MODEL ROCKETRY

December 1969
50¢

The Journal of Miniature Astronautics
Incorporating THE MODEL ROCKETEER

BUMBLE BEE
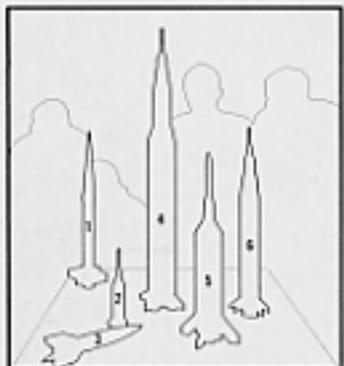(HORNET BOOST GLIDER)

YUGOSLAV NATIONAL CHAMPIONSHIPS

EXPERIENCE

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4	Saturn V	(1/100)
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engines not included in kits.

Take a close look at the model rockets pictured above. They're fine examples of the new, top-quality kits now available from Centuri Engineering Company. These accurately scaled historical models incorporate ultra-lightweight materials and new simplified construction techniques. Specially molded and formed parts duplicate the exact details needed to win those scale contests and science fairs. They look terrific . . . and fly great too!! All of these and many, many more are included in the world's largest model rocket supply catalog that's just been published. One hundred exciting colorful pages for just a quarter — and we'll refund the quarter on your first order too! Send for your copy today — right now — hurry!!

Cover Photo

The Soviet RD-107 "Vostok" shown on this month's cover was built by Aleksander Stojanovic of Nis, Yugoslavia. This 1/50 scale model was featured at the 1969 Yugoslavian National Championships this September. Power was by 5 engines, one in the core and one in each of the strap-ons. Coverage of the Yugoslavian Championships begins on page 4.

(Cover photo by G. Harry Stine)

From the Editor

This past year has been one of remarkable growth for the hobby/sport of model rocketry. The number of rocketeers in the nation has practically doubled this year. New manufacturers, bringing with them *new ideas,* have entered the model rocket market. Plans have been worked out for the first international model rocket championships, to be held next year in Yugoslavia. The membership roster of the National Association of Rocketry – responsible for competition in this country – has grown to its largest in that organization's 11 year history. Rocketry, all but dead on the West Coast only four years ago, has shown a remarkable resurgence in California, Washington, and Oregon due to the enthusiastic efforts of several interested individuals.

From the manufacturers, we can expect these innovations to continue in the upcoming year. The merger of Estes Industries with Damon Engineering is expected to have two effects on the hobby. First, the expansion of Estes production facilities and continued efforts in the Research and Development field should allow developments like the CINEROC movie camera to be introduced more widely. Second, the Damon experience in manufacturing small scientific equipment suggests that an effort may be made to introduce instrumentation and test equipment into model rocketry. Production of model rocket instrumentation by the newly announced Micro Instrumentation and Telemetry Systems Company should also encourage the research minded rocketeer.

The re-introduction of plastics into the

Letters to the Editor

"Foxmitter" Data

I have subscribed to and read your magazine for a year now and I am very impressed with your coverage of the model rocketry hobby. One of the ways in which your magazine is a great help to the hobby is through the exchange and general communication of ideas, products, and research which is currently being conducted. It is in this area in which I need a little help from your magazine.

I am researching a project on the relative changes in temperature with respect to altitude, using the "Foxmitter" as my main tool. I would like to carry my results farther than just the area where I live in order to come to a general conclusion about temperature effects in the lower atmosphere. If there is anyone else in the realm of your magazine who has conducted any related research about atmospheric temperature, a detailed report of their work would be very helpful in arriving at a true picture of this region of the atmosphere.

When I finish my report, material will naturally be acknowledged as to the author and the work which he did. Copies of the compiled report would also be sent to any interested contributors.

I would like to ask that if one decides to send me a report, please include all details about the flights, data received, and anything which in any way would be helpful. Also please make the reports neat and accurate.

Thank you very much for your help, and I hope something of real value will come from the compiling of this knowledge, proving that model rockets serve a definite purpose in scientific research.

Larry Shafer
Rt. 3 Box 290
Westminster, Md. 21157

Best of luck with your project. Perhaps other readers will be stimulated by your efforts to conduct similar research of their own.

Research and Development

Are the NAR Research and Development events doomed to be stereotyped into strictly engineering projects or is there still a chance that allowances can be made for truly interdisciplinary research, using model rockets as an integral part of such research?

This is the issue that the NAR must meet head-on and resolve quickly; or else many bright research-minded model rocketeers will drop R&D events like a hot potato.

NARAM-11, where some fine inter-disciplinary research projects were disqual-ified because they were not single-mindedly restricted to model rocket research, is a good case in point. This was particularly true in the Junior Division where we most need to develop the truly scientific approach to research! Apparently some of these youngsters know far better than their elders the true scope of present-day scien-tific research!

I see a great potential for good in the NAR. Indeed I am so impressed with this valuable service that I am serving as an adult section advisor; however, I shall continue to feel somewhat disappointed until we de-velop into a truly scientific organization. Neil Armstrong was much more than a journeyman engineer—he was also a scien-tist!

Let's shake ourselves loose and get where the action is! Let us encourage R and D projects that are truly interdisciplinary!

Carl W. Guernsey, NAR 11279
NARCAS Section
Camp Hill, Pa.

More Math

I wish to commend you on the increased value of technical and R&D articles. How-ever, there has been a slack off in math articles in recent issues of your magazine. I am aware that you have no direct control over this, but perhaps this will stimulate George Caporaso or Doug Malewicki to get their heads churning and produce one of their valuable mathematical works of art.

Tyndall Epps
Raleigh, North Carolina

Index MRm

I would like to compliment you on your first anniversary as a magazine. As a charter subscriber I have enjoyed it to the fullest, with the help of your friend Dick Fox.

Any good technical or semi-technical magazine like your own always, at least to me, improves 100% when it is indexed, especially by the year. As a model rail-roader, Kalmbach's indexed magazines have always been invaluable to me. I, for one, would be greatly aided if Model Rocketry were indexed.

At any rate, keep up the good work!

Douglas List
NAR 12273 JR
Bethlehem, PA

Competition Coverage

I'm glad there's a magazine for model rocketeers now. I've been launching rockets for three years now and knew nothing about National or Area competitions. I'd heard about NAR but didn't know how to join. I'm going to wait until next month's issue and use the application form included.

I hope you keep up the good work you have done on a great magazine. I like the technical articles, although I don't under-stand them. I suggest a beginners series or a glossary of technical terms so that its a little easier to understand what you're talking about. I've done my own research but many of your articles, especially the ones about Dynamic Stability, are far beyond me.

Ronald Blakemore
Poughkeepsie, New York

From Canada

A couple of days ago while in a local hobby shop, to my surprise, there was a magazine devoted entirely to model rocket-ry. I grabbed it, paid the 50c and raced home to read the entire magazine from cover to cover. I think your magazine is terrific! To my knowledge, yours is the first and only model rocketry magazine sold in Canada, and its a lot better than paying more for just a couple of pages in an airplane magazine.

David Carey
Regina, Saskatchewan
Canada.

Corrections to Conical Stability

Several typographical errors occurred in the article on Conical Stability featured in the October 1969 issue of Model Rocketry. The correct values for the C_D's are as follows:

Apex 1
$$C_{D_{eff.}} = .29 \qquad C_{D_{true}} = .34$$

Apex 2
$$C_{D_{eff.}} = .35 \qquad C_{D_{true}} = .41$$

Apex 3
$$C_{D_{eff.}} = .39 \qquad C_{D_{true}} = .46$$
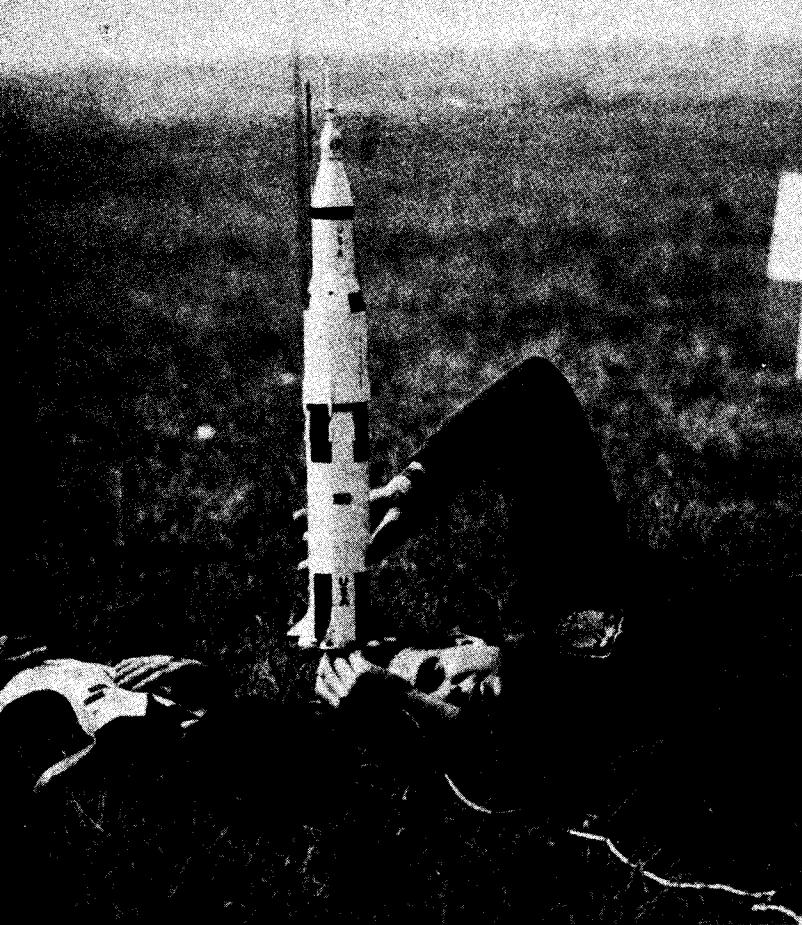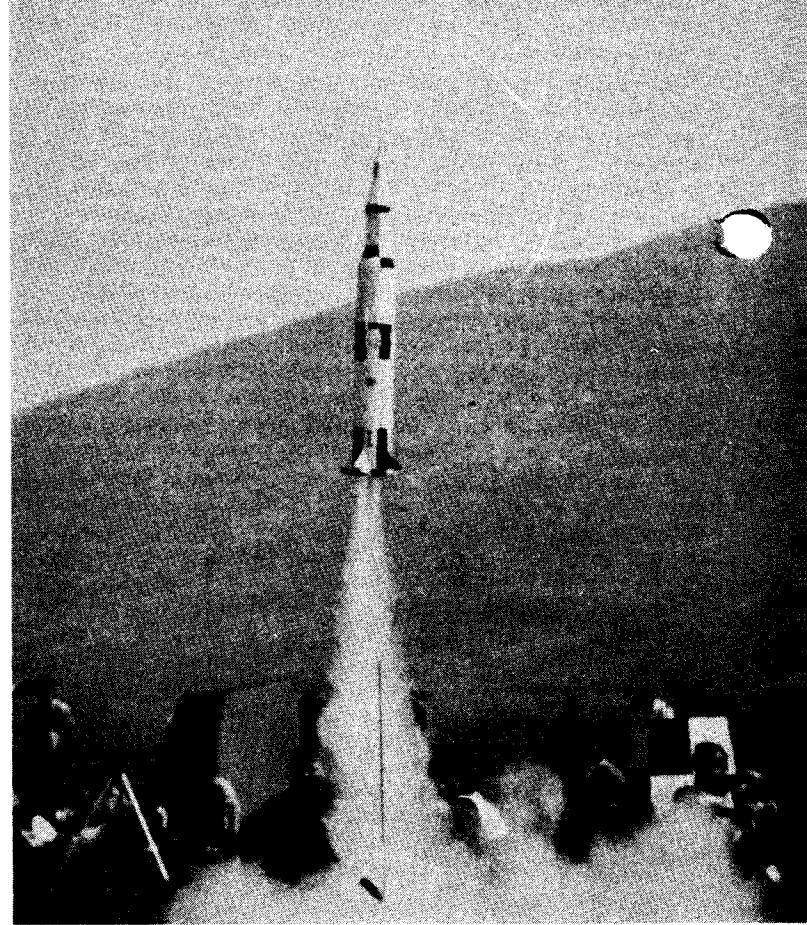
An "international" NASA Saturn-5 model being prepared for flight by Zygfryd Franckiewicz of Torun, Poland. The rocket was powered by a cluster of 5 Type C6-4 motors.

(All photos by Stine)

VRSAC:
CROSSROADS OF EUROPEAN ROCKETRY
YUGOSLAV NATIONAL MODEL ROCKET CHAMPIONSHIPS

Reported by G. Harry Stine

The place: a level, treeless area stretching for kilometers in all directions. The valley of the Danube River, ancient invasion route to Europe through which the armies of Rome, Ghengis Khan, the Huns, the Tartars, the Germans, and Turks, and the Russians have marched and countermarched for centuries, raping and looting as they went. Now an airfield for the training of aerobatic pilots, sailplane pilots, and parachutists for sport while an ancient Turkish bastion looks down from the nearby heights.

Now, today, September 27, 1969, the year of the Moon, the skies are filled with model rockets.

Vrsac, Yugoslavia.

The 5th National Yugoslav Model Rocket Championships.

150 contestants, also teams from Poland and Czechoslovakia.

Otakar Saffek from Prague with his cameras and beautiful scale models.

Dpl. Ing. Kosta Sivcev, a great Yugoslav aeronautical engineer and designer, president of the Yugoslav counterpart of the NAR, my genial host and translator.

Some of the most fantastic parachute and boost-glider flying I have ever seen.

And, surprisingly, the most attractive and accomplished young lady rocketeers in the world.

Fantastic offers for the Apollo 11 patch on my jacket.

Youngsters, shy at first, who had never in their lives before seen an American.

Gypsies – real ones – herding their sheep across the airfield.

8000 calories-per-day meals.

The helpful hands, the smiling faces, the communication between model rocketeers in spite of the language barrier . . .by means of hand waving, pointing, sketching, and similar words.

These are just some of the memories that I carry with me as a result of an official invitation from the Yugoslav Aero Club to attend their 5th National meet which was to serve as a shake-down for the forthcoming First World Championships for Model Rocketry. If all goes well, the World Championships will be flown on the same field at Vrsac (pronounced "Ver-shats" with the accent on the second syllable) in September 1970. Would I come to Yugoslavia for this national meet to criticize their facilities, contest operation, and general techniques? Would I help them? The answer was yes, and I went.

Belgrade is reasonably easy to get to by air, and I was greeted upon my arrival at the airport by Kosta Sivcev, the president of the Yugoslav rocketry commission. By car, we drove from the Yugoslav capital city of one million souls to the town of Vrsac some 82 kilometers northeast along a good two-lane paved road in a Yugoslav-built Fiat driven by a Yugoslav with lightning reflexes and an over-abundance of daring. At 120 km/h we dodged between farm wagons, tractors, and on-coming cars and trucks. In a matter of less

Every rivet and weld was in its proper place on Otakar Saffek's scale model of Little Joe II QTU powered by 7 ADAST motors.

(Above) M. Pintaric of the Osijek (Yugoslavia) club team prepares to place his scale Mercury-Redstone on the launcher. Model used 5 Madzarac motors in cluster.

(Below) Natasha Barac of Yugoslavia (left) is assisted in hooking up her scale model of the French Veronique rocketsonde by the other members of the Osijek club team.
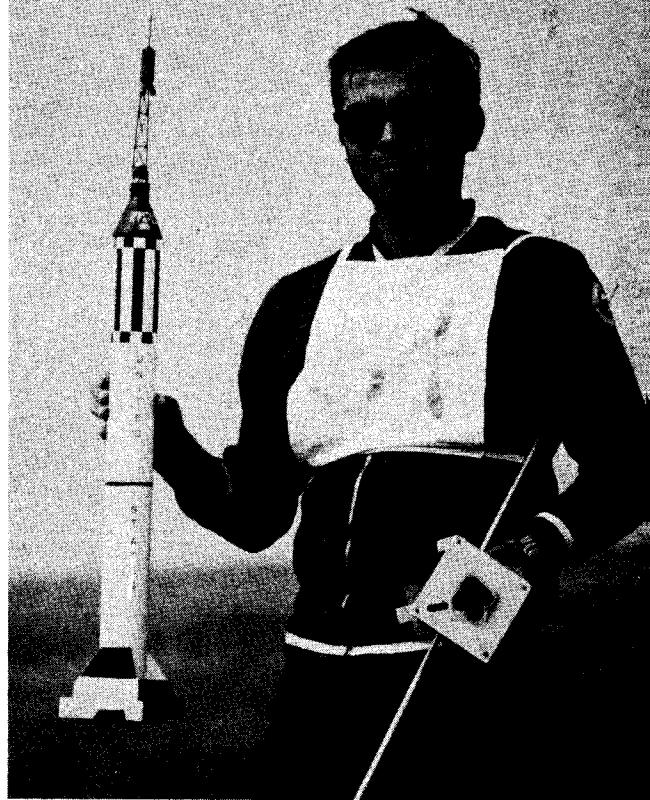
than two hours, we were in Vrsac, a town noted for its two beautiful churches — one Roman Catholic and the other Eastern Orthodox — and its fabulous grapes and wine. Located at Vrsac is the Saveznog Vazduhoplovnog Centra. Don't try to pronounce it. It's the main Yugoslav sporting aviation center. Two large dorms, a big mess hall and recreation building, and a large edifice housing the administrative offices and classrooms. I was told that the Center was capable of and used for the training of commercial transport pilots, that they even had three Link trainers for instrument flight training.

As we were shoe-horning my baggage out of the little Fiat, a large form appeared through the early evening gloom, saying hello in English. It was Otakar Saffek from Prague, Czechoslovakia. With the recent unpleasantness in Czechoslovakia, I had not expected to see him in Vrsac. But he had come as part of the Czech team. Saffek is perhaps the best model rocketeer in Europe in addition to being a top-notch engineer. You've all seen his photographs in these pages.

The next morning, everyone left for the flying field about one kilometer away. The weather was beautiful. No clouds. Deep blue sky. Not a breath of wind blowing. "We're in luck," I was told. "When the wind blows here, it comes in hard up the Danube Valley." Our luck held during the entire two days of the meet. The day after the meet was finished, the wind blew so hard that one could hardly stand up against it.
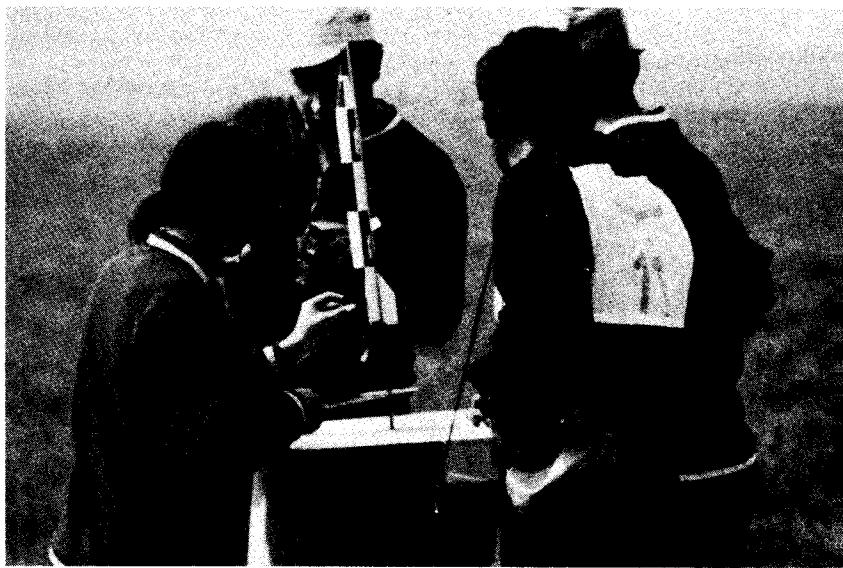
The field was great! The best place I have ever seen for flying model rockets. No trees. No rivers. No barriers to prevent you from chasing rockets for miles . . . except for the fact that the Rumanian border is but 7 kilometers away. I could see a possible major diplomatic crisis cropping up if any of my own models, bedecked in American flags, should happen to drift across that border! What would happen if an American rocket landed in Rumania? After all, my Parachute Duration model at Dubnica, Czechoslovakia had been found 17 kilometers away in 1966 . . .

Parachute Duration was the event flown that first day at Vrsac. Under the Yugoslavian rules, the model does not have to be returned. But with the dead-calm weather conditions that day, it didn't make any difference. No models were lost. And flight times were fantastic.
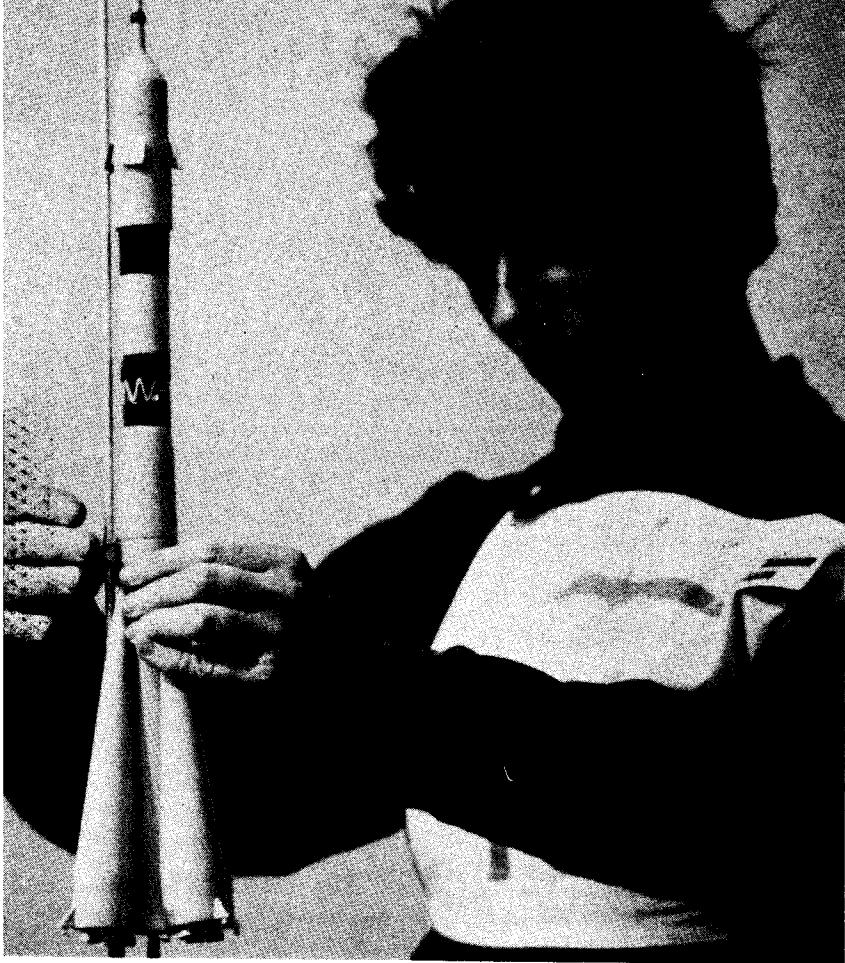
In the Parachute Duration competition, R. Petrovic of Nis, Yugoslavia clocked the fantastic flight time of 1478 seconds and recovered his model. V. Paravina of Nusic, Yugoslavia was second with a flight duration of 862 seconds!

There were several reasons for these very long durations. First, the weather was ablolutely perfect. No wind at all. Clear blue sky. No trees. Very little thermal activity to carry PD birds up-up-and-away. Second was the type of the biggest and lightest chute they can put in. A typical parachute duration model used a 20-mm tube about 130 mm. long with an ogive balsa nose and four highly-swept fins. The parachutes were 500 mm, 600 mm or even 1 meter in diameter with 8 or 12 shroud lines made of thread. The chute mateials varied, but were usually quarter-mil polyethylene cut

(Above) The Soviet "Soyuz" spacecraft was modeled by T. Krol of Poland in 1/100 scale. It was powered by a single 5 nt.-sec. Polish motor.

(Below) This unusual wooden launching tower was used by the Polish team at Vrsac for launching their parachute duration birds.

from plastic rain coats made in Hong Kong . . . hence the Yugoslav appellation of "Chiang Kai Shek parachute" for these thin bedsheets.

To boost their birds aloft, the Yugoslavs used their indigenous 5 Newton-second motor made by the Centar za Vazduhoplovno Modelarstvo in Belgrade (just CVM for simplicity hereafter), whilst others were made by Ing. Aleksandar Madzarac of Osijek, the head of a model rocket co-operative there. These were good motors 18 mm. in diameter and 50 mm long. They would fit into my American rockets, and our 18x70 mm motors would fit into their rockets. In fact, Madzarac and I swapped motors; I flew with one of his 5 N-sec motors while he made his last flight with a B3-3 of American make. Then we swapped models, and I brought his home with me.

The Czechs were using their highly reliable and greatly respected ADAST motors, now also in 18 mm diameter and 50 mm length. The Poles were flying with a new type of motor made in Poland 21 mm in diameter and 500 mm long.

The lovely thing about the European model rocket motors is their dense black smoke-delay charge. All have it. Against a cloudy sky (the kind most common there), it is like a pencil line against the white background. Against blue skies, it can also be seen.

A useful adjunct to the launch area was the very large 4-sided tote board on which were posted everyone's name and entry number. Everybody wore his entry number. Hence it was easy to discover who was who and where they were from. As each flight was recorded, the official timers would write the results opposite the contestant's name on the tote board. So you could also find out how the competition was going and what sort of performance you had to turn in to win.

With only two launch sites and 150 contestants, the Yugoslavs ran a very liesurely meet quite in contrast to the high-pressure competitions we run here in the USA. It took all day long to run the Parachute Duration event. You sort of sauntered up and flew whenever you felt the time was right. Nobody was in any particular hurry. There were no long processing lines. Yet there were often 6 to 10 parachutes in the air at the same time.

Since I had only 300 mm parachutes with me, I opted not to try to beat the Yugoslav times. Instead, we cranked off a few demonstration flights with American motors and new USA kits featuring plastic parts.

And lest anybody think that American model rocketry isn't highly respected over there, it should be pointed out that the Eastern Europeans do indeed look up to us. And they look to this magazine as an international standard. And they admit publicly that they've learned a lot from us. And they are primed to whup us in 1970 at the World Championships . . .

FAI Scale was flown at Vrsac, and it was the first time that the Yugoslavs had flown under these rules . . . although the Czechs and Poles have been doing so for some time. All scale models were turned in at the Center on Saturday night, September 27th, for static judging. I gave a thorough briefing on the scale rules to Gradimir Rancin, the Contest Director who is also secretary to the commission for aero and rocket modelling in Yugoslavia. Rancin and a crew of assistants then proceeded to judge the models that evening according to FAI standards.

There were some very nice scale models at Vrsac . . . mostly built from American data. Even the two USSR RD-107 "Vostok" models and the single USSR "Soyuz" launch vehicle were built from my drawings that appeared in an American modelling magazine. Generally, the workmanship is excellent on European scale models. In some cases, it is too good. For example, the mirror finish on the olive-drab Honest John when it should be a flat finish. Generally, there wasn't a line of balsa grain showing. The workmanship was excellent and would be graded very high here in the USA. Adherance to scale sometimes suffered, and degree of difficulty was often mis-judged in favor of the more spectacular models. But I have honestly seen much worse scale judging in our own National meets here, so there can be no faulting the Yugoslavs on their judging technique.

A modern version of the classic Renger Sky Slash II boost/glider was flown by M. Pelagic of Yugoslavia. Typical B/G's were large and very light.

Yugoslavia's young ladies were good competitors. G. Stanojlovic from Nosic prepares her elliptical-winged B/G for its first flight.

M. Pelagic of Yugoslavia displays his B/G model weighing only 7 grams. Secret is doped tissue over light balsa.

Most scalers were very large and very heavy, using clusters to lift them. Bodies were sometimes made from block balsa lathed to the correct shape and then hollowed out . . . resulting in a very strong if somewhat heavy model.

Typical scalers that showed up were Saturn-V, Vostok, Soyuz, Honest John, Veronique, X-15, Mercury-Atlas, Mercury -Redstone, Viking 10, Hermes RV-A-10, I.Q.S.Y.-Tomahawk, ASP-I, USSR SA-9 "Guideline," Loki-Wasp, Little Joe I, Little Joe II, and ARCAS. Many were built from AstroScale and other scale data that had appeared in this magazine.

The one thing that was evident was the fact that European modelers do not have access to the wide variety of paints and colors that we do . . . and they have great trouble getting the fluouescent colors.

Nevertheless, those scalers certainly looked good!

It was a different story the next morning when it came time to fly them.

In many ways, they suffer from the same malady as scale model airplane builders. They were good scale builders but not such good fliers. A couple of big models went unstable or crashed into the prep area.

And nobody thought to weigh the big ones to determine if they were within the 500-gram limit.

A huge Honest John blasted off with 8 ADAST motors roaring . . . only to plummet to destruction in the tent area because the modeler had used 7-second delay motors when 4-second delays would have been perfect.

The Mercury-Atlas model went unstable as forecast, in spite of the fact that the modeler insisted it would be stable with the CG ahead of the CP. The French Diamant satellite launcher model by T. Gruca of Poland went very well, and a beautiful flight was turned in by M. Pintaric's Mercury-Redstone.

The most international of all the scale models at Vrsac was a Saturn 5 built by Zygfryd Franckiewicz of Torun, Poland. Here was a Polish-built model of an American space rocket flying in Yugoslavia with 5 American Type C6-4 motors!

Yugoslavia has some very good girl modelers just as we do here in the USA. One of the best of them was Natasha Barac of Osijek who had a French Veronique rocketsonde that turned in a perfect 100-point flight. The Yugoslav girls expressed the strong hope that they might be able to compete against American girls in the 1970 World Championships.

There were two Vostoks at Vrsac -- one from Poland and the other built by Aleksandar Stojanovic of Nis, Yugoslavia. The Polish RD-107 used a cluster of 5 motors in the central core, while Stojanovic's had a single 10 Newton-second motor in the central core and each of the 4 strap-on boosters.

The biggest scale model at Vrsac was a one-to-one full sized model of the Loki-Wasp built by Jozef Vavrek of Czechoslovakia. Yes, one to one! But it was so big and heavy that even with a full cluster of 7 ADAST 10 Newton-Second motors going full-bore (which he achieved only on his second flight), Vavrek's giant achievement barely got high enough to crash.

I gained the suspicion that many of the Vrsac scale models were overweight and that some of them would not have qualified if they had been put on a balance. When clusters of 5 and 7 motors won't lift a model rocket, it's probably heavier than 500 grams!

When it comes to boost-gliders, however, the Europeans have us backed into a corner. The winning time at Vrsac is 427 seconds turned in by J. Punhalac of Valjevo, Yugoslavia. Again, weather and field were perfect for B/G duration. Flying in Swift B/G class with 5 N-sec motors, the Europeans were boosting high and straight while their glides were slow and very well-trimmed. They achieve this sort of thing by virtue of the fact that they may make as many as 5 or 6 powered trimming and test flights before going onto the launcher for their competition flights.

They build big B/G's over there with wing areas ranging upward from about 35 square inches. Most had 50 square inches or more. Some were basic Ranger Sky Slash II designs. Even the Flat Cat design (MRm, August 1969, pg. 42) was in the fight and doing very well, trimmed as I have never seen a Flat Cat trimmed before. The best B/G design in Europe seems to be Otakar Saffek's popular "Jiskra." (Stop screaming! Full plans are in hand and will be forthcoming in these pages!)

They also build 'em light. E. Pelagic of Sobar had a B/G design that weighed 7 grams in glide configuration! These light weights are achieved by using very soft, lightweight balsa and covering it with Jap tissue doped in place. This is, of course, an old model airplane technique, so I doubt if many American model rocketeers know about it. It is not easy to do . . . the first time. The bare model is
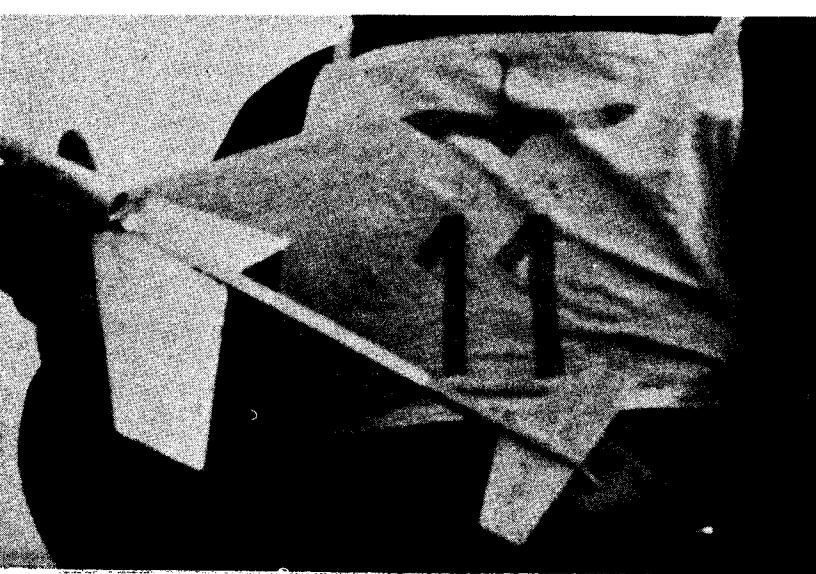
(Above) The Polish team prepares one of their B/G's for launch using an ingenious short tower-like launcher that eliminates the launch lug on the glider.

(Below) Otakar Saffek of Prague displays the excellent workmanship of his bevy of parachute duration models. Some were built with USA parts which are highly prized in Europe.

Ing. Aleksander Madzarac of Osijec, Yugoslavia displays his giant scale model of the German V-2 in White Sands colors. He used a cluster of 7 type C motors made by his co-operative.

(Below) Ing. S. Pelagic of Sobar, Yugoslavia shows a typical Yugoslav B/G design using simple motor ejection with a streamer.

first given one coat of dope. Then, the Jap tissue is dampened with water from an atomizer or air brush. It is then doped to the nude airframe. When all of this dries, the tissue will shrink and get tighter than your old jeans. Then you can put two or three more coats of clear dope on this for additional strength. Color painting is not necessary because Jap tissue or Silkspan comes in a variety of colors.

If you *really* want strength, use silk or nylon instead of tissue!

Very few pop pods were in use. Most modelers prefered to eject the motor casing with a streamer attached. This leaves a big, draggy motor tube on the front of the glider; but for some reason, these European B/G models don't seem to care. They glide and glide!

The Yugoslavs have a timing rule that bears some serious study for possible incorporation into our own new Pink Book. For the total score in a duration event, they ADD the two flight times together. This means (a) you gotta be a consistently good flier to win, (b) you can't win because you happened to get one good flight, and (c) you gotta fly twice to get in the money. This would mean a complete change in contest tactics for flying a duration event, but it might be fun to try it out first to see how well it works.

However, for the 1970 World Championships in Vrsac, we will be using the FAI rules which are identical to our current 1967 Pink Book rules.

Vrsac was a good shakedown for the World Championships, and lots of credit goes to Gradimir Rancin for organizing a good contest and running it in a very smooth manner. The flying area is the greatest I have ever seen, and I only wish I had been able to take along some really big stuff to fly there. The accomodations are great, the people friendly, and the prices quite reasonable. Food was good, and there was more of it than I could eat; our USA team will have to be trained as trenchmen.

The categories to be flown next year will be Scale, Parachute Duration, Sparrow Boost-glider Duration, and Swift Boost-glider Duration. Exact dates have not yet been established, but the meet will probably take place during the last part of September. The Yugoslavs are quite anxious to make a good show, and I am sure that we will not be disappointed.

A Design Study:

Model Rockets on the Moon

by Pat Stakem

Although we can't expect the hobby of model rocketry to spread to the moon for quite a few years, it is interesting from a design viewpoint, to look at a lunar launch situation.

Obviously, there would be an increase in performance due to the lesser surface gravity and lack of atmosphere. If we estimate the increase in performance due to lack of viscous drag at 1.5 times (from the author's experience with trajectory calculations) and the increase due to the lesser gravity force at 6 times, we'd get performance like this: a 2 ounce rocket that goes to 100 meters on the earth would go to 900 meters on the moon (300 ft vs. ½ mile), or the same vehicle could carry 16 oz of payload to the same 100 meters.

Also, the rocket engine itself could be expected to perform better in the lunar vacuum environment. A figure of merit for engine performance is the exhaust velocity, and the formula for this is:

$$V_e = \sqrt{[(2gK)/(K-1)\,(RT_c)\,(1-(P_e/P_c))^{(K-1)/K}]}$$

(Brinly, Rocket Manual for Amateurs, p. 113)

where:

R is the gas constant
T_c is combustion gas pressure
g — gravitational constant
P_c — chamber pressure
K — specific heat ratio of combustion products

The important thing to note is the term $(1-(P_e/P_c))^{(K-1)/K}$. As P_e goes to zero absolute (a vacuum condition) this term goes to one. For any other positive value of P_e this value is less than one. As is well known, a rocket nozzle reaction system is more efficient in a vacuum. The actual engineering design of the nozzle has to be optimized to the environment to get maximum performance, though.

Now that we have our rocket performing about ten times better than it did, we face a problem: guidance and stability. Of course, fins are useless in a vacuum. But neither are there any gusts of wind to deflect the rocket. If the vehicle is constructed to be radially symmetric around the thrust axis, and the thrust of the engine is directed vertically upward only, we have no real guidance problem. But to take care of those cases where we want to be absolutely sure of the flight path, we include a small inertial (gyroscopic) guidance system.

Similarly, recovery poses a problem. A chute or drag device, or a glider is useless. Retro-rockets seem the only answer, and this means a complicated timing and control system. So let's agree to orbit, and solve recovery headaches. Recall that in the lunar environment, an orbit can be achieved at any height about the surface sufficient to clear obstructions. Actually, due to gravity anomolies, it is not practical to have a lunar orbit much lower than 20 miles. So, we'll settle for about 35 km. Using these formulas as a basis:

$$V_b = I_{sp}\,g\,\ln N$$
$$h = V_b^2 / 2g$$

where:

V_b = Velocity at burnout
I_{sp} = Specific Impulse of Propellant
g = gravitational constant
N = Mass Ratio = Mass at take-off / Mass at burnout

I obtain the formula:

$$h = I_{sp}^2\,g\,(\ln N)^2$$

or, solving for the required mass ratio:

$$N = \exp\left((1/I_{sp})\sqrt{2h/g}\right)$$

This looks complicated, but knowing the specific impulse of the propellant, the desired height, and the gravitational constant, the required mass ratio can be calculated. In this case:

I_{sp} = 100 sec (a general figure for model rocket fuels)
$h = 35$ km = 3.5×10^4 m
$g = 1.64$ m/sec^2 (lunar 'g' constant)
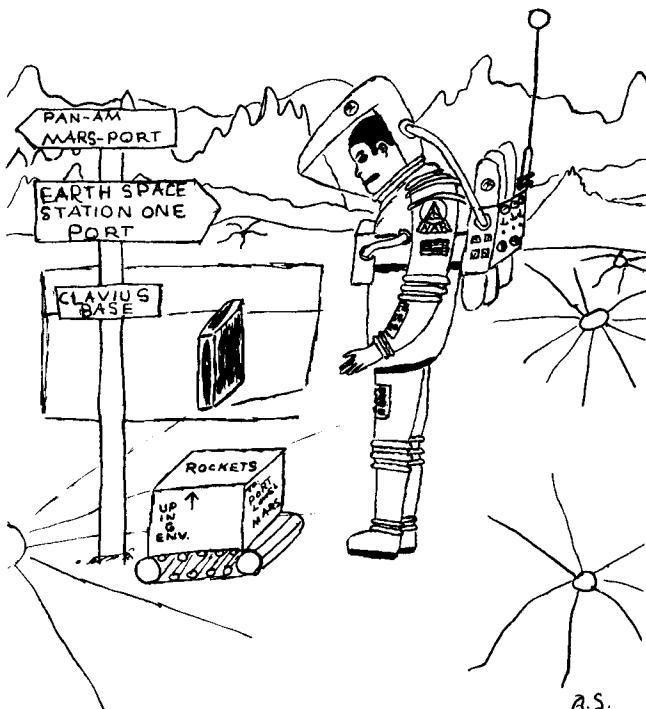
then,

$$N = \exp\left((1/100)\sqrt{2 \times 3.5 \times 10^4 / 1.64}\right)$$
$$\cong 6.2$$

This figure is higher than could be obtained from existing model rocket engines, except by staging. (Mass ratios of stages multiply to give a multi-stage vehicle mass ratio). In addition, we would want a booster engine with a relatively low thrust-long burn time, to avoid high inertial ('g') loads on the vehicle.
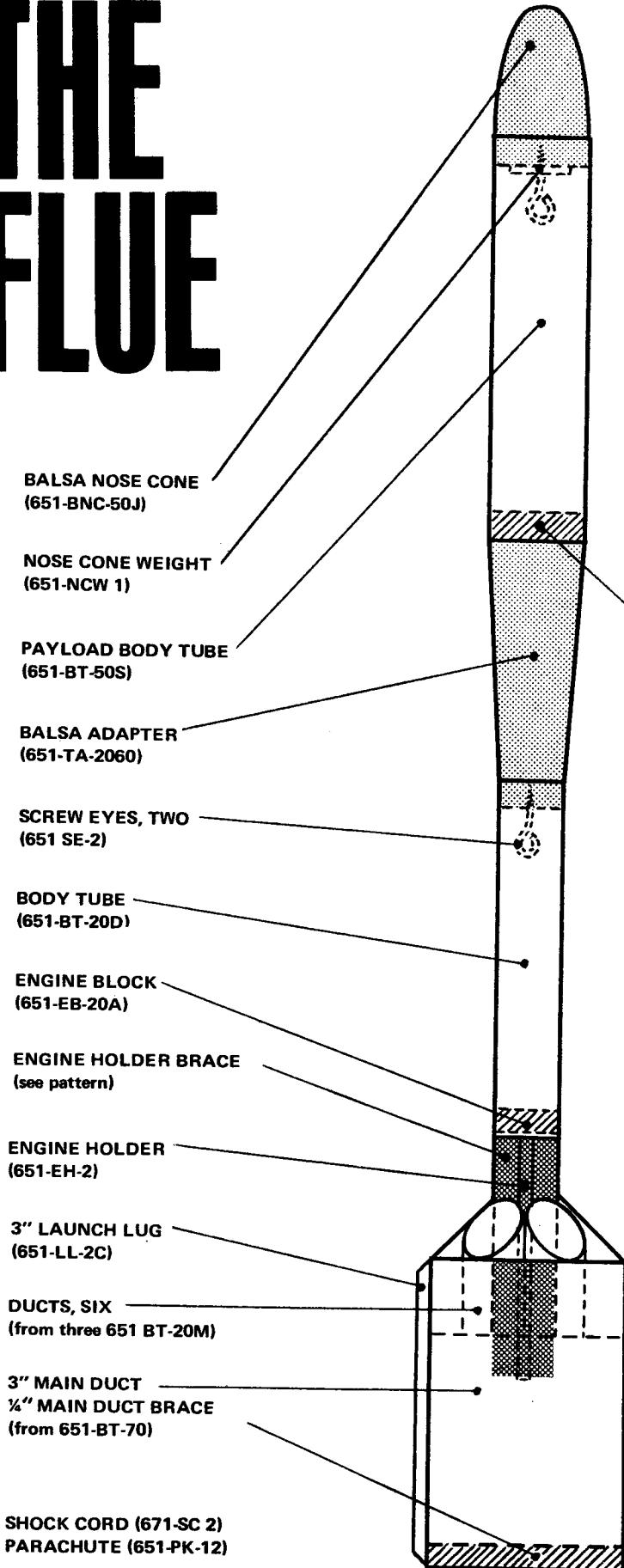
As to the construction of the lunar model rocket, it can be expected to be as different from a competition model as the lunar ascent stage is from a Nike-Smoke. Probably the best construction would be a light, welded aluminum frame. Design problems would include outgassing of materials in a vacuum environment, incident radiation effects, temperature control, just to mention a few.

So don't go off and build a model all ready for lunar-NARAM. This article was written only to point out a few of the problems facing rocket designers for the lunar environment, and to show model rocketeers that they needn't be left behind by the space program.
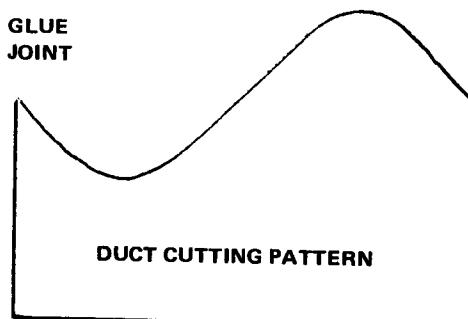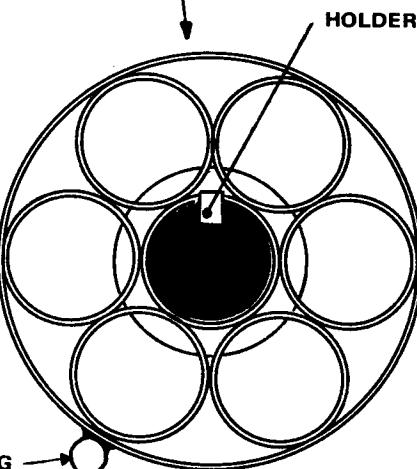
I've heard of holding NARAMs in the boondocks for political reasons, but this is ridiculous..

THE FLUE

FULL SIZE END VIEW OF BASE

HOLDER

LUG

BALSA NOSE CONE
(651-BNC-50J)

NOSE CONE WEIGHT
(651-NCW 1)

PAYLOAD BODY TUBE
(651-BT-50S)

BALSA ADAPTER
(651-TA-2060)

SCREW EYES, TWO
(651 SE-2)

BODY TUBE
(651-BT-20D)

ENGINE BLOCK
(651-EB-20A)

ENGINE HOLDER BRACE
(see pattern)

ENGINE HOLDER
(651-EH-2)

3" LAUNCH LUG
(651-LL-2C)

DUCTS, SIX
(from three 651 BT-20M)

3" MAIN DUCT
¼" MAIN DUCT BRACE
(from 651-BT-70)

SHOCK CORD (671-SC 2)
PARACHUTE (651-PK-12)

GLUE
JOINT

DUCT CUTTING PATTERN

WEIGHT 1.1oz. (31 gm.)
LENGTH: 16 in (40.64 cm.)

by
Melville
Grant
Boyd

The Flue is a unique model rocket that will give you many happy hours of construction and flying. It bears a resemblance to some other designs that employ body tubes as fins, but it has an advantage that sets it apart. The body tube fins provide a relatively large stabilizing area without the extreme weathercocking tendency found in rockets with large traditional fins. Figure 1 indicates the stabilizing technique. The cone of engine exhaust nearly fills the rearward end of the main duct, drawing out some of the air trapped in the upper portion of the duct. The resulting low pressure area causes more air to be drawn through the six little ducts, thus increasing stability.

The Flue is easily assembled from standard parts available from Estes Industries. White glue is used throughout.

LOW PRESSURE AREA

FIG. 1

Begin assembly by tracing the duct cutting pattern onto heavy paper. Wrap this pattern around one of the three 2¼" lengths of body tube, taping neatly where the two narrow sides meet. This pattern should form a collar that slides easily on the body tube. Slide the collar so that the flat end is flush with one end of the tube. You now have a pattern for drawing slanted lines neatly around the circumference of the three short body tubes. Cut each with a sharp blade, using an expended engine casing for support inside the tube. If you were extra careful, you should now have six small ducts of exactly equal length. Rub the diagonally cut ends on fine sandpaper placed on a flat surface.

Run a bead of glue along the longest length of two of these ducts. Position these on opposite sides of the 6½" length of body tube, referring to figure 2, placing the ends flush with each other. Set aside to dry.

Cut a 3" length and a ¼" length of the largest body tube, BT 70. The ¼" piece of BT 70 will form a ring inside the main duct, and acts as a brace. Simply cut the ring at any point, overlap these two edges at least ¼", and place the ring inside one end of the main duct. This will indicate exactly how much of the ring you must cut off in order to get a good fit. After cutting the ring to size, glue it in place. Set aside to dry.

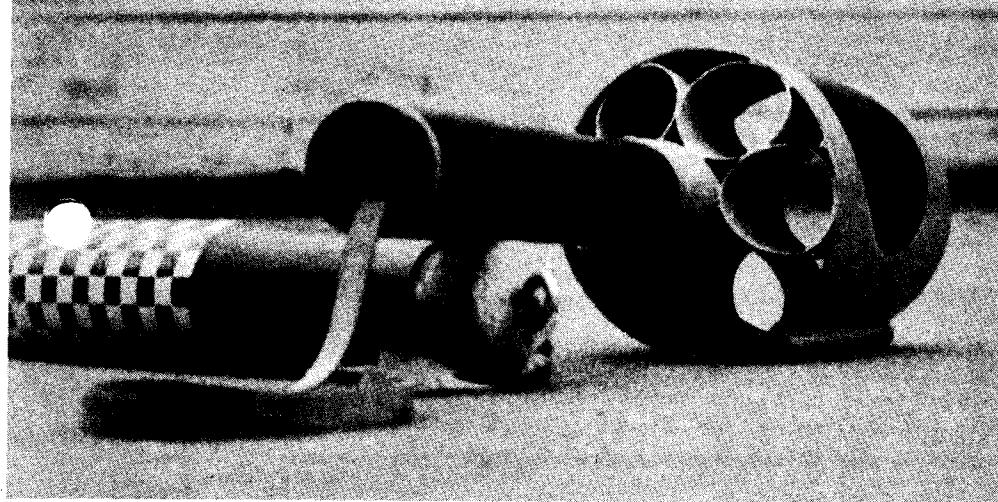Return to the duct assembly set aside earlier. Place two more small ducts on the assembly, referring again to figure 2 and the main plan. Mark all pieces where they touch, and remove. Apply glue to the marked points and replace the pieces in their original positions. Set aside to dry.

Turn one screw eye into the center of the small end of the balsa adaptor. Remove and squirt in a drop of glue, then re-insert the screw eye. Apply glue just inside the edge of one end of the 4" section of body tube. Quickly push this end firmly onto the large end of the adaptor. Set aside to dry.

Return again to the duct assembly. Mark the long body tube 4½" from the end without the assembly. This part of the construction requires extreme care. Refer to the main plan to see how the engine holder is placed in a manner that allows a little
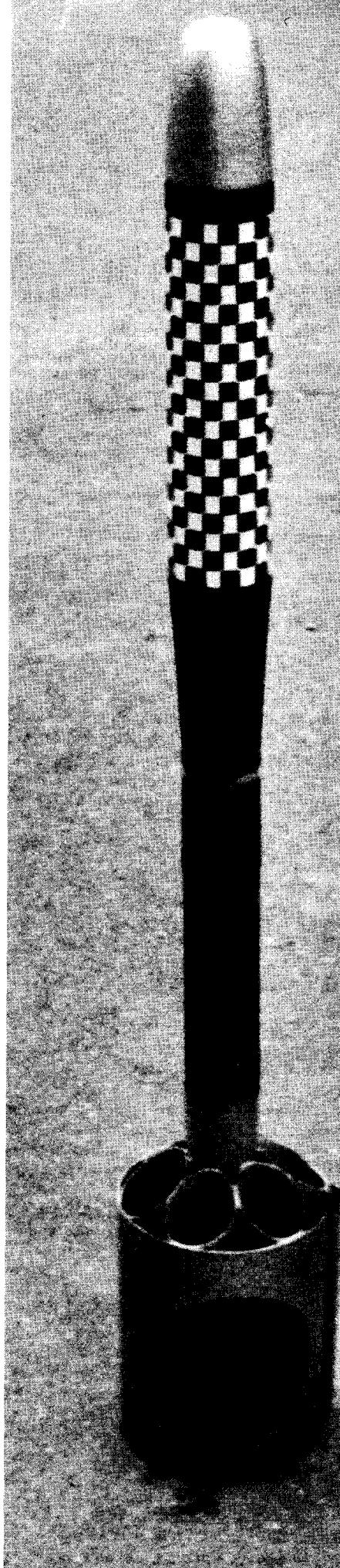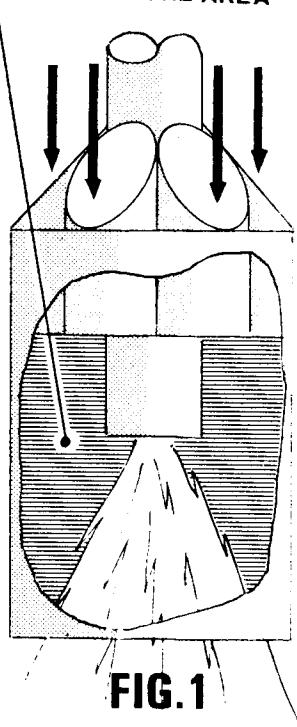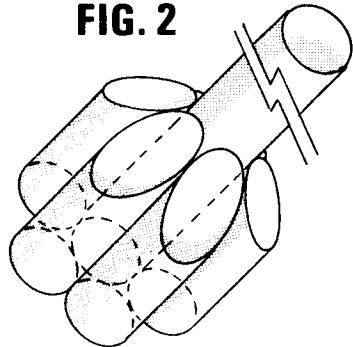
FIG. 2

upward movement ("end view of base"). This is to provide flexibility for removing and installing engines. Cut a small hole, just large enough to allow one little bent end of the engine holder to be inserted, apply glue to the hole and insert the engine holder. Apply a generous amount of glue, from the end of a stick, inside the body tube in the area of where the little bent end of the engine holder sticks inside. Quickly push the engine block into place by sliding it down from the upper end of the body tube. Two expended engine casings come in handy for this. The engine block may seem superfluous since you already have an engine holder, but experience has shown that when using only an engine holder the higher thrust engines tend to cause the holder to rip the body tube. Cut a piece of paper 5/8" wide by several inches long. Coat this paper with glue and wrap it around the body tube to hold the engine holder firmly in place (see main plan, "engine holder brace"). Now you may glue the final two small ducts in place, as you did with the previous two. And, as if you didn't know by now, set aside to dry. By alternating your work steps in this manner you can work uninterrupted by not having to wait idly while glue is drying.

Make a hole in the center of the nose cone weight large enough for the screw eye to go through. Insert screw eye through the weight and screw into the center of the nose cone base. This screw eye may be used for fastening various payloads inside the upper body tube.

Now you are ready to glue the main duct onto the rest of the rocket assembly. Insert the assembly into the main duct so that the top openings of the little ducts are flush with the top edge of the main duct. Mark the main duct where it touches the small ducts. Pull out the rocket assembly and apply glue to those surfaces which will touch. Reinsert the rocket assembly, taking care that the main duct aligns parallel with the rocket assembly. Allow this to dry while you assemble the parachute and shock cord assembly (refer to the figure entitled "shock cord mount").

Now that the rocket assembly is dry, glue the shock cord mount well down inside the lower body tube, allowing sufficient clearance for the balsa adaptor to be inserted.

Glue a 3" length of launch to the outside of the main duct, positioning it as shown in the end view on the main plan. Take care that it is exactly parallel to the axis of the rocket. Apply a fillet of glue to both sides of the lug.

Paint the inside of the main duct with several coats of heat resistant paint. You are now ready to apply the finishing touches. Paint the exposed balsa parts with filler or sealer, sanding lightly between each coat, until a smooth surface is obtained. Decorate in any manner desired. The original Flue was brush painted with Aero Gloss Metallic Maroon and Silver, and accented with Red ¼" checkerboard decals. The round decals represent the Libyan Air Force of all things!

Incidentally, if the shock cord mount ever pulls free, as it did with me after many flights, the lower half of the rocket will glide reasonably well to a safe landing.

q & a

Do you know how to compute how far model rockets will drift in a wind?

Mike H. Braun
Waco, Texas

The rate at which a model descends on a parachute is strongly dependent on the state of winds and thermal activity aloft. Winds aloft often differ substantially from those measured on the ground. Rockets from parachutes have been known to ascend rather than descend due to the influence of thermal currents in the air; some of them have drifted for more than ten miles from an initial deployment altitude of only 300 feet. Consequently, there is no way in the world to accurately predict the distance a model rocket will drift in the wind.

There is, however, a simple formula that will give moderately accurate results in cases of uniform wind and zero thermal activity and/or rapidly descending rockets (such as those using streamer recovery). Let h = altitude at which recovery device is deployed, given in feet s = rate of descent, given in feet/second v = wind speed, feet/second x = distance drifted, in feet Then the distance the rocket will drift, in feet, is given by $x = (hv)/s$

The rate of descent s can be determined by dropping the rocket with its recovery system deployed from some known height, say 20 feet and measuring with a stopwatch the time required for it to reach the ground. The altitude h can be computed or it can be measured with tracking theodolites. The wind speed v can be measured with one of the windmeters available in many sporting goods stores; alternatively, it can be calculated by solving the formula above for v after dropping the rocket from a known height and measuring x as the horizontal distance from the drop point to the landing point.

I have used both Testor's and AeroGloss dopes regularly in finishing modrocs. I have received poor finishes, however, because of a supposedly advantageous quality of dopes. Apparently, dopes don't adhere well to anything; body tubes, white glue, or sanding-sealed balsa. In the process of drying, my finishes usually shrink across inside curves, making unsightly bubbles.

My question is: How can I prevent the dope from "gapping" across fillets? What can be done to the dope to reduce its shrinking quality? And, if so, how can this be applied to spray dopes?

Robert Engelsen
Brooklyn, New York

It sounds to me as if you are using dope that is too thick in an attempt to get a one-coat finish. Also, you seem to be applying it too heavily. These are the only two things that have ever given me the difficulty you describe, and I have used both Testor's and AeroGloss dopes.

It isn't the shrinking quality of the dope you want to get rid of; it's the tendency to form a skin on the surface which dries long before the interior of the paint film does. It is this which causes gapping and bubbles.

You should be able to correct the situation by using only freshly-bought dope and thinning it. Try applying color coats with 2/3 or 3/4 strength dope. Of course, it won't cover completely in this state, and you shouldn't try to make it by painting it on heavily; this will again ruin the finish by causing runs as well as gaps and bubbles. Paint it on thinly, and do not be afraid to use five or more coats to obtain a satisfactory finish. I think you will find the extra effort well worth the result.

Any questions submitted to this column and accompanied by a self-addressed, stamped envelope will be personally answered. Questions of general interest will also be answered through this column. All questions should be submitted to:
Q and A
Model Rocketry *Magazine*
Box 214
Boston, Mass. 02123

What is a Drag Coefficient?

$D = C_D \tfrac{1}{2} dV^2 A$ $D = 0.0413 \, lbs.$ $C_D = 0.5$

$d = 0.00238 \, slugs/ft^3$ $A = 1 \, in^2$

$C_D = 0.5$ $D = C_D \tfrac{1}{2} dV^2 A$

by Dr. Gerald Gregorek
Ohio State University

A drag coefficient is many things to many people: to the beginning rocketeer it is some term the "technical types" use when discussing model rockets; to the technical types the drag coefficient gives clues to the performance of their rockets; but to many rocketeers, drag coefficient is a fuzzy term used to represent, in some fashion, the drag of their model rockets. Just what, precisely, is a drag coefficient and is it really worth worrying about?

To be sure, you don't have to know anything about drag coefficients to build good flying model rockets. Some basic rules — like those outlined by George Caporaso in the September 1969 issue of MRm — can guide you in reducing the aerodynamic resistance of model rockets, and you can do quite well. But, without drag coefficients you cannot find in actual number form, the drag in pounds, of a rocket. Drag coefficients enable engineers to quantify their studies; that is, to determine how *much* better one full scale rocket design is from another. Drag coefficients allow us to do the same with our models.

If we accept the need to use drag coefficients in our discussions of model rockets, we should be clear as to its meaning. Several articles have appeared in MRm which use drag coefficient concepts extensively. To get full benefit from these excellent studies, we must understand the basis of the drag coefficient.

Before we try to write any mathematical expression for the drag, let's use our imagination to think of the factors that might affect the aerodynamic resistance of a model rocket. Using our intuition, alone, we can come up with a lot of things which contribute to this retarding force. Some of these factors pertain to the rocket itself (like size, shape, and surface finish), others refer to properties of the air (the air density, for example) other factors include the rocket and the air (such as the speed of the rocket through the air and maybe the angle the rocket makes to the on-coming air stream). To keep from getting too confused we'd better stop, regroup and try to put these items in some kind of order.

To start with, let's select one item from each of the above three categories and say that it is the most important. We'll select size (the bigger the rocket the more retarding force we can expect), speed (we know the faster we go the more resistance we'll encounter) and air density (we know resistance must go up as the density increases — moving your hand through water is a lot harder than moving your hand through air, since the density of water is so much greater than the air density). Now we can write a short hand statement that *drag depends upon size, speed, and air density*. This is a true statement and is supported by experiment. Unfortunately, it is a weak statement and really doesn't help us much. We don't know how much drag depends on these factors. Besides we've neglected things like the rocket shape, surface finish, angle etc. How can we improve the situation? — introduce the drag coefficient.

The drag coefficient takes the shorthand form, incorporates all the other quantities we feel is important to drag and allows us to calculate a number, in pounds of force, that will be the air resistance for the particular rocket we are examining. Now after these preliminaries, we can introduce the first equation.

$$D = C_D \tfrac{1}{2} dV^2 A \qquad (1)$$

In this equation, D stands for drag in pounds, C_D for the drag coefficient (it has no units), d for the air density (at sea level we say d is about 0.00238 slugs/ft^3) V for air velocity in ft/sec (from experience we know velocity is extra important so we use V x V to obtain a correct representation) and A in square feet represents the size of the body (usually the cross-sectional area of the body tube). Now if we wish to find the drag force on a typical model with $C_D = 0.5$, A = 1 sq. in. flying at 100 ft/sec at sea level we will get:

$$D = 0.5 \times \tfrac{1}{2} \times 0.00238 \times 100 \times 100 \times 1/144$$
$$D = 0.0413 \, lbs$$

note that we divided the 1 square inch area by 144 to obtain A in square feet.

From this example, you can see what happens to the rocket drag if we change some of the conditions. Let the speed double to 200 ft/sec and the drag increases by a factor of four to D = 0.165 lbs. When the area of the rocket is doubled, the drag will also go up by a factor of two. If we reduce the drag coefficient to $C_D = 0.25$, the drag force will be cut in half. Flying in Colorado where the density is less will lower the drag too (that's where we should try for altitude records!).

Some mod rocks get into trouble when they try to compare designs by using drag coefficient alone. Remember, C_D is used to find the drag of a rocket and must be used in conjunction with the other factors. Even if the density and speed of two different designs are the same, the size, as represented by A, must be known to obtain the drag. It is entirely possible to have two different designs with different drag coefficients and still have the same drag for both birds. Consider a particular design, we'll call it Rocket 1, with $C_D = 0.5$ and A = 1 sq in. and another model, called Rocket 2, with $C_D = 0.25$ and A = 2 sq in. Both rockets will come up with the same drag when these numbers are inserted in Eq. 1. You can see that the model with the lowest drag coefficient does not necessarily give the least drag.

Where does that leave us? Hopefully, with a better understanding of the use and purpose of the drag coefficient. Also, with a built in alarm that activates anytime somebody quotes a drag coefficient — make sure you ask on what A the coefficient is based. As a last illustration, sometimes aeronautical engineers use surface area upon which to base the drag coefficient. In this case instead of a cross-sectional area of 1 sq. in., surface area (think how much of the rocket would get wet if dunked in water) might be 40 sq. in., then the drag coefficient of Rocket 1 will be 0.0125. Sounds great, pretty low doesn't it — but it still gives the same drag when we plug the C_D and A into Eq. 1.

Think about it.

the Escape Tower

by Tom Milkie

This month's diversion is, in the opinion of some diehard R & D ers to be a rather brute-force solution to a certain problem. The problem: Camroc pictures are generally of a rather small land area. To get a fairly large area in one picture, it is necessary to launch to a high altitude. This can cause problems with recovering the vehicle (Especially if the area to be photographed is the center of town and you're launching out of a baseball diamond or a bus stop or a pickup truck). The extra altitude also puts more smog (bleetch) in the picture. If your Camrocing is for details, blowing up a small Camroc (Camroc photo that is) can certainly lack that fine detail. Brute-force solution: Launch three Camrocs mounted together, taking three pictures that slightly overlap and take in a large area.

The *Scylla* is an ugly rocket. So is the *Little Joe.*

To build the *Scylla* , if you dare, cut, shape, sand, and finish all balsa pieces. (Any pieces fastened with cloth reinforcing should not be sanded or finished in the area where the cloth will be glued.) Cut all tubes to sizes shown, glue the Camroc mounting pieces on the forward body tube and glue in (or force fit) the nose cone. The Camrocs will be mounted at an angle so that the photo pattern (regardless of altitude) is three intersecting circles that meet at one point in the center.

You may now be wondering what that long BT-20 tube is for, other than getting in the Camroc pictures. That, my friend, is protection for your valuable Camrocs against parachute landings on rough terrain (and maybe that unavoidable prang?).

You may as well be working on attaching the fins (with cloth reinforcement) while working on the internal structure. The engine tubes are *carefully* glued together after the center tube is fitted with an engine hook. Since the 7 BT-20's are a tight fit for a BT-70, about a one cm strip must be cut from the outsides of each tube after the assembly is allowed to dry. This structure can then be fitted into the aft end of the BT-70 and sealed approximately air tight. Since these tubes are slightly shorter than an engine casing, if the assembly is mounted flush with the rear of the rocket, the engines (and thus the ends of the engine hooks) will be sticking out about 5 mm, for ease of removal.

Many of you true brutes may question the use of 7 engines. (Why not just a simple F?) Well, if you're any good at ignition (and you don't have to light every engine every time) you can use this much cheaper method of reaching altitude. The many different arrangements possible (different engines, combinations, delays, or use of spent engines) allow you to reach exactly the altitude that you want. Also, the high

The Scylla monster squats on the pad. That crows nest doesn't help the drag situation, but you could carve a fairing out of balsa or foam to improve it.

initial thrust of a cluster is good for getting that marginal bird moving right off that pad. (Thus keeping the pigeons from resting on it.)

Back to construction. When all fins are on, mount 6 engine hooks around the body. These can be made from thin music wire. Also mount a launch lug at the top of the booster section, half way between a pair of fins. Put cloth reinforcement over this too.
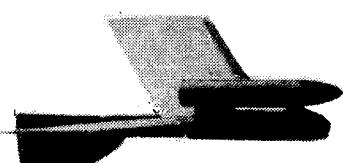
The adapter is not exactly an Estes part (TA-2070?), so you will have to hand carve one or turn it on a lathe. Start with a TA-6070 adapter on which you have drawn a 20 mm diameter circle on the BT-60 side. When completed and finished, glue it strongly to the BT-20.

Recovery systems are separate for the Camroc boom and the booster section. The lower section has a strong cord sewn into a fin which attaches to the 18 inch chute (packed first, after inserting lots of wadding). A screw eye mounted in the adapter attaches the upper structure to its 24 inch chute.

Camrocs are assembled as usual, except that the bottom pieces that mount the Camrocs to BT-50 tubes are not installed. The standard shutter strings should also be replaced with 18 inches of cord. The Camrocs are mounted with many tight rubber bands around their tops and bottoms. The shutter strings are run back to the adapter and run through the screw eye for ease of cocking. The adapter should fit tight enough to prevent the shutters from tripping until ejection.

Now, if you really want to be clever you could reverse the rocket and use 3 engines to lift 7 Camrocs .

the Scylla

BY TOM MILKIE

18 INCHES
OF BT-20

FRONT CAMROC MOUNT
SUPPORT ARMS GLUED
UNDER EACH PROJECTION

30 CM

NOTE:
LAUNCHING WITH A
4 FT OR GREATER
LAUNCH ROD (3/16)
WOULD HELP LIFT-
OFF

CAMROC GOES
HERE

2.7 CM

2.7 CM

RIM ON REAR
OF CAMROC
FITS IN HERE

6.7 CM

BALSA CHUNK (3) 1 CM X 1 CM X 2 CM
SEPARATES CAMROCS (SHAPE FOR TIGHT FIT)

REAR CAMROC SUPPORT
(MAKE 3) 1/8 BALSA

FRONT CAMROC
SUPPORT ARM
(MAKE 6 FROM
1/8 BALSA)

3 CAMROCS, MOUNTED WITH RUBBER BANDS,
CANTED OUTWARDS

REAR CAMROC SUPPORTS

SHUTTER STRINGS

CLOTH REINFORCED JOINT

GLUED

1 CM

CUT SLITS

BALSA CHUNK
AND GLUE FOR
EJECTION CHARGE
SEAL

6.5 CM

MODIFIED TA-6070 ADAPTER

LAUNCH LUG

24 INCH CHUTE

18 INCH CHUTE

WADDING

ENGINE HOOK IN
SPACE BETWEEN
TUBES

BT-70
TUBE
(24 CM)

4 CM

15 CM

8 CM

4 CM

9 CM

4 FINS

RECOVERY SYSTEM
STATIC LINE

ENGINE HOOKS

Automatic Computation for Rocketeers

by Charles Andres

This is the second in a series of bimonthly articles on programming a computer to calculate various parameters associated with model rocket performance.

The introductory article in the October issue explains the basic computer theory necessary to the program described below.

I: THE BARROWMAN CP METHOD

The program shown in Fig. 1 is a display of the Barrowman Center of Pressure Program. As one can see, the programmer has instructed the machine (in small letters) to display the program. It was printed out (in large letters). When typing out the program yourself, type from /input to /data, inserting /input before /job go. Then run and save the program, making updates if necessary.

Anyone who is familiar with James Barrowman's Report on the Calculation of Center of Pressures for model rockets will recognize the basic formulas shown in this program, and remember the variable symbols. For those of you who are not familiar with the report, it can be obtained for $1.00 from Centuri Engineering Corp., Phoenix, Ariz. Report No. TIR-33. The report explaines itself and shows the same formulas and equations used here. For those of you not familiar with the symbols, a list of those employed follows:

FIGURE 2

N	Number of fins
S	Fin Span
L1	Fin Chord
A	Fin Root Length
B	Fin Tip Length
R	Diameter of rocket at fins
M	Difference between tip length and root length (fin)
XF1	Distance from nose to fin root front edge
L	Length of conical nose
L3	Length of ogival nose
D	Diameter of rocket at base of nose
D1	Diameter of rocket at small end of conical shoulder
D2	Diameter of rocket at large end of conical shoulder
XCS1	Distance from tip of nose to front of conical shoulder
L4	Length of conical shoulder
D22	Body diameter at small end of conical boattail
D12	Body diameter at large end of conical boattail
XCB1	Distance from tip of nose to front of conical boattail
L2	Length of conical boattail
XN	Center of pressure location on conical nose
XN1	Center of pressure location on ogival nose
CNACS	Force on conical shoulder
XCS	Center of pressure location on conical shoulder
CNACB	Force on conical boattail
XCB	Center of pressure location on conical boattail
CNAF	Force on fins
KTB	Fin interference factor
CNATB	Total force on tail
XF	Center of pressure location for tail
CNA	Total force on entire rocket
X	Center of pressure for entire rocket

Beginners might wonder why we bother to compute the Center of Pressure (CP). This can be explained mainly in the Barrowman report, but to mention it briefly, we must know whether the CP is ahead or behind the Center of Gravity (CG) if we are to determine rocket stability. To date, the Barrowman CP method is the most accurate for predetermining the CP point.

As one may gather, after one finds the design rocket configuration and its CP point, he must move it to the desired CP point by either altering the configuration or adding or detracting weight from somewhere. The end result should be a stable rocket. I might rephrase Barrowman's precautions. One, maintain at least one body tube diameter between the CP and CG points (CP *behind* CG); and two, remember that these values are only good when the rocket is flying at small angles of attack.

Some of the few differences between the Barrowman formulas and mine are: that I assume that I can compute the CP of a rocket with X number of fins, merely by multiplying X by four. I have not done enough testing to assume that it is valid for other numbers of fins, but the program is already flexible if the hypothesis is valid. I also use the variable 'L' a number of times as did Barrowman. I therefore had to number them to distinguish them. Also, 'R' is the rocket's diameter, rather than radius. The program divides the value of R in half to arrive at the radius. (Can't make life too easy!)

The test data given is for the Aerobee 300 rocket, which is the same as the data given in Barrowman's first CP report from the Goddard Space Flight Center. Since the results shown check very closely with the results given in that report, I consider that this program is as accurate as his equations are. His final CP value for the Aerobee turned out to be 17.5 inches. The computer gives a value of 17.527 inches. This answer is probably not as accurate as it seems, but if measurements in the thousandths of an inch are ever possible on model rockets, the answer will then be considered valid. I think that it is probably valid to 17.52 inches now.

The Aerobee 300 design with all significant dimensions shown is illustrated in Fig. 2. I flew the Aerobee 300 after moving the CG back to the one caliber mark just as Mr. Barrowman did at NARAM-8. As did his, it flew absolutely straight up. The Aerobee is available in kit form from Estes Industries, Penrose, Colo.

The flowchart, Fig. 3, is a type of schematic diagram used in illustrating the entire course the computer will follow in executing the program. One will notice that I used L4 and L2 as the conditionals on whether there were conical shoulders and boattails on the design. Obviously, if there is not a length of shoulder given, there will not be a shoulder. If the length were given as negative, (an impossibility) the program would disregard the data, and either give no results or inaccurate ones. However, the program must make provisions for such a mistake. There is no need for 'if' statements when every other parameter will take some positive value. (Notice that if one wants to compute the CP on a finless rocket he will have to insert other 'if' statements before

the CNAF and KTB statements. This should be: IF(n) etc. for if the fin number is zero, there will obviously be no fins, and no need for these equations. Since very few model rockets fly without fins, and the calculation of the CP for these rockets would be fairly simple, it would not merit the extra program lines; although they certainly could be inserted without causing difficulty or sacrificing accuracy.)

When checking out and running your program for the first time, you should use the test data provided, and get the same answers that are shown in Fig. 1. If you do not receive the same answers, check your program carefully. Some may wonder why I have all of the partial calculations typed out in the end when we are only looking for the final CP. The primary reason at the beginning of my programming was to maintain a

Figure 1

```
M.0072 BEGIN ACTIVITY

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

FIGURE 3

BEGIN ACTIVITY

Computer orders ⬦
Start, stop, return ◯
Conditional
Input
Assignments
Output

/JOB GO

/FTC

REAL KTB, M, L, L1, L2, L3, L4, N

READ (1,10) N,S, L1, A, B, R, M, XF1, L, L3, D, D1, D2 XCS1, L4, D22, D12, XCB1 L2

$XN = .6666*L$
$XN1 = .466*L3$
$CNACS = 2*((D2/D)**2-(D1/D)**2)$

STOP

IF(L4) <0 $=0$ >0

$XCS = XCS1 + (L4/3)*(1+(1-D1/D2)/(1-(D1/D2)**2))$

$CNACB = 2*((D22/D)**2-(D12/D)**2)$

IF (L2) <0 $=0$ >0

$XCB = XCB1 + (L2/3)*(1 + (1-D12/D22)/(1-(D12/D22)**2))$

$CNAF = (N*4*(S/D)**2)/(1 + SQRT(1+(2*L1/(A+B))**2))$
$KTB = 1+.5*R/(.5*R+S)$
$CNATB = KTB*CNAF$

$XF = XF1 + M*(A+2*B)/(3*(A+B))+(A+B-A*B/(A+B))/6$
$CNA = 2+ CNACS+CNATB+CNACB$
$X = (2*(XN+XN1)+CNACS*XCS+CNACB*XCB+CNATB* XF)/CNA$

WRITE(3,11) XN, XN1, CNACS, XCS, CNACB, XCB, N, CNAF, XF, CNA, X

/DATA
3. 1.50 1.39 2.25 1.20 .976
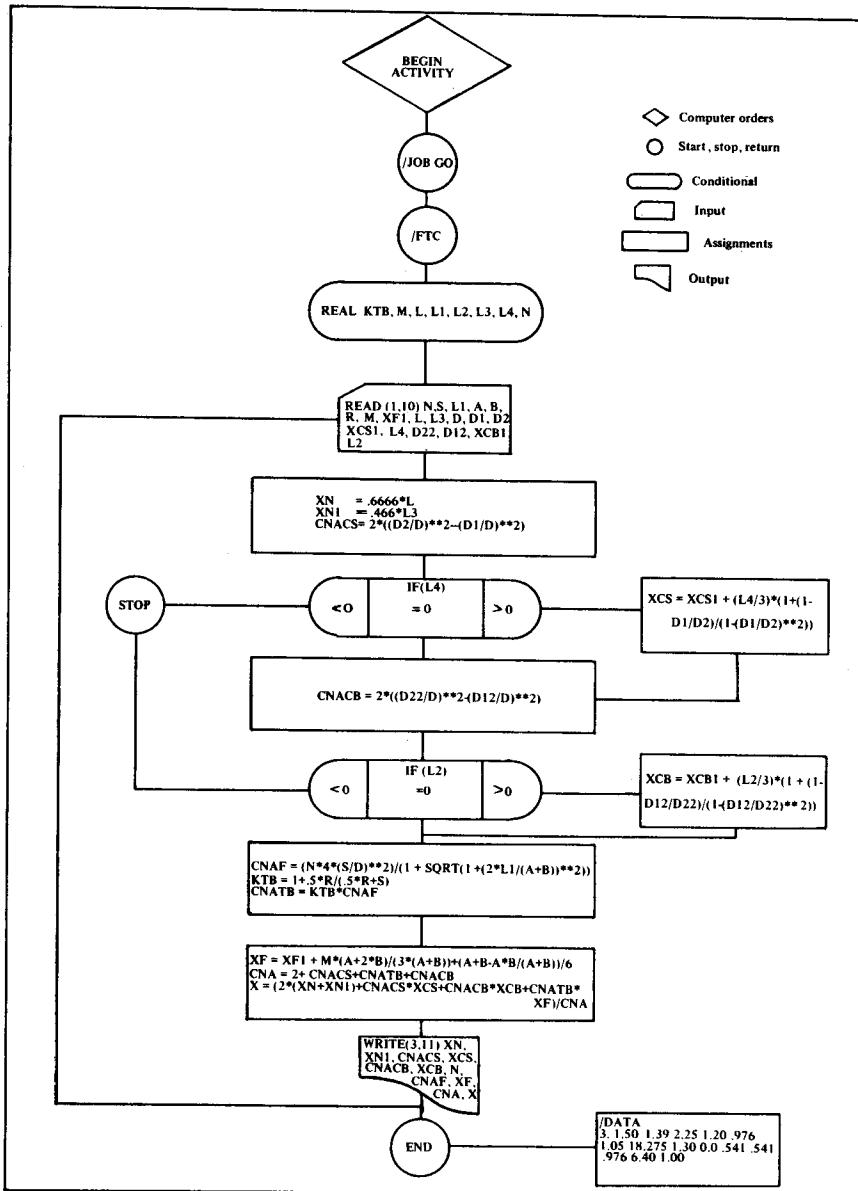1.05 18.275 1.30 0.0 .541 .541
.976 6.40 1.00

END

---

check on all parts of the program to make sure it was functioning properly. However, when this became no longer necessary, I had just discovered that many of the Cna values turned out to be needed for dynamic stability calculations. As you know from the Barrowman report, Cna is a dimensionless "force" which has no relevance to vehicle dimensions. It is needed in computing CPs however. But, if the programmer feels that he is never going to need these solutions, he can do away with them if he deems this necessary.

In the event that the program fails to give correct answers, or does not give answers at all, there are a few trouble-shooting tips which can prove helpful at this point. When and if you receive 'FORTRAN DIAGNOSTIC MESSAGES' have a copy of the IBM 360 RAX User's Manual handy. This lists many of the "messages" you may receive which you would otherwise be unable to read. Oftentimes, a number is given which refers to a specific flaw, which is otherwise impossible to detect. The Manual is available from IBM, and at least one copy should be present at the terminal. If the program compiles but does not give correct answers, make sure that all data is aligned correctly. If the decimal points do not follow the format pattern exactly, there is an excellent chance for incorrect answers. If all else fails, consult a computer technician at the main computer center.

The Barrowman CP program can be used with any single staged rocket with a conical shoulder or conical boattail. This covers more than half of all model rockets built, but needless to say, there are others. In a future issue, there will be a program for these "others" — two stage models, Saturn V's, oddball designs, etc. In my next column, I shall discuss altitudes and a program to accurately compute them.

Reader Design Page

The Hybrid is a two stage sport model designed by Gary Lindgren of Fanwood, New Jersey. The rocket has three features not found on most two stage models. They are 1) air intake mounted between the 2nd stage fins, 2) Balsa struts used for an engine mount in the booster. This allows the air to pass through the air intakes and right through the booster tube, and 3) slots are cut about 1 1/2" long and about 1/8 thick. The second stage fits into these slots.

The Hybrid can be launched with most engines. Note: All parts used on the Hybrid are available from SPACE AGE INDUSTRIES in Highland Park, New Jersey.

Booster Fin (3)
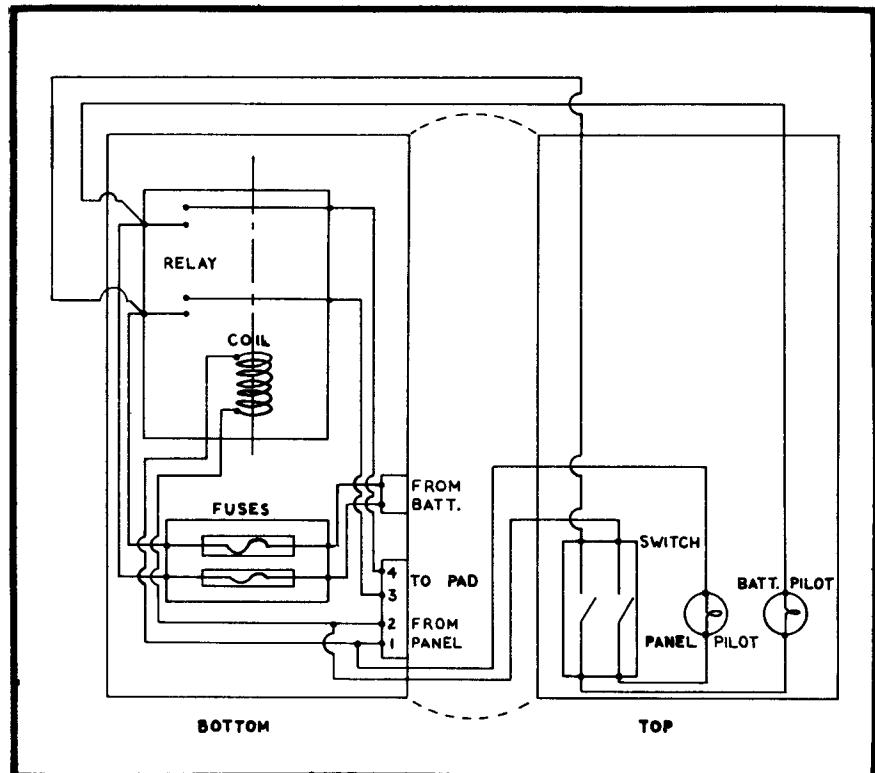
Each month Model Rocketry will award a $5.00 prize for the best original rocket design submitted by a reader during the preceding month. To be eligible for this prize, entries should be carefully drawn in black ink on a single sheet of 8½ by 11 paper. Sufficient information should be contained in the drawing so that the rocket can be constructed without any additional information.

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

Second Stage Fin (3)

Booster Engine Mount Struts (3) 1/8" Thick

Nose Cone (NC-20C)

T-20 (11")

13½"

17"

5"

Booster T-30

The
Wayward
Wind

by Gordon K. Mandell

Shown above is a schematic drawing of the relay ignition system described by Thomas P. Wuellete, Jr., of Pittsburgh, Pennsylvania. The topic of this month's column, the Wuellette relay system permits the rocketeer to attain ignition reliabilities in clustered models that approach those of single-engined rockets.

RELAY IGNITION

Over the past half-year or so I have repeatedly harangued readers of this column concerning a subject that's been one of my pet peeves for a long time: the needless duplication of effort in model rocketry research and development which arises from inadequate communication among the rocketeers. In an attempt to stabilize and advance the state of research and development in the hobby, I have called for all R&D-minded modelers to submit their brainchildren to me for comparison with the work of other modrockers elsewhere and elsewhen.

Well, I've been getting tons of mail all right – most of it, as I had feared, from people who were doing precisely what their counterparts of five or ten years ago had already done. A lot of the material run under the Wayward Wind logo in the past few months has been concerned with specific examples of some of the most commonly duplicated R&D work people have been sending in. But, lo, there are indeed grains of wheat amongst the chaff! I've been receiving significant numbers of letters from intelligent, articulate, and well-qualified R&D-ers who are engaged in work that is either completely original or the best single instance of its kind that has come to my attention to date. This month I'm going to describe an example from the latter category: a relay firing system designed and built by Thomas P. Wuellette, Jr., NAR 14696 and the Secretary-Treasurer of the North Pittsburgh Rocket Club.

Relay ignition systems are used to reduce the voltage drop resulting from a penalty that is unavoidable in conventional electrical firing systems: the necessity of passing current through 20 or more feet of No. 18 AWG wire from the firing panel to the rocket being flown. This practice is wasteful of battery power and causes the voltage that appears across the igniter when the firing button is pressed to be significantly less than the rated voltage of the firing battery. The "IR drop" in the leads, as it is called, can be disastrous when a cluster launch (which draws a lot of current) is attempted. Many are the rocketeers who have had one or more engines in a cluster fail to light when attempting to fire with a conventional launch system, and many are the embittered modelers who have sworn they would never touch a cluster design again, after watching all their hard work go up in smoke and come down in bits and pieces. The ideal solution to this problem would be to have the battery directly adjacent to the rocket and connected to it by heavy-guage wire leads interrupted by some sort of a switch which could be remotely operated using electrical power from the same battery used to launch the rocket, but which would draw very much less power than that needed to fire the model.

Precisely such a mechanism is a *relay*, an electromagnetically operated switch consisting of a coil, one or more fixed contacts, and one or more movable contacts restrained by a spring. Relays used for launching model rockets are of the "normally open" variety; that is, the spring holds the movable contacts so that they are not touching the fixed ones when no current is passing through the coil. When current *is* passed through the coil a magnetic field is set up which attracts the movable contacts toward the fixed ones. If sufficient current passes through the coil, the force due to the magnetic field is greater than the restraining force of the spring, and the movable contacts are "pulled in" until they touch the fixed ones. Current can then pass between the fixed and movable contacts to operate any desired electrical device -- in this case, our rocket igniters. The current required to make the relay "close" or "pull in" is quite small compared to that needed to fire the ignitors, and both the battery and the box containing the relay and its associated circuitry can be placed a foot or two from the rocket while the launch officer operates the system from a firing panel twenty feet away.

A simple relay launch system is described by Stephen Chessin in the January 1969 issue of **Model Rocketry**. Other similar systems have been employed in club panels such as the Metropolitan Area Rocket Society (MARS) panel.

The Wuellette relay firing system is shown schematically in Figure 1. This well-designed little device uses a 12-volt double-pole power relay (meaning that both battery leads are interrupted when no current is passing through the coil) and is designed for use with a 12-volt car battery. Current is

PARTS LIST

Description	Source	Part Number	Approx. Cost
Aluminum minibox, 5 x 4 x 3 inches	Allied	42 A 7639	$1.10
Power relay, 12 VDC, DPST, PR7DY	Allied	41 A 6511	5.40
Fuse holder, double	Allied	57 A 3010	.35
Fuses, 3AG std., 25A	Allied	57 A 3707	.30
Socket, 2 position, S-302-AB	Allied	47 B 0880	.32
Socket, 4 position, S-304-AB	Allied	47 B 0882	.42
Plug, 2 position, P-302-CCT	Allied	47 B 0802	.62
Plug, 4 position, P-304-CCT	Allied	47 B 0804	.73
Pilot light holders (2)	Estes	LH-1	.45 each
Pilot lights (2)	Estes	AL-12	.20
Switch, DPST	Allied	56 A 4647	.91
Alligator clips	Centuri	EMC-70	.25 pr.
Micro clips	Estes	MC-1	.25 pr.
Battery clips (2)	Estes	BC-1	.40 each
Wire, No. 18 guage	HW		.05/ft
Wire, No. 16 guage	HW		.08/ft

Plus the following necessary items: solder, soldering iron, and wire cutters.
Source Code:
Allied: Allied Radio Corporation
Estes: Estes Industries, Inc.
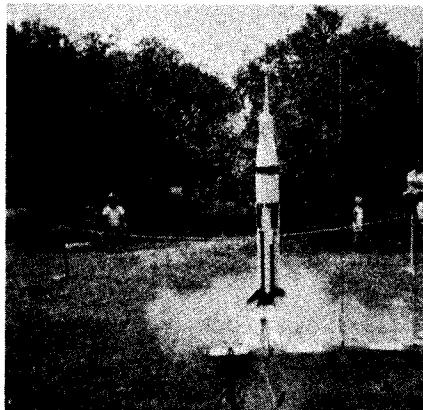Centuri: Centuri Engineering Company
HW: any hardware store

delivered to the relay coil from the firing panel through a twenty-foot length of two-conductor lamp cord which is connected to two of the four terminals of a four-position plug. The car battery is connected to the fixed contacts of the relay via a two-position plug at the end of a foot or two of No. 16 two-conductor wire. Tom Wuelette has incorporated an extra safety feature into the circuit at this point: two 25-amp fuses to prevent damage to the relay system in the event of an internal short circuit. He also uses two pilot lights to check the status of the system — one to determine whether the relay coil is receiving power from the firing panel; the other to determine whether the battery is properly connected to the fixed contacts of the relay. Both lights can be activated for inspection by flipping the double-pole toggle switch provided to "on," or both can be deactivated to save power by

turning it to the "off" position.

The battery power is fed to the rocket from the remaining two terminals of the four-position plug through two or three feet of No. 16, two-conductor wire. As the system was designed to fire clustered rockets, either a bus ring setup or an array of clip-whips (see June, 1969 **Model Rocketry**) would normally be attached to the "business end" of these leads. The relay launch system as described is designed for use with an ordinary model rocket firing panel having safety interlock, key, and firing button. The only differences between its use in a conventional system and its use with the relay system are that (a), the "firing" leads that would ordinarily go out to the micro-clips must instead be connected to the first two terminals of the four-position plug, and (b), since the battery is right next to the rocket, a twenty-foot length of two-conductor lamp

Liftoff! Between May and August, 1969, the original Wuellette system launched more than 100 clustered models without a single misfire.

cord is needed to connect it to the input terminals of the firing panel. Having thus modified your panel, you're ready to go . . . and don't sweat that clustered bird! Complete, simultaneous cluster ignition is no problem at all with the Wuelette relay system.

Many thanks to Tom Wuellette for taking the time and trouble to describe this fine launch system so that model rocketeers across the nation might benefit from its use. Tom compiled the parts list, sketched the schematic, and provided the photographs used in this description. His work is an example of design and construction of which our hobby can truly be proud.

You, too, can be a part of the forefront of development of model rocketry. You, too, can contribute to the advancement of this space-age hobby of ours. All you've got to do is let us hear from you! Send that pet theory, idea, design, gadget, or whatever, to me in care of The Wayward Wind, **Model Rocketry,** *Box 214, Boston, Mass 02123.*

Canadian Convention
Planned for Montreal

The Atmospheric Rocket Research Association is presently organizing a Canadian Model Rocket Convention and Competition The events will include guest speakers, films, displays, talks, a banquet, and a rocket competition . All rocketeers from Canada and the North-east United States who wish further information should send a self-addressed envelope to the ARRA, c/o Steven J. Kushnery, 7800 Des-Erables Avenue, Montreal 329, Quebec, Canada.

Boy Scout Jamboree
Features Rocket Demo

The Valley Forge Council of the Boy Scouts of America conducted a model rocket demonstration launching at the 1969 Annual Boy Scout Jamboree. During the three hour launching session an estimated 50,000 scouts witnessed the launching of 54 model rockets. Three launch pads were used to speed up the procedures, and only one of the 54 rockets fired was lost. Estes, Centuri, and MPC provided rockets and literature in support of the demonstration.

NEWS NOTES

Fourth Glen Ellyn
Demo Launch Held

The fourth annual model rocket demonstration by the Glen Ellyn Rocket Society was held on Labor Day, September 1, in South Park, Glen Ellyn, Illinois. The first rocket was fired by Jack Lancaster, Chairman of the Recreation Committee of the Glen Ellyn Park Board. In advance of the event, eleven local newspapers printed announcements. Additional advance publicity was obtained on the "Today in Chicago" television show seen on the Chicago NBC affiliate. Glen Ellyn Rocket Society members Steve Brown, Kent Hoffman, and Greg Clement spent 10 minutes on the TV show describing model rocketry and the society's activities.

Estimates on the number of spectators witnessing the launching from South Park ranged up to 2,000. The Chicago Tribune, the Chicago Sun Times, WGN TV, NBC TV, and several local newspapers sent out camera crews during the day. WGN TV featured 10 minutes of coverage on their Labor Day evening news at 10 pm.

As a result of the publicity obtained, the Itaska, Illinois police called to request help for an Itaska group interested in forming a model rocket club. A science teacher from Roselle, Illinois contacted the Glen Ellyn Rocket Society for information on introducing model rockets into his classes. Finally, Ernest Oberth, nephew of rocket poineer Herman Oberth, volunteered to give a lecture to the Society on the development of rocketry in Germany and Russia.

Itaska Illinois
Approves
Local Rocketry Club

Itasca Illinois village officials recently gave unanimous approval to a request by Frank C. Cieslak for establishment of an "Itasca Rocket Research Society." But in sanctioning the go-ahead for the local organization which will become affiliated with a national rocket research group, the village board of trustees qualified its approval to favorable clearance from the Federal Aviation Administration (FAA). The board's reservation toward seeking FAA approval was predicated on reports that FAA was investigating a model rocket show in Glen Ellyn held earlier.

Another question posed for FAA consideration was the possible effect model rocket launchings would have in the Itasca Greenbelt area where an FAA guidance control tower for landing approaches to O'Hare Airport will be installed.

Where FAA may have some reservations is that the proposed guidance tower will reportedly bring in commercial aircraft over Itasca at a height in the landing pattern of 1,650 feet. This was the apparent thinking of Village Pres. Wilbert Nottke and some of the board members. Yet, village officials were high in their praise for creation of the local rocket group and suggested that the society contact the Itasca Park District or local schools and churches for a possible meeting place.

Fly the

When was the last time a ½A put your B/G up for over a minute and a half?

BUMBLE BEE

For Hornet Boost/Glide

by Bob Singer, NAR 6102

The Bumble Bee is a small, light boost/glider designed specific-ally for Hornet competition. As a pleasant bonus it turned out to be simple and fun to fly, unlike so many other competition birds. Stuff your pockets full of ½As, take your launcher and a Bumble Bee down to the local school yard, and you can have a great time. If you use a larger engine be prepared to do some running. At a recent demonstration launch, I put a Bumble Bee up with a ½A6-2, and one minute and 45 seconds later it landed – still 30 feet up, in a tree. If it hadn't been for that glider-eating tree, I'm sure that I would have broken two minutes. In competition, the Bumble Bee is undefeated. Build one and see.

This glider was actually developed to beat the nationally published, airfoil-less boost glider, the M--TA, which, despite looks, turns out a good time with a ½A. The M--TA, very popular with a certain section in the WAMARVA area, is not too hard to beat with A or B engines in a modified hand launch glider. But for this latter type the low power of a ½A is prohibitive. Characteristically, a large glider will boost up fifteen or twenty feet and settle into a stable glide at about the same time that it settles into the ground. So for Hornet, a good glider must reach a healthy altitude, but must glide better than a 4" paper airplane ejected from a standard rocket. Lightness, low drag, good glide, and of course high reliability are important factors.

The obvious features that set the Bumble Bee apart from most other boost gliders are its small size, light weight (5 to 7 grams), and low aspect ratio wings. The wing itself is made from 1/16" balsa, but it is sanded to a good airfoil. This is more important than it might at first seem—it really reduces drag on the way up, and it keeps the glider up far longer than a flat wing ever could. In addition, it reduces the total weight of the Bumble Bee. While the wing thickness is only 4% of the average wing chord, spend those five extra minutes and make sure that the airfoil is true to the one shown in the drawing.

Spruce is used for the boom (body) of the Bumble Bee. While it weighs slightly more than balsa, it is virtually indestructable, and you don't have to use as much of it. A balsa boom of the size specified would probably break on the first rough landing.

The Bumble Bee uses a detachable pod system based on the one published by G. Harry Stine for his Flat Cat (Model Rocketry, August, 1969). Over the past few years this has been the only system that I have used. With a little care, you should never have a failure. By all means use a parachute for the pod, as shown, to eliminate the possibility of a "Red Baron".

Very few dimensions on this glider are critical. Wherever a high degree of accuracy is important it will be mentioned in the text or the dimensions will be written on the drawing itself. All other measurements and patterns can be traced or copied directly from the drawing.
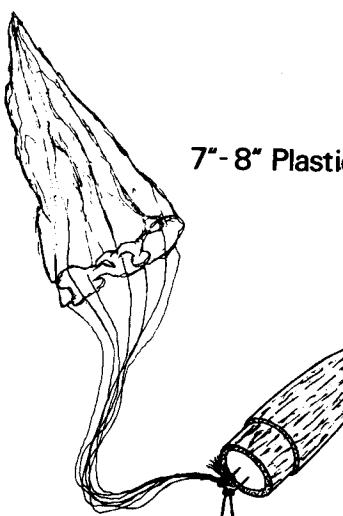
For all parts of this glider except the pod assembly I suggest that you use an acetate cement, such as Testor's Formula B, Aero Gloss, or Ambroid. These are much lighter than white glue or Titebond, and faster drying. For a glider the size of the Bumble Bee they are plenty strong. Be sure, however, to preglue all pieces one or two times before you join them. On the pod I use Titebond just to be sure of plenty of strength.

Start construction with the wing. Choose a good sheet of 1/16" C-grain balsa from which to cut the panels. C-grain is the cut of wood that is most resistant to warps and is the sturdiest. You can recognize it by its flaky appearance. If you think that this description is a little vague, ask your friendly local hobby shop owner to show you a piece —I think you'll see what I mean by "flaky". The lighter and whiter the sheet, the better.
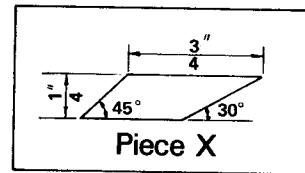
Sanding the airfoil may seem a lot more forbidding than it actually is. It isn't really that hard- but don't do a "half-way" job on

Author holds a finished Bumble-Bee. The color scheme was put on with felt tipped markers, adding very little to the total weight.
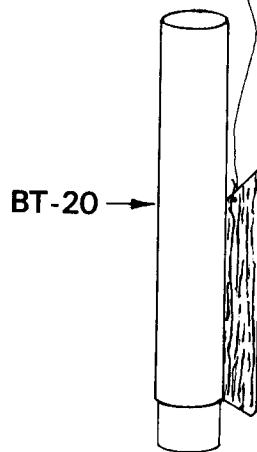
7"- 8" Plastic Parachute
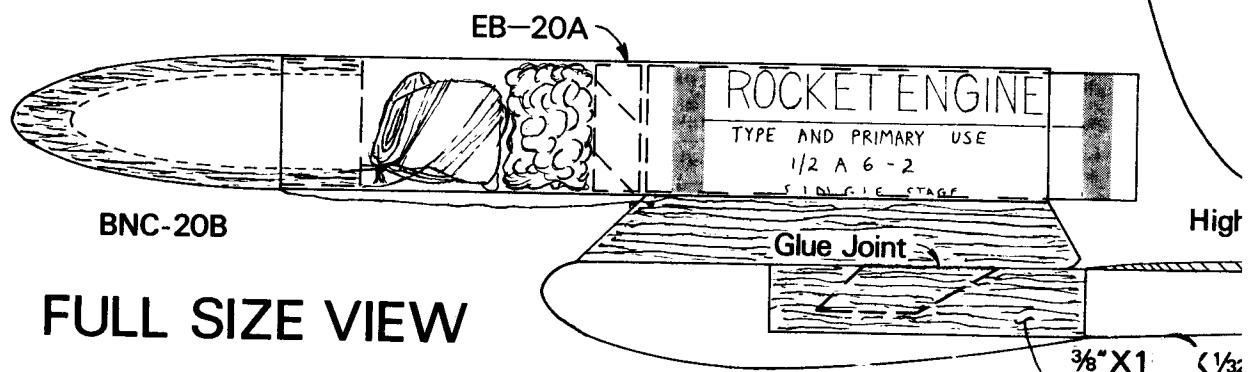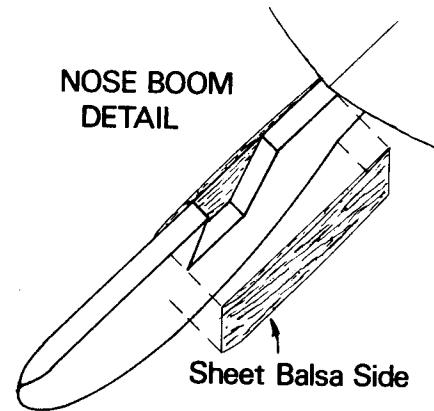
2" Long Gum Rubber Band

Approx. 4" of
Shroud Line →

BT-20 →

← Piece X

Piece X

$\frac{3}{4}$"

$\frac{1}{4}$"

45° 30°

**NOSE BOOM
DETAIL**

Sheet Balsa Side

EB—20A

ROCKET ENGINE
TYPE AND PRIMARY USE
1/2 A 6 - 2
SINGLE STAGE

BNC-20B

Glue Joint

High

FULL SIZE VIEW

$\frac{3}{8}$"X1 ⟨1/32

Well Fa
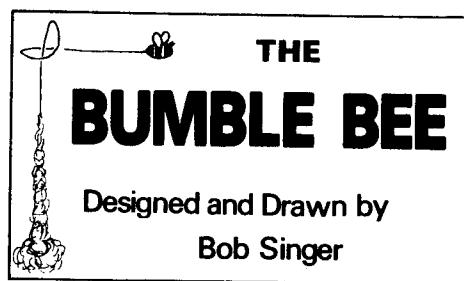
DIHEDRAL DETAIL–See Text

Wing Panels (2)
Cut from ⅟₁₆" Balsa
"C" Grain

FULL SIZE VIEW

→ Grain →

← Grain →

THE
BUMBLE BEE

Designed and Drawn by
Bob Singer

Cut Stabilizer and Fin
from Sanded Down
⅟₁₆" Sheet "C" Grain
See Text

Fuselage Section AA

Airfoil
at Root

Point

A

A

Cut Body From ⅛" Spruce

" B   Sides

aired

↑ Grain ↓

FULL SIZE VIEW

Grain

Cut Stabilizer and Fin from Sanded Down 1/16" Sheet "C" Grain See Text

Grain

THE
BUMBLE BEE
Designed and Drawn by
Bob Singer

Wing Panels (2)
Cut from 1/16" Balsa
"C" Grain

Grain

Fuselage Section AA

Airfoil
at Root

A

A   Cut Body From 1/8" Spruce

High Point

1/32" B   Sides

Piece X

3/4"
45°
30°
1/4"

Well Faired

3/8" X 1

Gum Rubber Band

NOSE BOOM
DETAIL

Sheet Balsa Side

ROCKET ENGINE
TYPE AND PRIMARY USE
1/2 A 6 - 2

Glue Joint

EB—20A

e X
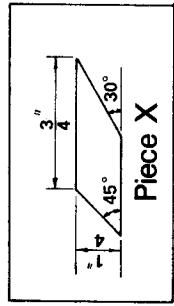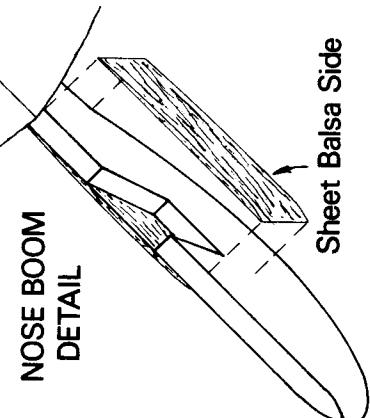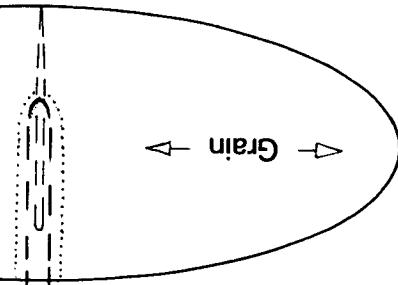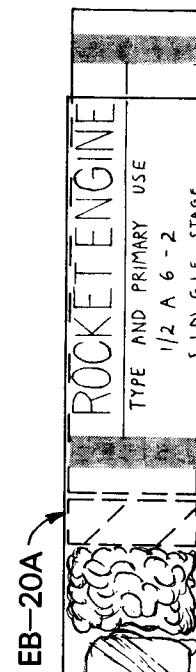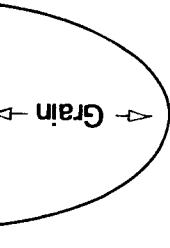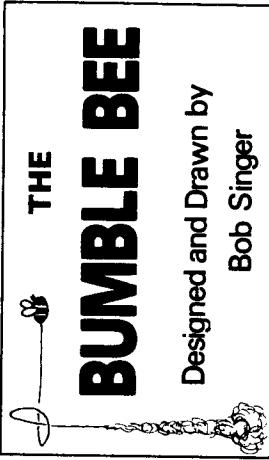
DIHEDRAL DETAIL–See Text

page 24/25 overlap (2 of 2)

FULL SIZE VIEW

← Grain →

Wing Panels (2)
Cut from ¹⁄₁₆" Balsa
"C" Grain

← Grain →

THE
BUMBLE BEE
Designed and Drawn by
Bob Singer

Cut Stabilizer and Fin
from Sanded Down
¹⁄₁₆" Sheet "C" Grain
See Text

Fuselage Section AA

Airfoil
at Root

A

High Point

Piece X

3"
⁄4

45°   30°

NOSE BOOM
DETAIL

Sheet Balsa Side

um Rubber Band

ROCKET ENGINE
TYPE AND PRIMARY USE
1/2 A 6 - 2
SINGLE STAGE

Glue Joint

B–20A

arachute

X

it. Don't settle for a fat airfoil. The only place where the finished wing should still be 1/16" thick is along the high-point line, shown in the drawings. If you want to, lightly mark the high-point on the balsa with a soft pencil to aid in sanding. The airfoil is almost straight back from there to the trailing edge but not quite flat.

Use 400 grit or maybe 320 grit sandpaper for shaping the sheet balsa. Anything rougher will inevitably leave deep scratches. If it seems that your paper is getting smooth, it is probably still good, but just filled up with balsa dust. Get an old toothbrush and scrub it (under the faucet if you have waterproof paper, such as 3M TRI—M—ITE WET OR DRY). Most likely your paper will be as good as new.

One of the biggest problems I have had with sanding fins and wings is gouging and oversanding the trailing edge, giving it a scalloped appearance. About half a year ago, though, I discovered that sanding the work when it is flat on a worktable makes it much easier to get an even, sharp trailing edge.

About the last ¾" or so of the wingtip tapers smoothly from maximum chord at the root to virtually nothing at the tip. It follows that the less tip there is, the less tip vortex generated. When you are done sanding the wing, the leading and trailing edge tapers should blend smoothly into the tip taper. After all, they are all part of the same curve.

The dihedral is 1" under each tip. You may have noticed that in the front view drawing the wings seem crooked. This will be explained later- disregard it now.

Find a side on a board or worktable that has sides perpendicular to the flat surface. Prop one wing panel up with a block of wood or piece of scrap so that the tip is 1" above the flat surface of the board, and with the *bottom* of the wing root edge lined up exactly with the edge of the board. Notice that the *top* of the root, which is sanded to an airfoil, is very slightly overhanging the edge of the table. Run a sanding block back and forth over the root, using the side of the board as a guide, until all the overhanging balsa is sanded away. Repeat this procedure on the other wing. Now, with the proper amount of dihedral, the two root edges will butt together perfectly.

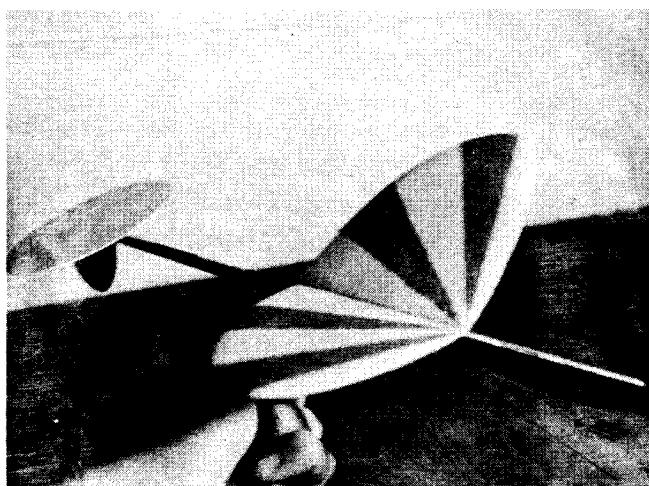Glue the dihedral in the following manner: First preglue both wingroots one or two times. Then lay a piece of waxed paper or Saran wrap on your worktable, and pin one wing panel down flat in the middle of it, airfoil side up. To that panel glue the second one, with the tip of the second panel propped up 2". Set this in a place where no one will set a book on it or kick it, and build the rest of the Bumble Bee while the glue is drying.

The stabilizer and fin should ideally be cut from 1/20" thick balsa. However, this size is quite hard to find, so you can use the 1/16" sheet left over from the wing, sanded down.

Ready to glide weight of the Bumble-Bee is only about 6 or 7 grams. If there's a thermal around this glider will catch it.

First copy the stabilizer and fin patterns from the drawing onto the 1/16" sheet. Cut them out and, with a sanding block, sand each piece flat until it measures 1/20" (if you don't have a suitable ruler try to match the maximum thickness shown for these parts in the side and top views). Here again, don't be lazy - 1/16" balsa is just too thick and heavy to use for these parts on a glider of this size.

After you have sanded the stabilizer and fin to the proper thickness sand both to a good symmetrical airfoil. (NOTE: Do not sand the part of the underside of the stab within the dotted line - this is where the stab is glued to the body, and to insure good alignment it must be flat.) Taper the stab tips and the tip of the fin to a point, as shown in the front view. This helps reduce the tip vortices on these surfaces. Set these parts aside temporarily while you cut out the body. The body, or fuselage, or boom or whatever you want to call it, is cut from 1/8" spruce stock, as was mentioned earlier. Trace the shape directly from the drawing. Use a factory cut edge for the top, because it must be straight to hold the pod, wing, and stabilizer perfectly in line. Spruce doesn't cut as easily as balsa so you may have to do a little whittling and rough sanding. When your boom matches the drawing in shape, round all the edges except the *top* , and taper the nose and tail as shown in the top view.

Carefully draw the piece X onto the boom as shown in the side view, using the exact measurements shown. Now, carefully, cut it out of the boom, in *one piece*. Save it for later. I have found that a razor saw is good for cutting out this part.
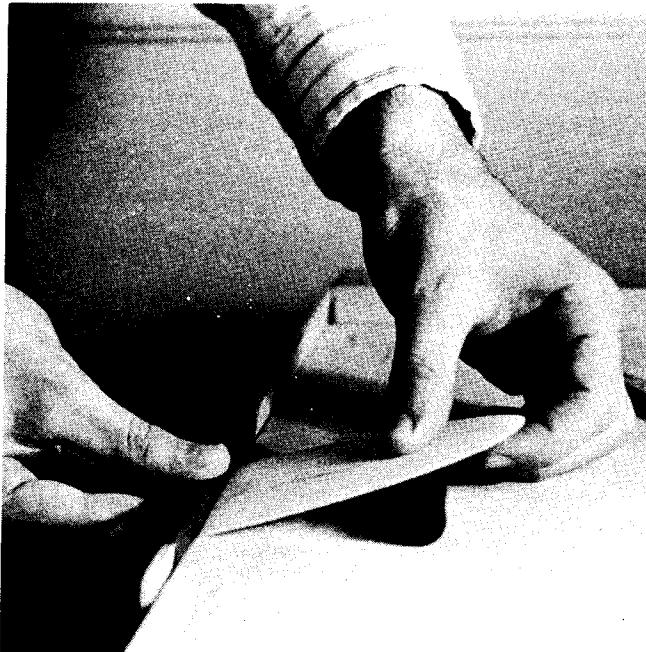
Cut out the two side pieces for the boom from 1/32" balsa sheet, or sanded down 1/16" sheet. Fair (airfoil) them well, as shown and glue them to the body. While they are drying, build the pod.

I built my pod from Estes BT-20, because it is lighter and of a slightly smaller diameter than the comparable Centuri tube. If you really feel strongly about it, though, use Centuri parts (attn: Leroy and Doug). Cut the body tube to the length shown, and glue the engine block in place so that the engine sticks 1/2" out the back. The pylon on which the tube is glued is cut from 1/8" balsa, or two sheets of 1/16" balsa laminated together. Streamline the pylon well, but of course leave the top and bottom flat. First glue the piece X to the pylon as shown and then glue the pylon securely to the body tube as you would a thick fin. Glue the launching lug on one side or the other in the corner formed by these two parts.

While the pod is drying finish building the body. Cut a 3" long shallow V-groove (refer to fuselage section AA on the drawing) where the wing will be attached. If anything, make the groove slightly deeper than is shown, to insure that the wing will sit properly. Now glue the stab and fin onto the body, making sure that everything lines up squarely. Support this unit somehow so that no pressure is put on the tail surfaces until they are quite dry. I usually stick the nose of my gliders between two books.

By now the pod assembly should be dry enough to work with. Install the recovery system as shown in the drawing. Notice that it is attached to the pod through a small hole in the front of the pylon. Make the hole with a straight pin or simply thread the line through with a needle. Tie the knot and smear a little glue around the hole. The parachute itself can either be cut down from a commercial one or cut from a plastic cleaner's bag. I like to use octogonal 'chutes 'because they can be made easily by folding the sheet of plastic in half, and then in half again, and then again, and cutting along the base of the isosceles triangle formed. Space inside the pod is at a premium, so don't make the parachute any bigger than necessary to qualify. Seven or eight inches across is a safe size. Use a U-shaped piece of paperclip instead of a screw eye. Press it into the side of the hollowed-out nose cone, as shown, and smear glue around it.

Next glue the wing assembly on. Notice that in the front view drawing the wing is at an angle to the body and the tail surfaces. This will put your glider into a flat, tight circle, which will keep it in a thermal and in sight longer. The glider will turn towards the lower wing. I personally like right-hand circles. Whatever, try to match the degree of tilt to that shown in the drawing.

Each wing panel is sanded to the proper dihedral bevel at the root to insure a strong wing joint.

Your Bumble Bee is now finished except for a few details. Put a few coats of glue on the bottom of the fin to help keep it from getting scraped up. Check the fit of the pod - this is very important. It should not be too loose or wobble but, fully loaded, it should fall off the glider by itself or with a gentle tap when the glider is held straight. Sand the piece X if necessary, checking the fit frequently.

Everybody has his own theory about the best finish, or lack of finish, for a boost/glider, but no one has any conclusive data (it's R&D time, guys). I would recommend leaving the Bumble Bee bare wood, colored with magic marker. This aids visibility but adds very little weight. A glider this small built out of spruce and C-grain balsa shouldn't warp unless you fly it into a swimming pool or store it in the shower.

Wait for a calm day or evening to trim your glider. Add weight to the nose until it just slightly stalls when you give it a gentle level toss. I use thin lead, such as from an old glue tube, for ballast. You don't need very much on a glider this small. Then take it down to a park or schoolyard and really wring it out. Watch as it slows down and settles into a glide. Add weight bit by bit, throwing it each time, until your Bumble Bee hangs just on the verge of a stall, but never actually does. This is the best trim for endurance. For windy weather, add a little nose weight until you get the best glide. I have found that masking tape is plenty heavy for the job, and is very convenient when I am out on the flying field.
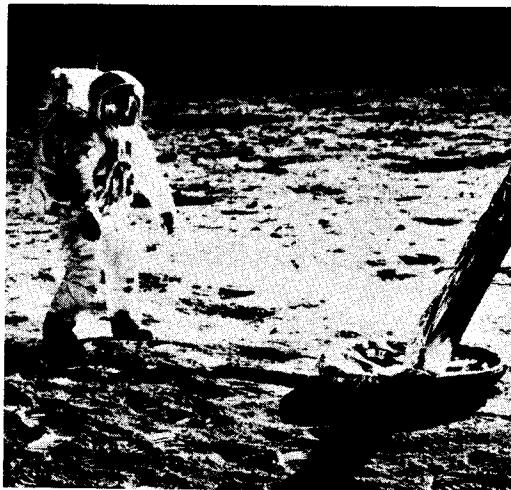
Flying the Bumble Bee is almost as simple as flying an Astron Alpha. Wrap some masking tape around the launch rod about a foot up from the pad. This holds the pod up so that the glider won't fall off before launch. If this precaution isn't necessary on your glider, then the pod fits on much too tightly. Load the pod like a regular rocket, taping the engine up for a very tight fit in the body tube. Cram the wadding and the recovery system in place. It may be a tight squeeze, but this helps blow the pod off properly. The nose cone shouldn't fit too tightly, but it should stay put when you shake the pod upside down. Now put the pod on the rail, attach the clips, and hang the glider on. Out of common courtesy be sure to remove the masking tape from the rail after your launch if somebody else is going to use the pad.

I think you will find this glider great in Hornet competition, and a lot of fun to build and fly. Don't be discouraged by all these instructions - it took me a month to write this article, but only two nights to design and build the B/G!

PASCACK VALLEY
Annual Regional Meet
October 19, 1969

The first Pascack Valley Annual Regional Meet (PVARM) got underway on a Rutgers University field on the morning of October 19th. Sponsored by New Jersey's Pascack Valley Section of the NAR, the

Chris Williams, North Shore Section president, prepares his design efficiency rocket for launching from a tower. He took first place in the Leader design efficiency competition.

contest attracted rocketeers from New York, New Jersey, Deleware, and Maryland. Advance publicity, through articles in the area newspapers, resulted in about 100 spectators arriving to witness the event. The

flying field, clearly marked by an actual Air Force Falcon airframe displayed by Tag Powell of Space Age Industries, was flat, and open, providing encouragement for many contestants who regularly fly in more restricted areas.
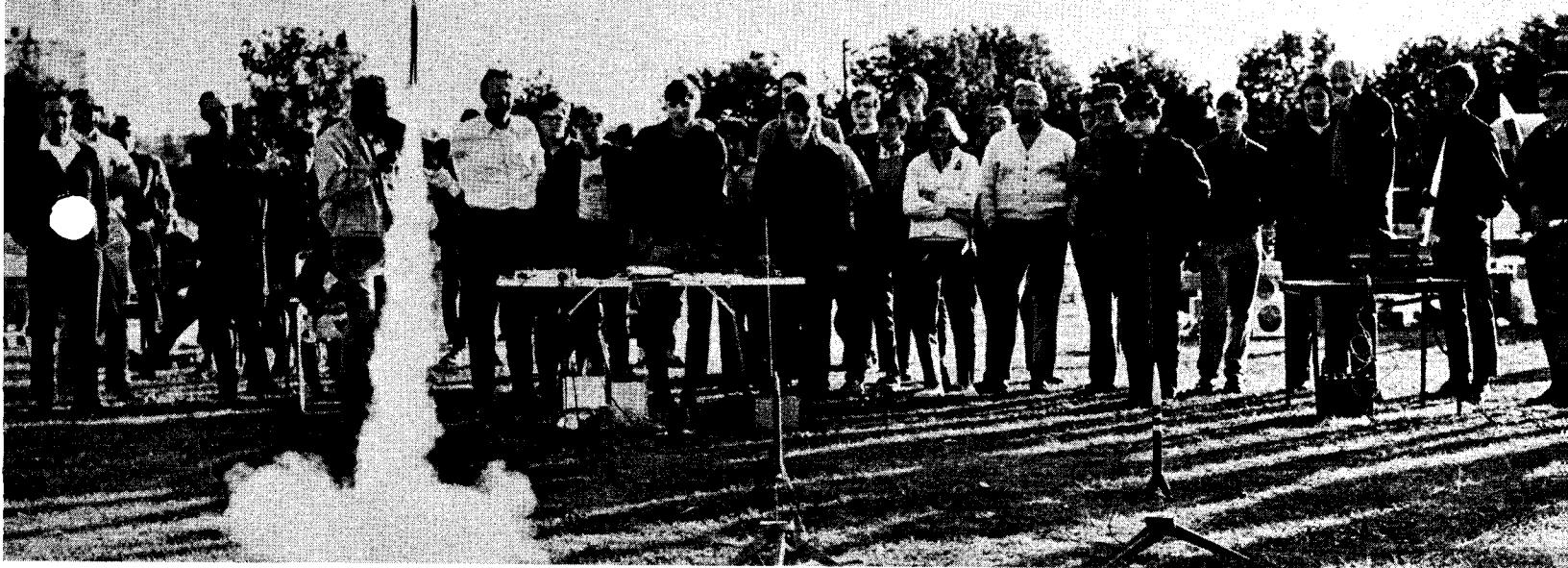
Contest Director Al Lindgren opened the meet by introducing NAR Trustee John Belkewitch, who launched the first rocket. That rocket, powered by three C engines and weighing only 14 ounces at liftoff, stood 8 feet high. It was constructed by Pascack Valley members Gary Lindgren and Robert Thayer, Jr., and took third place in R&D at NARAM-11. Unfortunately, one engine failed to ignite, and after a flight to about 100 feet the parachute deployed at only 4 feet above the ground. Some damage was done, but nothing beyond repair.

Seven events – Super Scale, Research and Development, Eggloft, Design Efficiency, Swift Boost/Glide, Spot Landing, and Drag Race – were on the schedule for the one day meet, so things were expected to be a bit hectic. By 11:15 AM everything was in order, and Eggloft was set to begin.

The trackers were a little out of practice, so many tracks were lost in this first event of the day. Most of the winners adopted a strategy of underpowering their birds to assure a track. Two stagers using high thrust engines didn't stand a chance, even though

PVARM RESULTS

EGGLOFT

JUNIOR
1st	Tony Mendel
2nd	Mike Bonner
3rd	Bob Colucci

SENIOR
1st	Ruth Jones
2nd	Tag Powell

DESIGN EFFICIENCY

JUNIOR
1st	Paul Stracke
2nd	Don McCauley
3rd	Bob Thayer, Jr.

LEADER
1st	Chris Williams
2nd	Craig Rader
3rd	Thomas Rosalanko

SENIOR
1st	Rick Jones
2nd	Shirley Lindgren
3rd	William Grier

SWIFT B/G

JUNIOR
1st	Leslie Lindgren
2nd	Bob Rack
3rd	Steven Stein

LEADER
1st	Chris Williams

SENIOR
1st	James Bonner
2nd	William Grover
3rd	George Chervanak

OPEN SPOT LANDING

JUNIOR
1st	Karen Clentano
2nd	Stuart Zaharak
3rd	Gary Lindgren

SENIOR
1st	Shirley Lindgren
2nd	Gary Bossony
3rd	Bob Thayer, Sr.

DRAG RACE

LEADER
1st	Chris Williams
2nd	Thomas Rosalanko
3rd	David Hunt

SUPER SCALE

JUNIOR
1st	Mark Wargo
2nd	Gary Lindgren

SENIOR
1st	Shirley Lindgren
2nd	Al Lindgren
3rd	Karl Feldman

R&D

JUNIOR
1st	Gary Lindgren
2nd	Mark Wargo
3rd	Steve Stein

LEADER/SENIOR
1st	Chris Williams
2nd	Al Lindgren
3rd	Karl Feldman

(Above) NAR Trustee John Belkewitch preps his Hawk B/G in a world record attempt.

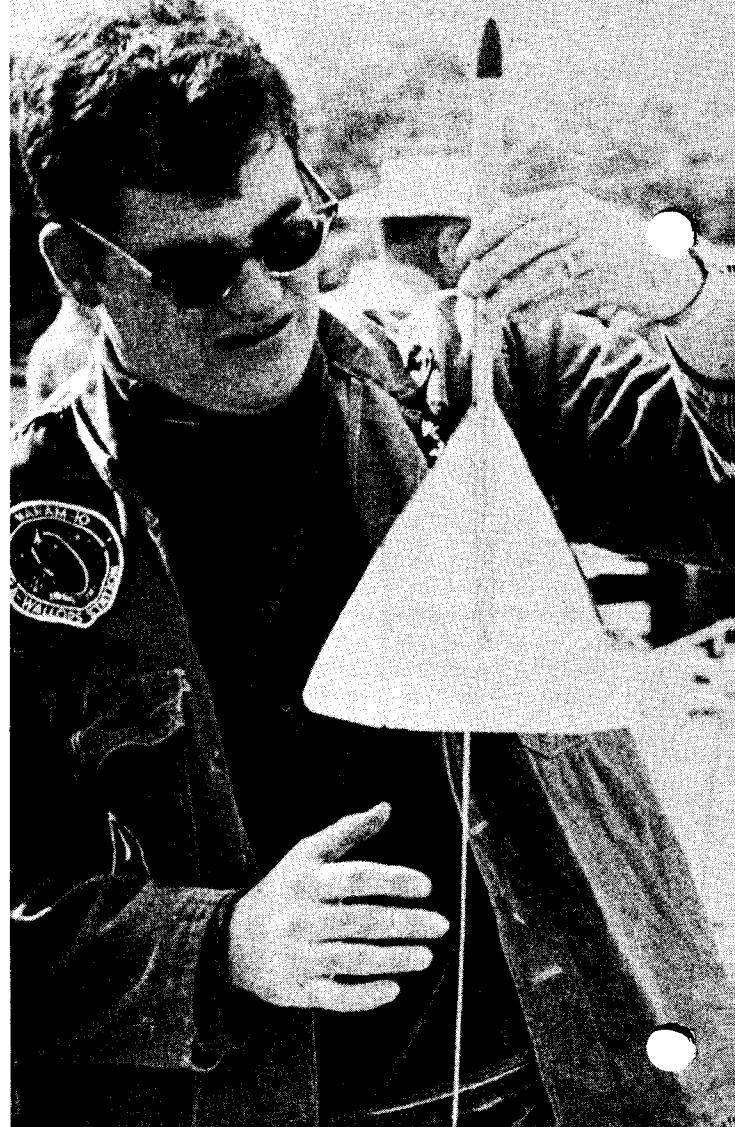(Right) Karl Feldman places his styrofoam Manta B/G on the pad. Karl, who has recently advocated the use of styrofoam for rockets, proved its structural soundness when the glider survived a crash undamaged.

the sky was clear. In Senior division, Ruth Jones took first place with a single stage egglofter, and Tag Powell, of Space Age Industries, took second. Tracking West was given a minor scare when an egglofter they were following weathercocked and impacted about 10 feet in front of the tracking scope.

John Belkewitch brought out his Hawk boost/glider in an attempt to establish a new world record in that catagory. The glider had previously flown for over two minutes in a test flight. However, the engine he selected had a long delay charge, and the glider came down below 100 feet before ejecting the engine. It headed straight for the ground, and the glider boom went through a cyclone fence, stripping off the wings, tail, and stabilizer.

Scott Brown, Gemini Model Rocket Society President, produced an unusual launch tower for his design efficiency bird. The tower, three 18 inch body tubes fastened over the top of three thread spools which were glued to a tilt-a-pad launcher, performed perfectly. Postflight inspection confirmed that not even the body tubes were damaged by the engine blast. A nice, inexpensive tower for those rocketeers interested in eliminating launch lug drag.

The Swift B/G event also brought some interesting rockets to the pad. A "Flying Jenny" biplane boost glider, built to double the size of the original Estes plans was flown by Will Grover. It turned in a 52 second flight, taking second place in the Senior division. Karl Feldman, who has pioneered the introduction of styrofoam into the hobby, flew an all styrofoam Manta, which arced over and crashed into the ground about 100 feet from the pad. The structural integrity of styrofoam construction was proven when Karl picked up the glider totally *undamaged*. Leslie Lindgren got an almost three minute flight for first place in the Junior division.

As the B/G event was drawing to a close, clouds began moving in from the West, and the meet was running a little behind schedule. Open Spot landing was flown by age groups, with only rockets in contention being measured. Winning was reduced to luck, because many contestants overpowered their birds, giving them flights to over 200 feet, and letting them catch the wind making prediction of the landing area impossible.

Drag race was run off four central launchers, allowing each rocketeer to fire his own bird. In drag race, two rockets are flown against each other in a heat. The winner is paired against the winner from another heat, etc., until an overall winner is determined. In each heat, one point is awarded for the first rocket off the pad (making it a test of the rocketeer's reflexes as well as the engine's thrust), one point for the lowest peak altitude, and one point for the last rocket to land. The winner in each heat is the rocketeer with the highest number of points for that heat. Chris Williams, President of the North Shore Section, took first place in Leader drag race in a heat against Thomas Rosalanko.

Super Scale, an event in which a scale model of a rocket and its launcher are built, showed a remarkable variety. The Lindgren family was out in force with Shirley Lindgren's scale Asp beating out Al Lindgren's Little John for the first place honors in the Senior division. Karl Feldman took third with a Black Brant IV. Among the Juniors, Mark Wargo captured first with an Asp, and Gary Lindgren took second with a Terrepin.
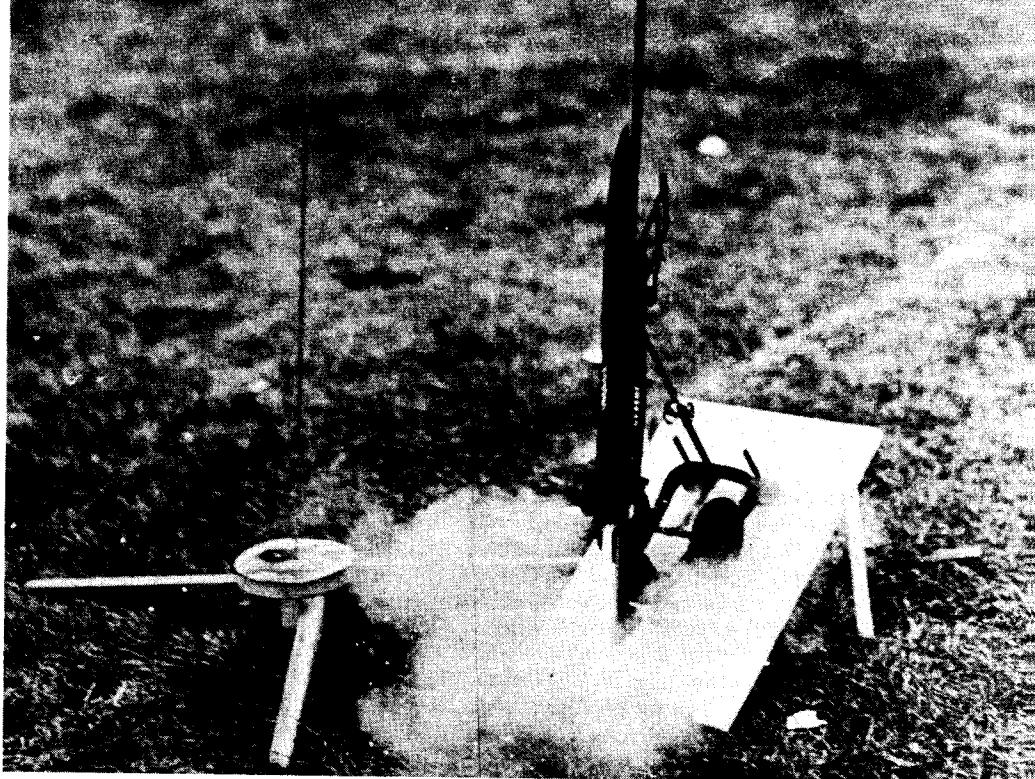
Research and Development saw some unusual ideas. Due to the fast approaching darkness, no formal presentations were made, but almost all the entries were test

flown from another pad simultaneously with the drag race. Gary Lindgren's silo launcher, employing a can with three 2 inch long slots (180° apart) to stabilize the vehicle, took first place. Several demonstration flights established that Gary's unique launcher did indeed stabilize the rocket. Mark Wargo took second place with his investigation of a method of stabilizing large base conical rockets. Third place went to Steve Stein for his 3 dimensional altitude data reduction board.

In Leader/Senior R&D, Chris Williams took first place with a transmitter constructed over the last two years. His device has a range of over 300 feet, and is equipped with a spin rate sensor. Al Lindgren took second place for his tracking data reduction tables, which, incidentally, were used for data reduction at the contest. Karl Feldman took third place for his investigation into the suitability of styrofoam as a modeling material for rocketeers.
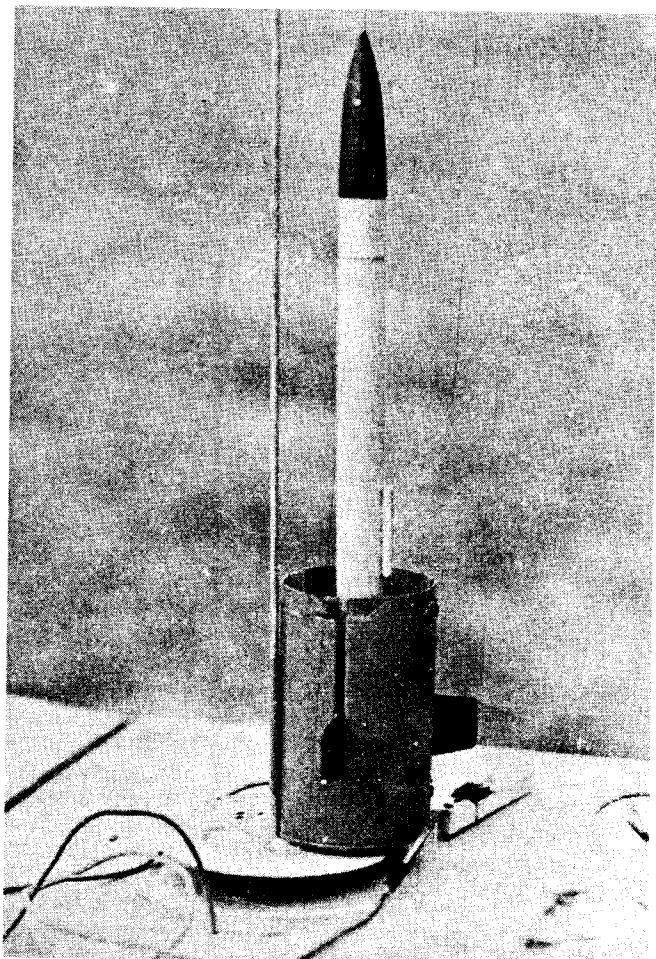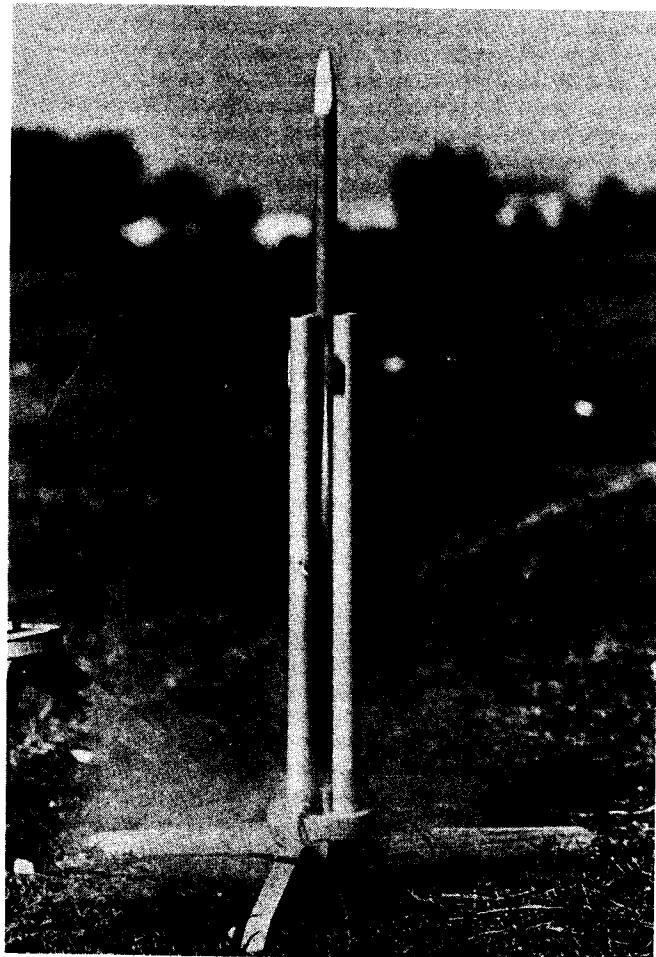
Just as the sun was setting, the contest came to a close and ribbons were awarded to the winners. It was at times a bit hectic, but good planning and cooperation from the rocketeers present allowed the seven scheduled events to be flown in a single day.

Contest Director Al Lindgren's super-scale Little John lifts off. He took second place in the super-scale event.

Scott Brown, Gemini MRS president, brought this simple tower launcher built from BT-50 tubes and thread spools. A construction article on this tower will appear in next month's Model Rocketry.

A unique launcher, built by PVS member Gary Lindren, took first place in Junior R&D. A demonstration flight proved this launcher did indeed stabilize the rocket.

FUNDAMENTAL PHOTO INTERPRETATION

by Forrest Mims

The advent of the Camroc rocket camera marketed by Estes Industries makes available to even the beginner in model rocketry a capability formerly reserved for only the most advanced rocketeer. Model Rocketry magazine has published several articles on the Camroc describing methods by which the camera's performance may be measurably improved (see Model Rocketry November 1968, January 1969, and September 1969). This paper will augment the earlier reports with general background information on aerial photography and an introduction to photometrics, mathematical techniques permitting the determination of rocket altitude at the moment of shutter release and ground measurements.

Aerial photography has a long and colorful history. From the beginning, when European battlefield photographers practiced their skills from baskets of hot air baloons, aerial photography has largely been the domain of the military. Aerial reconnaissance played vital roles in all wars of this century. More recently, however, numerous peaceful uses have been found for the art. Geologists now depend to a large extent on aerial photography for locating deposits of mineral resources. Surveyors and city planners use the technique to assist in the orderly expansion of transportation facilities. Agriculturalists benefit form weather data gleaned from cloud photographs and crop disease detection with the assistance of special filters and photographic emulsions.

Space technology has greatly enhanced the peaceful role of aerial photography. Photographs sent to special earth based receiving stations by instrumented weather satellites are an important part of modern weather forecasting. These satellites also provide a means for large scale geological and vegetation surveys. The many spectacular photographs obtained during the manned Gemini series provided the impetus for scientific and government planners to form an earth resources program employing satellites equipped with high–resolution camera systems.

The ambitious student of model rocketry will likewise find aerial photography far more than a novel method of obtaining snapshots. An excellent model rocket club project, for example, would be an aerial survey of the club's launch site and tracking sites. Furthermore, there are numerous possibilities for research projects involving rocket aerial photography: surface wind surveys using smoke flares, infrared photography, use of color filters, micrometeorology, and smog studies are but a few of the possibilities. The scope of any rocket aerial photography experiment will of course, be greatly enlarged if the experimenter has the capability of lofting a small movie camera.

The experimenter will find a few simple equations quite handy for determining information from aerial photographs. Photographs taken by single frame cameras of the Camroc catagory are classified as either vertical or oblique. Vertical photographs are obtained when the lateral cross section of the camera lens is parallel (or nearly so) to the earth's surface in the camera field of view. Oblique photographs are obtained when the camera lens is at some angle to the earth's surface in the camera field of view. Vertical photographs are by far the easiest to interpret as their scale is uniform. Oblique photographs result from a short parachute ejection delay time and have a non-uniform scale (see Figure 1).

The height at which a vertical photograph was obtained is expressed:
$$h = f \times PSR \qquad (1)$$
where f is the camera focal length, and PSR is the photo scale reciprocal. PSR may be expressed:
$$PSR = D/d \qquad (2)$$
where D is a known physical dimension of an object in the photograph (e.g. length of a car) and d is the photo dimension of the same object. (NOTE: All dimensions must be in similar units--for example, both D and d should be expressed in inches, feet, or meters. Naturally h will be expressed in the same unit as d and D. Also, the photo measurement d should be obtained from the negative. If a print of the negative is used, d will have to be adjusted to any enlargements to the print. For a print magnified two times (2X), for example, d must be divided by two.)
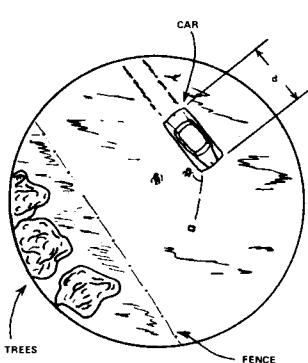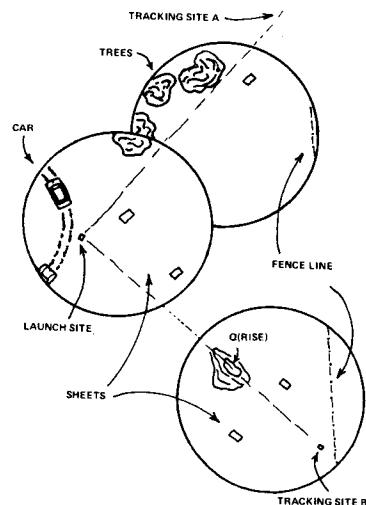
Example 1

h = (fD)/d
d = 1.5 CM; BUT PRINT IS
  2X ENLARGEMENT.
  THEN d = 1.5 CM/2
d = 0.75 CM
D = 6.00 M
f = 7.62 CM (CAMROC)
THEN h = (7.62 X 600) / 0.75 CM
h = 6096 CM or 61 M
61 M = 200 FT

Example 2

FIND DISTANCE FROM LAUNCH
SITE TO TRACKING SITE B.
h = (fD)/d (USE SHEET REFERENCES)
d = 2 CM/2 = 1 CM
D = 50 FT = 15.24 M
f = 7.62 CM (CAMROC)
THEN h = (7.62 X 1524) / 1 CM
h = 116.13 M
TRACKING SITE TO LAUNCH d =
21 CM/2 = 10.5 CM
D = (dh)/f D = 160 M = 524.8 FT
PSR MAY ALSO BE USED.

FIG. 1. MAJOR AERIAL PHOTO CLASSES

Equations (1) and (2) above may be consolidated to form:

$$h = (fD)/d \qquad (3)$$

EXAMPLE 1:

It is apparent that equations 1–3 can be employed to provide information pertaining to the dimensions of most objects in a vertical photograph if the PSR is known. Then:

$$D = d \times PSR \qquad (4)$$

EXAMPLE 2:

The distance from launch rack "A" to tracking site "B" was measured with a 50 ft tape and found to be 500 ft by the tracking crew of the Delta Rocket Society. However, doubts existed as to the accuracy of the measurement due to a small rise at "Q". An aerial photographic survey of the area using a Camroc showed the doubts to be valid. In order to provide ground distance references, six white sheets were placed in pairs at random locations, the sheets of each pair being parallel at their longest axis and their near sides being exactly 50 ft apart.
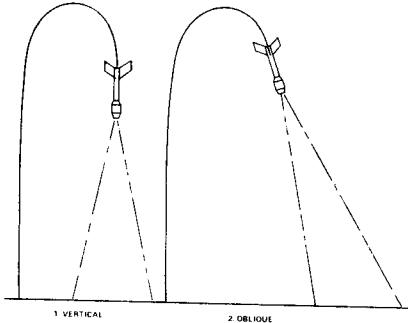
In many cases it will be inconvenient for the experimenter to prearrange for reference targets on the ground. And of course the position of reference targets may fall outside the rocket camera field of view. The experimenter should then be prepared to measure the height of his camera at parachute ejection (signified by a puff of smoke and not always at the peak of trajectory). With h known, the above equations may be used to find ground dimensions. For example:

$$D = (dh)/f \qquad (5)$$

and

$$PSR = h/f \qquad (6)$$

This paper has presented a basic review of aerial photography and photometrics. Photometrics of oblique photographs is more involved than that for vertical photographs. In an oblique photograph, the equations above apply only if D and d are parallel to the horizon and in the same plane. Then of course h is not the altitude of the camera at exposure time but the distance from the camera to the object measured. For a detailed discussion of oblique photometrics the experimenter is encouraged to consult his local library.

References

Department of the Air Force: Basic Photography (AF Manual No. 95-1); U.S. Government Printing Office, Washington, D.C.; 1959. Lueder, Donald R.; Aerial Photographic Interpretation; McGraw–Hill Book Co., New York; 1959.

New Product Notes

Space Photos, has in its stock over 450 35 millimeter slides in full color, and many more in black and white, taken by U.S. Astronauts, plus photos, postcards, and wall-posters. They have just recently come up with a 25" x 38" wall-poster on the trip of Apollo 11 which tops anything in the visual space field.

There are 25 different full color photos reproduced on this poster, with each one fully described. The photos, in chronological order, tell the story of Apollo 11 simply, concisely and accurately, and it makes a perfect adornment and tool for almost any science classroom or for a wall decoration in any home.

Individually, the Apollo 11 poster, lithographed on quality 100 pound enamel sells for $1.50. (Special quantity prices are available.) The posters and any of the other space slides, postcards and pictures can be ordered by mail and will be shipped immediately.

Space Photos has been in this visual space education business for almost as long as NASA has been orbiting humans, but this particular Apollo 11 wall-poster has won even the plaudits of the Astronauts who usually are most blase about their pictures. Order from Space Photos, Dept. MR, 2608 Sunset Blvd., Houston, Texas 77005.
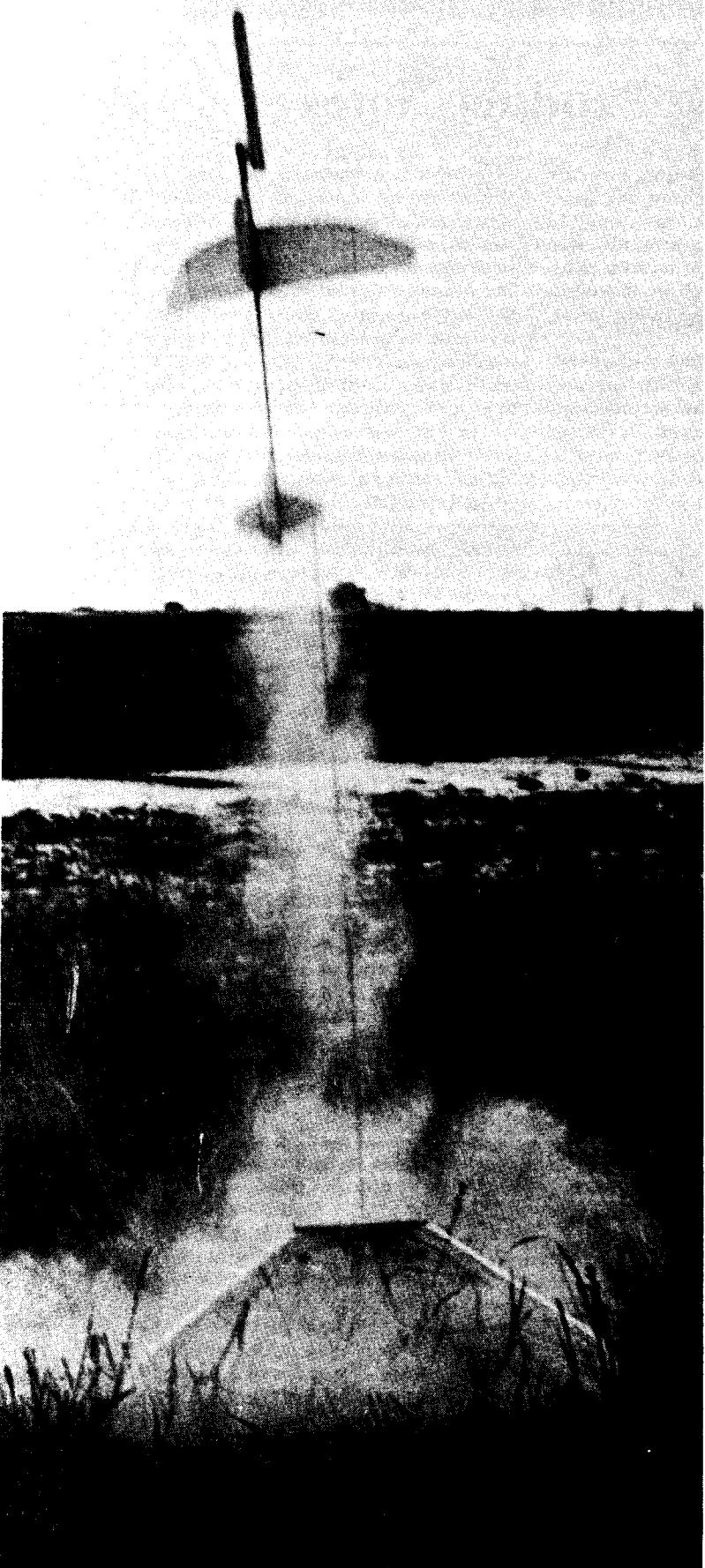
Reliance Engineering in Albuquerque, New Mexico has announced the formation of a subsidiary company for the manufacture of miniaturized electronic and telemetry systems designed for model rockets. The company is called Micro Instrumentation and Telemetry Systems (MITS). Reliance Engineering president Henry Roberts announced that "MITS is presently conducting an intensive research program involving high quality miniature telemetry systems."

The first commercially available model rocket telemetry transmitter is among the first items to be offered by MITS. Accessory modules including a tone beacon, temperature sensor, and a roll rate sensor, as well as tracking lights, ground systems for data reduction, and light weight, water activated batteries will soon be available.

MITS has prepared *The Booklet of Model Rocket Telemetry* to introduce rocketeers to their telemetry equipment. Copies of the booklet are available at 25 cents from MITS, 4809 Palo Duro ave. N.E., Albuquerque, New Mexico 87110.

The Log of Apollo 11, a new publication of the National Aeronautics and Space Administration, is now available from the Government Printing Office. Following the flight from liftoff through recovery, the Log contains a mission timeline for the 8 day flight as well as 18 color photographs documenting the mission. Many of the spectactular photos of the lunar surface activity are reproduced in full color. The booklet can be purchased for 35c from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Lectronix has introduced a light flasher kit containing all parts (except batteries) necessary to construct a transistorized tracking light for model rockets. Employing standard flashlight bulbs, easily replaced at any hardware store, complete instructions are included with the "Blinky" kit. Mounted on the circuit board included, the Blinky will fit in a BT-60 or larger payload section. Two AA cells can be substituted for the two D cells specified to lighten the payload weight. Priced at $3.50, the "Blinky" kit is available by mail order from Lectronix, PO Box 42R, Madison Heights, Michigan 48071.

BOOST/GLIDER

PERFORMANCE

by Douglas J. Malewicki

SUMMARY

This article presents several graphs which will enable model rocketeers to predict the flight duration times of their gliders from any specified initial height above the ground. The basic techniques of how to use these graphs to obtain practical results for your gliders are demonstrated through the use of detailed examples and problems.

Actual glide speeds can also be determined and the effects on glide durations due to temperature and launch altitude variations can be accurately taken into account.

In order to help your overall understanding of glider performance, an additional graph has been included to show you just exactly how much duration is affected by percentage changes in Lift, Drag, Weight, and Wing Area.

It should be mentioned that the glider duration graph can also be used for predicting parachute durations. The reasons why this is valid will become apparent upon studying the derivations of the basic equations which govern parachute motion and glider motion as presented in the appendix.

INTRODUCTION

My interest in establishing some basic duration criteria for model rocket boost gliders was initially prompted by two shortcomings in my Radio-Controlled Boost Glider design—namely: 1) its limitation to the B4-2 engine, and 2) the fact that it is too much of a "floater" and lacks real "penetration" in windy-day flights.

My intuition told me that if I reduced the glider's overall size that I could eventually reduce its drag during rocket boost to a value acceptable for use with C6-5 engines. Altitude at pop-pod ejection would be considerably higher as a result, however, the glider with its greatly reduced lifting wing area would descend at a *much faster* rate and a correspondingly higher forward velocity.

The increased forward velocity would be very desirable as the glider would have better "penetration" into higher winds. In other words, it could still keep moving forward rather than flying "backwards" as it appears to observers on the ground—which was the problem in high winds with the present "floater" R/C B/G.

Also one must consider the possibility that the extra altitude gained during a more efficient boost phase might even offset the higher rate of descent of a less efficient glide phase. Thus, the

overall duration might stay the same, might decrease, or might even increase.

That's when I started feeling that a method was needed to scientifically predict these results in advance in order to see whether or not the above thoughts had any validity and were worth pursuing. The graphs and derivations presented in this paper are the results of this effort.

The examples, problems, and solutions have been especially designed to make you aware of some of the potential uses that can be made of the material. Note, however, that in order to get the *complete* flight performance picture you will need a copy of Centuri's TIR-100 (which is sold for $1.00 postpaid), which enables you to predict the peak altitude reached by any size and weight rocket powered by any Estes or Centuri model rocket engine. The peak altitudes found with TIR-100 will be the *starting* altitude to use with the methods presented here. The duration for this altitude is then computed assuming a steady, straight glide to the ground in non-varying smooth, calm air without any consideration for possible hot air thermals.

In actuality, the glider will not be in a "steady" glide for at least a couple of seconds after pop-pod separation. In the case of a "death dive", it will never attain a steady gliding flight at all. We cannot account for this variation with our "steady" glide theory, so we just simplify the problem by assuming that the altitude lost in the transition from rocket powered vertical flight to horizontal steady gliding flight is zero

As you gain experience, you will be able to estimate the actual altitude lost in the transition to steady glide and can take it into account in your duration predictions, if desired. However, in view of the departures from theory that may arise from weathercocking during boost (non-vertical ascent) and the unknown luck factor of thermals it is hardly worth the effort and I personally don't bother trying to account for it.

The Basic Gliding Performance Equation

The equation which we use to determine how long a glider flying through the air takes to descend each foot of altitude is:

$$t = \frac{(C_L)^{3/2}}{C_D} \frac{\sqrt{\tfrac{1}{2}\rho}}{\sqrt{W/S}}$$

This probably doesn't make any sense to younger rocketeers who have not had any formal aerodynamics courses, but it should help if we replace the symbols with words which describe them as follows:

$$\begin{array}{c}\text{duration} \\ \text{in seconds} \\ \text{for each foot} \\ \text{of altitude}\end{array} = \frac{\left(\begin{array}{c}\text{Aerodynamic} \\ \text{Lift} \\ \text{Coefficient}\end{array}\right)^{3/2}}{\left(\begin{array}{c}\text{Aerodynamic} \\ \text{Drag} \\ \text{Coefficient}\end{array}\right)} \frac{\sqrt{\dfrac{\text{air density}}{2}}}{\sqrt{\dfrac{\text{weight}}{\text{wing surface area}}}}$$

In the long run it takes a lot *less* effort to write a single symbol like S and mentally keep in mind that "when I see S I have to think of wing surface area", than to completely write out "wing surface area" each and every time you use it.

For further simplification and mental clarification we combine some of the above terms and give them new names.

$$\text{AERODYNAMIC GLIDE FACTOR} = \frac{(C_L)^{3/2}}{C_D}$$

$$\text{WING LOADING} = \frac{W}{S}$$

or our duration equation acquires new meaning as follows:

$$\begin{array}{c}\text{time in seconds} \\ \text{to descend each} \\ \text{foot of altitude}\end{array} = \left(\begin{array}{c}\text{aerodynamic} \\ \text{glide factor}\end{array}\right) \frac{\sqrt{\dfrac{\text{air density}}{2}}}{\sqrt{\text{wing loading}}}$$

Thus, we can see that the higher the aerodynamic glide factor $(C_L^{3/2}/C_D)$ the higher the resulting duration (t). Similarly, the lower the wing loading (W/S)—meaning the smaller the proportion of total glider weight carried by each square inch of wing surface area—the longer the resulting duration (t). Lastly, we can observe that the higher the density of the air (ρ) in which we are flying, the longer it will take to descend each foot of altitude.

Air Density

The air density (ρ) is not a variable which we can control and optimize through proper design. It merely depends on the air temperature and elevation above sea level of the field where you are flying your glider and obviously varies from day to day.

Wing Loading

The wing loading for a given glider is determined once you weigh it and measure its wing surface area. A simple way to get a value for the surface area is to trace the outline of the wing on graph paper that is printed with one inch squares. Then count up and total all the full squares and fractions of squares to obtain the total area in square inches. (Note that the tracing is made with the wing flat and in reality each wing panel is tilted up on the assembled glider by an amount called the dihedral angle. As a result, the true area actually contributing to lift is slightly reduced. You can take it into account by multiplying the flat wing surface area which you measured by the trigonometric cosine of the dihedral angle. However, when one considers the inherent inaccuracies in "counting the squares", this dihedral correction to wing surface area is usually not worth the effort).

Once you have measured the wing surface area and weighed the model you obtain its wing loading (W/S) by dividing its weight (W) by the wing surface area (S).

Aerodynamic Glide Factor

The aerodynamic glide factor $(C_L^{3/2}/C_D)$ is made up of the glider's non-dimensional aerodynamic lift coefficient (C_L) and its non-dimensional aerodynamic drag coefficient (C_D). Most of you younger rocketeers who have not had any formal aerodynamics courses as yet are now probably grumbling that C_L and C_D have *absolutely no* meaning and in a way you are perfectly right! It's easy to understand the concepts of weight (W) and wing surface area (S), but these last two aerodynamic terms can't very well be felt with your fingers or measured with a ruler.
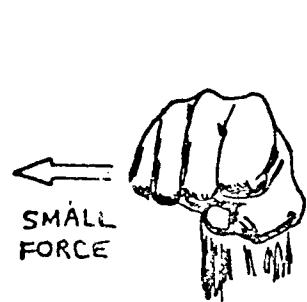
In actuality the C_L and C_D terms are found *indirectly* using simple mathematical equations that contain "things" you can "feel" with your hands and "measure" with rulers and which in themselves make sense. Reasons why we bother with this obvious extra work and how we go about actually determining numerical values for lift coefficient (C_L) and drag coefficient (C_D) will be explained shortly.

It should be fairly easy to understand the concept of an *aerodynamic force* from experience. Any blob of matter (an arbitrarily shaped object) that has air flowing over it must necessarily be affected by the resulting force of this wind.

You can "feel" these aerodynamic forces yourself by holding your hand out of a car traveling at 60 miles per hour. Your muscles, in essence, are your built-in weighing scale and you soon find out that: 1) the aerodynamic reaction force increases with *velocity* (it is larger at 60 MPH than at 30 MPH), and 2) it varies according to the *size and shape* of the object exposed to the airflow (the total aerodynamic force acting on your hand when it is clenched in a small fist is less than when you fully extend your fingers and form a cup to catch the air).

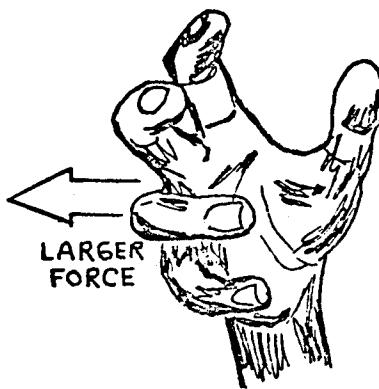If you then hold your hand out while keeping it flat like a wing, you find that tilting your hand up a bit causes a tendency for your hand to be forced upwards in addition to the usual tendency to be pushed backwards. Of course, you notice that tilting down causes an opposite effect. The important conclusion is that the resulting force due to the wind *is not* necessarily in the same direction as the wind is flowing.

SMALL FORCE

LARGER FORCE

CLENCHED FIST   OPEN HAND

Now if you knew exactly how much force in ounces was being produced and at what angle to the airflow this reaction was inclined, we could use trigonometry to find out what part of the total aerodynamic force can be considered acting in line with airflow (which we call DRAG FORCE), and what part of the total aerodynamic force can be considered as acting perpendicular, or at right angles, to the airflow (which we call LIFT FORCE).Where θ is the angle between the drag force(D) and the total aerodynamic force (R).

If you have a scale plastic airplane model with a wing span of about one foot, you might be curious in seeing how much more significant the lift force produced by a true airfoil shaped wing can be. Holding the model from the rear so as not to interfere with the flow over the wing you soon learn that at 60 miles per hour that the lift varies considerably with small changes in the angle at which you incline the wing to the flow. We should now mention that this angle is called the angle-of-attack of the wing; it is represented by the greek letter alpha (α), and is measured in degrees relative to the airflow direction.

In modern day wind tunnels, the total aerodynamic force (R) and its angle to the wind (θ) are not measured but instead, the Lift Force (L) and Drag Force (D) are read directly in ounces (or pounds) which saves some trigonometric calculations.

Summarizing the information we have gathered so far by merely holding our hand out of a car window, we can conclude that Aerodynamic Drag and Aerodynamic Lift vary with:
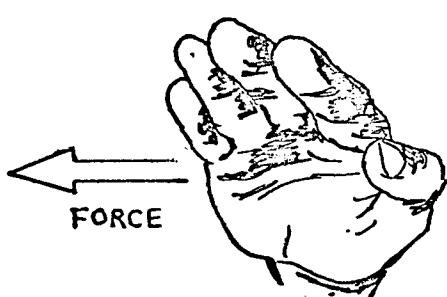
1. Speed of the air flowing over the object.
2. The size and shape of the object.
3. The angle-of-attack of the object (excluding such things as spheres—for which you will have considerable difficulty convincing the wind that you have increased or decreased its angle-of-attack). That's about it—or can you think of anything else that might cause drastic changes in the resulting forces?

What happens if instead of a car and air you are in a boat going 30 miles per hour and you let the water flow over your hand. Yes, there will be a considerable increase in the force. This is because water is much denser than air. Thus, the density (denoted by the greek letter ρ rho) of the material in which we are flying can affect the resulting reaction forces.

Normally, it is difficult to sense the changes in the density of air that occur as a result of temperature and elevation changes because the percentage change is fairly small. In fact, for most of our work with models we just use a constant value for density which corresponds to its value at a temperature of $59°$ F at sea level (zero altitude).
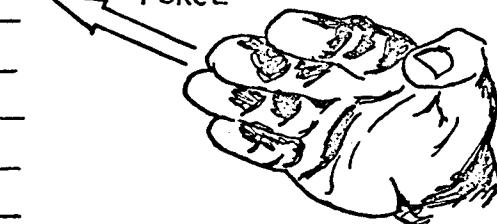
The basic aerodynamic formulas which relate all of these terms as they actually affect the Drag and Lift forces are presented here in the shorthand language of mathematical symbols.
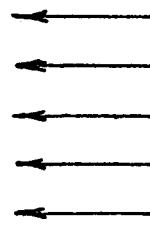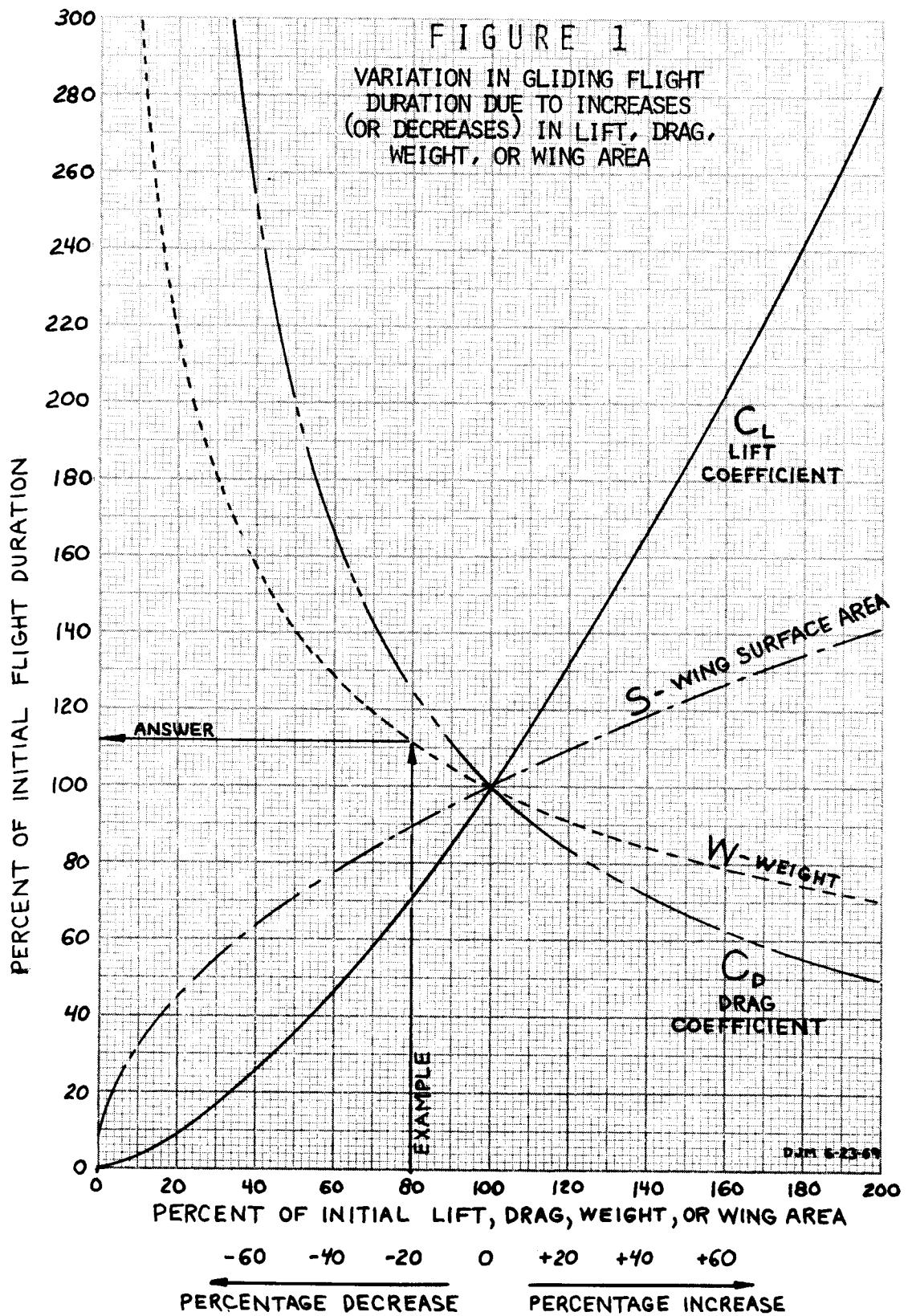
WIND   WIND

AERODYNAMIC REACTION FORCE

R

FORCE

FLAT   TILTED UP

FIGURE 1

VARIATION IN GLIDING FLIGHT
DURATION DUE TO INCREASES
(OR DECREASES) IN LIFT, DRAG,
WEIGHT, OR WING AREA
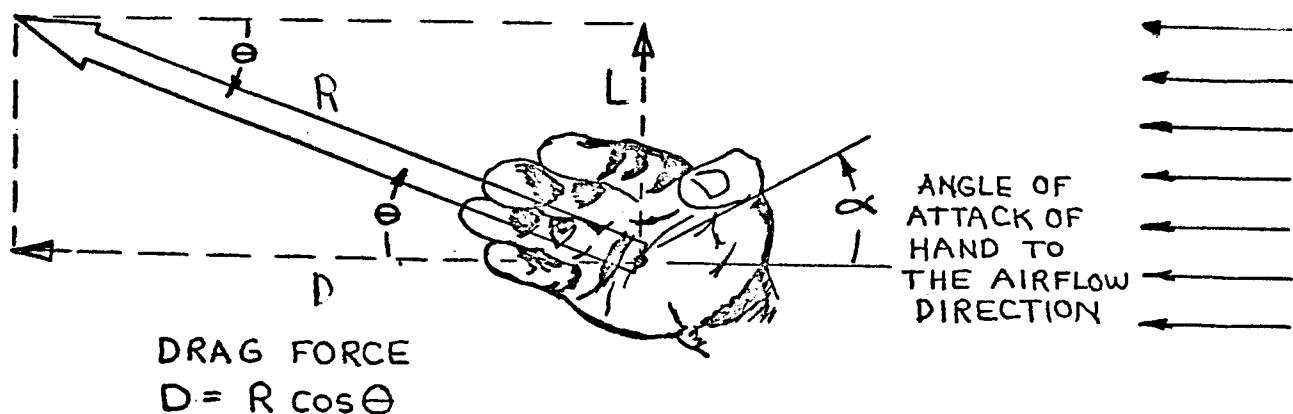
R = TOTAL AERODYNAMIC REACTION

LIFT FORCE
L = R sin θ

AIRFLOW DIRECTION

L

α

ANGLE OF ATTACK OF HAND TO THE AIRFLOW DIRECTION
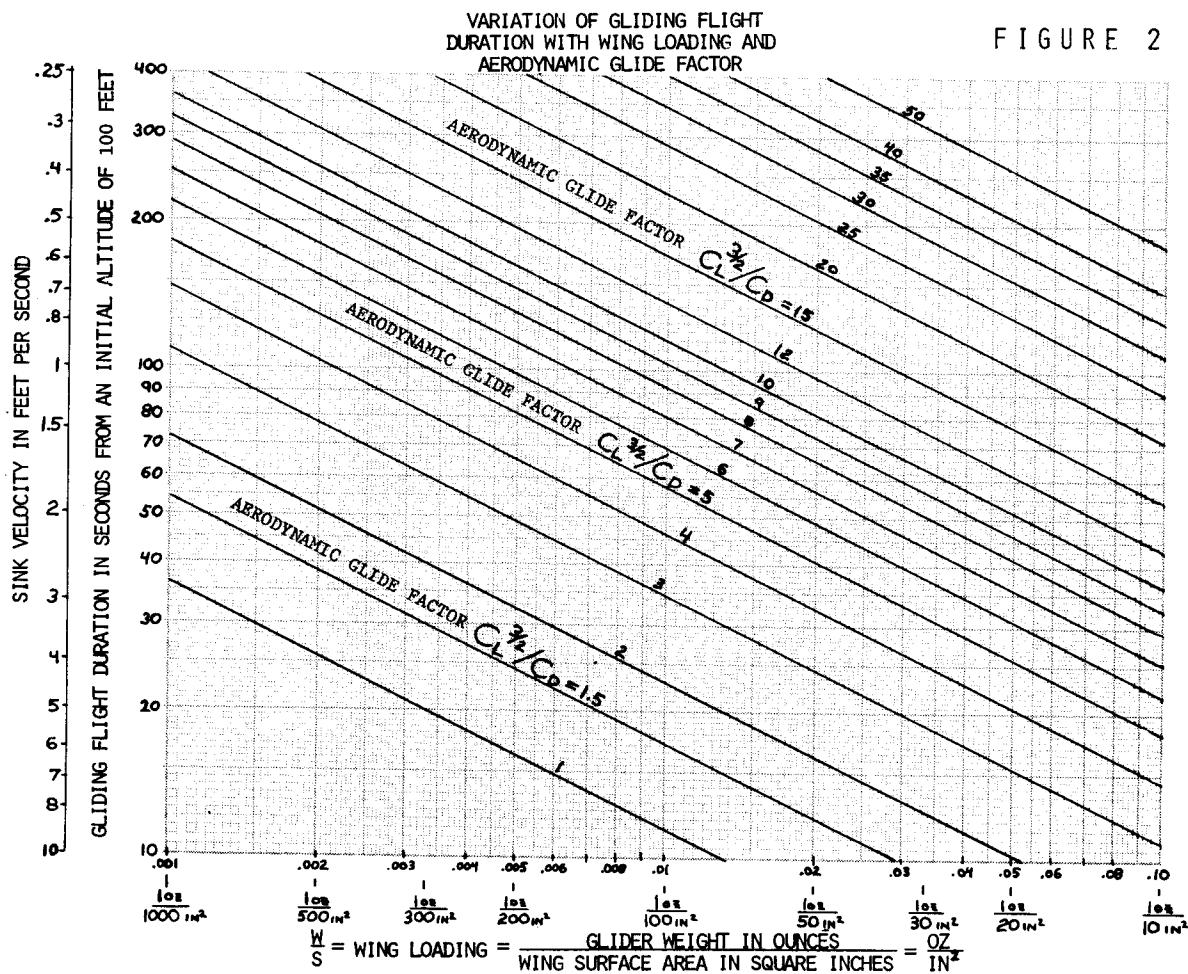
DRAG FORCE
D = R cos θ

LIFT FORCE = L = C_L S ½ ρ V^2 (perpendicular)
DRAG FORCE = D = C_D S ½ ρ V^2 (parallel to airflow)

Where we use the wing surface area (S) to get "size" involved in the formulas and aerodynamic coefficients C_L and C_D to get "shape" invloved in the formulas.

Solving these basic equations directly for C_L and C_D, we obtain the abstract aerodynamic Lift and Drag coefficients in terms of items that can be measured (forces, areas and velocities).

$$C_L = \frac{L}{(S)(\frac{1}{2}\rho V^2)}$$

VARIATION OF GLIDING FLIGHT
DURATION WITH WING LOADING AND
AERODYNAMIC GLIDE FACTOR

FIGURE 2

$\frac{W}{S}$ = WING LOADING = $\frac{\text{GLIDER WEIGHT IN OUNCES}}{\text{WING SURFACE AREA IN SQUARE INCHES}}$ = $\frac{OZ}{IN^2}$

$$C_D = \frac{D}{(S)(\frac{1}{2}\rho V^2)}$$

Right now you are probably thinking to yourself: "Why are we bothering with all this intermediate work???" One reason is that if we can calculate C_L and C_D we can compute the aerodynamic glide factor

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

and immediately say something about the expected duration of our gliders by using the glide performance graphs.

A more important reason is that most of us don't have access to good wind tunnels. We hope that in the near future model rocketeers studying at universities with wind tunnels will start testing various model rocket boost gliders and publishing the results in MODEL ROCKETRY magazine.

You will soon find that C_L and C_D will be the *key* to applying someone else's wind tunnel results to improving your own glider designs. Admittedly, we can't do much with C_L and C_D right now, but as data starts appearing, those who take advantage of it, I predict, will be the contest winners of tomorrow.

Aircraft manufacturers make considerable use of aerodynamic coefficient data whenever they are designing new airplanes. Can you imagine a wind tunnel large enough for a full scale Boeing 747—ridiculous! Instead, much smaller scale models are built early in the preliminary design phase for use in existing wind tunnels.
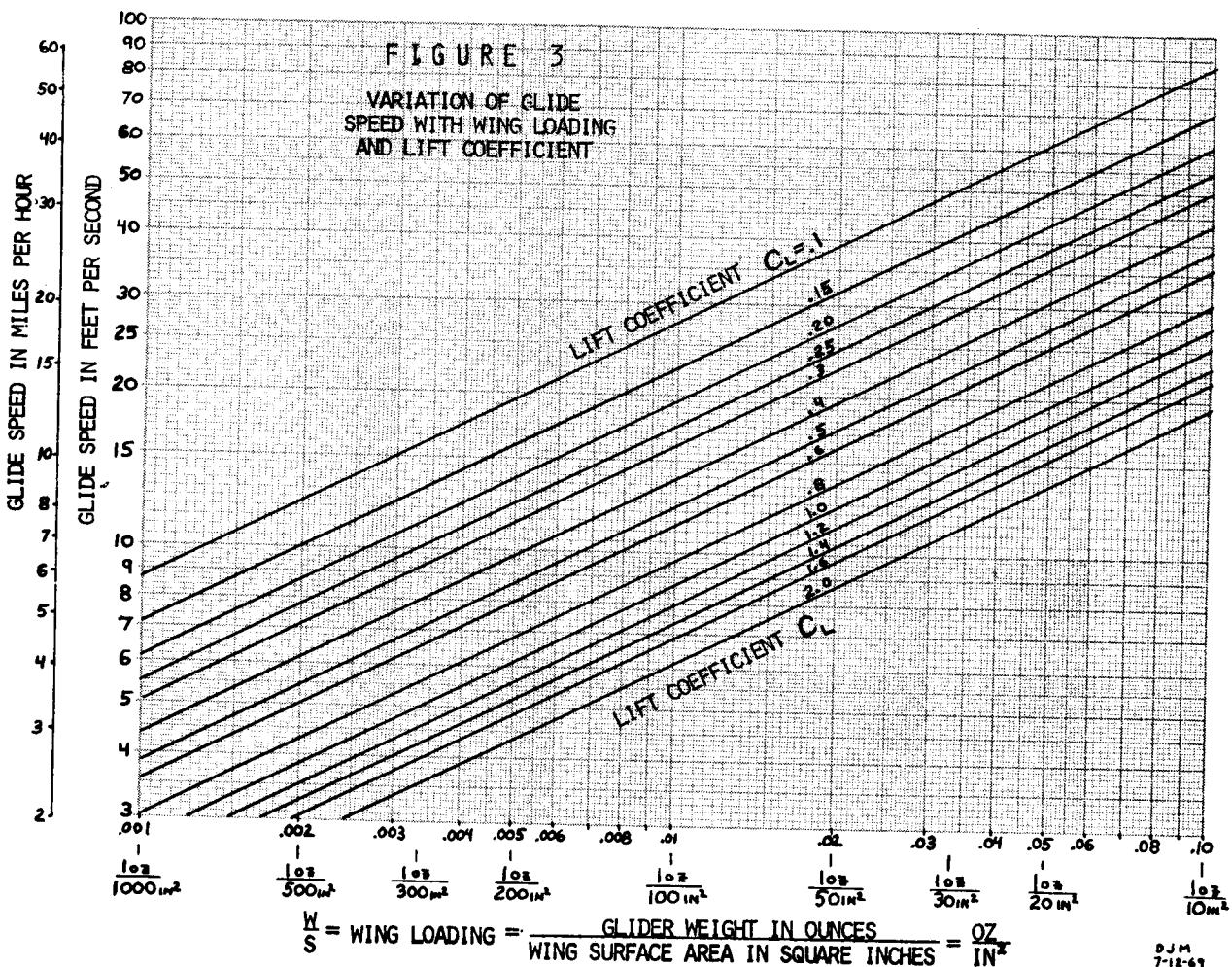
Then lift and drag forces are measured on these models at several different angle-of-attack conditions.

Finally, aerodynamic lift and drag coefficients are computed using the above formulas in conjunction with the known values of the model's wing surface area (S), velocity of the air flowing over the model (V), and air density (ρ).

Once C_L and C_D have been evaluated at these various angle-of-attack conditions, one can then compute $C_L^{3/2}/C_D$ which is a measure of glide duration capability and C_L/C_D which is a measure of range capability.

These wind tunnel values of C_L and C_D are then used by the design engineers in conjunction with the wing surface area of the full-size aircraft (S), the *actual* cruise speed (V) of the real airplane, and the density of the air (ρ) at the altitude which the *actual* aircraft will be cruising in order to compute the Lift Forces and Drag Forces that can be expected on the *full-size* airplane. The technique, as you probably have guessed by now, also applies to model rocket boost gliders. Note that similar curves were presented in MODEL ROCKETRY (Nov., 1968 issue) by Gordon Mandell for various paraglider configurations. With these C_L and C_D curves, Gordon directly concluded which configuration was best.

With the above aerodynamic coefficient graph, you can see that the aerodynamic glide factor ($C_L^{3/2}/C_D$) depends on the angle-of-attack (α) at which the jet is flying. The maximum glide factor occurs at an angle-of-attack of 11 degrees and it would be this angle at which the pilot would trim his plane to fly—if his engines quit and he was interested in staying up in the air the longest possible time.

FIGURE 3

VARIATION OF GLIDE SPEED WITH WING LOADING AND LIFT COEFFICIENT

$\frac{W}{S}$ = WING LOADING = $\frac{\text{GLIDER WEIGHT IN OUNCES}}{\text{WING SURFACE AREA IN SQUARE INCHES}} = \frac{OZ}{IN^2}$

Model rocket gliders, unfortunately, don't have the capability of being re-trimmed in flight for flying at the optimum aerodynamic glide factor (unless the elevator—the moveable part of the horizontal tail surface—can be pivoted up and down remotely from the ground using radio control). Our models are merely built to some configuration and that configuration is then *forced* to fly in a stable manner by the use of ballast to shift the CG point. In fact, at present we don't even know what angle-of-attack a typical glider should be flown at in order to achieve maximum aerodynamic glide factor.

It is very possible that over the years hand launch and free flight type glider enthusiasts have stumbled on designs that just happened to fly right at the angle-of-attack for maximum $C_L^{3/2}/C_D$. Something akin to Darwin's theory of evolution and survival of the fittest occurs. One modeler makes a change which improves his glider's performance. It wins a couple of contests, is then copied, and is further improved upon by others. Thus, without knowing anything about aerodynamics it seems that this sort of trial-and-error engineering would eventually converge on designs that will just happen to be operating at the angle-of-attack corresponding to the maximum aerodynamic glide factor. I really don't know whether or not aeromodeling has advanced to this point yet and won't believe it until I see some actual numbers.

Presently I am taking a 3 credit-hour summer graduate research course at Wichita State University which involves designing and building a system for measuring Lift Forces, Drag Forces, and something called Pitching Moments (which we'll talk more about in future articles). This will be installed in their 100 mile per hour, 4 foot diameter wind tunnel and then full-size gliders of about 1½ foot span will be tested in winds between 10 and 15 miles per hour which corresponds to the actual glide speed of a high performance boost glider or hand launch glider. The resulting data will obviously be very enlightening.

I also intend to obtain aerodynamic data on all of the existing manufacturers' boost glider kits. Thus, we should be able to establish some basic performance criteria for the various B/G types and come up with ideas for obtaining more optimum glide durations for each kit.
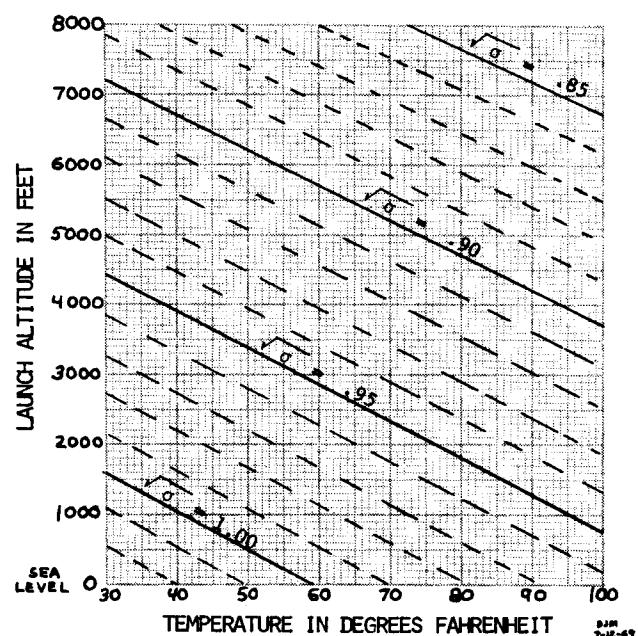
This will be the starting point. There is considerable work to be done—especially when one considers that a boost glider must be optimized for both minimum drag during rocket boost (where speeds may be 200 miles per hour) and then for steady gliding (at speeds around 10 miles per hour). What airfoil shapes will be best and how important a slick surface finish is will be just two of the many questions that need to be answered!

It might be appropriate at this time to invite other model rocketeers interested in getting involved in such research to write me in care of the magazine. You will need access to a good, low speed wind tunnel, which means we have eliminated just about everyone who doesn't live near a university with an aerospace curriculum. The wind tunnel also must have a force balance capable of accurately measuring very small values of Lift, Drag and Pitching Moment. I can supply plans for constructing a suitable sting type force balance using electronic strain gages which can be used as is or improved upon as desired.

Those of you who are college students should be able to obtain credit for such work just as I have done. Even the costs of machining such a force balance can usually be justified by the school because its applications are not limited to model rocketry use. It turns out that since the balance is capable of measuring very small forces, that existing plastic scale models of aircraft and missiles (Revell, Aurora, etc.) can be purchased and built quite cheaply, especially in comparison to the cost of the usual wind tunnel model.

Thus, aerodynamic data can be obtained on any rocket from the V-2 to the Saturn V (including the Apollo Command Module itself); for any aircraft from the Fokker Triplane and Sopwith Camel to the B-70 and X-15; or any other vehicle which has proven popular enough to be kitted by one of the large plastic manufacturers. This

FIGURE 4
AIR DENSITY COMPENSATION GRAPH

is especially nice for studying aircraft aerodynamics because duplicating the variable configuration of the typical modern airplane (landing gear up and down; flaps up and down; moveable control surfaces, speed brakes and spoilers; variable sweep wings; etc.) usually means expensive custom built one-of-a-kind models. In other words, the total cost to the school for one wind tunnel balance plus many, many plastic models will probably come out significantly cheaper in terms of total labor and material costs than one new custom built wind tunnel model. Anyway, this concept of extending the usefulness of the wind tunnel in its role as a teaching aid should be a good argument to present to your professor when you are trying to talk him into allowing you some research credit-hours on such a project.

Before anyone who is familiar with the more sophisticated aerodynamic concepts such as the effects of Reynolds Number and Mach Number begins shaking his head, we will have to admit that low speed wind tunnel results on something like a three inch diameter Apollo Command Module won't really mean much when the data is scaled up to analyze a real full-size re-entry situation. However, the usefulness of the device as a teaching aid still exists and until we explore in depth what such things as Reynolds Number mean, we can't really consider it.

In future MODEL ROCKETRY issues I intend to go into what is Reynolds Number and how its effect can be accounted for—same for the Pitching Moment Coefficient and how can we use it to establish a desired trim condition which will result in flight at the optimum aerodynamic glide factor.

Meanwhile, back to basic Boost Glider Duration Performance.

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The Story of the Steel City Section

Father of the Convention

by Elaine Sadowski

It seems to be a commonly held belief in the NAR that the members of the Steel City Section crawl out of holes in the ground once a year, hold a convention, and then crawl back in until the next convention. However, section members have taken many awards at NARAMs, and they have given numerous lectures and demonstrations and held model rocketry classes.

The section was founded in 1964 by Jay Apt. Of the twenty-five people attending the first meeting, twenty-one became members. The section's first contest, SCRAM-1 (Steel City Rocket Aerial Meet–the name was first proposed as a joke, but our Contest and Records Committee got desperate and adopted it.) was originally scheduled for December 27, 1964. A special pre-contest launch was held for the press, with rather disastrous results. Most of the rockets never got off the launch rack, and many of those that did exploded or crashed, causing one reporter to call the event "a real blast", a "smashing success", and "Black Sunday." The contest itself was postponed due to foul weather and was finally held on January 3, 1965. Since that time the section has held twenty-three more contests, some successful, and some not so successful (usually due to our ever-trusty launch panel, which had to be repaired or adjusted before, during and after nearly every contest, and which used to pick up Pittsburgh Pirate baseball games over the PA system between racks:–that's been fixed, though). Section members have also attended many area and regional meets, and, of course, the nationals.

The first national meet attended by section members was NARAM-7, held at Aberdeen Proving Grounds in Maryland in 1965. Jay Apt attended NARAM-6, but that was before the section was founded. Jay and his partner Dave Bayard won the national team championship, and the team of James and Joel Davis and George and Gary Whitmyre won the reserve championship. That year the Steel City Section ranked third in the nation in total number of points.

Eight section members, William Block, Robert Hausman, Marvin Lieberman, Thomas Mitchell, Alan Stoltzenberg, Arnold Pittler, James Davis, and of course, Jay competed at NARAM-8 at the Clinton County Air Force Base in Wilmington, Ohio in 1966. Bob Moeller, Steve Sckelly, and Elaine Sadowski went as range support assistants. Jay handled the publicity for the meet, and he even got an article about it into Time magazine. Section members placed in many events, and the Davis-Davis-Whitmyre-Whitmyre team got a record 820 foot first place in Pee Wee Payload.

At NARAM-9, held in Mankato, Minnesota, in 1967, the team of Jay Apt and Jim Davis placed first in the team category, Bill Block took the Junior reserve trophy (which was presented by then Vice President Humphrey), and the section placed second in total number of points. Two section members, Jay Apt and Elaine Sadowski, were elected to the newly formed Leader Administrative Council. Jay and Elaine were re-elected at NARAM-10, held at Wallops Station in Virginia.

In 1966, members of the Steel City Section participated in an aeronautical exhibition at the Allegheny County Fair. The exhibition was sponsored by the Pittsburgh Institute of Aeronautics, and that group paid for the section's booth. The display included a rear-screen projection on which slides of section, regional, and national meets were shown, examples of the various types of rockets, and rocket engines, a cut-away model, a poster telling what model rocketry is, and literature supplied by the NAR and manufacturers. In addition to this, an outdoor show was held with

Mark Mercer leads a discussion group at the Second Pittsburgh Spring Convention, March 17 to 19, 1967.
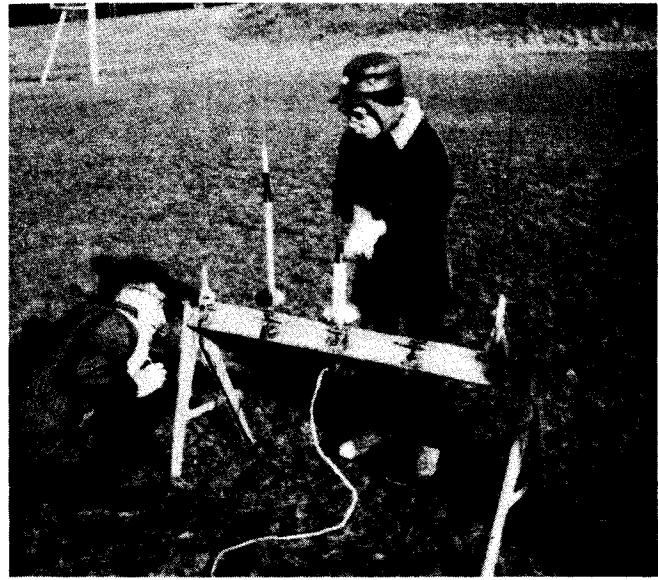
Joe Persio and Pat Stakem safety check rockets at the Second Pittsburgh Convention.

Preping rockets at the Shadyside Academy launch field.

model airplane demonstrations, the U.S. Marine Corps Band, (which we almost tripped with our phone wire that was stretched across the field), a World War I dog fight, and of course some model rocket launching. The show was covered on WQED, the local educational television station.

In July, 1967, the section sponsored an open model rocket contest for non-members. The contest was publicized on local radio stations and in the Pittsburgh Press and the Pittsburgh Post-Gazette. Entry blanks were distributed through the hobby shops. Twenty contestants showed up, some of them coming from West Virginia, and many spectators were present. The affair was moderately successful, and a similar contest was held in October 1968.

The Steel City Section participated in an air show held at the South Hills Village Shopping Mall along with groups from the Civil Air Patrol, the Academy of Model Aeronautics, Airlines, aircraft manufacturers, and other related groups. Each group was given a night in which it could demonstrate its activity. The section members built rockets at their display. Passers-by would write their names and addresses on slips of paper and place them in a box. On the last day, slips were drawn from the box, and the rockets were given to those whose names were on the slips. But by far the most impressive part of the display (which included scale, F engines and sport models, and photographs and trophies from contests) was an indoor rocket launch which ran every half hour. The set up was very difficult to accomplish. Guide wires were attached to a balcony above the exhibit. The rocket, a very heavy one built by Arnold

Pittler and flown with a ¼A engine, rose to a height of approximately thirty feet on the wires. The parachute then ejected, but the descent was not very gentle—the fins of the rocket cracked after five firings. About 50,000 people saw this exhibit. On the last day of the air show there were model airplane flights and model rocket launches in the parking lot. Although it was a cold day, we had trouble with winds, our walkie-talkie, and, of course, our ever-trusty launch panel. However, the crowd was impressed with our finale, the firing of D, E, and F engine birds, which went off successfully.

In 1965, Jay Apt taught a model rocketry class for the Office of Economic Opportunity. The classes were held at a church, where classes and tutoring in geology, baseball, math and physics were also being held. The class was successful, and in the second year Jay was joined by Dave Bayard, Jim Davis, and Arnold Pittler.

In the spring of 1966, Jay Apt was contacted by Mr. Antonio J. Botti, who asked him to teach a model rocketry class at the School for the Blind. The class, which had twenty members, stressed the basic principles of model rocketry. The students built Astron Marks with the additional help of Arnold Pittler, and Bob Moeller. Such a fundamental principle as the law of action and reaction was taught. The rockets were then taken to the Shadyside Academy middle school where they were launched. The blind children could not of course, see the rockets go off, but they could hear them.

The activities of the members of the Steel City Section have been numerous and varied, including more than an annual convention. At present there are 47 members in the Section.

LAC CONVENTION QUESTIONNAIRE SUMMARY

Recently received from Jay Apt and the LAC were the results of questionnaires administered at the 1969 Pittsburgh and MIT conventions. The views of rocketeers in attendance make excellent reading for *all* NAR personnel; the members have said a great deal.

Most were between 14 and 17 and average experience in model rocketry was about 3.7 years. Most had been in NAR for 2 years or less and cross sections showed an approximately equal division between section and non-section members.

In both surveys:

a)flying for fun and R&D ranked as the two most popular interests (contests fell third or fourth)

b)a small majority felt the renewal packets were adequate but the following inclusions were suggested for improvement:

-a directory of membership
-a list of standing records
-a free plan or tech report
-wrap-up of events of previous year
-calendar of coming events
-list of manufacturers
-list of NAR committees and officers and addresses
-copy of NAR By-laws

Several people suggested a new NAR flyer, preferably flashier and more detailed, while others urged HQs in different parts of the country plus more advertising and press coverage. Most people seemed satisfied with HQ's performance but the numerous suggestions indicated that much else is desired.

c) general communications appeared in need of help across the board. Less than half knew what committees exist, fewer knew how to contact them, while almost all who had contacted officers felt response was satisfactory. (Ed. note: an article covering NAR structure and communications has been in preparation for several

months and should appear in the January or February issue.)

d) most were satisfied with section services but several notable suggestions were made:

-more personal contact with sections and between the President and sections

-improve contest sanctioning procedures

-more get-togethers; e.g., conventions

-lectures and advisors to visit sections

-prepping a "snow-job" kit to aid in legal hassles

e) NARTS services were for the most part found satisfactory; numerous new plans and reports were requested, however. (Ed. note: we are still trying on TRs - got any you'd like to volunteer?)

f) the few new NAR publications were considered quite satisfactory with a majority considering them good to excellent (discussed were the R&D Methods Guide, NAR Tech Review and the LAC Section Manual). Only a few (about 20%) had seen a Section Manual. (Ed. note: the Section Manual provides many answers to the above suggestions; a copy may be obtained through LAC secretary, Elaine Sadowski, 1824 Wharton Street, Pittsburgh, Pa. 15203-send $.25 to cover mailing costs. It contains chapters on contests, publicity, range equipment, demonstrations, newsletters, etc. and is well worth reading.)

g) it was found that most people do not compete in contests; most people also wanted non-flying activities at contests; including short courses and discussions as well as social events. One suggestion that has popped up several times in the past as well is that NAR negotiate some sort of trophy package deal so local contests can offer more than points. Only a minority knew how to apply for a record. (Ed. note: article on this also forthcoming.)

h) many comments were made about conventions and their organization. Generally, more organization was wanted in the discussion groups, more time (less hurry), more advanced (and capable) lecturers and a more personalized atmosphere among modelers.

Coupled with the convention comments were suggestions for other NAR sponsored activities. Specifically; more convention-discussion group-seminar-workshops, a scholarship contest, legal aid, field trips and tours and advanced research work.

These two surveys serve as ideal sounding boards for the membership's views on NAR directions. Many of the suggestions are in the works already, many more are in the planning stage. Needed most, however, are people willing to initiate the ideas on their own and see them through. NAR doesn't have that many people on its staff such that it could tackle a tenth of the above suggestions. Interested in making a place for yourself in the NAR Hall of Fame? Take on one of these projects. If you're interested, drop us a line and we'll put you in touch with people of similar interest. If enough of you pitch in, no job is too big. Right now several people are working up plans for a typical weekend workshop (sort of a mini-convention). Any takers?

ATTENTION ALL SECTIONS

Now is the time that all sections will be renewing their section charters for the new year. NAR Headquarters requests that you be sure and note your section's number (under the new system) to help speed up processing and return of the new charters. Also include with your renewal form the date your section was originally chartered. Section Director B. Atwood especially requests this bit of information.

One further request/suggestion is to be given special attention. Since each section's NAR insurance could be voided if there are not 10 registered (up-to-date) members in the section it is suggested that the section send in the membership renewal applications for its members, along with their fees, all at one time. This prevents any dispute and will also speed up the process of renewal for the section and its members.

If there are any questions on procedure for renewal just send your questions to NAR-HQ.

SECTION NEWS

Editors Note To All Sections

As editor of NAR Section News I would like to thank all of those sections that have responded to communications from my office. Of the 64 sections now listed on the official section roster a total of 46 have already returned their cards listing name and address of official news contact.

The increase in communication that will be and is provided through my office (my desk and one file box in my bedroom) as editor will soon help increase interest in NAR activities through section activities throughout the nation.

In order to suppliment the interest raising aspects of Section News I have a request for all sections. How was your section formed and how does it now operate? Is your section a school activity, a private – in the home – activity, or through a local civic organization such as Boy Scouts, J. C.'s or whatever? This history need only be a page or so or whatever you want to write.

Again, thanks to those sections that have already responded.

I hope to be hearing from you all real soon. Remember that there is a two month backlog on all news so get reports of coming events to me way in advance and also Remember: IF I DON'T HAVE IT - I CAN'T PRINT IT - - - so get that news in!!!

Sincerely, Charles M. Gordon Editor NAR SECTION NEWS

QUICKIE SURVEY

NAR Section News would like to make a quick survey of all NAR sections. We would like *each section* in NAR to answer the following question: "How many NAR members are in your section, as of December 1, 1969?" With this information we will be able to tell how many NAR members actually belong to sections and which section has the most.

We are depending on you for an accurate count. Just send your answer on a postcard with the name of your section to: NAR Section Survey c/o Charles Gordon, Editor, 192 Charlotte Drive, Laurel, Maryland 20810 .

S.S.B. Busy

The Star Spangled Banner Section of Severna Park Maryland was really busy this past summer in the promotion of model rocketry, as reported in *The Banner*, newsletter of the section.

In June, 1969, members of the SSB section provided launch facilities for the C. Melvin Sharpe Health School of Washington, D.C. The school members helped them fold their parachutes, load the engines, launch the rockets and recover them. Enthusiasm abounded and many forgot their handicaps. This was the second year SSB members helped at this launch.

On July 16, 1969, about ten members of the section held a lecture and demonstration of model rocketry to a girl's 4H club in LaPlata, Maryland. Later that same day the group moved down to Ft. Mead, Maryland to present a demonstration to 150 inner city children at the base. After launches of both rockets and gliders the NAR film was shown. The kids as well as their instructors were really enthused by it all.

Nice going SSB for all your fine work in bringing model rocketry to more people in the Washington D.C.-Maryland area.

Western Area Regional Meet

The Western Area Regional Meet will be held near Las Vegas, Nevada on December 28-29, 1969. Sponsored by the Orbits Section, the contest will be flown from a Dry Lake 15 miles east of Las Vegas. Events scheduled are: Open Payload, Parachute Spot Landing, Scale, Scale Altitude, Eggloft, Class I Parachute Duration, Plastic Model, and Swift B/G. Contact Cody Hinman, 241 South Seventh, Las Vegas, Nevada for further details.

THE MODEL ROCKETEER

ODDS & ENDS

The Cosmotarians of Gladstone, Oregon, along with the North-west Rocket Club, participated in a demonstration launch at the OMSI/Salem Air Fair on August 9th and 10th. At the launch they were honored with a visit from Apollo 7 astronaut Walter Cunningham and the U.S. Air Force test pilot Colonel Stevens. Both Mr. Cunningham and Colonel Stevens enjoyed launching several rockets, as well as autographing members' rockets and discussing model rocketry with them.

****

The Glen Ellyn Rocket Society of Glen Ellyn, Illinois held its fourth annual Labor Day demonstration launch in south park in Glen Ellyn. Demonstrations included displays of various types and designs of model rockets as well as actual launchings for the spectators.

****

The Annapolis Association of Rocketry, of Annapolis, Maryland, in collaboration with the Annapolis Chamber of Commerce partici-pated in a scientific and technical symposium at the Annapolis Armoury October 31, Nov. 1 and 2. Displays included model rockets on display and provided literature to visitors.

****

The annual Awards Banquet of the Randallstown Rocket Society of Randallstown, Maryland will be held Nov. 22, 1969.

****

Pascack Valley section of New Jersey has informed Section News that it has a total of 52 members as of September 1, 1969.

If your section is anywhere near this figure, either up or down, then your section's official news contact should send it in as of December 1, 1969. A listing of the top five or ten sections will be listed if enough responses are received so *get those totals in now.*

****

The Mid Atlantic Regional Shoot No. 4 (MARS-IV) was held October 25-26 at the Aberdeen Proving Grounds, Aberdeen, Maryland, and sponsored by the Star Spangled Banner section.
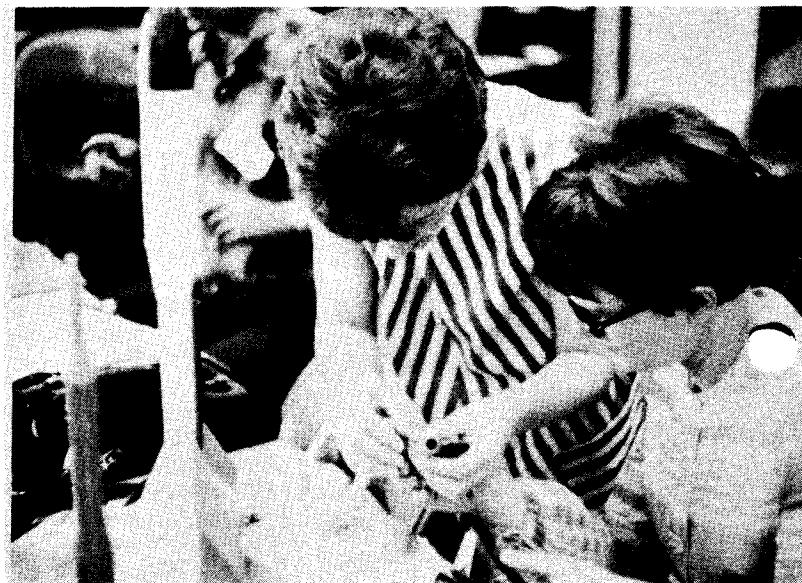
AEROSPACE WORKSHOP
IN WASHINGTON

A month long aerospace workshop for elementary and secondary teachers under the joint sponsorship of the Washington National Guard and Central Washingto State College, was held at Camp Murray, Tacoma last summer.

The program was designed to provide participants with a background of information about space and aviation that will be usable in the classroom and in other learning-teaching situations. 70 teachers from throughout the state attended.

Many speakers, including several from model rocket clubs, enriched the workshop and tours of the local science and military installations highlighted the educators' program.

Personal participation by teachers included construction and flight of model airplanes and rockets, stressing the impact of learning by doing which will lead to the use of models in classroom work.

Photos show classroom work and preparations for launch. The quality of modelling shows that anyone (even women teachers!) can master model rocketry easily.

CIVIL AIR PATROL REPORT

When Civil Air Patrol's national headquarters at Maxwell AFB, Ala., announced in July that model rocketry was now an official cadet activity, the news was unprecedented in the anals of National Association of Rocketry history.

CAP, with more than 60,000 senior and cadet members in squadrons in every state, has established its model rocket program according to NAR guidelines and rules. At least one senior CAP member must join the NAR to be fully knowledgeable of the safety code and act as range officer during launchings. All other related activities such as meetings, laboratories, and workshops will be conducted by CAP cadets.

As NAR's liaison member to CAP, I asked John V. Sorenson, CAP's assistant deputy chief-of-staff for aerospace education and training, (an acquaintance since 1964), to provide a capsule view of the new program goals. His letter, stated, "In the model rocketry manual, you will find that we (CAP) encourage all CAP units to form NAR sections and compete in NAR meets. Also, any CAP model rocketry activity must conform to NAR standards."

His letter also contained a special appeal to NAR members that could mean the answer for those who cannot join or form a section. In time, a section would most likely be official. Jack wrote, "I would like for you to encourage NAR members to seek out cadet squadrons within their states and help them start NAR sections ... this might be the best way to get the model rocketry program going for CAP – get some people working with cadets who know NAR and model rocketry." Jack has been an NAR senior himself for several years.

A look at CAP's Manual 50-20 revealed that amateur rocketry is not allowed. Briefly stated, the objectives of the CAP MR program is to: provide cadets with an opportunity to increase their knowledge of aerospace sciences ... activities and opportunities for the development of aerospace leadership skills ... arouse interest in aerospace careers that require a knowledge of rocketry ... and employ an interest in model rocketry to enrich the total development of CAP cadets.

In the months ahead, CAP unit commanders will be seeking qualified cadets to open model rocket activities. Those selected will have a six-week initial program to start off with, which may be tailored according to prior experience. The CAP senior who will instruct the course (if NAR members are not available) has been requested to consider purchase of NAR's official hand-

book by G. Harry Stine.

Selected cadets must be at least past the Phase I mark and may not cut their scheduled standard Phase II classes or labs. The entire program is to be conducted according to NAR's U.S. Model Rocketry Sporting Code (which has been reprinted with permission in the manual), and operational requirements established by the FAA.

For all launchings CAP has decreed that the minimum personnel required for supervision will be a range officer, safety officer, and first aid officer. At official CAP model rocketry competitive meets, minimum supervisory personnel include the above three, plus a launch supervisor, spectator control officer, range guards, observers and trackers, and an information officer for publicity.

Requirements of the CAP program include the construction, launching and evaluation of models in four categories from scale, altitude, payload, boost-glide, drag race, aerospace systems, R&D, or parachute duration. Also, a diagram of typical NAR range, and a journal of all activities completed must be submitted.

Lastly, cadets must satisfy their commanders by demonstrating skill and knowledge, and by being tested and orally examined on all aspects of the model rocketry program. Included is the requirement to assist in organizing or administering an NAR section.

Cadets who pass a part of this program are awarded silver stars to wear on the Goddard ribbon of their uniform; cadet officers are awarded CAP's distinctive pocket badge for completion of all parts.

The last paragraph to the manual is worth noting in part, to grasp the serious intent of CAP to effectively organize and compete with NAR sections:

"Each squadron ... is encouraged to establish an NAR section. CAP units can then enter into competitive meets with other NAR units on section, area, regional, and national levels. Application for the establishment of an NAR Section may be obtained from NAR, 1239 Vermont Avenue, NW, Washington, D.C. 20005. (two copies of the completed application must be forwarded through CAP National Hqs (CPE) for further indorsement and recommendation).

How did the CAP program evolve? Several years ago CAP aerospace education officials under Jack's leadership recognized the benefits of model rocketry to give cadets that rare, practical experience with related subjects of their training program. CAP contacted many varied sources, among

them were FAA, NASA, USAF, model rocket manufacturers, and the officially recognized organization for the aerospace hobby-sport, the NAR.

In 1967, the NAR Liaison Committee chairman, G. Harry Stine, appointed me, a USAF sergeant and veteran CAP aerospace education officer, to coordinate the proposals and actions of CAP. It was my success combining model rocketry in the curriculum of CAP's overseas counterpart program for U.S. dependents in Europe, called the Aerospace Cadets of Europe (ACE), that led to this appointment.

Initially, I worked out a program from a draft manual prepared by CAP in 1965-66. Later, a finished product was tested in a classroom/lab/launching schedule through cooperation of my CAP unit, the Colorado Springs Composite Squadron. This finished manual together with recommendations from an NAR standpoint was sent to Jack Sorenson in late '68. The final manual dated May '69 first appeared in July.

So now, in 1969-70, CAP intends to take that same first cautious step that NAR members took nearly ten years ago. Hesitant at first because of a respectful concern for the safety of thousands of cadets who would participate, insurance problems, and wanting a solid foundation to benefit CAP rocketeers through aerospace education ...

NAR members nationwide should recognize that CAP's action was not only based on the favorable record of millions of model rockets launched in the U.S., but more directly due to the foresighted, safety-minded founders of the NAR.

Will NAR members help make CAP's new program a success? Why not check your local phone book for the CAP unit in your area? Or, how about contacting CAP cadets who attend the same school?

As NAR-CAP liaison, I would like to be kept informed of your progress in forming CAP cadet NAR sections. News clippings, photos or other details may be sent in my name to the NAR Hqs.

Earlier this year in The Model Rocketeer column, I predicted that in time CAP members would number half of the total NAR membership. I have not changed that prediction, even though there are only about 50 CAP members registered in NAR at present.

Civil Air Patrol was not the only U.S. organization that could effectively use model rocketry for education. There are still many youth organizations which can benefit from NAR leadership-membership.

–Larry Loos, NAR 7127

THE MODEL ROCKETEER
EDITOR'S NOOK

Merry Christmas to you all! May Santa fill your stockings with more than feet.

How do you like this issue? We have several longer articles for your enjoyment and information while the weather stills launch pads for a few months. Thanks go to trustee John Worth for the Workshop article, to Elaine Sadowski for the history of the Steel City section and to Larry Loos for the CAP policies feature. A special thanks goes to Jay Apt and the LAC for the interesting preliminary results of two NAR Evaluation Seminars held at the last two conventions. An expanded analysis will appear in the future.

By now the reasons for the $1.00 increase in dues should be known to all, but a fast recap appears appropriate at this time. NAR has a new office system, new commitments and a new insurance levy. We had our coverage increased (at no cost) last year to $300.000, so we are definitely getting our money's worth now. NAR has a new magazine now with a great potential and further expansion of services may necessitate further expenditures - thus NAR needs the extra bread.

How can you get your full money's worth? Use the services; participate in NAR affairs; help improve NAR by telling what you want. Presently, feedback is minimal. While two issues of the Rocketeer have been sent out as of this writing, I have yet to receive any comments, pro or con, on the new newsletter. Isn't it silly to gripe if no one hears your ideas? Send me a note via HQ or my new home address: 156 2nd Street, Troy, N.Y. 12180. Friends and associates please note that is a new address. Mail sent to 258 Broadway will be forwarded but my recent rapid change of address may result in some delays in answering mail sent to Broadway. If you feel rich, I can be phoned late most nights at 518-272-8118. Your opinion *is* important to NAR and its leaders.

I received one letter not directly concerned with major NAR policies but which I believe needs airing. It covers a pertinent topic which appears also in the evaluation seminar article. It is not pleasant, but perhaps for that reason alone, it should be covered.

The major item at hand is R&D judging and the commentary (abridged by me) is from my personal friend and a section president (of Pascack Valley), Bob Mullane, NAR 4157. His views are his own and do not necessarily reflect the views of any NAR trustee or officer. Bob noted that at NARAM-11: "... The judging was done by eight officers from the Air Force Academy (a Pink Book violation since the judges were not NAR members); that is, they judged what was left after the NAR R&D judge disqualified any project which didn't meet *his* rules for R&D projects. He was heard to comment something to the effect of: "I can tell just by looking at them which projects are good and which aren't." Who made him the single man (god?) who should decide the merits of a project? What happened to the system at NARAM-10, where the judging was done by three NAR members who were prominent in the field of R&D and who as a group, could be very fair in judging and who, because of their own outstanding work in R&D and contact with people doing R&D work, could judge on the basis of sound R&D methods, not on arbitrary whims. This reporter feels very strongly about this point and feels that since he has done several NARAM winning projects and since he was not entered this year, he talks with some authority and a good deal of objectivity about this judging. R&D is the one place where members can make original contributions to the sport, and if projects are going to be arbitrarily DQ'ed without giving the contestant a chance to defend his work (as everyone was given at the last NARAM) a lot of people are going to get discouraged and the hobby of model rocketry is going to lose one of its greatest sources of original work. And if NARAM R&D judging is going to be run this way, it cannot help but stagnate the development of improvements and research in model rocketry."

The new NAR CD, Dick Sipes, is giving R&D judging a careful reappraisal and will probably have something to say on the matter of non-NAR judges. One side comment: sometimes personnel is squeezed tightly and outside aid is needed - this is probably agreeable to all, provided the aid is knowledgeable enough to be useful. It is difficult to condone, however, the public relations practice of using VIP's as judges without consent of the judged. When a contestant enters a meet (especially a Nationals, and especially R&D) he has invested some effort in his project - and thus has the right to expect the best in complete, impartial and competent judging. At past Nationals (NARAM-10 being an exception) Air Force and NASA officials were prime personnel on the judging staff. This was allowed due to the lack of qualified technical help. Now however, sufficient help is usually available. There is no excuse for grabbing older officials as judges simply because they are older. At NARAM-10, the ages of the NAR members judging were 18,21,and 27 yet all were quite capable of judging most R&D projects. Let's face it: to judge a model rocket project you need to understand the hobby in some depth, and not just the theory behind it. This is especially true when it comes to disqualifying a project. The present rules are too hazy to refer to and, as a result, varying degrees of stringency have been applied. The result is grumbling, frustration and suspicion of favoritism .

I would like to conclude this personalized commentary by making reference to the evaluation question involving adherence to the Pink Book: in both surveys a disturbing fraction noted "eye closing" and "exceptions to the rules were being made for the 'top brass' ." This practice often is more apparent than real as the 'top brass' usually knows the rules better and thus fouls up less. BUT — the cliques and clans that do favor themselves are probably a major cause of apathy and dissension. If the Association is to have internal harmony and widespread spirit and participation, such practices must cease. It is unfortunate that mention should be made of this affair, but as an increasing percentage of the members are new, all older members must be certain to set a good example at all times lest the practice of "Oh come on, Bill, let it pass" become habit.

—Linsay Audin

(Club Notes continued)

A new club is being formed in the Peoria, Illinois area. Interested rocketeers should contact Roger Jeremiah at 631 Perkin Ave., East Peoria, Ill. 61611.

The New Brunswick New Jersey Model Rocket Club has been prohibited from launching from its usual site on the University Heights campus of Rutgers University. The ruling prohibiting them from launching on the University Heights campus goes back to June when two of the club's rockets, launched in a 12 mph wind, drifted into a swimming pool. They recently attempted a launch from Rugers University's New Brunswick campus. The Rutgers Campus Patrol arrived but found that the June ruling only affected the University Heights Campus, so the launching was permitted. Club president, John Rusyn, however, expects that the university may extend the ruling to include all campuses. (From the New Brunswick Home News)
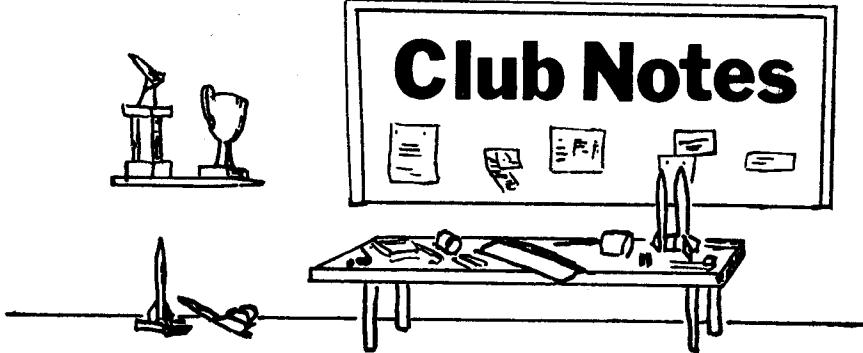
Rocketeers in the Memphis, Tennessee area are invited to contact Norman Alexander, 2518 Corning Avenue, Memphis, Tennessee 38127 who is interested in starting an NAR section in that area.

Pittsburgh's Steel City Section sponsored an open launching for all rocketeers in the Pittsburgh area on Sunday October 26th. The purpose of the launch, held at the Shady Side Academy, was to attract new members to the section.

The first edition of *The Probe*, newsletter of the Tri-City cosmotarians NAR Section, reports the results of their first sanctioned club contest. The events were Class 2 Altitude, Pee Wee Payload, Egg Lofting, Boost Glide, and Class 3 Parachute Duration. No times or altitudes were reported, but the winners were Wanda Boggs in Leader Altitude, and Gary Allen in Junior Altitude; Jim DeBoer in Leader Payload, and Gary Allen in Junior; Jim DeBoer in Leader Eggloft, and Jim Hagedorn in Junior; and Jim DeBoer in Leader PD, with Glen Johnson in Junior. The Kirkman/Black/Teague team captured first place in Junior Spot Landing.

The Federal Aviation Administration, which investigated the Glen Ellyn Rocket Society after a woman in the Chicago suburb complained that their model rockets flown in a Labor Day demonstration were dangerous, has ruled that they complied with all required safety regulations. The October 3rd Chicago Sun-Times reported that the local rocketeers aren't menacing air traffic after all. The club has invited an FAA official to give a lecture to its group at a future meeting.

(From the Editor continued.)
hobby by the L.M. Cox Company, with their line of plastic scale models, and by Model Products Corporation, with their plastic fin units and nose cones, will make rocketry more attractive and simple for the beginner. Plastic structures introduced to model railroading by Plastruct will be used to construct more accurate scale launch pads and towers.

New developments from Competition Model Rockets, following fast on the heels of their revolutionary plastic egg capsule, should improve the level of serious competition in the hobby. The interest shown by other manufacturers such as Space Age Industries, introducing Bryant Thompson's *Tempus Fugit* in kit form, and MPC, with a proposed *Flat-Cat* kit, in making competition more *easy for the beginner*, should encourage many new rocketeers to get involved in contests.

The long forgotten launch tower as well as the never exploited closed-breech launcher have shown up in competition this year. The hobby has progressed to the point where merely throwing a model together and taking a first place will be a thing of the

past. In boost/glide design many rocketeers are still weak on aerodynamic principles. Flights of under 15 seconds could be seen taking third place in the 1968-69 Contest Year. However, the first meets of the 1969-70 Contest Year indicate that even the difficult B/G events are showing some improvement.

Liquid cold propellant rockets, such as those introduced by Vashon Industries, have demonstrated their popularity with new rocketeers. The difference between their construction and performance and that of solid propellant model rockets makes necessary a rethinking of all model rocket safety codes. Rules for competition between these cold propellant rockets will have to be worked out. The compressed gas propellant employed in these rockets could also be used to *activate* various control surfaces on rockets and boost/gliders.

Centuri Engineering, Rocket Development Company, and Flight Systems have not as yet disclosed their plans for the upcoming year. The year promises, however, to be filled with exciting developments, with a new emphasis on instrumentation, competition, and beginners projects.

Club Notes

The Randolph Township Model Rocket Club staged a demonstration launching for spectators at New Jersey's Morris County Fair. Many of the young rocketeers are students or former students of William Grier, an elementary space science teacher at Ironia School. The club's 35 members were invited to compete for prizes in the competition flights held during Randolph Township Day at the fair.

Chris DeVoney, a student at Maine West High School, has submitted a proposal to city officials to legalize model rocketry in Des Plaines, Illinois. His proposal, based on the NFPA code, is designed to allow city officials to designate a firing site for the area's 75 rocketeers.

The model rocket club in South Windsor, California is looking for new members. They have recently been given permission to fly from private property owned by J.E. Shepard, Jr. a local resident. James Hill, who instructed the group, is interested in forming a South Windsor NAR Section. Interested rocketeers can contact him at 644-0781.

The Whitewater Model Rocket Club under the direction of Dr. Stonscipher, has changed its name to the Mariner Rocket Society. This organization is planning a public demonstration launch as well as a contest for southern Wisconsin rocketeers in the spring. Any individuals or organizations in the southern Wisconsin area interested in participation in the contest are invited to contact Russ Schmunk , 1118 Highland St., Whitewater, Wisconsin, 53190 for further information.

The Bethlehem, Pennsylvania YMCA Rocket Club staged a successful competition between their NAR Section and other clubs from Pottstown and Harrisburg, Pennsylvania and Phillipsburg, New Jersey. Gregory Gillman of the Harrisburg NARCAS Section took first in spot landing with 15 feet, 9 inches. Thomas Gillman, also of NARCAS, took the parachute duration prize with 97 seconds. Carl Guernsey placed first in B/G duration with 58 seconds, making it a NARCAS sweep of first place in all three events.

The Meadville Aerospace Research Association held a demonstration launch from the Crawford County Pennsylvania Fairgrounds on Saturday, August 9th.

The latest issue of *Con-Trail*, newsletter of the North Pittsburgh, Pennsylvania, has announced a winter club contest scheduled for December 7th and 14th. Events to be flown from the North Side field include Scale, and Construction and Design.

Dave Clark would like to start on NAR Section in the Southport-Indianapolis Indiana area. Interested rocketeers should contact him at 338 Webb Drive, Indianapolis, Indiana, 46277.

On Saturday July 19th the Pascack Valley Section and the NAR Leader Administrative Council sponsored a field trip to the Grumman Aircraft plant in Bethpage, New York. The trip was attended by about fifty NAR members from New York, New Jersey, and Connecticut. The tour began with films about Grumman, Apollo 8 and 9 and the nightmares of an aircraft carrier flight officer. It then moved on to the static test area, the Lunar Module final assembly area, the model shop (where a mock up of the Apollo Applications Program telescope mount were being prepared), and a hanger where CBS News had a full scale LM on a mock lunar surface.

(From *Impulse*, newsletter of the PVS)

A new model rocket club has been formed in Stevens Point, Wisconsin. According to club president Randy Cigel, the club has about 15 members, but is still seeking a senior advisor. Their present launch site is an open field behind the Ellis Stone Construction Company off Highway 66.

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MPC Mach 10 Series. Four contest-rated and contest-proven balsa and fiber-tube rockets. Icarus-C...perfect for contest flying in the FAI/NAR Pee Wee Payload events. Flare Patriot ...the only rocket specifically designed for the NAR Quadrathon Competition and a proven design of NARAM-11. Theta-Cajun...a sporty altitude and duration model patterned after NASA rocketsondes. Lambda Payloader...for sport flying and small payloads in a clear payload section.

Motors. A range of 18 x 70 millimeter rocket motors to meet contest and sport flying needs. Safety certified and Contest certified by the National Association of Rocketry. A3-2, B3-3 and C6-4 plus dash-zero motors in types A, B, and C for staging requirements.

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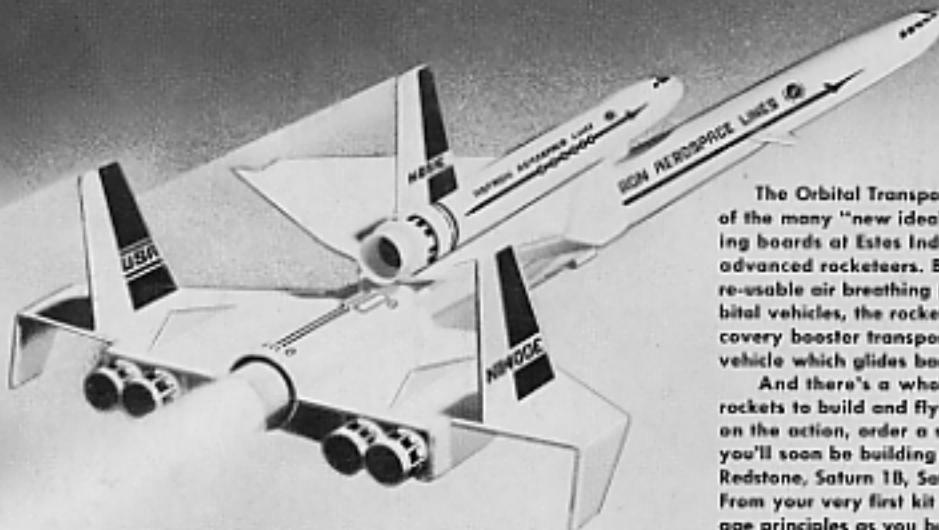
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