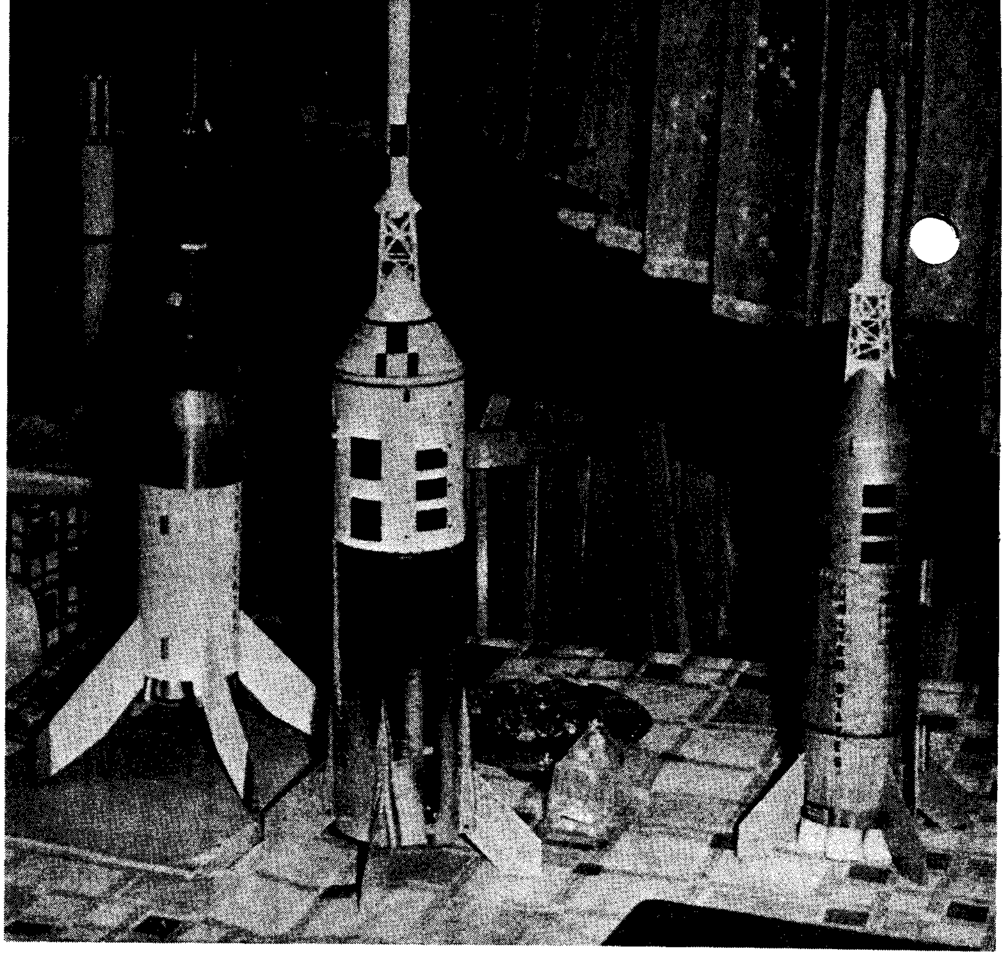
The Triad before prepping



How not to wire a cluster. I couldn't find anywhere to hook up the micro-clips so I didn't fire it. Note that it stands up either right side up or upside down. Very nice for installing ignitors.


THE
TRIAD
0 1 2 3 4 IN.
DRAWN BY R. SINGER 6/70





Scale models were quite popular at this Czechoslovakian competition. At left is A. Klein's scale model Diamant complete with launch tower. This highly detailed model, powered by a single Adast engine, took second place in scale. Above are the Little Joe's flown. At left is Karel Urban's th scale Little Joe I which took 6th place overall. The center model is P. Bares' Little Joe II, buil‹ ..om the Centuri scale model kit. To the right is the first place winner, O. Saffek's Little Joe II. Note the tremendous amount of hand detail on this model.

Czech Competition

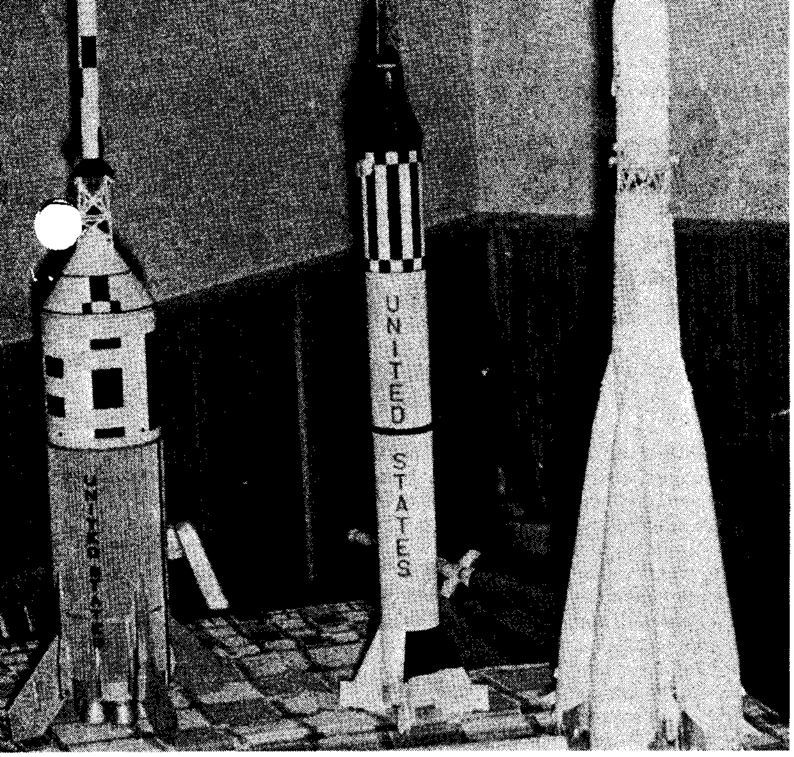
Photos and Text by J. Divis

On the 21st of March, 1970 a contest named "Cena Slovenskeho Raja" opened in Spisska Nova Ves in the center of the Tatras mountain range. When we arrived at Spisska Nova Ves we found ourselves in the middle of winter. On the airport, where all the models were launched, was 40 cm of snow, but the 50 participants from Czechslovakia did their best in heavy conditions.

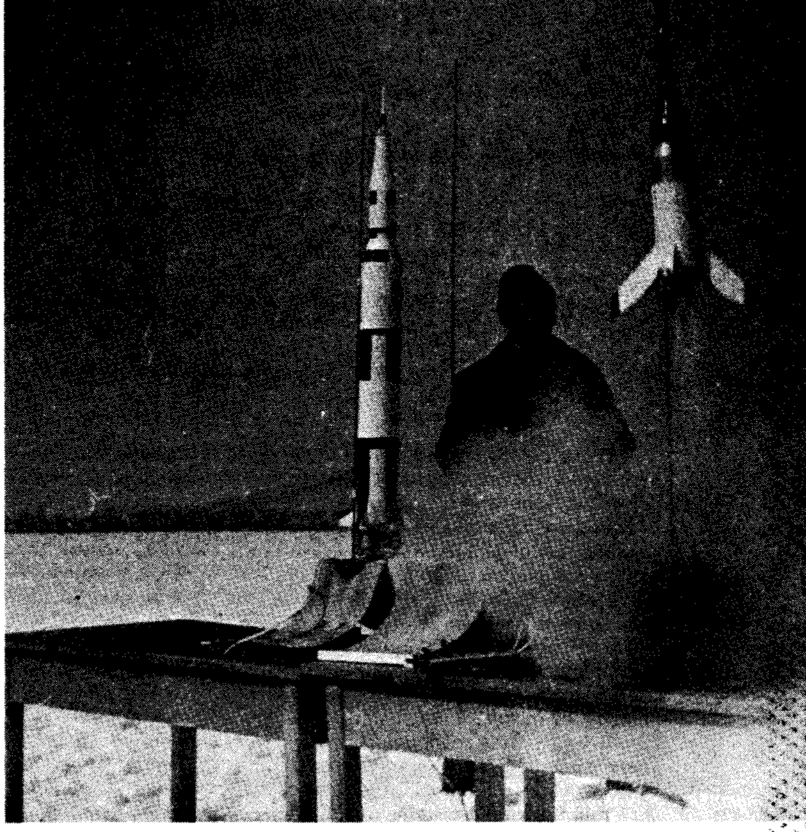
There was very bad weather and a 10 to 15 meter per second wind on the first day. Boost/gliders were not able to be flown in this weather, and the best parachutes were flying 3 to 5 kilometers from the airport. Recovery of the parachute models was hindered since it was difficult to find them in the deep snow.

On the second day of the contest we had very sunny weather with only 1 to 2 meter per second winds – just what we like. B/G's were on the program again in ideal weather conditions. Following that was the most interesting part of the contest – scale models. Saffek took first with a Little Joe II powered by 7 Adast engines. The second place model was a Diamant powered by a single Adast engine. The model, complete with a scale launcher, was constructed by A. Klein. My own Little Joe II, which was ahead of Saffek's on the static scale judging, took third place. I had planned to launch the model with 7 Adast 10 newton-second engines, but it was over the weight limit and I could only use 4 engines. Only three ignited, and the model fell down from 10 meters, but thanks to the snow there was no damage.

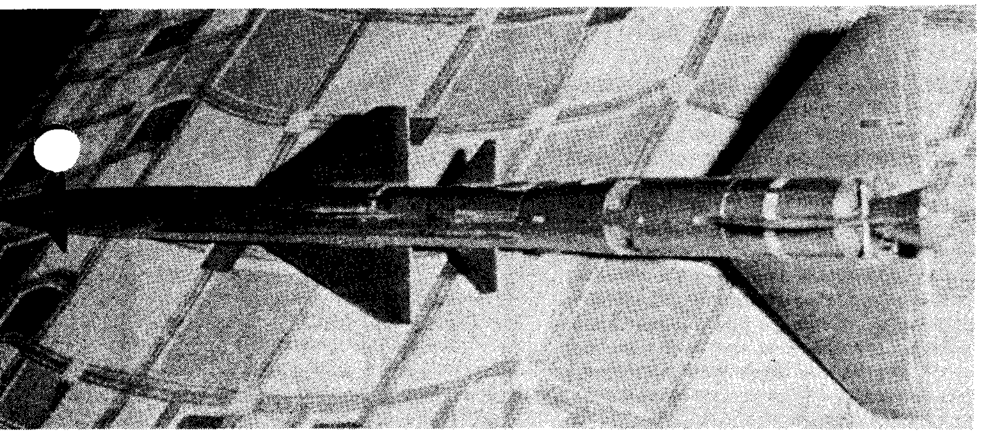
Mr. Brehovy shows an interesting and unı way of launching a boost/glider.



J. Divis' scale Little Joe II (left) has excellent detailing on the tower and body corrugations. The Mercury-Redstone, also built by J. Divis, took third place in the competition. The Vostok, by Mr. Jerabek, is modeled in the USSR's white display markings. Note the detail of the interstage adapter.



On the left is a 1/125 scale Saturn-V. To the right is Karel Urban's 1/28 scale Little Joe I. The LJI took 6th place after a successful flight.



This scale model of the USSR Guideline was constructed by Mr. Jelmek.

Parachute Duration

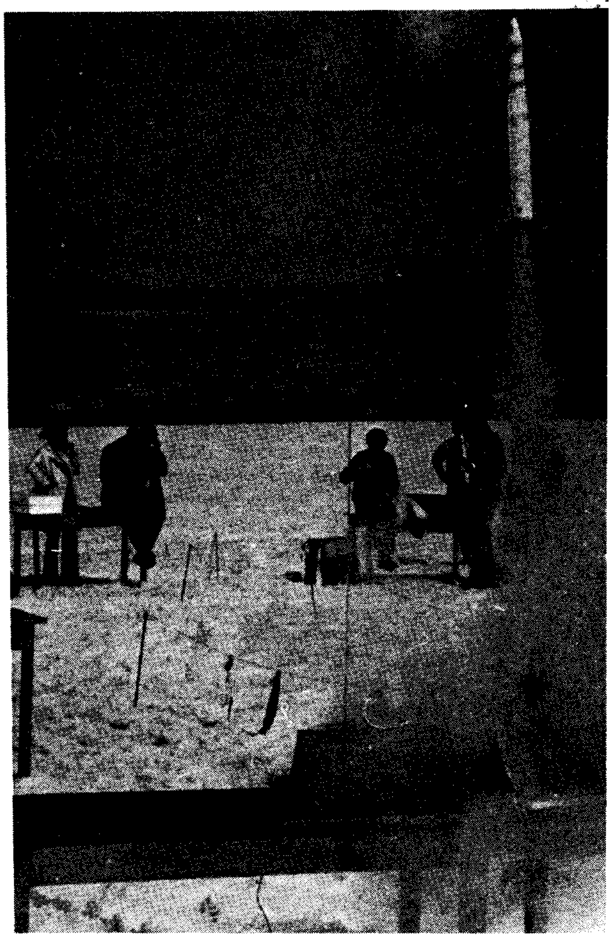
1st	F. Spacek	RMK Prague	185 sec.
2nd	O. Saffek	RMK Prague	155 sec.
3rd	P. Kyncl	RMK Prague	150 sec.

Boost/Glide Duration

1st	V. Repa	Bratislava	145 sec.
2nd	O. Saffek	RMK Prague	134 sec.
3rd	M. Horvath	Bratislava	130 sec.

Scale

1st	O. Saffek	RMK Prague	Little Joe II	813 points
2nd	A. Klein	———	Diamant	757 points
3rd	J. Divis	RMK Prague	Mercury-Redstone	737 points



Mr. Smaha's scale Thor-Delta lifts off. This is a large scale model, powered by 7 Adast 10 N-sec motors.

Breathing Rate Sensor for Your "Foxmitter"

by Richard Fox

This article is the second in a new series on model rocket telemetry. Last month I described a transmitter designed for use as a payload in model rockets. The transmitter was capable of sending a steady beacon tone to the ground, for use in locating the rocket. This article describes a plug-in-module for the transmitter which allows the transmission of either the heartbeat or the breathing rate of an on-board biological specimen, or the transmission of the spin rate of the rocket.

Since the start of model rocketry, ants, bees, crickets, flies, grasshoppers, mice, gerbils, and even fish have experienced the "thrill" of a ride in a model rocket. Many of these "scientifically designed" biological payload flights were complete successes, meaning that the passenger survived. Some researchers even went so far as to test their specimen by running it through a maze before and after the flight. It is doubtful whether any of these tests of the *structural strength* of the passenger while in the air, or of its resistance to harassment by the experimenter while lost in a maze on the ground produced any useful scientific data. (Some of it certainly is memorable, but not useful.)

The sensor described in this article provides, for the first time in model rocketry, a means of obtaining *legitimate scientific data* on the effects of model rocket flight on small animals.

Breathing Rate Sensor

The breathing rates sensor measures the expansion and contraction of the chest of the specimen, and converts the data into an audio tone which rises and falls with each breath. The sensor consists of a light source pointed at the belly of the subject, and a light sensor pointed at the reflection of the light on the belly. With each breath, the belly moves towards and away from the light sensor, and the received intensity rises and falls. This change in intensity causes the resistance of the sensor to rise and fall, and that change in resistance is converted to a rising and falling audio tone by the transmitter circuitry. Figure 1 shows a typical arrangement of the sensor and light source.

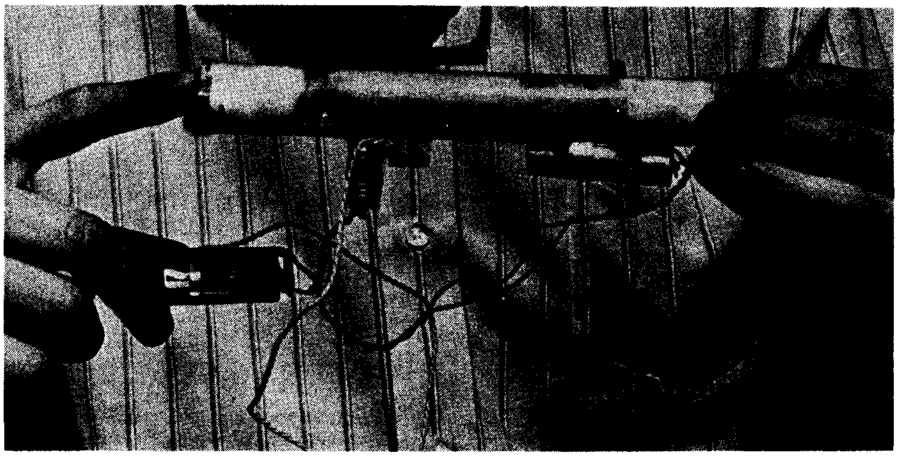
The sensor works on practically all vertebrates, and it has been tested in flight on mice. A separate article next month describes the vehicle used in the tests, and the arrangement of the instrumentation in the payload capsule.

Heart-Beat Sensor

The principle of operation of the heart-beat sensor is simple. A light source is placed next to the body of the subject, and a light sensor is placed on the opposite side of the subject (see Figure 2). The light transmitted through the subject will vary with each heart beat. You can see the effect on yourself by placing yourself in a dark room and shining a pen-light at your thumb-nail. Watch the back side of your thumb, which will glow red, and you will notice that there is a slight throbbing of the light traveling through the thumb with each heart-beat. This variation in light is sufficient to be detected by a photo-cell.

The effect is present on many parts of the human body, and all vertebrates show it to some degree, but the reader will have to experiment with the animal he has in mind, in order to find the best location for the sensor. In general, the area should be about ¼ inch thick, and free of hair.

The principle behind the heart-beat sensor is not new. It was first mentioned to me during a discussion group on instrumentation held at the M.I.T. Convention in April of 1970. A quick library search revealed that a heart-beat transmitter for humans, which operated on this principle,



A mouse is loaded into the payload capsule.

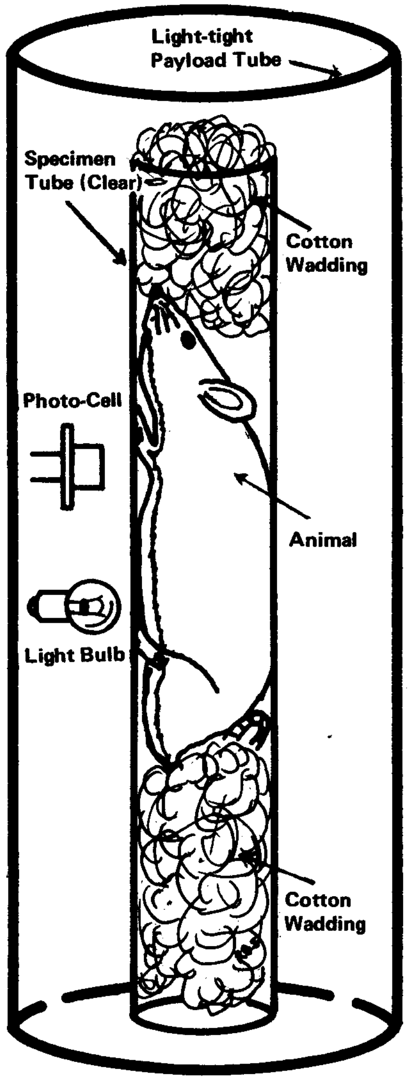


Figure 1: Breathing Rate Sensor. Light reflects from the belly of the animal and is detected by the photo-cell.

was in use in 1959[1]. Foreign literature on the subject dates back to 1950.

The circuitry used in the heart-beat module of the Foxmitter converts the light transmitted through the body of the specimen to an audio tone which is transmitted to the ground and received on a Citizen's Band channel. The frequency of the tone fluctuates with each heart beat, there-by providing a direct read-out of the specimen's heart rate.

Spin-Rate Sensor

The module which is capable of measuring the heart-beat and breathing rate of an animal is also capable of measuring the spin-rate of a rocket. A spin-rate sensor measures the number of revolutions which a rocket makes while it is in flight. This information can be used to eliminate spin as a source of blurr in Camroc aerial photographs, or it can be used in experiments studying the effect of spin on rocket performance. In fact, theory indicates that the spin-rate of a rocket with canted fins should be linearly proportional to the velocity of the rocket. This use of the spin-rate sensor might be able to tell you how fast your rocket is going. The sensor also might be used to evaluate the suitability of parachute designs.

The sensor measures the spin-rate of the rocket by indicating what part of the sky it is looking at. The section of the sky which contains the sun is much brighter than the section of the sky opposite the sun. If the spin-rate sensor is pointed out the side of the payload section, it will produce a high frequency audio tone when it is pointing at the sun, and a low frequency audio tone when it is pointing away from the sun. As the rocket spins in flight, the tone received on the ground will rise and fall with each revolution of the rocket. The signal transmitted in flight can be tape recorded, and the number of rises and falls per second counted to obtain the spin rate.

[1] G. A. Harten and A. K. Koroncal, A Transistor Cardiotachometer Philips Technical Review, Vol. 21, no. 10, p. 304-308.

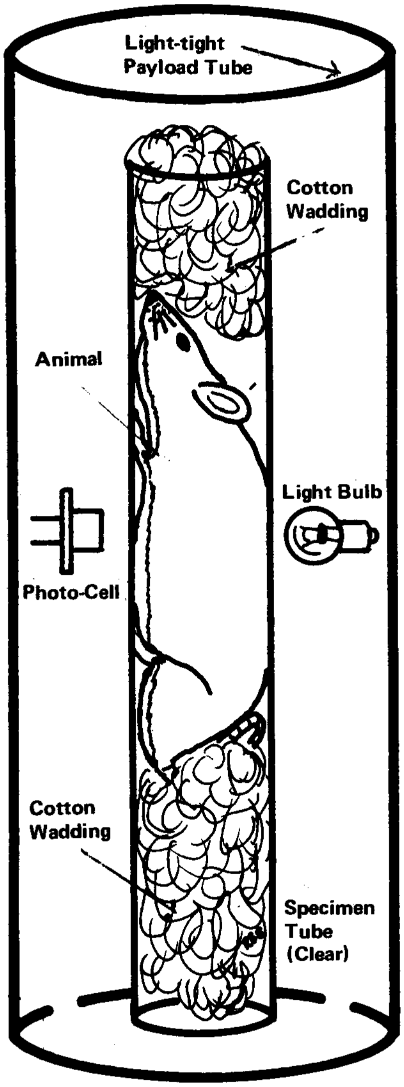


Figure 2: Heart Beat Sensor. Light transmitted by a thin section of skin is modulated by the heart beat.

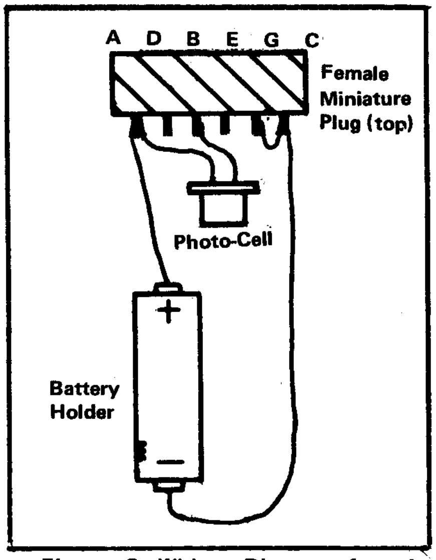
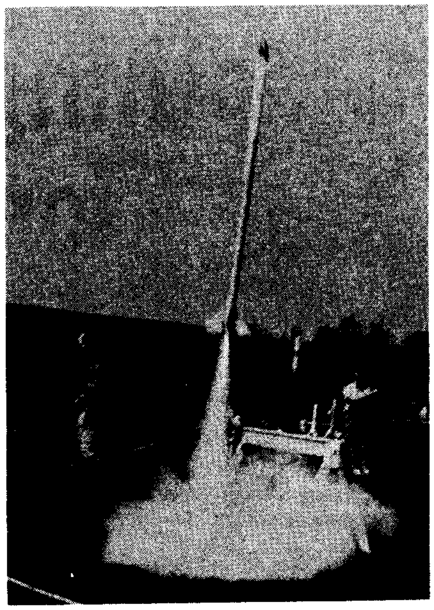


Figure 3: Wiring Diagram for the Breathing Rate, Heart Beat, and Spin-Rate Sensors.



Liftoff of one of the first "Foxmitter" mouse flights.

Construction

The electrical wiring of the heart-beat breathing rate spin-rate sensor is shown in Figure 3. (These three sensors are electrically identical; they differ only in their application.) Figure 4 shows a schematic diagram of the sensor.

The location of parts on the sensor module is not critical, and the wires leading to the photo-cell may be as long as neces-

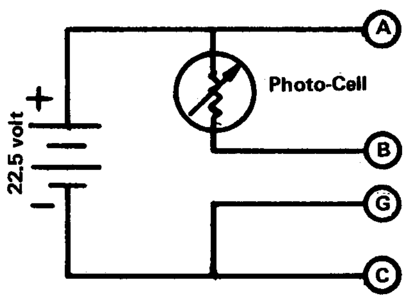


Figure 4: Sensor Schematic Diagram.

PARTS LIST

Photo-cell	**Clairex model CL703**
Female miniature connector	**R/C Craft connector model #19K61, 6 pin $.49 from Ace R/C Higginsville, Mo. add $.50 for handling**
Battery Holder for 22.5 volt battery	**Keystone #50053 available from Lafayette as #34E50053**
Light Bulb	**type 112 1.2 volt**
Battery	**1.5 volt penlight,**

A complete kit of parts for this sensor module is available from Astro-Communications, 3 Coleridge Place, Pittsburgh, Pa. 15201 for only $2.75.

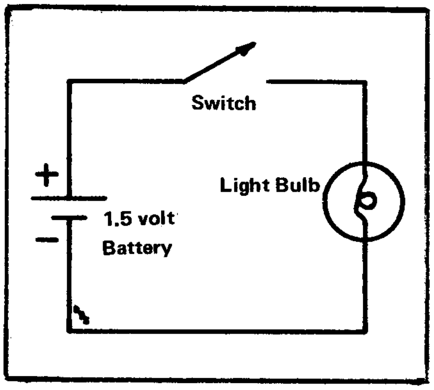


Figure 5: Light Source Schematic Diagram.

sary. Use care in soldering the wires to the photo-cell. Excessive heat may damage it.

The heart-beat sensor and the breathing rate sensor require light sources. Figure 5 shows the construction of a simple light source.

Flight

The signal from the Foxmitter has been received over a mile from the launch site while the rocket is in the air. If you have taken the time to build the transmitter, put a little effort into obtaining an expensive walkie-talkie or CB receiver. Walkie-talkies which cost less than $15.00 each do not have the sensitivity to pick up distant signals.

The heart-beat sensor and breathing rate sensor should be positioned with care. A slip-shod set-up will result in nothing but a steady tone being received during the flight. Test the sensor out on the ground before using it in flight.

The tone produced by the photo-cell circuitry increases in frequency as the strength of the light falling on it increases. The spin-rate sensor tone can be pushed into the supersonic frequency range if the photo-cell is pointed directly at the sun. If the tone of your spin-rate sensor is too high, mask off part of the photo-cell.

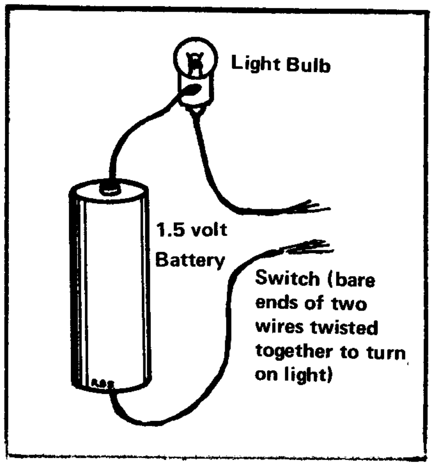


Figure 6: Light Source Wiring Diagram.

Next month's article will present an improved temperature sensor, and some unusual uses for it.

Astroscale Data.....

Korolev RD-107 "VOSTOK"

by G. Harry Stine

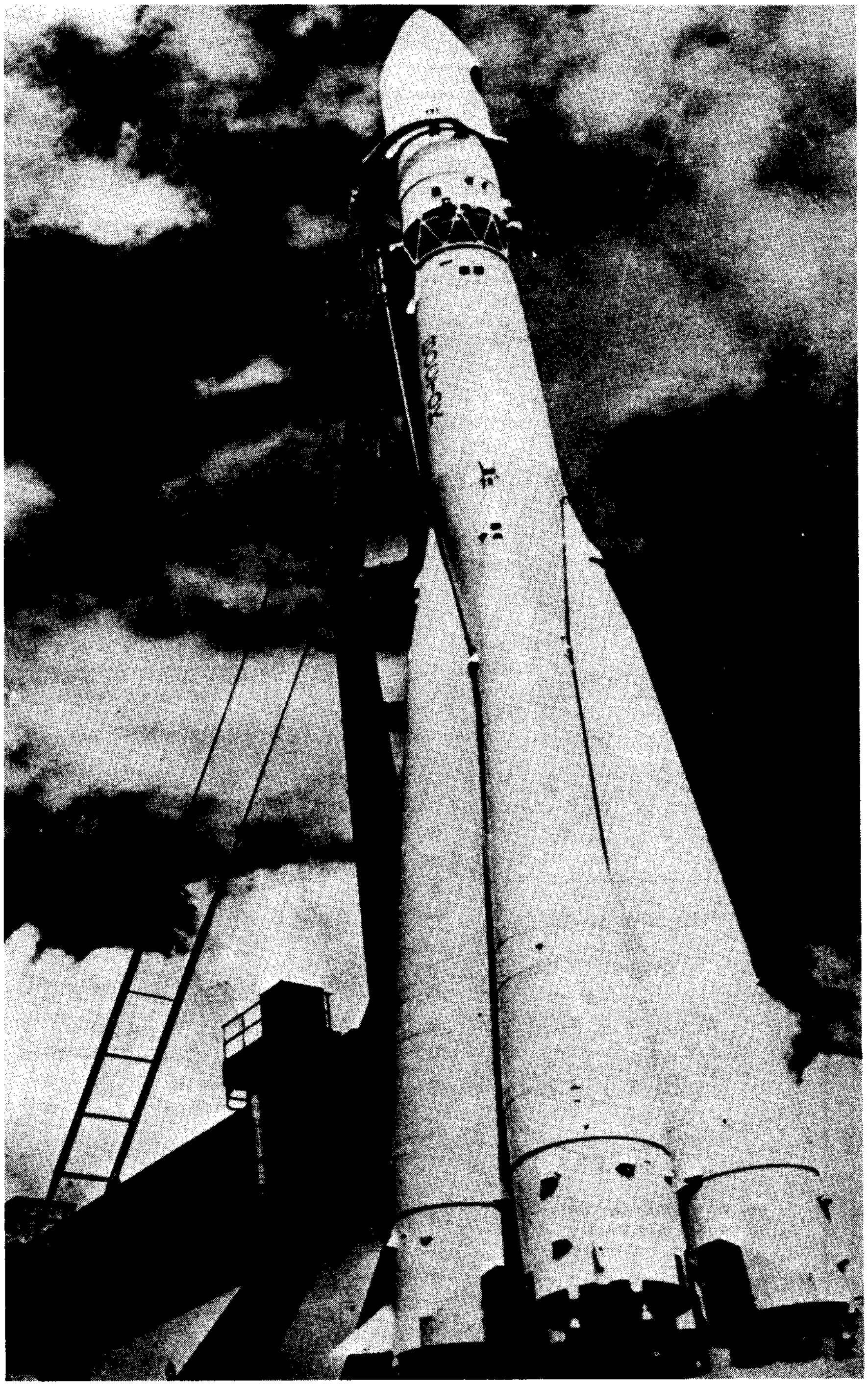
During the first decade of the Space Age, the space program of the U.S.S.R. was carried out primarily with the use of the RD-107 carrier rocket ("raketi nositeli") which was reportedly designed and developed by the bureau headed by Sergei Pavlovich Korolev.

Known to the outside world during his lifetime only as the "chief designer" or "chief constructor" of the Soviet space systems, Korolev's official title was "laboratory head" of the Institute of Machine Sciences of the U.S.S.R. Academy of Sciences. According to information released from the U.S.S.R., Korolev was responsible for space vehicles ranging from Sputnik 1 to Voskhod 2, including the carrier rockets which launched them. Following the accepted practice of the Soviet aeronautical industry where the designation of an airplane includes the name of the chief of the design bureau responsible for the design, we have taken the liberty of extending this tradition into Soviet astronautics by assigning Korolev's name to the RD-107 carrier rocket for which he was responsible.

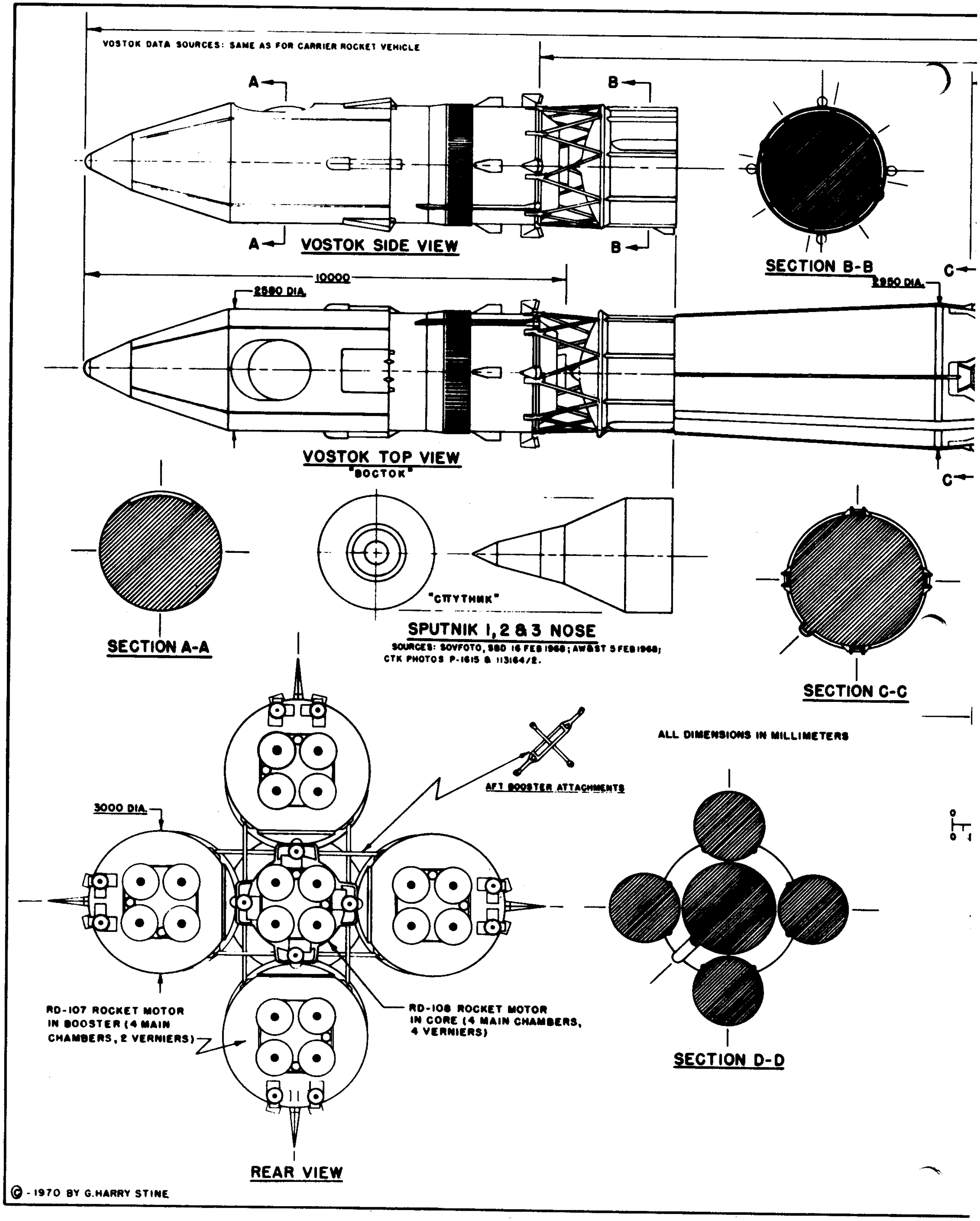
As well as Soviet astronautical history can be pieced together by the author, Charles S. Sheldon, Donald J. Ritchie, Norman L. Baker, and other Soviet astro-history specialists in the western

(Special note: Normally, all information bearing the copyrighted label **AstroScale** *is drawn from accurate and reliable sources such as factory drawings or actual measurements of the prototype; it is also checked and re-checked to insure technical and historic accuracy. However, in the case of the AstroScale data for the Korolev RD-107, information had to be pieced together over a period of nearly three years from diverse sources, and it has not been possible to obtain from the U.S.S.R. an authenticated drawing of the RD-107 which matches what can be seen on the many available photographs of the vehicle. The one exception has been a Soviet drawing re-printed in the American magazine,* **Aviation Week & Space Technology,** *which proved to be inaccurate upon close examination.*

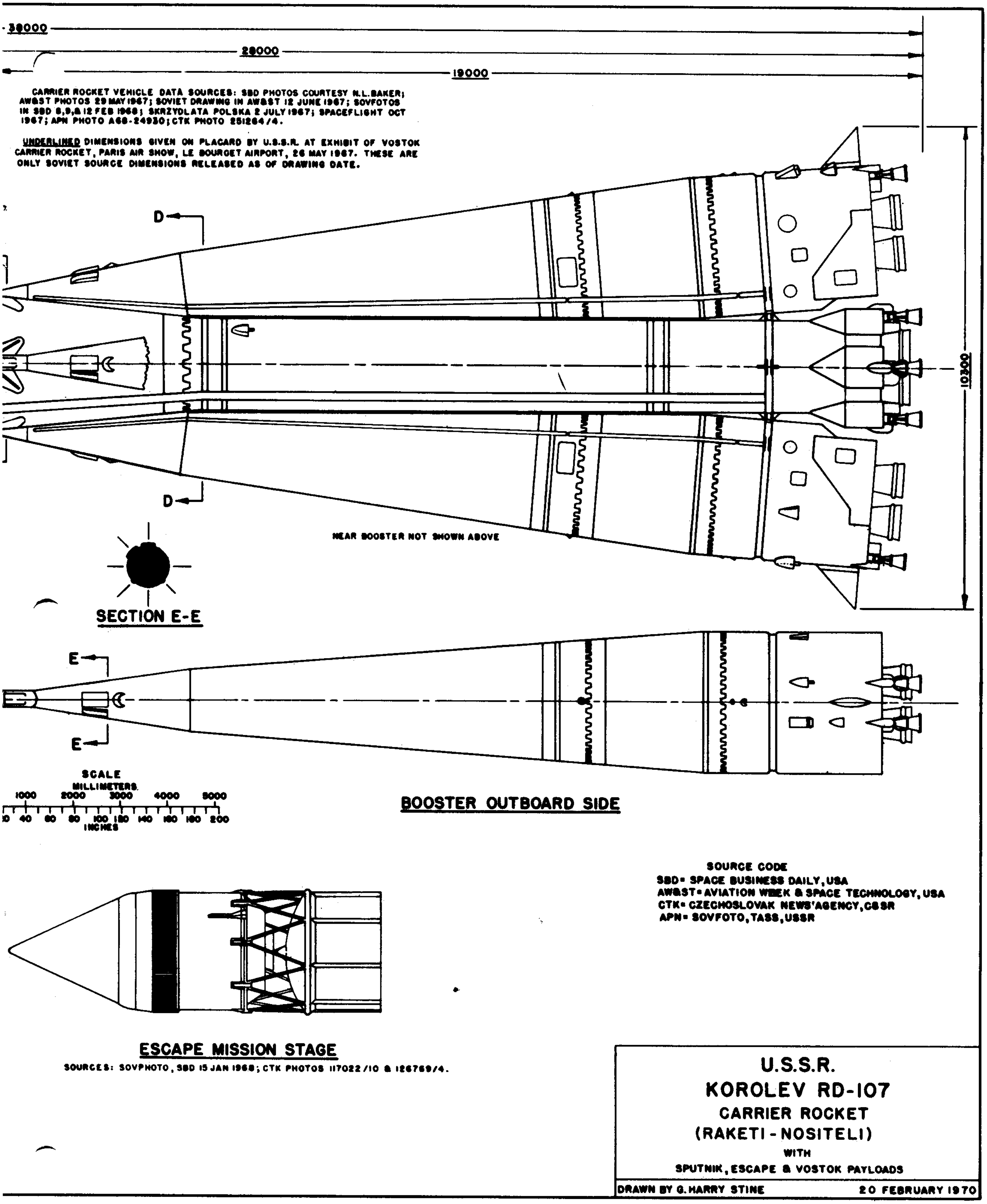
Therefore, all data for the AstroScale drawing accompanying this text was obtained from published photographs through the use of accepted principles of photographic interpretation of the sort normally used to obtain scale information on aircraft from photographs. The AstroScale drawing can therefore be considered to be the most accurate published to date, yet it must remain provisional until official sources in the U.S.S.R. release accurate, dimensioned drawings of the RD-107.)



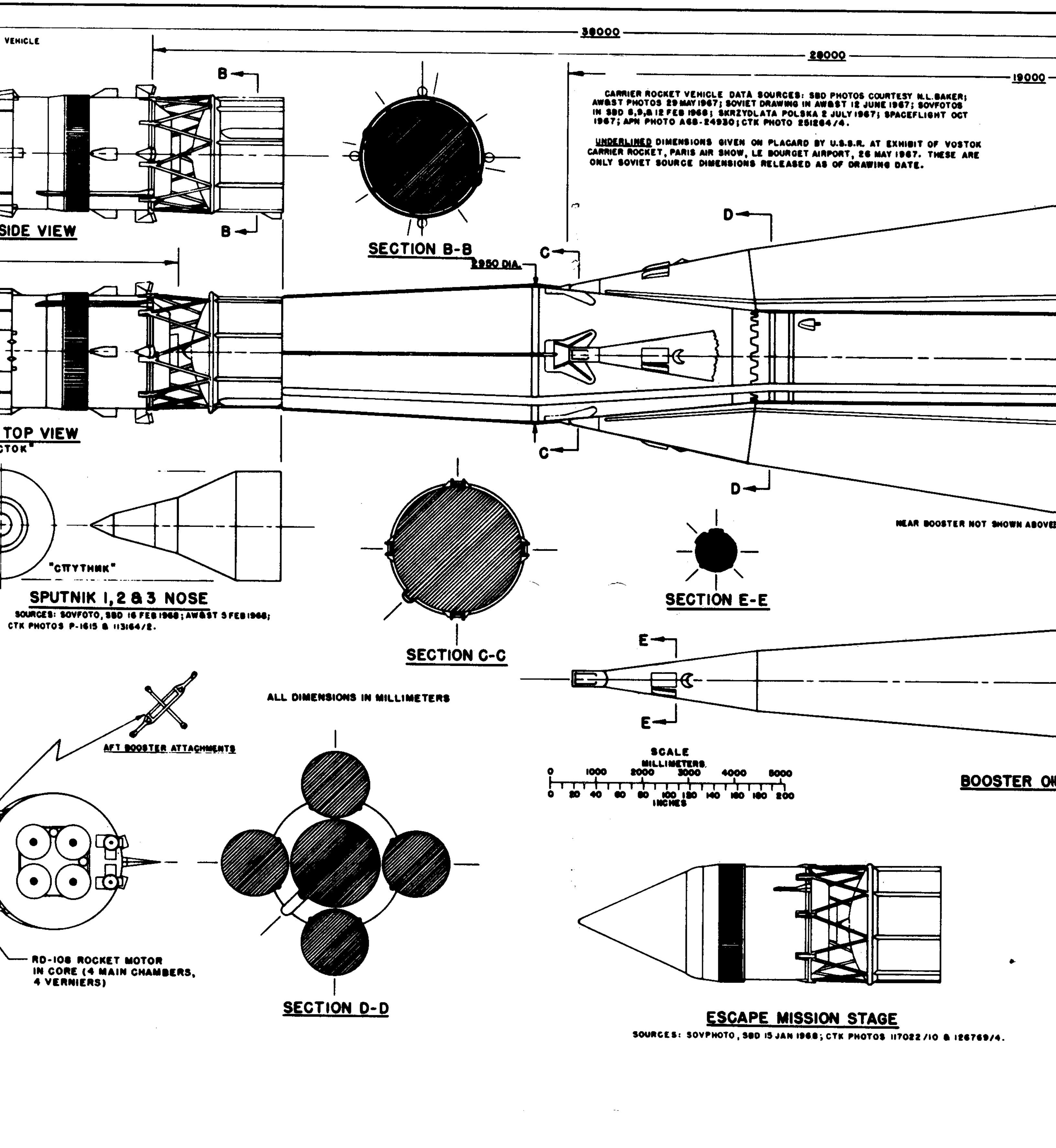
The Korolev RD-107 Vostok carrier rocket on display in front of the cosmonautics pavillion in Moscow, USSR. This is the same vehicle displayed at Paris in May-June, 1967, however the "BOCTOK" lettering has been changed from horizontal in Paris to vertical for the Moscow display. (CTK-TASS Photo 251264/4 dated 29 August 1967.)



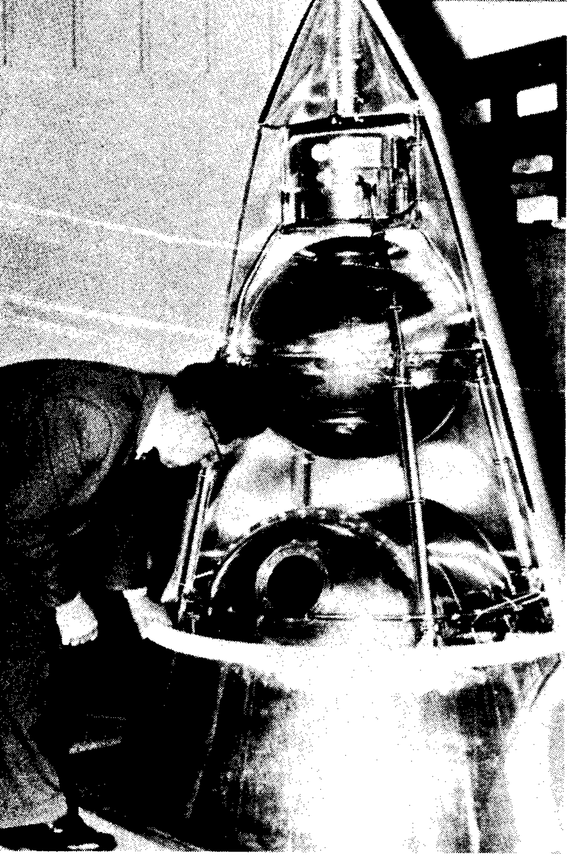
VOSTOK DATA SOURCES: SAME AS FOR CARRIER ROCKET VEHICLE
A
A
B
B
VOSTOK SIDE VIEW
SECTION B-B
10000
2580 DIA.
2950 DIA.
C
C
VOSTOK TOP VIEW
"ВОСТОК"
SECTION A-A
"СПУТНИК"
SPUTNIK 1, 2 & 3 NOSE
SOURCES: SOVFOTO, SBD 16 FEB 1968; AW&ST 5 FEB 1968;
CTK PHOTOS P-1615 & 113164/2.
SECTION C-C
ALL DIMENSIONS IN MILLIMETERS
AFT BOOSTER ATTACHMENTS
3000 DIA.
RD-107 ROCKET MOTOR
IN BOOSTER (4 MAIN
CHAMBERS, 2 VERNIERS)
RD-108 ROCKET MOTOR
IN CORE (4 MAIN CHAMBERS,
4 VERNIERS)
SECTION D-D
REAR VIEW
© - 1970 BY G.HARRY STINE

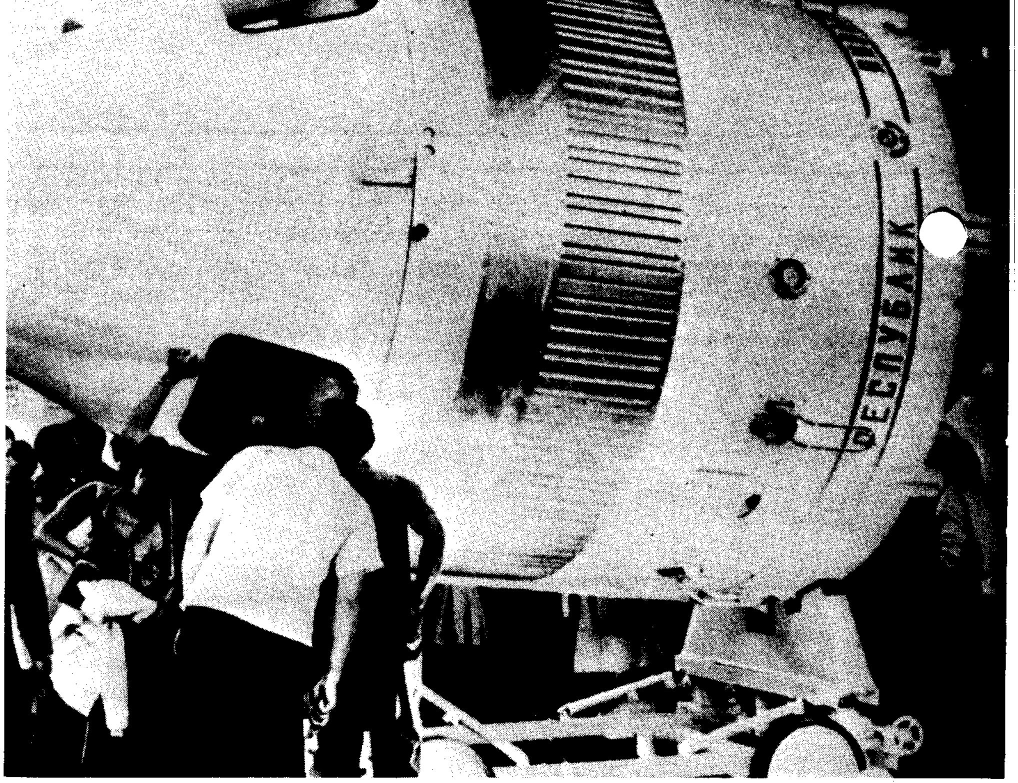


38000
28000
19000
CARRIER ROCKET VEHICLE DATA SOURCES: SBD PHOTOS COURTESY N.L.BAKER; AW&ST PHOTOS 29 MAY 1967; SOVIET DRAWING IN AW&ST 12 JUNE 1967; SOVFOTOS IN SBD 8,9,& 12 FEB 1968; SKRZYDLATA POLSKA 2 JULY 1967; SPACEFLIGHT OCT 1967; APN PHOTO A68-24930; CTK PHOTO 251264/4.
UNDERLINED DIMENSIONS GIVEN ON PLACARD BY U.S.S.R. AT EXHIBIT OF VOSTOK CARRIER ROCKET, PARIS AIR SHOW, LE BOURGET AIRPORT, 26 MAY 1967. THESE ARE ONLY SOVIET SOURCE DIMENSIONS RELEASED AS OF DRAWING DATE.
D
D
10300
NEAR BOOSTER NOT SHOWN ABOVE
SECTION E-E
E
E
SCALE
MILLIMETERS
1000 2000 3000 4000 5000
0 40 60 80 100 120 140 160 180 200
INCHES
BOOSTER OUTBOARD SIDE
SOURCE CODE
SBD= SPACE BUSINESS DAILY, USA
AW&ST= AVIATION WEEK & SPACE TECHNOLOGY, USA
CTK= CZECHOSLOVAK NEWS AGENCY, CSSR
APN= SOVFOTO, TASS, USSR
ESCAPE MISSION STAGE
SOURCES: SOVPHOTO, SBD 15 JAN 1968; CTK PHOTOS 117022/10 & 126769/4.
U.S.S.R.
KOROLEV RD-107
CARRIER ROCKET
(RAKETI-NOSITELI)
WITH
SPUTNIK, ESCAPE & VOSTOK PAYLOADS
DRAWN BY G. HARRY STINE
20 FEBRUARY 1970



VEHICLE
38000
28000
19000
CARRIER ROCKET VEHICLE DATA SOURCES: SBD PHOTOS COURTESY N.L.BAKER; AW&ST PHOTOS 29 MAY 1967; SOVIET DRAWING IN AW&ST 12 JUNE 1967; SOVFOTOS IN SBD 8,9,& 12 FEB 1968; SKRZYDLATA POLSKA 2 JULY 1967; SPACEFLIGHT OCT 1967; APN PHOTO A68-24930; CTK PHOTO 251264/4.
UNDERLINED DIMENSIONS GIVEN ON PLACARD BY U.S.S.R. AT EXHIBIT OF VOSTOK CARRIER ROCKET, PARIS AIR SHOW, LE BOURGET AIRPORT, 26 MAY 1967. THESE ARE ONLY SOVIET SOURCE DIMENSIONS RELEASED AS OF DRAWING DATE.
SIDE VIEW
SECTION B-B
2950 DIA.
TOP VIEW
"CПУТНИК"
SPUTNIK 1,2 & 3 NOSE
SOURCES: SOVFOTO, SBD 16 FEB 1968; AW&ST 5 FEB 1968; CTK PHOTOS P-1615 & 113164/2.
SECTION C-C
NEAR BOOSTER NOT SHOWN ABOVE
SECTION E-E
ALL DIMENSIONS IN MILLIMETERS
AFT BOOSTER ATTACHMENTS
SCALE
MILLIMETERS
INCHES
BOOSTER
RD-108 ROCKET MOTOR IN CORE (4 MAIN CHAMBERS, 4 VERNIERS)
SECTION D-D
ESCAPE MISSION STAGE
SOURCES: SOVPHOTO, SBD 15 JAN 1968; CTK PHOTOS 117022/10 & 126769/4.





(Left) Nose shroud and internal arrangement of the Sputnik-2 payload. (CTK Photo P-1615.)
(Above) The RD-119 powered escape mission stage used on the early Luna shots during display in Paris, France on September 6, 1961. (CTK Photo by V. Lomez, 126769/4.)

world, the Soviets began immediately following World War II to develop an ICBM capable of lofting a nuclear warhead. By 1952-1954, it became obvious to both the USSR and the USA that thermonuclear warheads were feasible; the USA proceeded with the paper design of very large Atlas ICBM's capable of carrying the then-large thermonuclear warheads, but opted not to construct the large design-study versions of the Atlas. On the other hand, the USSR apparently decided to proceed with the very large launch vehicle required. The result was the SS-6 ICBM, oft-times referred to in the West as the T-3 ICBM.

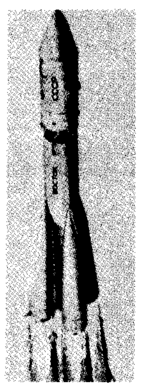
The engineering parsimony of Korolev and his designers is obvious in the RD-107, which is the SS-6 ICBM. Since a large vehicle was required, take-off thrust had to be large. An excellent, reliable liquid propellant thrust chamber already existed, probably developed from the Peenemunde A4 engine, capable of delivering 25 tons of thrust but operating at a chamber pressure of 885 pounds-per-square inch – roughly three times that of the A4 chamber. Korolev and his designers clustered four such chambers together and, since turbo-pump technology was fairly well established in contrast to the technology necessary to build very large combustion chambers, designed one large turbo-pump to supply the 4-chamber cluster. The result was the RD-107 rocket engine with 4 main chambers and 2 smaller vernier chambers all driven from the same turbo-pump; the RD-108 rocket engine is the same 4 main chambers plus 4 vernier chambers supplied from a single large turbo-pump.

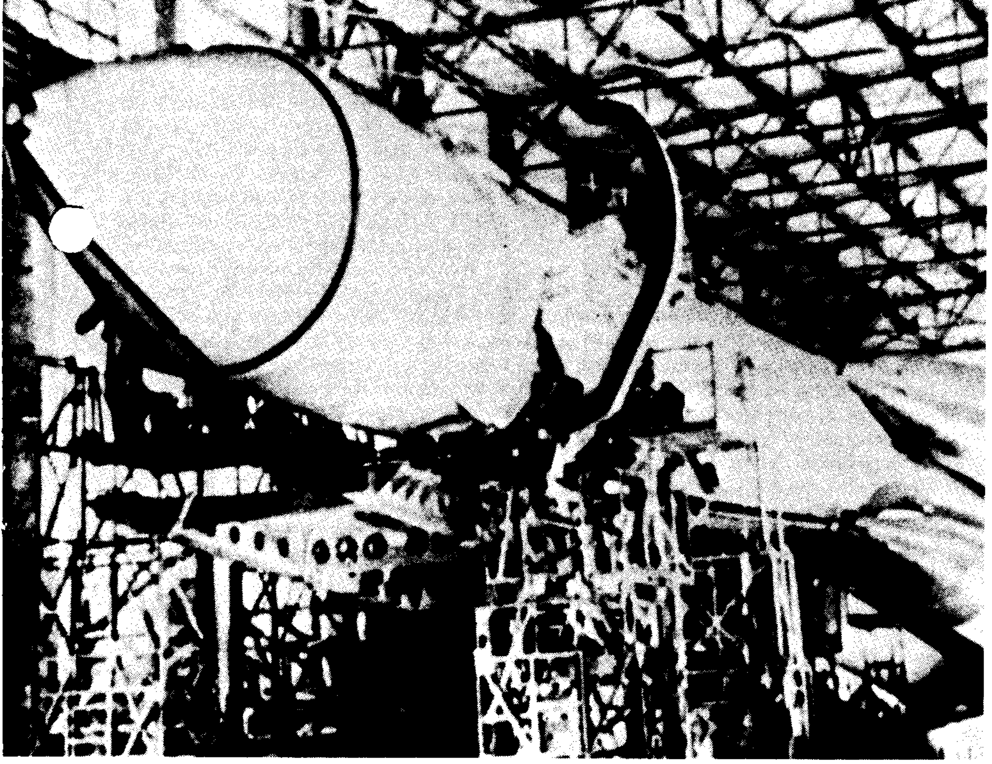
With much the same rationale as used by USA designers for the Atlas ICBM, Korolev utilized true parallel staging for the SS-6, clustering 4 strap-on boosters around a central core vehicle. Thus, the reliability problems involved in the development and proving of air-starts on upper stages of series-staged rockets were avoided. And very high liftoff thrust was made available.

The SS-6 was designed for horizontal assembly and transportation. The original concept was to deploy the SS-6 on railway sidings along the Trans-Siberian Railway. The SS-6 was thus designed as a very robust vehicle capable of withstanding the shocks and accelerations of horizontal rail transport.

The first launchings of the SS-6 took place in the Spring of 1957 and were tracked by the long-range radars of the USAF located at Samsun, Turkey for this specific purpose. The launch site for these SS-6 tests and for subsequent RD-107 flights is the Soviet "Cape Kennedy" called Baykonyr Cosmodrome. No actual locations of Baykonyr Cosmodrome have been revealed at the time of this writing, but it can be assumed that it is located somewhere near the town of Baykonyr north-east of the Aral Sea in Kazakstan at or near the terminus of the railway line which serves this region.

With the large SS-6 booster rocket available, Soviet scientists of the USSR Academy of Sciences had at their disposal an orbital launch vehicle capable of lofting a payload of about 3,000 pounds into a near-earth orbit. On October 4, 1957, an SS-6 did perform the orbiting task, inserting Sputnik-1 into orbit in addition to the 8,000-pound central core of the SS-6 which was separated from the 184-pound spherical satellite. The entire SS-6 – called the RD-107 in its space booster role – including the 4 strap-on boosters was used, and Soviet color motion picture films are available showing the Sputnik-1 launch with the RD-107 in this





(Above) Horizontal assembly and checkout of the RD-107 Vostok carrier rocket in the hanger at Baykonyr Cosmodrome. (CTK Photo 252396/3.)

(Right) The RD-119 escape mission stage of the RD-107 vehicle on display at the pavillion of the USSR Academy of Sciences, Moscow in 1959. (CTK Photo 117022/10.)

configuration. Admittedly, the RD-107 was operating at far below rated orbital payload with Sputnik-1; this was apparently done deliberately since the flight also probably served as a reliability test flight. Readers' attention is called to the fact that the USA did precisely the same thing with Atlas-10B.

Less than a month later, on November 3, 1957, an RD-107 was used to launch the 1,120-pound Sputnik-2 into orbit carrying the live dog Laika, giving it the distinction of being the first astro-biological test flight. Because the orbital re-entry problem had not been completely solved at that time, no attempt was made to recover Laika who was deliberately poisoned in flight long before Sputnik-2 re-entered the earth's atmosphere and burned up.

The third space flight with an RD-107 booster was made from Baykonyr on May 15, 1958 then Sputnik-3 weighing 2,925 pounds was orbited.

By itself, the RD-107 was limited to orbiting about 3000 pounds. However, an upper stage powered by the RD-119 rocket engine was added by Korolev in early 1959. This RD-107A version lobbed the 3245-pound Luna-1 capsule toward the moon and into solar orbit. This was followed by numerous RD-107A flights sending roughly 600 to 3000 pounds to escape velocity. With the addition of the RD-119 upper stage, the orbital weight-lifting capability of the booster was raised to about 10,400 pounds.

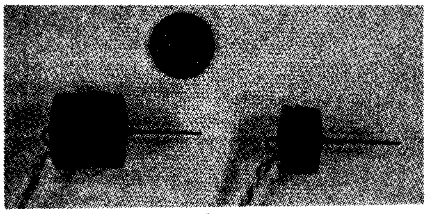
Following six unmanned orbital flights to test the Vostok spacecraft, Soviet Air Force Major Yuri A. Gagarin rode the Vostok-1 on a one-orbit manned flight on April 12, 1961 to become the first man to orbit the earth.

Further flight data on the RD-107 is detailed in the flight history.

SEE NEXT MONTH'S MODEL ROCKETRY
FOR MORE VOSTOK SCALE DATA

New Product Notes

Ace Radio Control has introduced a new, lightweight radio control receiver suitable for use in Hawk and Condor boost/gliders. The Commander DE Gem receiver measures 1-1/16" x 1–1/2" x 1/2". Weight of the bare receiver (without servo or batteries) is 0.5 ounce. Operation is on 2.4 to 3.0 ounces. The receiver is available in two versions. The 12K3 version, for use with the Bentert actuator only is priced at $30.75. The 12K2 version, for use with the Adams type actuator, is priced at $51.50.



Bentert Actuators

The 12K3 model, when used with the ultra-light Bentert actuator and two silver oxide cells of the M76 series, weighs in complete at less than 1.25 ounces.

Both receivers are available on all of the 27 MHz frequencies except 27,255. All of these receivers work well with the Ace pulse transmitter.

Ace Radio Control is also the US distributor of the Bentert actuator used in Doug Malewicki's Radio Controlled Boost/Glider printed in the August 1969 issue of **Model Rocketry.** A complete catalog of Ace products is available for $1.00, refundable on your first order, from Ace RC, Box 111R, Higginsville, Mo. 64037.

MPC has announced the release of a flying model rocket launch pad engineered with authenticity and performance in mind. The tripod base and gantry of this lunar lectric launch pad are molded in durable girder-style plastic, and features a 22 inch base span. A special tilt adjustment and wind direction indicator are located in one of the legs. A metal exhaust deflector plate and ceramic core which insures non-shorting and safe launching of all rockets are located atop the tripod. Snap-in electrical terminals and self supporting micro clips are attached to the gantry. The total pad height is 15 inches plus a 3 foot steel launch rod with adjustable launch lug support. The MPC Lunar Lectric Launch Pad sells for $5.00.

Also new from MPC is the Lunar Lectric Launch Controller for firing flying model rockets. The controller is pistol shaped for sure grip comfort and maximum control. A safety key, continuity light in recessed launch button assures deliberate launchings. A fifteen foot firing line also insures accident proof launchings, and a ten foot power cord with a car lighter adapter makes the presence of a supervising adult a mere necessity. The MPC Lunar Lectric Launch Controller sells for $5.00.

Spacemasters Enterprises (PO Box 424MR, Willoughby, Ohio 44094) has announced that they will be adding the MPC line of rocket kits to their mail order line. They are offering a complete mail order service on all MPC and SAI rocket kits including the new MPC "Vostok." In addition Hawk, Revell, Aurora, AMT, Countdown, Lindberg, and Monogram plastic model kits will be available from Spacemasters Enterprises. A complete catalog is available for only 25¢.

The Lectro-Space-Development Company has introduced their first model rocket kit – the "LECTRO 1." The kit, standing over 18 inches tall, will retail for $1.50. Including a plastic nose cone, 0.920 OD body, and airfoiled fins, the kit is the first to offer both 18mm and 21mm engine mounts, allowing A, B, a,d C engines of all manufacturers to be used with the "Lectro 1." The kit will include a 12 inch diameter, ¼ mil thick parachute.

Lectro-Space-Development will soon introduce a "Blinky" capsule, consisting of a transistorized light flasher, a 3" transparent nose cone, separate battery compartment, nose block, screw eye, and snap swivel. The complete kit, fitting their 0.920 OD body tube, is expected to retail for $5.95.

Other products now in the planning stages are a complete line of single and multi-staged kits, body tubes, plastic nose cones, plastic and monocoted balsa fins, parachutes, remote control launch panel, and a tri-pod launch pad with ceramic blast deflector. A catalog is available from Lectro-Space-Development Company, Dept. R, 912 Columbus Ave., Bay City, Michigan 48706.

"Analysis of Apollo 8 Photography and Visual Observations," a recent publication containing photographs of scientific interest, has been issued by the National Aeronautics and Space Administration.

Photography on the 1968 Moon-circling mission was designed to furnish data on approach topography and landmarks for the early Apollo landings; scientific merit and roughness of areas for possible follow-on Apollo landings; and the broad structure and characteristics of the lunar surface.

The 336-page book, NASA SP-201, contains black and white photographs and it may be purchased for $4.25 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.20402.

NEWS NOTES

Model Rockety Goes Underground

Model rocketry has recently taken a bold step into uncharted territory: "underground" magazines. The March issue of the *Whole Earth Catalog* carried a half-page article giving a general introduction to the field of model rocketry. Surely this is a first in advancing the art.

A quote from the Catalog describes itself: "The Whole Earth Catalog functions as an evaluation and access device. With it, the user should know better what is worth getting and where and how to do the getting . . . An item is listed in the Catalog if it is deemed: 1) Useful as a tool, 2) Relevant to independent education, 3) high quality or low cost, 4) Easily available by mail."

That all sounds pretty grand, but it's true. Leafing through a copy of the Catalog, especially the Fall or Spring issue, will reveal that many wondrous, unusual and very useful things fit the above criteria. It is a great "tool" for anyone interested in do-it-yourself technology. A person with a scientific bent can find information sources on many unusual technological activities capable of being handled by individuals. However, at face value, the Catalog looks like a very strange Hippy newspaper, what with the diverse and sometimes radical opinions expressed.

I saw this as an opportunity to make the subject of model rocketry available to a segment of the population apparently previously untouched by it: the young adult "turned off" by what he considers the boring Establishment. The article briefly described the NAR, **Model Rocketry** Magazine, Estes Industries and Centuri Engineering in an attempt to give an overall view of model rocketry.

Hopefully this will attract some dynamic and creative people to direct their energies constructively in the worthwhile activity of model rocketry. Maybe we will see a few of these people someday at a NARAM Research and Development contest!

The Whole Earth Catalog, with a circulation of about 30,000 is available at most large news stands, or by subscription from:

Whole Earth Catalog
558 Santa Cruz Avenue
Menlo Park, California 94025

($8 yearly, or $4 Spring or Fall issue, $1 for January, March, July or September issue.)

— Melville G. Boyd

Experimental Parachute Duration Results

Written By: Douglas Malewicki
Experiments Conducted By: Carl Kratzer

Last month we presented the *theoretical* Parachute Duration graph. That data was based on an assumed aerodynamic drag coefficient of $C_D = 1.0$ in conjunction with the reference surface area (S) of the chute while laying flat. The Parachute Duration Efficiency graph presented this month shows you how *real* parachutes differ from the theoretical guess.

History

The basic graph for theoretical $C_D = 1.0$ parachute duration was part of my 1967 NARAM-9 R & D entry. Until the advent of **Model Rocketry** magazine, the means for providing such information to the mass of technically oriented rocketeers was nil – meaning it all collected dust in the corner.

Model Rocketry magazine has been in existence since late 1968 so you may question why we waited *until* mid-1970 to publish the data. The answer is that I really didn't feel it could be as simple as $C_D = 1.0$ and wanted to see some *good* experimental results before I could justify any confidence in the graph. Here is where things became quite interesting!

At NARAM-11 (August '69) I spent some time talking with Bruce Blackistone about what I was after. Bruce had entered an R & D report on clustered chute flight characteristics, which in my eyes made him the sole expert parachute experimentalist in the NAR. After NARAM, I decobwebbed the 1967 graph, made a copy for Bruce, and had it in the mail to him along with some specific test requests on August 18, 1969.

On September 21, 1969 I *finally* got a reply from "Intergalactic Exports, Inc." Once the envelope was opened, it turned out to really be from Bruce. His letter started out with a friendly KILL! MAIM! DESTROY! directed to unfortunate me. It turns out I was one of the R & D judges who disqualified Bruce's report on cluster chutes for complete lack of neatness and crude preparation. His plea, claiming that out of his entire beloved female flock only one could type and she was sick at the time, was deemed not quite satisfactory by the judges.

Anyway, after similar entertaining digressions Bruce plunged into the business at hand by stating that his scientific research interests centered on clustered parachutes and that I should *really* be talking to Carl Kratzer. Bruce's two page summary of Carl's efforts during the previous two years convinced me to request Carl's assistance.

I had a letter in the mail to Carl on September 22, 1969. Unfortunately, it was directed to his home address in Bethesda, Maryland. The letter was forwarded to him (via subsonic 4th class snail) at Cornell University in Ithaca, New York and by the time I received a reply it was October 18, 1969.

Carl was very enthusiastic about the project and suggested we conduct our tests where Bruce ran his – at the Cole Fieldhouse at the University of Maryland. This fieldhouse has a 100 foot high indoor ceiling which would be a great asset in minimizing errors incurred by having to test outdoors in winds or indoors in the usual gym with shorter available drop test heights.

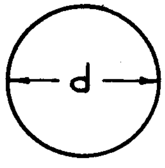
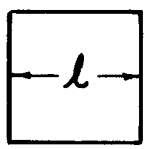
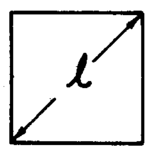
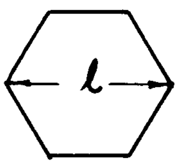
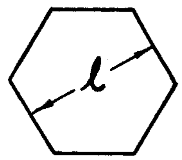
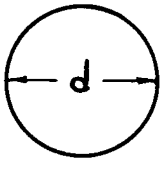
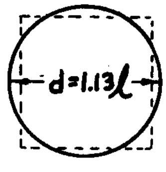
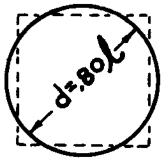
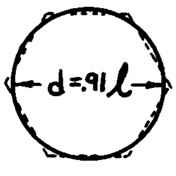
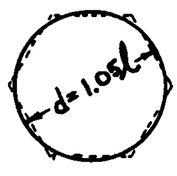
I had a letter back to Carl on October 22nd which went into details on what tests I would like to see and I also mentioned that the Solar Missileers Model Rocket Club here in Wichita, Kansas had volunteered to construct the necessary variety of chutes for the duration measurement tests. I received an answer from Carl on October 27th – things were finally rolling!! Gave him a call later that week to discuss final test plans and procedures. The very next day I took care of ordering a bunch of Estes parachutes and BT-50 body tubes, nose blocks, and shock cord.

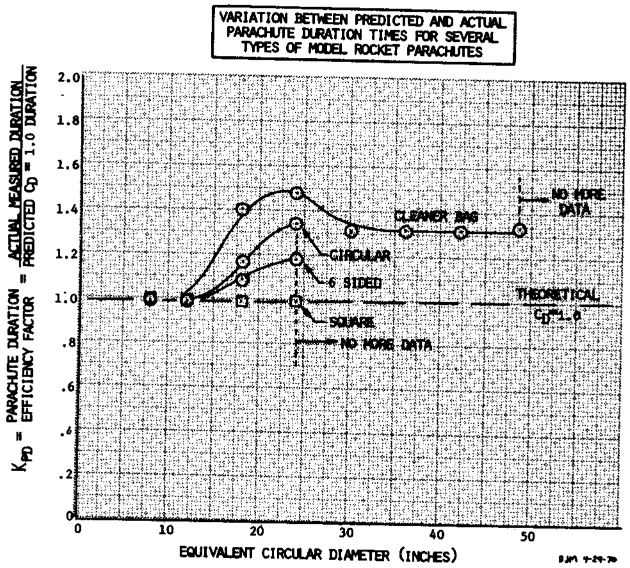
Each chute was to be attached by a shock cord to a 6" length of BT-50, which had a nose plug glued in the bottom end. This provided a container to carry various amounts of lead weights and also helped to more realistically simulate the additional aerodynamic drag one could expect due to the rocket suspended below its chute.

In order to reduce the amount of testing required, Carl and I decided that we would only measure durations for square, hexagonal (six-sided), and circular chutes of 8", 12", 18" and 24" diameters made from the .00075" (3/4 mil thick) Estes chute material. In order to verify the graph for larger diameters, we also intended to test 8", 12", 18", 24", 30", 36", 42", and 48" diameter circular chutes made from .00025" (1/4 mil thick) plastic Dry Cleaner Bags. There were to be 20 different chutes in all.

Now if you think about it, square and six-sided chutes do not really have a "diameter". In an effort to simplify interpretation of the final test results, we came up with surface area formulas for the non-circular chutes. These allowed us to calculate a basic dimension (ℓ) for each type chute which would give us the identical *surface area* of a circular chute of any given diameter (d). These relations

EQUAL REFERENCE SURFACE AREA FORMULAS

TYPE OF PARACHUTE	CIRCULAR	SQUARE	SQUARE	SIX SIDED	SIX SIDED
BASIC CHUTE DIMENSION					
FORMULA FOR REFERENCE SURFACE AREA (S)	$S = .785d^2$	$S = \ell^2$	$S = .50\ell^2$	$S = .65\ell^2$	$S = .866\ell^2$
EQUAL AREA EQUIVALENT CIRCULAR DIAMETER					



are summarized in the table.

Exact size patterns were laid out for the various types and sizes of chutes. Then Larry Lyons, the President of the Solar Missileers, took over, precisely constructed the test chutes and attached BT-50 tubes to order in an amazingly short time. The complete package was on its way to Carl in Ithaca, New York on November 9, 1969.

The actual drop tests were conducted by Carl on January 28 and 29, 1970! The reason for the additional *two and a half month delay* was that Carl ran into considerable red tape in obtaining official approval for use of the Cole Fieldhouse (our ideal and coveted enclosed temperature controlled environment).

Several University of Maryland officials were hesitant about letting Carl have access to the high platform. They had already refused the school newspaper photographers, the "pep" committee, NBC television, and the mountain-climbing club for reasons of "safety and insurance regulations". The platform is an ideal place to photograph the University's basketball games, but the reporters were told emphatically "NO!" What chance did Carl, a student from a school some 250 miles away from the University of Maryland, have with a similar request? Fortunately, Carl persisted until he finally got to the top of the line. Mr. George O. Weber, the Director of the Physical Plant at the University, considered the goals of the project worthwhile and much to all of our grateful thanks was pleased to allow Carl to use the platform for the experiments.

Conducting the Tests

Once permission was obtained, it was simply a matter of accurately calibrating the reference height to be used and to then round up enough healthy volunteers. After estimating that 23.2 healthy humans would be completely exhausted from retrieving chutes (approximately 10 minutes to climb down to the floor and return), Bruce Blackistone, Carl's #1 volunteer, came up with a "better idea". He borrowed his father's deep sea fishing rod and attached a small plastic bucket to the end of the line – presto – a high speed parachute crane exited. Greg Jones (NAR 5636) of Bethesda, Maryland was Carl's #2 man. He was in charge of keeping track of chute size, type, weight and duration times for each separate drop.

The parachutes were all dropped from the 90 foot high platform. The stop watches were started as the chutes passed the accurately measured reference height level of 78 feet 3 inches and were stopped when the chutes touched the floor. Dropping the chutes from above the reference level was done so that they would already be in a stabilized descent velocity condition during the entire timing period.

240 individually timed drop tests were conducted in all. Each of the 20 parachutes was tested at 4 different weight values, which means 80 combinations were investigated. Also, each combination was tested 3 separate times in order to obtain a more accurate average duration value.

Five months passed from initiation of correspondence until the 240 tests were completed. For whatever its worth, that averages out to 1.6 drops per day!

Observations During the Tests

Before we discuss how the actual experimental results compare to the theoretical C_D = 1.0 predictions, we will present Carl's observations concerning characteristic flight differences between the various chute types.

1. The 8" chutes were really not suited for any additional weight. With the attached BT-50 tubes, they weighed in at .25 ounce. They dropped at a reasonably slow rate *only* when *no* extra weight was added. Even in that case the chutes did not fully open.
2. The hexagonal chutes and the circular chutes appeared to perform nearly identical.
3. Square chutes seemed to drift the least. The clear Cleaner Bag chutes drifted the farthest.
4. The Cleaner Bag chutes opened easier and more completely apparently due to the lower stiffness of the thinner material. They also very nearly approximated a true hemispherical shape. This was attributed in part to the thin material and more probably to the large number of shroud lines (12 lines on the 24" chute on up to 24 lines on the 48" chute).

Comparing Tests to Predictions

Shortly after the tests were completed, Carl mailed all the raw data to me. I then wrote a small computer program which: 1) averaged the three test times for each condition, 2) corrected the data to duration per 100 feet of altitude (instead of for 78 feet 3 inches), and 3) further corrected these answers for the atmospheric density differences between actual test and an ideal standard 59°F sea level day. Next, the resulting t_{100} duration times were plotted on the theoretical C_D = 1.0 graph for each proper diameter and weight condition.

In this form the data told us immediately that: 1) the velocity squared drag law was being followed exactly

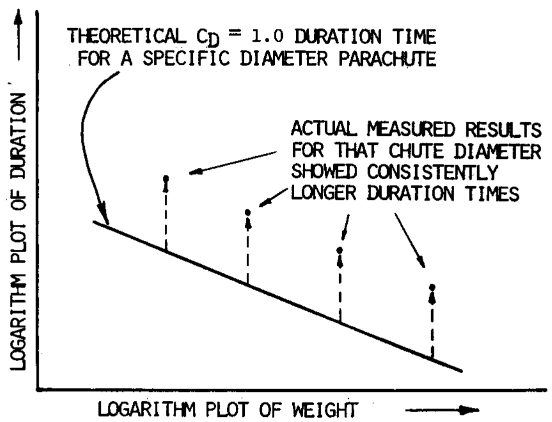
$$D = C_D S \tfrac{1}{2} \rho V^2$$

and 2) that the drag coefficient (C_D) had a constant value, which was independent of weight. Initially, I guessed that the drag coefficient (C_D) would vary with weight. I suspected that flexible chutes would assume somewhat different blossomed shapes in proportion to how much weight was suspended during the descent. If this was

Larry Lyons of Wichita, Kansas prepared the test parachutes.

true, the data would *not* have resulted in new lines exactly parallel to the theoretical predicted duration lines as shown:

TYPICAL EXPERIMENTAL RESULTS



We should especially note that for any given equivalent circular diameter, the experimental line gave equal or higher durations than one would expect if the drag coefficient was equal to one as originally assumed. Thus, we can conclude that true model rocket parachute drag coefficients are greater or equal to one.

The Parachute Duration Efficiency Factor graph on the previous page shows just how much each type of chute varies from the theoretical $C_D = 1.0$ prediction.

To use this new graph in your parachute duration optimization studies, you first determine the theoretical $C_D = 1.0$ duration per 100 feet of altitude (t_{100}) using the graph presented last month. Next, you find the Parachute Duration Efficiency Factor (K_{PD}) from this new graph for the specific type of chute at the proper equivalent circular diameter. Multiplying the theoretical answer by the efficiency gives you the true duration per 100 feet of altitude that you can expect on a non-thermal standard 59°F sea level day.

$$\left(\begin{array}{c}\text{true duration}\\ \text{for each 100}\\ \text{feet of altitude}\end{array}\right) = \left(\begin{array}{c}\text{theoretical duration}\\ \text{for each 100}\\ \text{feet of altitude}\end{array}\right)\left(\begin{array}{c}\text{Parachute Duration}\\ \text{Efficiency Factor}\end{array}\right)$$

$$\text{TRUE } t_{100} = (\text{THEORETICAL } t_{100})\,(K_{PD})$$

The fact that the Efficiency factor also varies with equivalent circular diameter was quite unexpected and we can't as yet offer any explanations as to why it occurs. Each dot on the Efficiency graph represents the average of 12 tests and so can be considered realistic. The 240 individual data points were all quite acceptable and no wild scatter existed whatsoever. Also notice that three types of chutes show the *same* general trend of increased efficiency as equivalent circular diameter increased from 8 inches up to 24 inches. The square chutes on the other hand, seemed to have a constant $C_D = 1.0$.

The Cleaner Bag parachute data fortunately extended our knowledge beyond 24 inches in diameter. It, of course, was very intriguing to see the Duration Efficiency drop and then apparently hold steady as diameter was increased further. Again, we can't explain why. A peak Duration Efficiency of 1.5 was achieved by the 24 inch diameter Cleaner Bag chute. $K_{PD} = 1.5$ essentially means that it takes 50% longer to descend from a given altitude than one would expect if $C_D = 1.0$.

Knowing the Parachute Duration Efficiency Factor also enables us to find the "true effective drag coefficient" of a given chute.

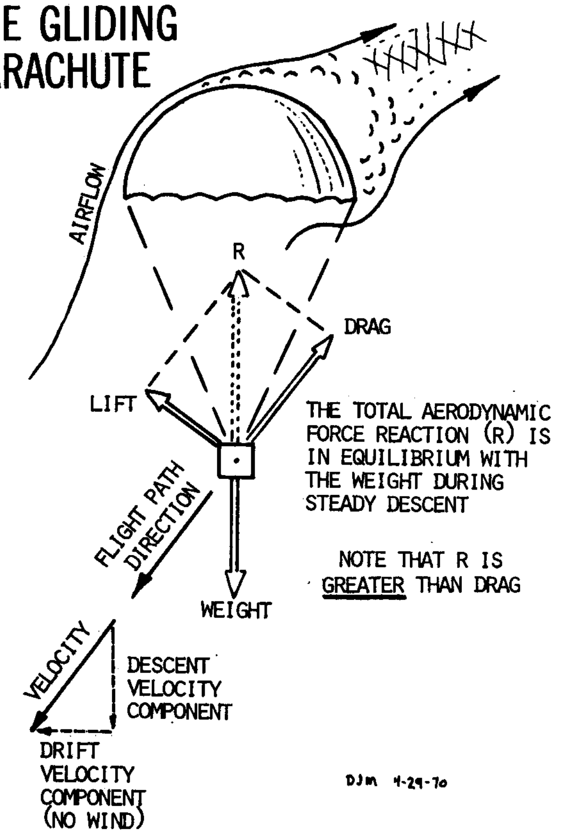
$$\text{TRUE } C_D = (K_{PD})^2$$

In the case of the 24" Cleaner Bag chute

$$\text{TRUE } C_D = (1.5)^2 = 2.25$$

This is absurdly high to anyone familiar with aerodynamics and it tells us that the chute is gliding and generating Lift in addition to Drag as shown below:

THE GLIDING PARACHUTE



Carl Kratzer's earlier comments that square chutes drifted least and Cleaner Bag chutes drifted most helps confirm the gliding pheonomena. Since the tests were indoors, the drift *must have been* due to gliding rather than the usual cross-wind type of drift incurred outside.

Dr. S. F. Hoerner's book "Fluid-Dynamic Drag" discusses Gliding Parachutes on page 13-24 of his 1965 edition. His data shows effective drag coefficients as high as 3.3 for hemispherical non-porous chutes in a gliding descent.

Optimizing Parachute Duration Performance

First of all we can start out by stating that these experiments have not really yielded any startling new information.

Most experienced rocketeers are already aware that the Cleaner Bag type chutes are best for competition events for several reasons. Since the Cleaner Bag material is thinner, a given size chute can be packed into a smaller volume and it will weigh less too. As Carl noted, being thinner also means they are correspondingly less stiff which results in both faster opening and a more truly hemispherical shape (which may or may not be related to the tendency to glide). As the drop tests also show, Cleaner Bag chutes are slightly more efficient during descent.

The standard Estes type chutes, on the other hand, are far easier to assemble, are not anywhere near as delicate, and seem much less prone to melting from the ejection charge. In many a wind plagued Parachute Duration event, maximum time aloft is not anywhere near as important as successful retrieval. A standard type square chute can easily end up in the winner's circle under such circumstances.

As always, model rocketry optimization involves such "engineering tradeoffs". Another example of a tradeoff is the common practice of using short engine delay times to kick giant chutes out *before* the rocket reaches its maximum possible altitude. The really large chutes refuse to unfurl and blossom if ejected at the peak where the rocket's velocity is near zero. They need the high speed associated with an early ejection to insure full deployment.

Just how much altitude is lost in the process is an interesting question. Perhaps one might be better off with a smaller chute that would reliably open at the peak.

If we could easily determine how high the rocket is at the instant of ejection, we would be in a better position to say something definite about this engineering tradeoff.

Jim Anderson of Wichita, Kansas (NAR 16236) has been interested in this very question. After several months of work, he has come up with a very simple method for precisely determining just how much altitude is lost by ejecting either before *or* after the rocket has reached its peak altitude. Next month we will present his method.

Future Research

Carl Kratzer's initial series of drop tests combined with the theoretical $C_D = 1.0$ duration graph finally provides answers to *some* of the basic questions concerning parachute duration. We do not claim to be experts with all the answers. In fact, our work has raised more new questions, while answering just a few of the old.

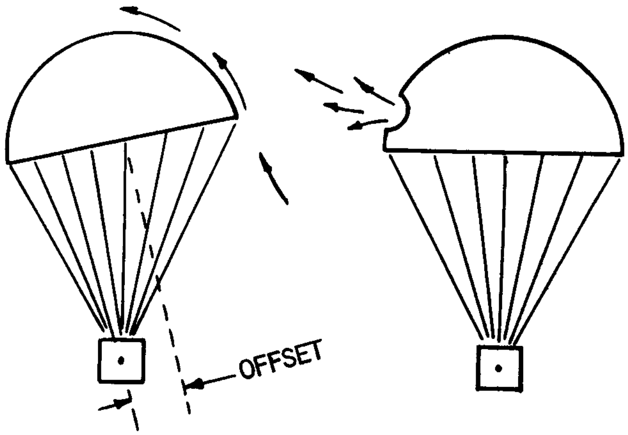
We both have many ideas for improvements and additional questions which will require more experiments to prove or disprove. We would like to see others get involved and can see several worthwhile R & D or Science Fair projects to whomever is interested. The following list will hopefully be of some use in that respect.

Experiment 1

Since gliding increases time to descend, we should be investigating what can be done to improve gliding capability.

Perhaps offsetting the supported weight as shown below would provide sufficient angle-of-attack to help induce gliding. If so, what degree of offset maximizes the glide?

What about cutting a hole in the chute to allow the air to escape sideways and produce an effective side thrust? If it works at all, what is the optimum size and location for such a hole?



Maybe a combination of both ideas would be better than either alone? In order to measure the affect of any changes accurately, indoor drop tests will be required to eliminate the wind and thermal variables.

Perhaps some small weight offset accounted for the 24" Cleaner Bag chute being so high. I would like to see half a dozen supposedly identical 24" Cleaner Bag chutes built and dropped a dozen times each to see if any consistent variation occurs between them.

Experiment 2

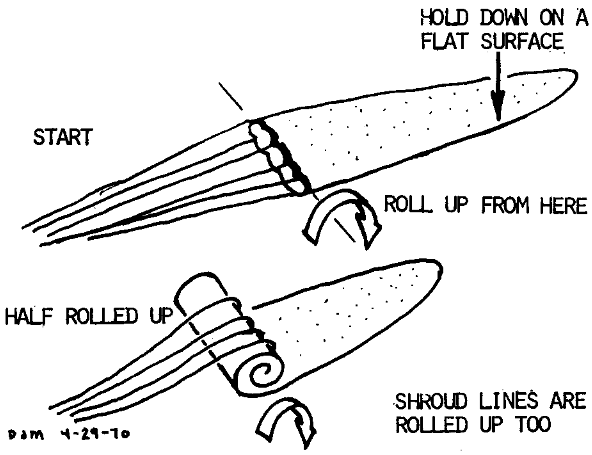
Carl is especially interested in the effect of shroud line *length* on the duration capability of a given parachute. Such tests should be run with shroud line lengths which are ½, 1, 1½, 2, 2½ and 3 times the diameter of the chute to see what the general trends are. For simplicity, start with the longest length and then progressively tape or knot the lines together at the desired shorter lengths.

I myself am curious as to how the *number* of shroud lines affects duration. I use a large number of my Cleaner Bag chutes merely because they look more realistic and give a better hemispherical shape. Does it really make any difference?

Also, when I build a chute with a large number of long shroud lines I use regular fine thread rather than the heavier and stronger carpet type thread in common use. It saves a bit of weight and packing volume. The large number of shroud lines means that the tensile strength requirements for the individual thread is proportionately reduced. To date I have not encountered any outright breaking problems. However, I do have to use sticky cellophane tape and double knot the attachment ends to prevent pullout.

Folding and packing giant Cleaner Bag chutes used to be difficult due to entrapped air. Puncturing the entire surface with a pin prior to assembly (50 to 100 teeny holes) has completely eliminated that problem.

My lines are usually about twice the diameter of the chute. This is not done strictly for aerodynamic reasons, but because my packing technique uses the lines themselves to help unfurl the chute. After ejection, shroud line tension quickly unrolls the whole package. Just one more idea for you to experiment with on your parachute duration birds.

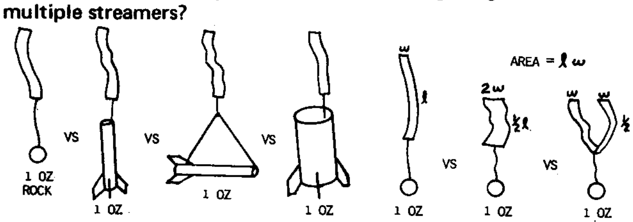


Experiment 3

It would be informative to see accurate descent time data for other types of recovery systems: featherweight for the Astron Streak; tumble recovery for the Scout and Sprite; helicopter recovery for the Gyroc; and, of course, streamer recovery on a variety of rockets.

Research into streamers alone would be a large undertaking. Due to the significant portion of drag on the rocket body itself, streamer tests should also be conducted separately with rocks or other high-density objects. Comparing the two durations would show how much of the drag was due to the rocket and how much was due to the streamer.

Another question is if total streamer area is fixed, is duration affected by increasing width and decreasing length? What about multiple streamers?



Streamers flutter during descent. With higher weights they descend faster and flutter differently. Might the overall drag coefficient *vary* with weight?

Experiment 4

Lastly, I would also like to see duration measurements on a variety of brands of PING PONG balls. If it turned out that they all had very nearly identical weight, drag, and duration characteristics we may have a new way of accurately measuring altitude. One could eject a ping pong ball at peak altitude and time its descent (if it isn't too small to be seen). I suspect they will fall fast enough so as not to be strongly affected by thermal conditions.

On the scene report.....

MIT Model Rocket Convention

Following only two weeks after the Pittsburgh Convention the 1970 MIT Model Rocket Convention was held on the April 3-5 weekend. Sponsored by the MIT Model Rocket Society, this Convention provided an opportunity for technically minded rocketeers to exchange information on their current areas of research. Almost 150 rocketeers from 12 states gathered in the MIT Student Center for the opening session on Friday evening.

In general the MIT discussion groups were more technical than those at Pittsburgh. Forrest Mims, who had come all the way from Albuquerque, New Mexico to participate, led a group on model rocket telemetry. His emphasis was on "optical telemetry," which has been explored by only a few researchers. He divided optical telemetry into several areas, the simplest being the light flasher. Using a standard multivibrator circuit (such as the one described in the September 1969 issue of **Model Rocketry**) the flight path and velocity of a night launched model rocket can be recorded on photographic film. He discussed his experiments using "light-emitting diodes" for telemetry (for a description of this method see *The Experimenter's Notebook,* June 1970 **MRm**). Though presently not practical because of cost, Mims also suggested that laser telemetry should be researched.

Doug Malewicki, in his B/G discussion group, opened with a review of "pitching moments." He then displayed two new pop-pods which he has recently been investigating. These pods, approximately 18 inch lengths of BT-20, are quite a bit longer than normal pods. They are attached to the boom in the usual manner, thus allowing them to extend over a foot in front of the boom. Use of this type of pod reduces the pitch down moment which results from the off axis thrust line. Use of the lengthened pos also increases the moment of inertia during the boost phase. Doug claims that these pods have resulted in superior performance during initial testing.

In another B/G discussion group Bob Parks and Bob Singer reviewed the standard boost/glider construction techniques. They then considered the usefulness of such new materials as styrofoam wing sections for competition B/G's. The discussion concluded with the suggestion that the built-up wing technique, long employed in model airplane construction, might also be useful in B/G's. It allows the weight of thick section wings to be reduced substantially. Both Bob's are currently working on built-up wing Condor class boost/gliders. In a third B/G discussion group, Dr. Gerald Gregorek reviewed the Basic Boost Glider design techniques described in his presentation at Pittsburgh.

In a discussion on the use of computers in model rocketry, Charles Andres discussed the desirability of linking the static and dynamic equations in one program which could be used to determine model rocket stability. The idea of simulating actual flights on visual computer displays was also discussed.

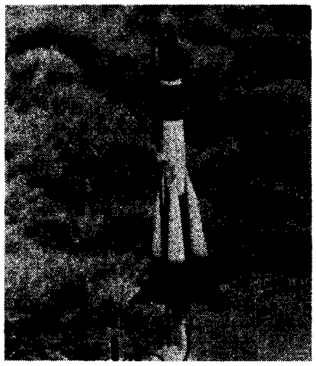
Richard Fox, who has been experimenting with radio-telemetry for over three years, led a group on transmitters. He discussed the design of the new "Foxmitter-2," which eliminates many of the minor problems encountered with the earlier design. The use of telemetry in performing scientific experiments was discussed. Forrest Mims suggested that Dick consider a heartbeat sensor operating by detecting the difference in light transmission based on blood flow. That suggestion resulted in the development of the heartbeat sensor described in an article elsewhere in this issue of **Model Rocketry.**

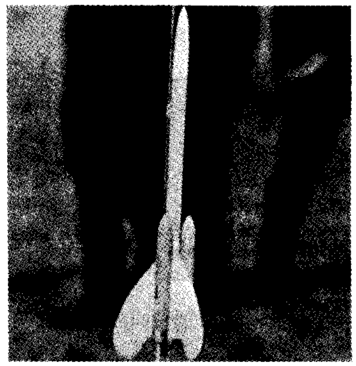
Early on Saturday morning, the rocketeers were bussed to L. G. Hanscom Field for the launching. The first rocket off the pad was a home-designed boost/glider built by Walter Raudonis and powered by an Estes D-engine. Though the B/G pranged, it did prove that a well built B/G can hold together under the acceleration of a D. Dick Fox launched a thermistor payload using "Foxmitter-2" telemetry. He got a beautiful flight and tape recorded the data, but the recovery system failed to deploy and the payload crashed into a concrete runway.

During the manufacturers' demo launchings Harry Stine unveiled the MPC "Vostok" for its first public flight. Using the oversize fins the model was quite stable, even in the high winds experienced at Hanscom. The MPC Lunar Patrol, sporting two well-trimmed "parasite" gliders, was also popular with the crowd. The Estes Sprint, a new high-performance kit, demonstrated its capabilities in a stable, high-altitude flight. Tag Powell flew the SAI Quasar, with three pop-off booster pods, as well as the SAI competition design, the Tempus Fugit.

Following the launching, rocketeers gathered at the MIT Student Center for a series of technical presentations. First up was Doug Malewicki who reported on a series of parachute duration experiments performed by Carl Kratzer. A complete report on their results appears elsewhere in this issue of **Model Rocketry.** Forrest Mims followed with a discussion of the results of his Ram Air Control experiments (described in detail in the February and March 1970 issues of **Model Rocketry**). Recent experiments done at the US Air Force Academy

Ed Brown and Frank Genty prepare the new Estes kit line for flight. The Cherokee-D, powered by the D-13, the Sprint competition design, and the two-stage Beta (left to right) were flown during the manufacturers' demo launches.

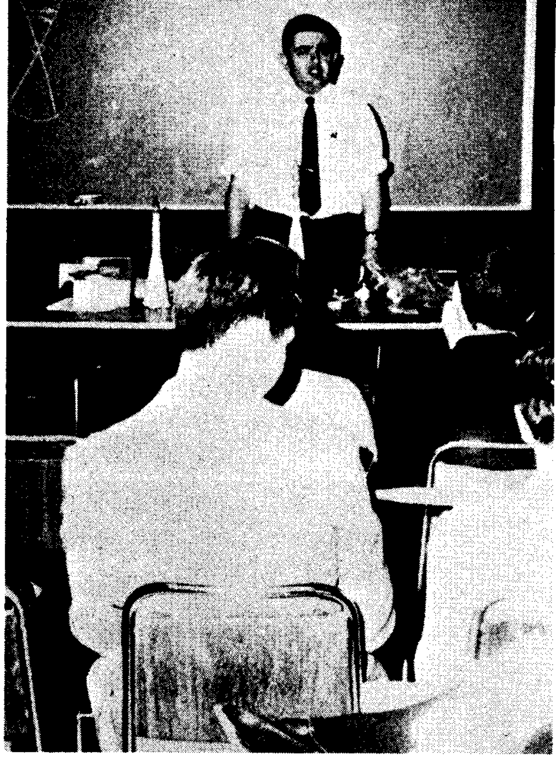




The new MPC "Vostok" (left), the first plastic flying model rocket kit, was introduced at the Convention. Harry Stine added white paint over the olive green to simulate the frost which forms on LOX tankage. (Right) SAI's newest model, the Quasar, turned in a perfect flight with all three strap-ons and the core igniting.

Charles Andres presents a summary of his investigations on supersonic model rocket flight. He has already made one attempt to fly his 2-stage, F100 powered rocket through the sound barrier.

Lindsay Audin explains his investigation of fluid injection into model rocket engine exhausts. His experiments indicated that some thrust augmentation is provided.



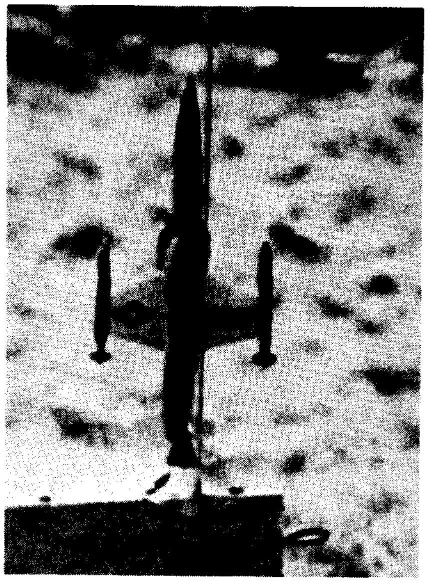
Harry Stine discusses plastic model conversion techniques. Recent space successes have resulted in the introduction of a large number of plastic kits suitable for conversion.

indicate that a maximum force of one pound can be obtained from a 4 inch diameter nose cone containing a ram-air tube operating at an air speed of 200-400 feet/second. He also described the wind tunnel assembly which he employed. This unique tunnel, which is strapped on to an automobile, is described in this month's *The Experimenter's Notebook.*

Lindsay Audin described his experiments on liquid injection into model rocket

Walter Raudonis prepares his D-powered B/G for flight. This B/G was the first rocket off the pad. It stayed together under the D's power, proving that Eagle B/G can be built.

exhaust for thrust augmentation. He employed a spent engine casing in tandem with the active engine, and injected water into the exhaust stream in the empty engine casing. For the small (A through C class) engines covered by his experiment, the best flow rate was on the order of 1 cm^3/sec. Lindsay concluded that the amount of thrust augmentation does not seem commensurate with the weight of the plumbing required. However, for the large FSI



One of the most unusual models to show up at this year's Convention was a converted plastic airplane kit. It amazed everyone, including the RSO, when it left the pad, flew straight up, deployed its' chute and was safely recovered. What's next in plastic models?

engines, this method of thrust augmentation might be practical. He also suggested that water injection at an angle to the thrust line might be used as a method of model rocket course control. Additionally it was suggested from the audience that the injection of Freon or another gas with a lower boiling point than water might be beneficial.

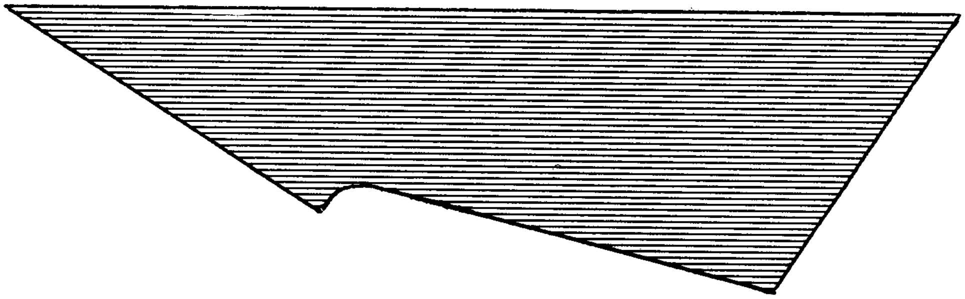
The question of supersonic model rocket flight was discussed by Charles Andres. He gave a detailed account of his attempt to break the sound barrier during the flight of a two-stage, F100 powered rocket in early February. The attempt failed due to a 3 second delay between first stage burnout and second stage ignition. The upper stage ejection charge was observed, and trackers closed on this charge at 6300 feet.

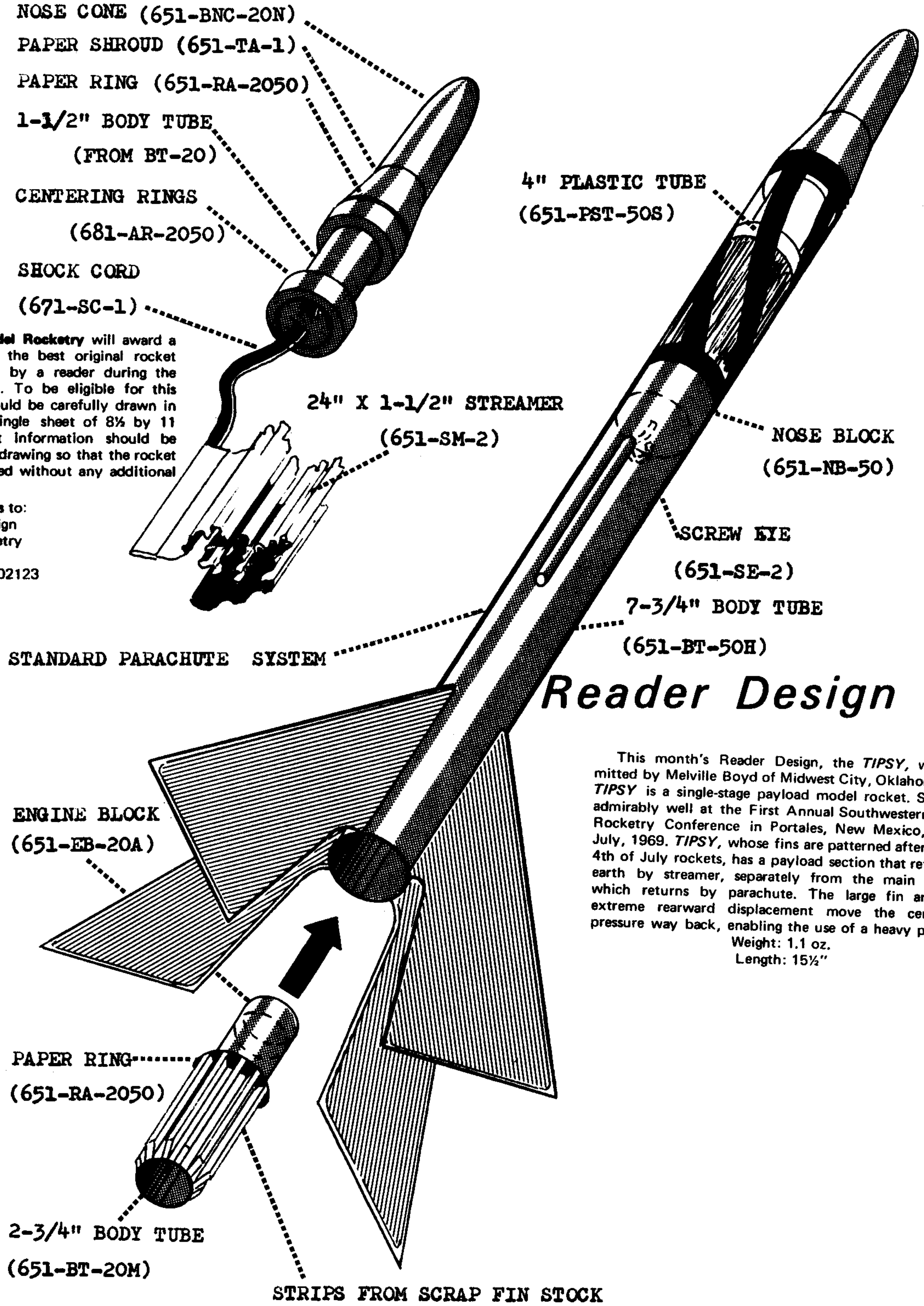
Carl Guernsey presented the results of his investigation on the aerodynamics of conical model rockets. His experiments indicated that there is a decided advantage to using a conical rather than a cylindrical model rocket airframe. Using three conical rockets with different base diameters, all powered by the same engines, Carl obtained the following results:

Base Diameter	Average Tracked Altitude
0.736"	409 ft.
0.766"	433 ft.
0.976"	370 ft.

The indication was that the drag coefficient goes down in proportion to the degree of divergence of the conical body tube. His results were in line with those earlier reported by Gary Schwede.

The final presentation was made by Cody Hinemann. He traced the history of model rocket movie camera payloads, and described the new Estes CINEROC. He also described a series of experiments in which he flew a Kodak movie camera on a model rocket.





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

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

Reader Design Page

This month's Reader Design, the *TIPSY,* was submitted by Melville Boyd of Midwest City, Oklahoma. The *TIPSY* is a single-stage payload model rocket. She flew admirably well at the First Annual Southwestern Model Rocketry Conference in Portales, New Mexico, during July, 1969. *TIPSY,* whose fins are patterned after certain 4th of July rockets, has a payload section that returns to earth by streamer, separately from the main vehicle, which returns by parachute. The large fin area and extreme rearward displacement move the center of pressure way back, enabling the use of a heavy payload.

Weight: 1.1 oz.
Length: 15½"

The Old Rocketeer

by G. Harry Stine NAR#2

"CUSTOM PLASTIC PARTS?"

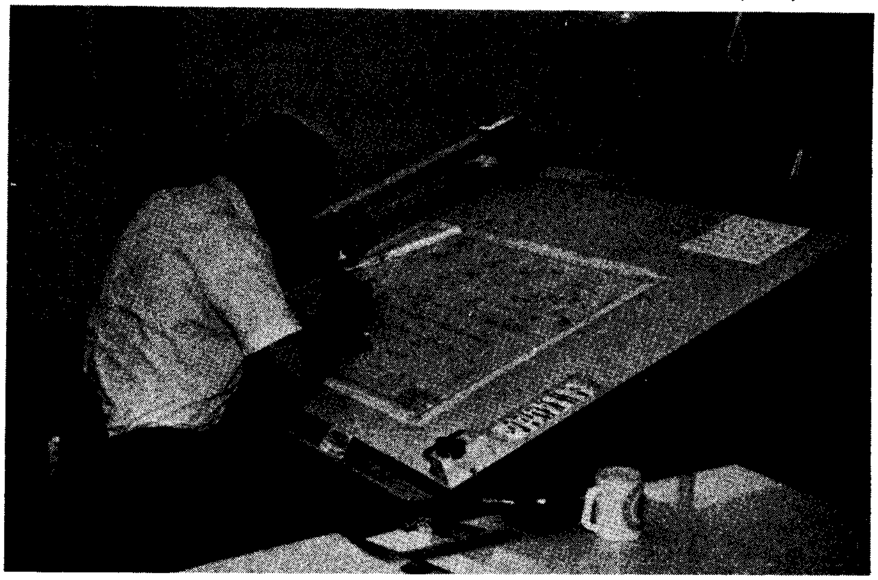
At the M.I.T. Convention, I overheard a young model rocketeer say something to the effect that "Stine should not be allowed to compete against other people because MPC will make custom plastic parts for him." I had a hearty chuckle at this until I stopped to think about it more carefully. And it occurred to me that this young rocketeer simply did not have the foggiest notion of what it takes to make an injection-molded plastic part. . .and the same was probably true of thousands of other people, too. So, at the risk of being further accused of writing publicity for one of the model rocket manufacturers with whom I happen to be associated as a consulting engineer (which means that they call upon me when they need me), I allowed as how I had oughta inform the uninformed about what it takes for this manufacturer to make a "custom plastic part" for me. . .and for 100,000 other model rocketeers.

In almost all cases, a plastic part starts out on the drawing board. However, it may also begin as a rough-hewn prototype made from wood, metal, plastic, or anything else that can be shaped. Be that as it may, it still must go through the drawing board step where an expert draftsman-designer makes highly accurate dimensioned drawings and cross-sections of the part, usually several times larger than its final size in order to gain accuracy. This draftsman must also be a designer because he must know the how and why of injection molding of plastics, how much draft or draw to allow for in parts, how to adjust for shrinkage, and a hundred other little tricks of the trade that he may have taken years to learn. The result of hours and hours of painstaking work over a drawing board is a set of drawings which are then double-checked by a number of people to make sure that this is really what the part should look like. If it is a component in a larger assembly such as a kit, it must be checked on paper to insure that it will fit with other pieces in the kit. You really have to be able to think in four dimensions for this. . .three spatial dimensions and one time dimension, especially if the parts move with respect to each other, if they disassemble, or if they must be assembled in a certain order. This sort of thing can drive you right up the wall. . . .

The next step is the model shop where experienced model makers convert the drawings into actual three-dimensional parts. Normally, parts for a kit are fabricated two to four times the size they will finally be in the kit, just to insure greater accuracy. These model makers aren't balsa butchers; balsa is much too grainy for their use. They work in clay, steel, epoxy, paraffin, basswood, pine, beeswax, styrene, lucite, plexiglass, pot metal, and almost anything else that can be shaped. Some of them are trained sculptors. All of them are experts. All of them are good machine tool operators.

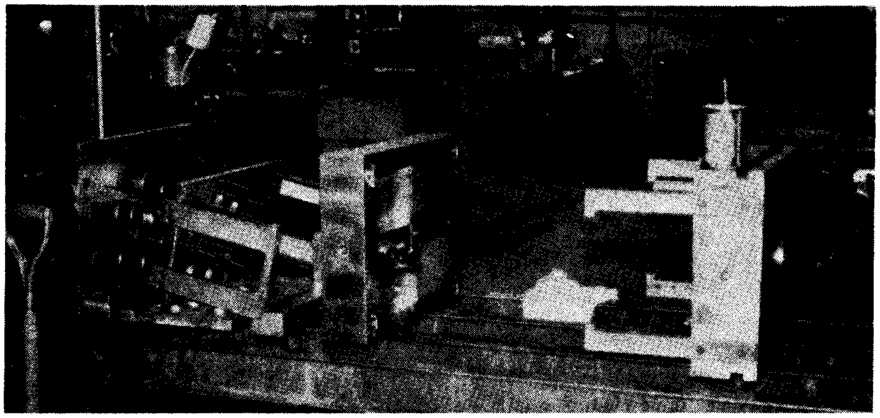
If there is more than one part involved, the model maker then gets assistance from a tool and die maker to lay out the arrangement of the parts in the mold. He must know where to inject the plastic to get it to flow correctly into the mold to make the part, and then he must lay out the parts so that each receives the injected plastic from the "runner" or "tree" at the proper place. With complex molds, this can get to be like assembling a Chinese puzzle. From this layout, another drawing is made showing the layout of parts in the mold. And then another drawing is made indicating the design of the mold itself. These drawings can be quite complex and take weeks of work to complete.

With a sheaf of drawings and the prototype out-size models, the mold maker himself now starts to work. Nearly all precision molds for injection-molded plastic parts are cut from hard steel. This is a real art. The mold maker works from the oversize model using a three-dimensional pantograph to hollow out a hard steel block to the exact shape of the piece. At this point, it is rather



A plastic part starts out on the drawing board where an experienced product engineer such as Dan Tassell makes accurate dimensioned drawings. Here Dan is working on the assembly drawing of the Titan-IIIC model.

In the model shop, Bill Felicia checks the 2.5-times larger model of the RD-107 Vostok boosters against the final plastic model.



This block of hardened steel is the plastic mold for a launch controller handle. It weighs several hundred pounds and consists of several parts such as extractor pin plate, positive mold, negative mold, and actuator plate.

crude with no surface engraving and no locator pins. It may take months to make a single, simple mold cavity. As you can imagine if you look at some plastic parts, they can be very complex molds indeed.

For tiny human figures, the mold maker works from an oversize statue and uses the three-dimensional pantograph cutting tool to make the mold. The result is so accurate that on many figures even as small as 1/100-scale you can recognize facial expressions by using a magnifying glass. Every wrinkle of clothing is reproduced, too.

When the mold is finished, it is mounted in an injection molding press for testing. At this point, it may be a 300-pound assembly of steel and must be lifted into place with a crane. The small injection molding press has a screw ram that injects 200-degree F. styrene plastic into the mold under several hundred pounds-per-square-inch pressure, while at the same time holding the mold halves together with greater force to keep the liquid plastic from squirting out at the mold parting lines and causing "flash." The result of this little operation may be only a dozen or so "test shots" which are prototype parts turned out of any old plastic that happens to be in the machine at the time. The purpose of the test shots is to check appearance, size, shape, gating or injection point of the plastic into the part, whether or not the mold cavity will fill correctly with plastic, and whether the part will fit correctly with other parts when it cools off and shrinks.

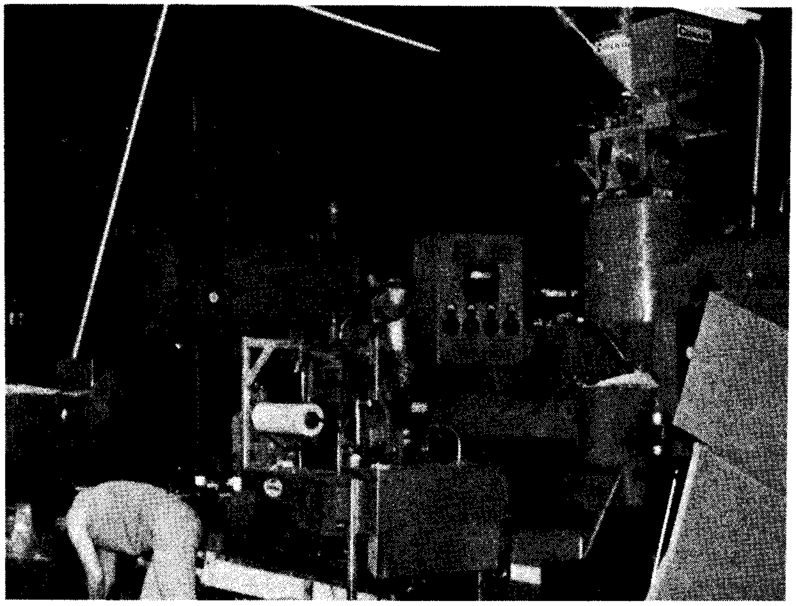
Usually, some small adjustments must be made to adjust for fit. At this point, if you've made a mistake in size or shape, it is very difficult to change things. You've got a couple of hundred pounds of steel with some odd-shaped holes in it, and you'd better be right before they start cutting them holes, buddy, or them parts ain't gonna be right! If you don't mind spending a little more money – you may have sunk ten thousand dollars into the project at this point – the mold maker can weld up some holes, change things by cutting more steel, etc.

After the changes are made, you get another handful of test shots and you try again. . .hoping this time that everything fits because the time schedule is getting tight. The kit is due to be on the market in weeks . . .

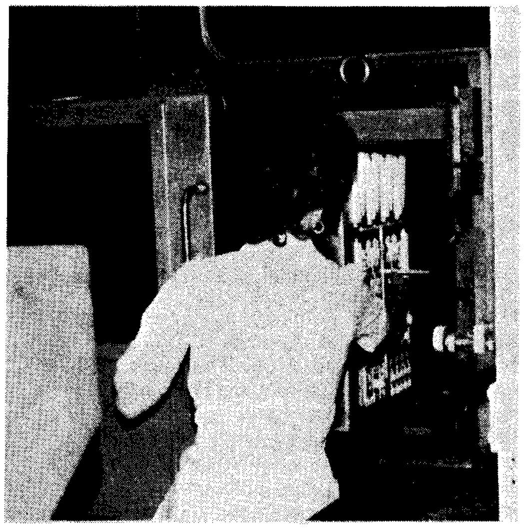
If the plastic piece is to fly, you've got to go through a flight test program, too!

Finally, the last touches are put on the mold by the mold maker – little engravings of fine details, lines, rivets, and so forth – and the mold maker delivers that $25,000, 400-pound block of hardened and polished steel at your door. . .and collects his money.

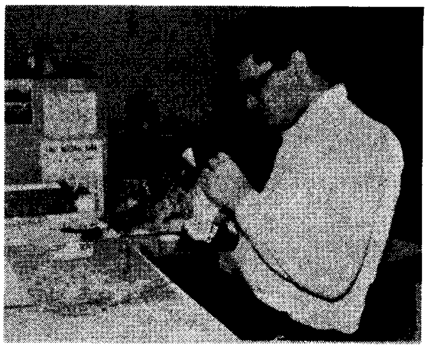
Now you are ready to hoist it into your own injection molding press and start making "custom plastic parts." This requires a crane and fork-lift. And some very strong and trained hands. The injection molding press is no small item, either. They can be more than 50 feet long and stand over 10 feet high. It must have a source of 3000-psi hydraulic pressure, a source of cooling water, beaucoup kilowatts of electricity for heating the plastic, and somebody to work the machine. A couple of hundred pounds of pelleted polystyrene plastic of the proper color is loaded into the hopper, and a start-



This little gadget is an injection molding press. Yes, that is a railing around the top of it so that the upper portions of the press can be worked on.



Here's the heart of the matter. The mold has opened and the girl machine operator is reaching in to take out a complete set of RD-107 Vostok parts from the mold. This is a photo of actual production operation.



The final test comes when all the parts are put together in a final assembly test just to make sure that the production moldings are correct.

up man begins the process of getting this behemoth warm in the right places, cold in the right places, very hot in some places, and adjusted to a fine tolerance of thousandths of an inch when those mold halves come together. This is like tinkering with a wild bull elephant in heat.

At last this goliath of a misbegotten steel whale swings into action. . .*chung. . .grind grind grind. . .clunk. . .hiss. . .thunk whunk chunk*. . .and 50 tons of machinery go to work. Finally, the two huge blocks of steel part and a 90 pound girl reaches deftly in between them, removes 2 ounces of hot plastic from the mold, and closes the safety door. . .signalling the machine to start its cycle again. With a pair of ordinary diagonal cutters, the girl quickly snips the custom plastic part from the molding tree, throws the scrap into a ginder where it will be chewed up for re-use, and hands me my custom plastic part so that I can to out on the contest field and thereby have that great advantage over all the other contestants. . . In the meantime, the company's comptroller is standing there with a bill for about $50,000. . .Since I cannot pay the bill this week and still purchase that Mercedes Benz I ordered last month, I am forced to tell the company to continue running the machine to turn out another 100,000 parts or so. You know how it is. . .As long as the danged machine's running, you might as well crank out more of those custom plastic parts at the rate of a couple thousand of them per hour . . . and if you're doing that you might as well put them in a bag and header and try to sell them to other model rocketeers . . . Who knows, we might recover the initial capital investment some day.

In other words, friends, there ain't no such thing as a custom-molded plastic part. Not at any price that you or I could afford. There is far too much highly trained manpower, man-hours of expert labor, and thousands of dollars worth of precision machinery involved. It takes a good 9 months and lots of gray hairs from the original drawing to the final production part. There is no room whatsoever for a mistake.

Ah, but there is nothing like opening that kit at last and starting its assembly. Good grief! They forgot and turned the locator key on this part by 90 degrees! It won't go together at all! They must have molded thousands of them by now! Get on the telephone. . .Quick, man!. . .

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

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

NAR

MEMBERSHIP ANALYSIS

A statistical analysis of NAR members and sections has been made by Director of Section Activities, Robert Atwood. Studies of the membership tapes during December 1967, April 1969, and April 1970 indicate growth trends in different regions of the U.S. Due to space limitations, only the breakdown of membership by NAR regions rather than states are presented below. Atwood made the following observations from the data:

– NAR is growing and I expect the rate will accelerate.
– We have a number of sections and members who register for only one year.
– We are slow in achieving our potential in urban areas and even losing ground in New York and Connecticut.
– Mid-America Division shows our best growth in both sections and members with Pacific Division following closely behind. From a percentage standpoint, Mountain Division is doing well.

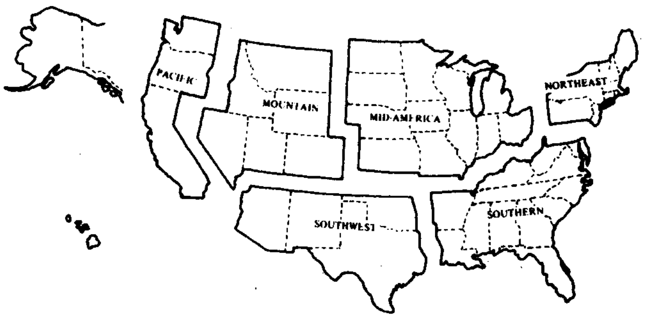
Mr. Atwood hopes to supplement the Division Managers with State Department Heads and eventually Urban Area Chiefs for cities with population exceeding 100,000.

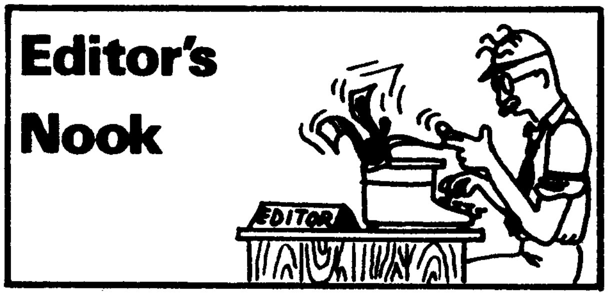
The chart reproduced below compares the geographical distribution of NAR membership and sections with the U.S. population (1960 census).

NAR DIVISIONS	13 DECEMBER 1967		16 APRIL 1969		15 APRIL 1970		U.S. POP
	Members/Sections		Members/Sections		Members/Sections		
NORTHEAST	35%	38%	34%	38%	31%	29%	25%
SOUTHLAND	22%	30%	22%	26%	21%	26%	24%
MID-AMERICA	21%	14%	22%	20%	23%	22%	28%
SOUTHWEST	6%	9%	7%	2%	6%	3%	8%
MOUNTAIN	2%	2%	3%	2%	4%	3%	3%
PACIFIC	14%	7%	12%	12%	15%	17%	12%
TOTAL NUMBERS	2660	44	2502	40	3513	58	

NAR DISTRICTING MAP

This map shows the states included in each of the NAR's six geographical districts. The NAR districting plan was created to provide local assistance to NAR sections and to aid in the formation of new sections. A list of the District Directors is published each month under the large NAR masthead.





There has been some confusion among NAR members as to the proper address to send correspondence directed to *The Model Rocketeer.* Letters sent to **Model Rocketry** magazine require forwarding to us, a process which is both inconvenient and time-consuming. All material intended for *The Model Rocketeer* should be sent directly to the Editor or via NAR HQ; both addresses appear on the first page of the section. NAR Section News should continue to be sent to Charles Gordon, Section News Editor. Likewise, notices of address change from NAR members must be sent to NAR HQ and *not* to **Model Rocketry** magazine. Failure to observe this simple procedure may cause a lapse in your magazine subscription as NAR mailing tapes are prepared at HQ.

We get letters too! I have received several letters concerning the "NARAM-13 Site Disclosed" article of April issue. For example, Robert Hartman of Taylor, Texas writes: "After reading the article in the April issue of your magazine on the site selected for NARAM-13, I began to suspect that much of it was a very funny joke. Not that I mind Madame Zinsky's Funeral, Palm Reading, and Good-Eats Parlor being one of the sponsors. She is OK by me. It's just that I didn't know that she was interested in model rocketry. So before I begin to plan on paddling a kayak down the Koyuk River and confronting kodiak bears, I would like to know just how much, if any, was true, or if it was a joke (which I admit was very funny and quite entertaining)." Well, it seems that the Contest Board has been swamped with letters and phone calls from angry members who don't want to fly NARAM-13 in Nome, Alaska. We confess. Bruce Blackistone and myself were the culprits responsible for that bit of April Fool humor. But I hope you took the rest of the issue seriously!

Last month I reported the selection of Scott Brown as the new Technical Editor. I have since received offers from a few more members willing to help with preparation of technical material for *The Model Rocketeer.* Now Scott Brown will concentrate on procurement of reports and plans, Justin Brehm will check for accuracy and provide technical illustrations, and Dan Starr will rewrite the material into polished form. Also, Steve Fentress will continue to provide cartoons and other artwork.

NARAM-12 SCHEDULE OF EVENTS

The following is a *tentative* schedule of activities to be held at NARAM-12. All dates and times are subject to change.

Sunday, August 16:

8:00 PM	Contestants Briefing

Monday, August 17:

8:00 AM	Opening Ceremonies
8:30 AM	Sparrow Boost/Glide
11:00 AM – 1:00 PM	Submission of Scale entries
12:30 PM – 3:00 PM	Lunch (tour of MSC)
3:00 PM	Design Efficiency
7:00 PM	Range Closed
8:00 PM	Trustee Meeting
Evening:	Scale judging: NASA films

Tuesday, August 18:

8:30 AM	Egg Lofting
11:00 AM – 1:00 PM	Submission of Space Systems Entries
12:30 PM – 3:00 PM	Lunch (tour of MSC)
3:00 PM	Scale flights
7:00 PM	Range Closed
8:00 PM	Triennial NAR Meeting (Election of Trustees)
Evening:	Space Systems judging: NASA films

Wednesday, August 19:

8:30 AM	Swift Boost/Glide
11:00 AM – 1:00 PM	Submission of R&D entries
12:30 PM – 3:00 PM	Lunch (tour of MSC)
3:00 PM	Space Systems flights
7:00 PM	Range Closed
8:00 PM	Trustee Meeting
7:30 PM – 10:30 PM	R&D Judging Interviews
Evening:	NASA films

Thursday, August 20:

8:30 AM	Class 1 Parachute Duration
12:30 PM – 2:00 PM	Lunch (tour of MSC)
2:00 PM	Open Spot Landing .
4:00 PM	R&D Presentations and launches
7:00 PM	Range Closed
8:00 PM	Trustee Meeting

Friday, August 21:

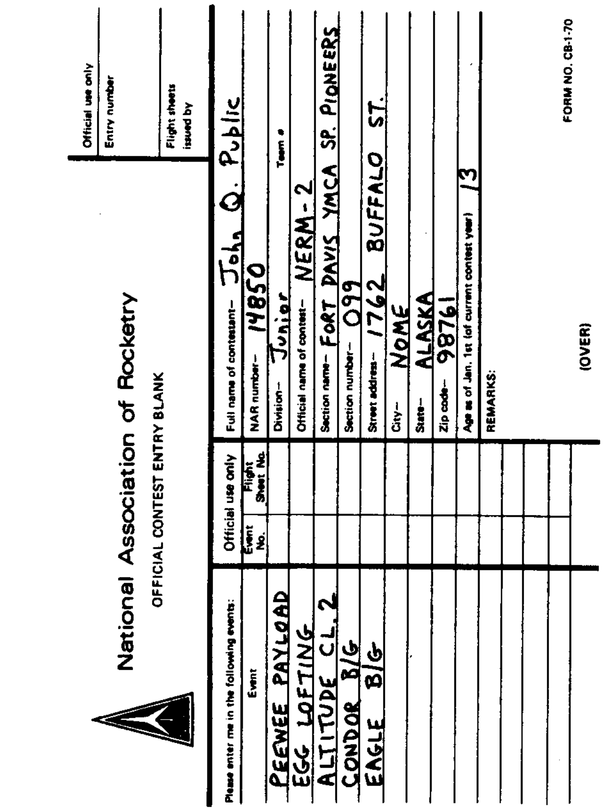
8:30 AM	Beach Party
11:00 AM	R&D Exhibition
3:00 PM	Award Banquet

NEW CONTEST BOARD FORMS

The NAR Contest Board has announced the adoption of new contest and record application forms for use in NAR sanctioned competitions. The new forms were designed by Contest Board Chairman, Richard Sipes, in order to facilitate processing of contest results by computer. The new forms take effect immediately and supercede all previous versions. A special packet is being sent to all chartered sections explaining the proper use of the new forms.

Contestants are advised that all Contest Entry Blanks must be filled out completely and legibly as shown below, including all necessary signatures. The Contest Board will not accept incomplete or illegible entry forms in the future. It is necessary that all contestants enter their *section number* on the form. A copy of the NAR Section Roster with section numbers has been sent to all sections. Contestants not flying with a section must enter three dashes (- - -) instead. Also, all teams must write to the Contest Board to obtain a special *team number* which must also be entered onto the form. Local Contest Directors should ascertain that all forms are properly filled out before returned to the Contest Board.

New Contest Flight Cards have been color coded for Junior, Leader, and, Senior age divisions. The cards have provisions for the newer events such as Egg Loft and Design Efficiency which were not included on old cards. The Contest Board has also printed revised forms for Sanction Applications and NAR Record Attempts.



National Association of Rocketry
OFFICIAL CONTEST ENTRY BLANK

Official use only: Entry number; Flight sheets issued by

Full name of contestant– John Q. Public
NAR number– 14850
Division– Junior
Team #
Official name of contest– NERM-2
Section name– FORT DAVIS YMCA SP. PIONEERS
Section number– 099
Street address– 1762 BUFFALO ST.
City– NOME
State– ALASKA
Zip code– 98761
Age as of Jan. 1st (of current contest year) 13
REMARKS:

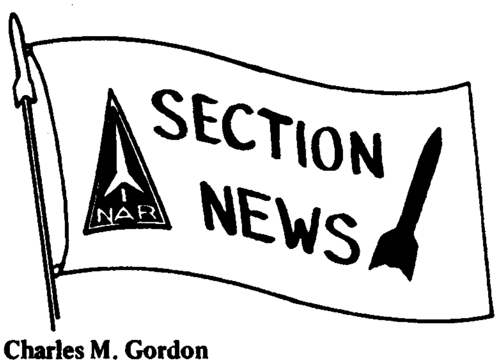
Please enter me in the following events: Event	Official use only: Event No.	Flight Sheet No.
PEEWEE PAYLOAD		
EGG LOFTING		
ALTITUDE CL. 2		
CONDOR B/G		
EAGLE B/G		

FORM NO. CB-1-70

(OVER)

LAC ELECTIONS POSTPONED

The ballot for Leader Administrative Council elections which was to appear in this issue has been withheld due to delays in communication arising from the recent Post Office strike. Many NAR members received their April issues too late to submit resumes and nominations before the May 1 deadline. Late resumes are being accepted and elections have been temporarily suspended pending arrival of other resumes. The ballot will either be held in the next issue or else voting will have to be deferred until NARAM-12. Sorry for the inconvennience.



By Charles M. Gordon

QUICKIE SURVEY – "Try, Try, Again."

A few modelers may remember how last December Section News asked each section to take a "Quickie Survey" of how many members it had as of 12-1-69 and to send it in for publication.

Results of this survey were very discouraging with only eleven sections responding at all with the totals and those totals ranging as of from 11-1-69 to 2-14-70. Only three sections have their totals as of the 1st.

We would like to try again.

Will each section president please have total number of members in your section as of July 1, 1970 sent to: NARSN SURVEY, c/o Charles Gordon, 192 Charolette Dr., Laurel, Maryland 20810.

DO IT NOW!!! – When something happens in your section, from a rocket launch to a special lecture, to a demonstration or display, to *anything*, TELL SECTION NEWS!

So many times, when something happens in a section, the news is received too late to be used while still fresh. To wait even a week can mean as much as a month delay in the reporting of the event.

When something happens, write it down and send it in. DO IT NOW!!!

Members of the Pascack Valley Section (Harrison, N.J.) were given a New Jersey Bell lecture and film presentation "Destination Moon" by Mr. Arthur Emerson, public relations supervisor for the telephone company. This presentation described the planning program for the U.S. space effort and the contributions of the Bell System.

The section also enjoyed a 22 minute color film taken during the Apollo 11 spaceflight. It took them from liftoff to recovery including Astronaut Armstrong's first walk on the moon's surface.

* * * * * * * *

Congratulations to the Santa Clara (California) Rocket Association Section on the publication of Vol. 1 No. 1 of their section newsletter, *HI LIGHTS.* Included in this first issue was a quick description on home-developing of Camroc film.

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ONE DAY REGIONAL – *ZOG 43,* newsletter of the NARHAMS Section (Lanham, Maryland) reports that on July 11th, the NARHAMS, along with newer sections in their area, will host a three event regional contest (ODR?).

The purpose of this contest is to give these sections a chance to break into contest directing as simply as possible.

* * * * * * * *

Many rocketeers know how unsure cluster rocket ignition is for the inexperienced (and sometimes experienced) modeler. The Northside Rocket Club Section (Atlanta, Georgia) has all section members who plan to fly cluster birds first make a test stand firing, igniting the number of engines he plans to use. This idea could well be used by others throughout the nation.

* * * * * * * *

On April 12, The Pascack Valley Section held it's PASVAL-11 Section meet at the Rutgers Stadium in Piscataway, New Jersey. The section reports earning 484 contest points at this meet.

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An interesting note appeared in the March issue of the Xaverian Sections Newsletter (Brooklyn, New York) telling of another use for crepe paper besides streamers. Since it is usually advertised as "flame-proof", crepe paper sheets can make for ejection wadding both cheap and doubly useful.

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The New Hawkeye Section (Davenport, Iowa) wished to hear from other sections in the Iowa and Illinois area on arranging contests. Contact Dan Leckington, 2108 Marquette Street, Davenport, Iowa 52804.

* * * * * * * *

The Annapolis (Maryland) Association of Rocketry Section has surveyed a permanent tracking baseline for their regular launch site. Elevation differences have also been corrected for calculations. This allows for quick and easy setting up at all launches.

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Congratulations to Steel City Section (Pittsburgh, Pa.) for a well run convention 1970.

* * * * * * * *

The South Seattle Rocket Society Section (Washington State) would like to swap newsletters with other NAR Sections throughout the country. Please send them to S.S.R.S., 15824 43rd Street, Seattle, Washington 98188.

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An NAR Section is now being formed in the Fairfax, Virginia area. Interested model rocketeers should contact: Randy Thompson, 10814 First Street, Fairfax, Virginia 22030.

* * * * * * * *

Remember the Pascack Valley Technical Symposium (Mini-Convention) to be held in late September or early October. For details as they become available send to: MINI-CONVENTION, c/o Bob Mullane, 34 Sixth Street, Harrison, N.J. 07029.

* * * * * * * *

The editor of N.A.R.S.N. would also like to thank the following sections for sending in news and/or correspondence for this issue. Sorry we couldn't get yours in but keep it coming and good flying.

Bethlehem ABM's Section
Model Rocketeers of Lodi New Jersey Section
North Jersey Rocket Association Section
Star Spangled Banner Section
Three Rivers Section
Tri-City Cosmotarians Section
Wheaton Rocket Association Section

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The National Association of Rocketry welcomes the following new sections to the organization. These sections were chartered since the last section roster was published.

MIDDLETOWN, ODESSA, TOWNSEND
ASSOCIATION OF MODEL ROCKETRY
c/o Nancy E. Hammond
RD 1 Box 35
Townsend, Deleware 19734

WESTOVER C.A.P. SQUADRON SECTION
c/o Douglas Squires
P.O. Box 231
Chicopee, Massachusetts 01021

EAST COAST EXPERIMENTERS SECTION
c/o Lois Marie Fusco
345 Cedar Avenue
Holmes, Pennsylvania 19043

LUCKY 13 SECTION
c/o Mark Taras
Rt. 1 Box 1497
Montgomery, Texas 77356

HOBBY LOBBY BOOSTERS SECTION
c/o Robert William Miller
P.O. Box 3763
Lafayette, Louisiana 70501

NORTHWESTERN INDIANA ROCKET
ASSOCIATION SECTION
c/o Robert Furr, II
201 South Park
Fowler, Indiana 47944

CENTRAL MODEL ROCKET CLUB SECTION
c/o Richard H. Jones, Jr.
29 International Avenue
Piscataway, New Jersey 08854

PALATINE MODEL ROCKETRY
CLUB SECTION
c/o Vernon Weder
648 East Mill Valley Road
Palatine, Illinois 60067

The following old sections have also rechartered with NAR since the last rooster.

#125 MEMARONECK LARCHMONT
c/o Bernie Ferrer
350 Prospect Avenue
Memaroneck, New York 10543

#128 METRO ATLANTA SOCIETY
FOR EDUCATIONAL ROCKETRY
c/o 3643 Mill Creek Road
Atlanta, Georgia 30319

#163 WHEATON ROCKET ASSOCIATION
c/o Jerome H. Trager
Hobbies Unlimited, Incorporated
Wheaton Plaza
Wheaton, Maryland 20902

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The South Seattle Rocket Society will be hosting PaNoWAM-1 (Pacific Northwest Area Meet) which will be held July 25-26 at the Boeing/Kent Space Center. Events are Class 2 Altitude, Egg Lofting, Swift B/G, Sparrow B/G, Class I Parachute Duration, and Open Spot Landing. Interested modelers should contact Jess Medina, 15824 43rd Avenue South, Seattle Washington 98188.

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SPECIAL REMINDER – This is a special reminder to any model rocketeer who will be writing to NAR SECTION NEWS this summer.

From now until August 10, 1970, the editor of N.A.R.S.N. will be working as a counselor at a summer camp in upstate Pennsylvania. ALL NEWS, submitted during this time *ONLY*, should be sent to:

Charles Gordon
c/o Camp B'NAI B'RITH
Starlight, Pennsylvania 18461

Any news that gets to the regular N.A.R.S.N. address will be forwarded weekly.

PROPOSED AMENDMENT TO THE NAR CONSTITUTION

1. Insert following as Article XII:

Section 1: The Leader Administrative Council (LAC) is an auxiliary body whose purpose shall be to develop Leader member responsibility through the organization of projects which will utilize Junior and Leader member talent in helping to fulfill the purposes of the Association.

Section 2: The LAC shall consist of seven (7) Leader members and one (1) Trustee. The Leader members of the LAC shall be elected annually from the Leader members of the Association by the voting members of the Association for a term of one year, or until their successors are elected. The incumbent LAC members shall organize and execute the election of their successors. The Trustee member of the LAC shall be appointed by the President of the Association.

Section 3: The Trustee member shall be the LAC advisor and liaison between the LAC and Board of Trustees. The Trustee advisor must be kept informed of all LAC plans and activities; but shall have no vote in LAC affairs.

Section 4: All LAC communications to the sections or general membership and all LAC commitments of NAR funds must have the prior approval of the Trustee advisor. The LAC shall submit an annual report of its activities to the Board of Trustees.

2. Renumber current Articles XII, XIII, and XIV to XIII, XIV and XV respectively.

MINUTES OF THE LAC MEETINGS

The following is a summary of the official minutes taken at meetings of the Leader Administrative Council on March 21 and April 4, 1970. Copies of the complete minutes are available to members sending a self addressed stamped envelope to Jay Apt, LAC Secretary, 40 Woodland Road, Pittsburgh, Pa. 15232.

March 21, 1970. The meeting was called to order at 10:27 PM at the Holiday Inn North in Pittsburgh, Pennsylvania. In attendance were LAC members Elaine Sadowski (Chairman), Jay Apt (secretary), Bob Mullane, Joe Persio, Gary Spriggs, and observers Larry Loos, Marvin Lieberman, Pat Stakem, Gordon Mandell, Karl Feldmann, and Dick Fox.

The minutes of the November meeting were not read aloud but were approved unanimously with one minor addition.

Elaine distributed copies of the proposed amendment to the NAR constitution concerning the LAC. The amendment will be discussed at the next Board of Trustees meeting. The members unanimously chose to have the LAC Advisor selected by the NAR President rather than elected by the LAC members. Elaine will notify Jim Barrowman (LAC Advisor) that the LAC endorses the amendment in its present form.

Elaine opened discussion of status reports on LAC projects. Mike Poss wrote Elaine concerning the progress of his computer program for NAR contest data reduction and point accounting. It has been written but is still in the debugging stage. He will have it ready to present at NARAM-12 or sooner. Joe Persio mentioned that Dick Sipes (Contest Board Chairman) already has a program as reported in the March issue of *The Model Rocketeer.* Gary Spriggs said that Dick plans to use the program at NARAM-12. Elaine said that Mike's program will be used for local and regional contests.

Gary reported on his efforts to prepare an administrative structure chart of the NAR. He has written both Dr. Beetch (NAR President) and Bryant Thompson (Vice-President) but has received no replies. Joe suggested that a flow chart be constructed from the NAR by-laws and send it to Dr. Beetch for approval. Gary agreed to do this.

Gary also gave the following report on selection of International Championship Teams: The size of the team should be determined by the amount of money available. The opportunity to attend the Internats, he feels, should be extended to the Senior, Leader, and Junior National Champions and one member of the National Championship Team. If they cannot all attend then the respective reserve champions should replace them. In addition, observers should be sent as NAR representatives. He said that Dick Sipes envisions regional eliminations for NARAM by 1973. Gary said that a 13 month lead time should be allowed to select a team. Jay Apt commented that selection by total contest points will not necessarily produce the best team because, for example, a great scale modeler might not be able to enter every possible meet in a given contest year. Gary said that selection by committee would be biased towards modelers known to them. Jay said that unknown modelers are probably not as good as the known ones because they have never been honed by competition.

Gary said he will detail the regional elimination procedure in a forthcoming open letter. At this time he left the meeting to catch his return transportation.

Bob Mullane made two points about Internats selections: 1. Going on the basis of a single meet will not necessarily produce a team of the best rocketeers. 2. The Internats requires modelers with specific skills, not overall champions, therefore we should have selections by committee which could base its decisions partly on contest performance. Larry Loos noted that the Europeans selected their teams by committee. Jay read the paragraph of the minutes of the November meeting which reported discussion of the Internats selection. Elaine, Jay, Joe, and Bob decided that their method was best of those already discussed.

The discussion was then directed to the make-up of the selection committee. After several suggestions were made, Gordon Mandell recommended that the following heirarchy of selection boards be established: a 5-man primary board which would decide among people brought to their attention by several means including petitions, nominations from members of the board, and having won an event being flown at the Internats at the last previous NARAM. Anyone who is dissatisfied with the selection could appeal to a 3-man appeal board. He could further appeal the board's decision, if not unanimously made, to the NAR President.

Larry Loos offered his services to Greg Scinto to help write the new Section Manual chapter on Photographs.

The meeting was recessed at 12:30 AM (March 22) for dinner and reconvened at 1:30 AM.

Bob then gave reports on the LAC projects for which he is responsible. Reporting on the project to write a new NAR flyer, he said that Jim Kukowski has already re-done the flyer. He said that John Worth has asked the LAC to send in copy and lay-out for a one-page flyer for inclusion in manufacturers kits. Bob has sent this to Worth. Gordon Mandell said that the cost of 100,000 copies of a 1-page, 1-color flyer is about $365.

Bob then presented a report on NAR Technical Services. He commented that any new O&P reports should be done by Dick Sipes or someone else in close contact with the Contest Board. He stated that NAR evaluation seminars held at three places last year indicate that new O&P reports are badly needed. Dick Fox said that except for the jacket patches and decals NARTS is outclassed by the manufacturers and **Model Rocketry** magazine. Gordon suggested that NAR produce certain basic reports on tracking, etc. which can be done better than manufacturers due to their product prejudices. Bob will contact Dr. Gregorek (Standards and Testing Chairman) about obtaining engine test data sutiable for NARTS publication.

Jay said he would contact Mrs. Thompson about sequence of NARTS ads to be run in *The Model Rocketeer.*

Joe then gave his report on the new LAC election procedure. A notice will appear in the April, 1970 issue of *The Model Rocketeer* announcing the elections. Candidates resumes and a ballot will be published in the July issue. Bob said that the newly elected LAC should have a meeting of NARAM.

Larry Loos said that he had been appointed Press Director for

NARAM-12 and asked for the LAC's assistance. He will need help in escorting the press, and directing camera men.

Noting that the LAC would meet again at the MIT Convention the meeting was unanimously adjourned at 3:00 AM.

April 4, 1970. The meeting was called to order at 9:53 PM at the MIT Student Center in Cambridge, Massachusetts. In attendance were LAC members Elaine Sadowski (Chairman), Jay Apt (Secretary), Bob Mullane, Joe Persio, and observers Lindsay Audin, Carl Kratzer, and Doug Malewicki.

Joe Persio wished to have added to the minutes of the March meeting that he believes future LAC members will not be mature enough to chose their own advisor. The minutes were then unanimously approved with that correction.

Elaine called upon Jay Apt to discuss the revised edition of the NAR Section Manual. Jay said that he had talked with Jim Barrowman (LAC Advisor), who advised delaying final offset-printed form of the manual until December while obtaining comments from Dick Sipes and Bob Atwood in the meantime. Jay had told Jim that since the LAC had been receiving requests for the manual a preliminary edition would have to be printed before NARAM-12.

POINT STANDINGS AS OF APRIL 1, 1970

Junior Division:	Points	Factors used
1. John Albert	395	4
2. Carl Guernsey	303	3
3. Craig Streett	279	4
4. Gary Lindgren	252	3
5. Barry Friedrichs	242	4
Leader Division:		
1. Mark Evans	569	4
2. Mark McGaffey	384	4
3. Bob Deleon	335	4
4. Chris Williams	306	3
5. George Pantalos	260	3
Senior Division:		
1. Forrest McDowell	545	4
2. Maurice Stubblefield	339	3
3. Bernard Russell	346	4
4. Shirley Lindgren	291	3
5. Gerry Gregorek	241	4
6. L. Streett	241	4
Team Division:		
1. Brewer-Hamon	198	3
2. Meerdter-Meerdter	156	3
3. Ball-Hagedorn	141	3
4. Sipes-Sipes	128	4
5. Barrowman-Barrowman	126	3
Sections:		
1. Apollo-NASA	4746	4
2. Pascack Valley	1737	3
3. CSAR	1709	4
4. MARS	1626	4
5. YMCA Space Pioneers	1006	2

MORE NARAM-12 INFORMATION

NARAM-12 will be held at the NASA Manned Spacecraft Center near Houston, Texas on August 16-21, 1970.

Entry fee is $1 per event and a minimum of six out of the nine events must be entered.

Housing for contestants, range crew, parents, and other NARAM officials will be provided at the Ramada Inn, Holiday Inn, and Sheraton Inn. All three motels are located within walking distance of the launch field although transportation will be provided for the lazy. Housing cost is $4.50 per person per night with three people in each room (three single beds). Motel reservations for the parents of contestants can be made through the NAR.

The launch field measures approximately 3000 by 6000 feet with the longer dimension in the direction of the typical wind current.

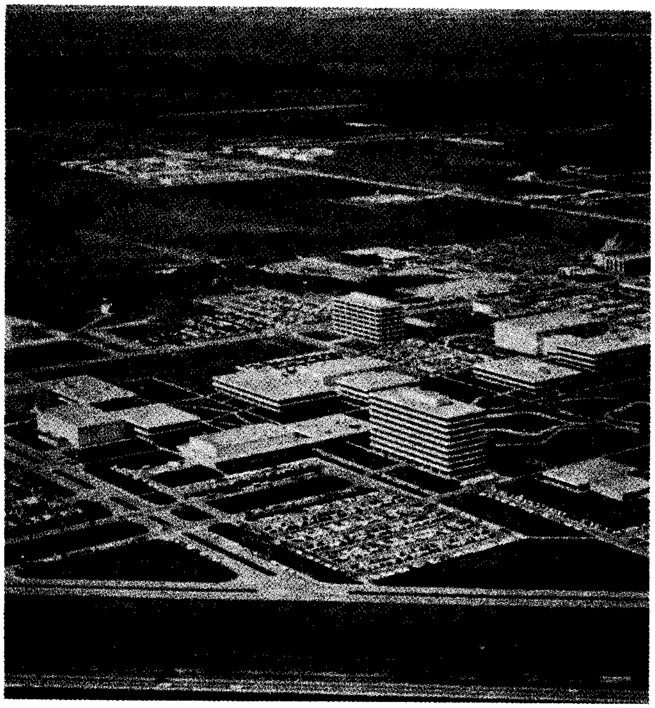
The weighting factor for Research and Development will be zero (no contest points awarded). However, a special set of trophies will be given to the first, second, and third place R&D winners in each age category.

NARAM-12 is being hosted this year by Apollo-NASA section with Forrest McDowell coordinating activities with the Contest Board.

The Houston-Galveston vicinity of NARAM-12 offers the greatest family facationing opportunities that have ever been available for a National Championships. The area offers public beaches, fishing piers, an aquarium, zoos, golf courses, museums, planetariums, botanical gardens, the Albert Thomas Space Hall of Fame, and many other possibilities to visitors. Within the Manned Spacecraft Center there is a wealth of informative and interesting tours and exhibits including the Central Data Office, the Flight Acceleration Facility, and the Mission Simulation and Training Facility.

This year contestants have an opportunity to participate in the largest Nationals yet, fully computerized for efficiency and accuracy, and reasons to bring the whole family along too. NAR can make motel reservations for the parents of contestants also.

New NARAM-12 Site



Aerial view of the Manned Spacecraft Center at Houston, Texas. The launch area is indicated by the arrow. This view is looking northwest. (NASA Photo.)

DEALER DIRECTORY

(Club Notes, continued)

Simpkins, c/o The Federation, 3042 Atwater Drive, Burlingame, California 94010.

On April 19, 1970 the Nova Model Rocket Club and the Virginia Rocket Center, a local hobby shop, sponsored a public launch to promote model rocket safety to the people of the Richmond area. The launching was held at the Henrico county police station. Over 50 rockets were launched from the club's ten position launcher and only one was lost. In April Nova President Bill Ritchie appeared on a local television program to discuss the differences between "basement bombers" and model rocketeers. The club is still looking for new members in the Richmond area. Rocketeers can contact Bill Ritchie at 1303 Beverly Drive, Richmond, VA 23229 or phone 282-3926.

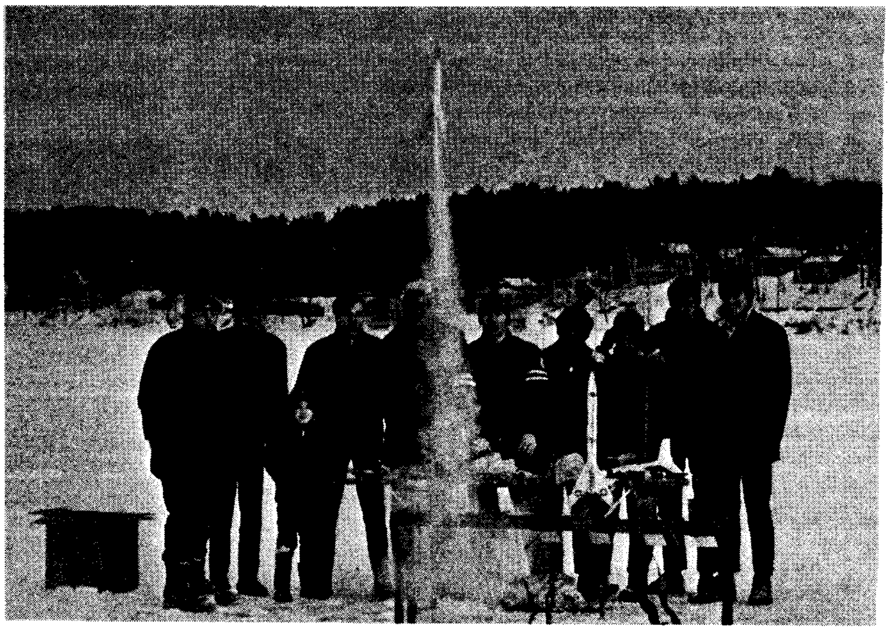
Another new club is being formed in San Francisco. Interested rocketeers should contact Gerald Louie, 1344-A Mason Street, San Francisco, Calif. 94133 or phone 981-6043.

The Green Bay, Wisconsin Park Board approved the use of Perkins Park in Green Bay as the site of three model rocket competitions sponsored by the Brown County Squadron of the Civil Air Patrol. Chet Miller, Park and Recreation Director, encouraged the rocket contest as a unique new use of city park areas, and the board gave unaminious consent to the request. Randy Peterson, meet launch officer, explained to the board that 30 to 40 competitors were expected to compete at the meets which will be open to the public.

Thirty one model rockets were launched during a 90 minute demonstration sponsored by the Aerospace Research Association of Northwestern Pennsylvania. The demonstration, held in mid-March, was conducted at the county fairgrounds. About 100 spectators were present at the launching, even though bad weather and high winds hampered the activities.

The Saginaw Institute of Model Rocket Assembly and Design (SIMRAD) of Saginaw, Michigan, held a "Man in Space Day" on May 17th, 1970. About fifty rockets were launched in this scale event. The club also plans a contest for June 21, 1970. SIMRAD meets each Sunday at the local high school for a launch. Interested rocketeers can contact Roger Schneider, 934 Thurman Street, Saginaw, Michigan 48602.

The Space Explorers Rocket Club is looking for new members in the Greenwich, Glenville, Byram, Connecticut area. The club would also like to start a NAR Section in Greenwich, Connecticut. Any adult and rocketeers interested should contact Jim Waurishuk, 178 Weaver St. Greenwich, Connecticut 06930. Phone 531-6882 or Bob Jackson, 176 Weaver St. Greenwich,



A model rocket club has been formed at St. Dominic Regional High School in Lewiston, Maine. Organized by students Paul Giguere and Pierre Bosse, under the supervision of science teachers Louise Forgues and Sister Edwina, the society has been very active in its first three months. The members raffled off a portable radio to raise the $70 needed to purchase tracking theodolites and a public address system. The club plans to use a six pad firing system and the range communications equipment formerly owned by the disbanded Lewiston Model Rocket Society. Two club launchings were held in the sub-freezing winter weather, and a series of competitions and demonstration launchings are scheduled for the spring. Currently club members are involved in several projects including the development of a tracking light system for night launched model rockets, experimentation with various nose cone shapes, an investigation of the Krushnic effect, construction of a low velocity wind tunnel, and the design and development of several new and unusual rockets.

Connecticut 06930.

The Monroeville Association of Model Rocketry of Monroeville, Pennsylvania is looking for new members. The club was organized in 1964 under another name, and is now being reorganized after several years of extinction. Rocketeers interested in joining the club can call Mark Olsheskia (372-8341) or Paul Bittner (372-0382).

The Kokomo High School Rocket Club in Kokomo, Indiana, held its first contest on April 12, 1970. Eighteen contestants participated in the launching of over 70 rockets. Russ Kuhn of Columbus, Indiana, took first place overall in the contest, Jeff Becker and Bill Ingrum launched a series of demonstration rockets including a Centuri Nike-Smoke and an FSI Penetrator. Gift certificates from Van's Hobby Shop in Kokomo were awarded as prizes.

Rocketeers in Bollinger and Cape Counties in Missouri interested in forming an NAR Section should contact Jeffery D. Estes, Route 1, Box 40, Marble Hill, Missouri 63764.

The Annapolis Association of Rocketry reports, in the latest issue of *The Voyager,* that their February 14th practice shoot was held as scheduled. The weather: 14 knot wind from the North, 28 degree temperature, moderate to heavy snow. Despite the inconveniences caused by the weather, 36 rocketeers showed up for the launch.

Pennsylvania's North Pittsburgh Rocket Club and Three Rivers NAR Section held their elections on January 28th. The results, reported in the Three Rivers *Contrail,* are as follows: Dennis Brandl, president; Rich Labash, vice-president; and Tom Wuellette, secretary-treasurer.

Houston's Apollo-NASA Section staged a demonstration launching at Thumb Park in Lake Jackson, Texas on Washington's Birthday. The demonstration, similar to Apollo-NASA demonstrations at the Six Flags Over Texas amusement park and their Astrodome launch, was designed to stir up model rocket interest in the area, and encourage Lake Jackson rocketeers to start a club.

On Saturday January 24, 1970, the Albuquerque Model Rocket Club, located in Albuquerque, New Mexico, hosted its regular monthly launch. According to the report contained in the ARC-Polaris *Constellation,* over 225 persons, ranging from Albuquerque youngsters to engineers at the Sandia Corporation, attended the launch. The club, which regularly launches from Albuquerque Academy, has a launching facility including two multiple position launch racks allowing 15 rockets to be launched. Jas. O. Ebaugh, who worked at White Sands during the V-2 program, was a special guest at the launch, and participated in the firing of a scale V-2 model. Since its organization, only one year ago, the Albuquerque Model Rocket Club has been one of the most active clubs in the Southwest.

On March 7th, twenty-two members of the Maryland's Annapolis Association of Rocketry gathered at the Bay Ridge Club House to view the solar eclipse. At exactly 12:27 PM Sam Atwood, AAR president, first noticed the moon's disc making contact with the sun. Most club members viewed the eclipse through one thickness of exposed film, but one member, Beth Dees, used a telescope equipped with special filters to give an enlarged view of the eclipse. Though the eclipse was not total in the Annapolis area, club members did notice a temperature drop in the area.

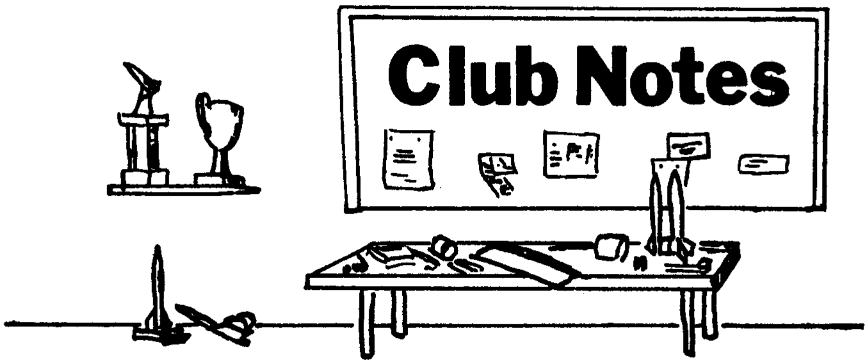
The South Seattle Rocket Society would like to swap newsletters with other clubs and NAR Sections. They request you send your newsletter to SSRS, 15824 43rd Street, Seattle, Washington 98188.

The Spartans Rocket Club of Chicago, Illinois has been organized. The club, which presently has eight members, is seeking new members in the Chicago area. Interested rocketeers should contact Brian Freeman, 3705 W. Belden, Chicago, Illinois 60647.

The Brandywine Hundred Rocket Society (BHRS) has been organized in Wilmington, Delaware. Club officers are Martin Smith, president; Rock Ferris, vice-president; and Steve Stein, secretary-treasurer. The club meets weekly at the nearby YWCA. Launches are held every two weeks on Saturday. The club, with 12 members, is presently constructing a new electric launch setup. Wilmington, Delaware, rocketeers interested in joining the club can call Martin Smith at 475-4816 or write Rick Ferris at 2029 Kynwyd Road, Wilmington, Delaware.

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

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



The latest issue of *Emanon,* newsletter of the New Canaan, Connecticut, YMCA Space Pioneers, reports the results of their April 18th contest. In the Scale event Harry Stine took Senior first place with an Arcas while Sven Englund won in the Junior division with a Vostok. In Plastic Model Harry Stine placed first in Senior with a Hawk Jupiter C, and Rob Dunbar took Junior first place with a Revell LM. In addition AMT Saturn V and Revell Gemini plastic models were flown by A. Jacobsen and the Sr. Englund Team respectively. E. Goodwin took first place in Sr. Spot Landing with 22.27 meters, while Mike Mooney won in the Junior Division with 10.50 meters. A Jacobsen and Rob Dunbar took first place in Senior and Junior Drag Race respectively. In Class 1 PD Harry Stine took first with 64 seconds, while Bill Fraser took Junior first with 85 seconds. In the Sparrow B/G competition, D. Joseph took first in the Senior Division with 62 seconds, while Rob Dunbar took first in the Junior Division with 35 seconds.

This contest raised the Space Pioneers total contest points to 1538 for the 69-70 contest year. Rob Dunbar is leading the club's Juniors with 147 points, while A. Jacobsen leads the Seniors with 155 points.

On April 5th the Space Explorers of Greenwich Conneticut, held a model rocket competition. In Class 1 Altitude Jim Waurishuk took first, while Joe Bellantoni placed first in Class 2 Altitude, and Dom Archino placed first in Scale Class 2 Altitude. John Kovach placed first in Swift B/G, and Alan Carlo won the Parachute Duration event. The club is presently planning a joint competition with the Western Junior High School Rocket Club.

A new NAR Section is in the processes of being organized in Burlington, Indiana, 15 miles west of Kokomo, Indiana. The Burlington Organization of Astronautical Sciences will be under the direction of Senior Advisor David Brewster. Rocketeers interested in joining the club should contact Brian Ruby, Box 218, Burlington, Indiana 46915.

The National Aeronautics of Sayre Avenue in Perth Amboy, New Jersey has changed its name to the Raritan Valley Rocket Research Society (RVRRS). The club plans to join the NAR, and welcomes inquireries from interested rocketeers: RVRRS, c/o Daniel Tucci, 542 Sayre Ave., Perth Amboy, New Jersey 08861.

The Cedrom Rocket Research Society of Canarsie, Brooklyn is looking for new members. Interested rocketeers should contact James Castiglione at 241-2160 or David Druven at 291-6944.

The Model Rocket Club at Berrendo Middle School in New Mexico held its second model rocket launching on April 1. The club, sponsored by science teacher Dean Jackson, was organized as a school activity so that students could learn more about model rocket construction and operation. Doug Hunton took first place in the club's second launch with a flight to 1,388 feet, while Bruce Harrington taking second with an 883 foot flight.

A model rocket club has been organized at Milford High School in Milford, Massachusetts. The rocket club is part of the science club program under the direction of Mrs. D. Lockitt. Recent club activities, including the launching of a goldfish in early April, have been covered by the Milford News.

On April 12th New Jersey's Pascack Valley Section held a Section meet at Rutger's Stadium in Piscataway, New Jersey. Twenty-nine club members attended the club's eleventh and biggest Section competition. Events included Scale, Plastic Model, Class 1 PD, Hornet B/G, and Egg Lofting. PVS accumulated 484 contest points at the meet.

On July 11th, 1970 Maryland's NARHAMS NAR Section, along with some of the newer sections in the area, is sponsoring a three-event regional contest. The purpose of the meet is to allow many of the newer sections in Maryland to gain experience in running a large contest.

Jerry Absher would like to start an NAR Section in Butte, Montana. Interested rocketeers should contact him at 1138 W. Park, Butte, Montana, or phone 792-0689.

An NAR Section is being formed in the Hardin County Kentucky area. Interested rocketeers should contact Terry Dean (NAR #16158), 306 Cheryl Ave., Vine Grove, Kentucky, or phone 877-5898.

A new model rocket club is being formed in the San Francisco Bay Area of California. Area rocketeers interested in joining this club should contact Shaun

(Continued on page 46)

November 7th, 1969 was the date of the Gamma-1 (Grafton Aerospace Model Missile Association) model rocket contest. Though the club had sponsored contests before, this was to be the biggest yet. Posters were put up in the local hobby shops and grade schools, and Jeff Nichols of the Nicolet High School Rocket Club in Milwaukee was contacted.

We developed a new scoring system for use in this contest. Four events — Single-Stage, Multi-Stage, Cluster, and Boost/Glide — were scheduled. Points were assigned for: 1) the appearance of the rocket, 2) the condition after recovery, 3) percentage of rocket recovered, 4) altitude, 5) payload weight carried, 6) type of recovery system, and 7) flight performance. In each category a maximum of five points could be awarded. In addition 2 points were given for semi-scale models, and 3 points for exact scale.

After judging for appearance, the single-stage competition began. There were a number of spectacular flights, with over 3/4 of the contestants catching their rockets in mid-air to avoid being penalized for landing damage. Mike Pusch came in first place with his scale Arcon. It reached an altitude of 650 feet carrying a 2 ounce payload. Tied for second place were Jeff Laydon and Tom D'Amico. In the Multi-Stage competition James Veloon took first place with a Delta which flew to over 1000 feet.

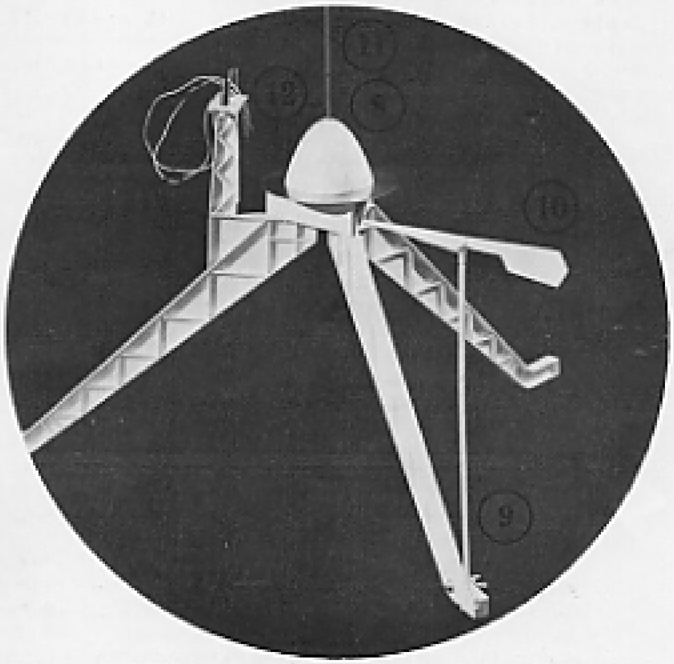
The first cluster model flown was a scale Saturn-V built by Jeff Quandt. Spectators watched as the rocket lifted off, climbed to an altitude of 10 feet, turned, and crashed. First, second, and third places in this event went to Jim Veloon, Mike Pusch, and Tom D'Amico, all flying Estes Cobras.

In the boost/glide competition the first launch was made by Tom Wolfenberger, one of the youngest competitors in the meet. His design, the "Slippery Joe," was OK except that the rudder was mounted directly behind the engine tube. Needless to say, the "Slippery Joe" didn't do too well. His multi-stage rocket, however, had made a gliding return, and we discovered that if he had entered his multi-stage bird in B/G, he would have taken third place. As it was, Jim Veloon took first place with an 18 second flight, Mike Pusch took second with 13 seconds, and Wayne Davis, flying an Orbital Transport, took third with 10 seconds.

— Jim Veloon

ONE GOOD THING...

LEADS TO ANOTHER



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