The MARS™ Pathfinder

Official Publication of MARS™, the Section 136

Monroe Astronautical Rocketry Society, of the NAR®

January, 1997 | Rochester, NY | Volume 10, Number 1

ДВИНА

MODELING THE SOVIET V-750VK DVINA AIR DEFENSE MISSILE

a k a SA-2B (U.S. designation), or Guideline Mod 1 (NATO codename), by Ray Lewis

Authors Note: After I read my final draft of this article I realized that my wife might be correct. Perhaps I am obsessing over this SA-2 thing. Oh well, it's a pretty tame obsession. It keeps me occupied, doesn't cost too much and doesn't hurt anyone. I still think that, regardless of the purpose of the missile (to break things and kill people), the SA-2 is the neatest looking rocket or missile ever made. Maybe, for the sake of my marriage, my next scale model project should be more benign, like a nice colorful sounding rocket.

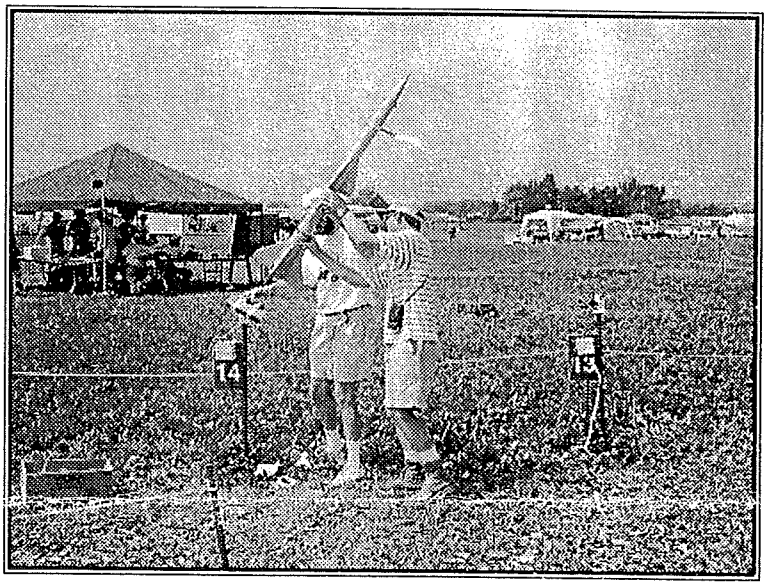
This article is intended to document the chain of events related to my interest in developing a scale model of an SA-2 missile, and leading up to the flight of my model at NARAM 37. Why? Because it was fun and interesting for me, and I thought others might benefit from it or be entertained by the story. In addition, I wanted to request information that readers might have or know about.

Information I'm specifically interested in:

1. *Locations, with addresses and contacts, of other SA-2 missiles and/or launchers anywhere in the world;*
2. *Photographs, especially color, of SA-2 missiles and/or launchers;*
3. *Books and magazine articles, not included in my bibliography, that contain photographs and/or descriptions of SA-2 missiles and or launchers; and,*
4. *A specific book,* Soviet Air Defence Systems, Design and Operation, *by Steven J. Zaloga, Jane's Information Group.*
5. *A block style Cyrillic (Russian) character font set (similar to Helvetica or Arial) for MS-DOS applications (Microsoft Word). I have a Cyrillic character font set, but it has Roman style letters and I want one to better match the stencil markings on these Russian missiles.*

I'd appreciate hearing from anyone with any of this information. Write me at 6949 Stone Hill Road, Livonia, NY 14487.

Credit: The SA-2 diagram accompanying this article was provided by and is used with the permission of Steven J. Zaloga.



TWO TO GET READY — Bill Owens bears a hand as Ray Lewis readies his two-stage model of the DVINA Surface-to-Air missile during the NARAM-37 Sport Scale event. Photo by John DeMar. ➢

PART 1

This is the first part of a planned multi-part article. In Part 1 I describe what I found to be an interesting, although infamous, rocketry anniversary marked by NARAM 37. From a human standpoint the coincidence marked a negative event involving much human pain, suffering, and loss of life. The article is not meant to glorify that aspect of the event. I offer my apologies to anyone directly affected by painful memories or feelings evoked by this article. This article is intended solely to recount the event from a historical perspective and to provide a dramatic introduction to an otherwise "dry" NARAM 37 article.

(continued on Page 6)

Inside this Issue:

Op / Ed

Rhymes of the Range

We're Baaa-ack!

Our newsletter is back, and it has a new name. "Why did we change it?" one reader has already asked. We changed the name because, although we liked the old name, the new name is cool, too. And there's a probe being launched sometime in the coming months that shares the same name.

MARS Observer would have been a cool name, too, but that probe of a few years ago disappeared into the wild blue yonder without a trace. (Come to think of it, it would have been a good name for our newsletter during its long hiatus period during the post-NARAM-37 decompression period. The probe had disappeared. So had our newsletter.)

But, of course, there's another reason why we changed the name. One of our favorite rockets has this name. Who could possibly resist an Estes Pathfinder? Long and slender, it looks great. We could even have a club rocket, just as NOVAAR does.

Another reason for a change is that when Dan founded the newsletter, in 1988, MARS had been inactive. Rather than include the MARS name in the title, or use the name of the old newsletter (the *Full Blast*), Dan decided to use a different name. His mission was to get the club going again, a task at which he succeeded. We felt the time had come for the newsletter to be more closely identified with the club.

So, rest assured, we do not believe in change for change's sake alone. We simply found the *Pathfinder* name irresistible.

I'd like to take this opportunity to thank John DeMar for taking complete responsibility for the previous issue. It looked great, and it gave us some breathing room. John continues as Associate Editor, and will probably edit some more issues in the future.

This change is purely cosmetic. We change a few letters around, but it's basically the same sheet as before.

There have been other, more substantial, changes happening in our section. I had served as president for three years. Some clubs have "presidents for life." I"m glad MARS isn't one of them. With the same people always in charge, things tend to stagnate. With a change in leadership, new ideas and perspectives have more opportunity. Please congratulate Andy Schecter on his election to president and Pat Finan on his election as Vice President. Ferenc Róka continues as Treasurer, a job he's held for many years. (Ferenc made it plain that he doesn't want to be *Treasurer* for life!) Please wish them all the best.

Have fun & fly 'em high!

John ➢

MARS Pathfinder is published by MARS™, Section 136 of the National Association of Rocketry, as a service to its members and rocket enthusiasts in Central and Upstate New York. Domestic subscriptions are currently $6 per year. Please write for information on subscriptions outside the United States.

Submissions from all people are welcome. We prefer electronic form; please contact us for details. We accept photographic slides, prints, and Photo CD.

Editors of other newsletters and journals are welcome to reprint material which appears in *MARS Pathfinder*, provided they extend to us a reciprocal privilege and they cite the author and this journal, unless the article, plan, or what-have-you indicates something to the contrary. Please contact the author if that's the case.

The *Pathfinder* actively supports the NAR Newsletter Exchange Program. Please participate in this important program by swapping with us and other sections! Contact the editor for more information.

Pathfinder Online: Available through the MARS™ Homepage, `http://www.nysernet.org/staff/billowens/mars.html`.

MARS is a trademark of the Monroe Astronautical Rocket Society.

MARS™ *Pathfinder*

Founded in 1988 by Daniel W. Wolf as the Upstate Rocketeer

Editor-in-Chief: John Viggiano
Associate Editor: John DeMar
Photo Editor: Patrick Finan
Typography: Hermann Püterschein
Contributors: Ray Lewis, Ferenc Róka, Bill Owens, Steven Zaloga

MARS™ Officers:

President: Andrew Schecter
Vice President: Patrick Finan
Treasurer: Ferenc Róka
Secretary: John Viggiano
Immediate Past President: John Viggiano
President Emeritus: Dan Wolf

MARS Membership and *Pathfinder* Subscription Information:

Ken Kaleta, 52 Beverly Hts., Rochester, NY 14616
(716) 663 - 3363

As the Rocketry World Turns

news and rumors heard 'round the hobby, by John Viggiano and Ferenc Róka

Manufacturer News. . . The 1995 National Hobby Show has come and gone long ago, and was covered in a *Sprocketry* article. In this column, we present some details that either wouldn't fit, or were too speculative for the *Sprocketry* article, or somehow or another weren't as appropriate for that forum (and are for this one).

First on the list was the Estes booth. Located along the back wall, it was one of the larger booths at the show. I already knew NCR would be there, after having been acquired by Estes. What I wasn't prepared for was the presence of Sterling, a manufacturer of model aeroplane kits (everything from static display to RC) and Weston, a model airplane engine manufacturer. One Estes employee was overheard remarking, "We've only just begun buying companies." Apparently, Estes has been on (and continues on — see below) a buying spree.

This makes sense, because Estes can only do so much to increase its sales of rocketry products, which continue to be its core business. The key to expansion clearly involves other product lines. Last year saw the introduction of the rubber powered Light Glider product line. In addition to the acquisition of NCR, Sterling, and Weston, Estes has introduced this year a series of die-cut balsa hand-toss gliders, most patterned after hot fighter jets. This builds on their considerable expertise die-cutting balsa parts, making kits, and marketing them. On the down side, the hand-toss glider market is not a large one, and the price tag on each item tends to be under a buck or two. Given the hot appearance of these gliders, and the Estes name on the box, Estes is positioning itself at the high end of this market.

Since the show, held the last weekend of October, rumors have been flying that Estes has made yet another acquisition, this time of Cox. In addition to their injection molded line of RTF rockets, Cox makes model airplane glow engines in mostly small sizes. With the Astroblaster having been the hottest RC kit of 1993, and people having converted the model for 0.049 cubic inch Cox glow power, this would also seem a great fit.

Estes is clearly attempting to transition from being, in many people's minds, synonymous with model rocketry to being synonymous with things that fly. We can only speculate on what's in store, but our cloudy crystal ball seems to indicate that Estes has just completed Year 2 in a five year plan which would culminate in their offering a complete line of hobby products (not just things that fly) through its own distribution company. They have already demonstrated they could operate without the distribution assistance of Great Plains, the original owner (see below) of Quest — when Quest was started, Estes reportedly refused to do business with Great Plains, cancelling a $4 million order (over 20 percent of its annual revenues). Whether they could operate without Horizon, as well (the other huge company which distributes Estes products) remains to be seen, though we are hard-pressed to think of many full-line hobby stores that would not be interested in carrying Estes, even if it meant dealing with their own distributor. Look for them to buy some companies in related businesses, including radio control gear, and something from Eastern Europe in the injection-molded plastic model business. Will they get back into kites? They probably will, if they can find the right company, one which sells high performance stunt kites, which sell for $40-$250, rather than the $2-$3 dime-store kites from Hy-Flyer.

Bob Smith Industries, which makes the popular CAs and epoxies sold in hobby stores with the store's name on the product, has introduced a gel CA product that's super-slow setting. I've been getting something like this in hardware stores in small containers to keep in the range box. A hobby-grade product could only be an improvement.

James Evans, president of Sig, tells us that nearly all balsa is now plantation grown. This takes place on high ground, resulting in lighter wood. Getting good contest-grade wood is still not trivial, but the average piece of balsa in a rack will probably weigh less than a same-size sheet would have ten years ago, when there was less plantation growing and more hunting for trees in the wild, cutting them down, and floating them down the river. Of course, this means its harder to get high-density wood for glider booms and turning squares. He also showed some pieces made with Sig's new laser cutter. They fit beautifully. A company wishing to make a small run of kits (one hundred units or so) could use this value-added service, providing Sig with a .DXF (drawing exchange file) from a CAD package.

Laser Machining was displaying a couple of laser cutting and scoring machines. These things are going to make a big impression on this hobby; the edges they produce are smooth, the shapes precise, and the designs virtually unlimited.

One company has already taken the plunge and invested in their own equipment. Stellar Dimensions had a line of rockets featuring laser-cut parts. Their kits have a square cross section, and the owner, Pat, was convinced he was the first person in history to make a rocket with a polygonal cross section. "We're going to file the patent application next week," he told me. I'm sure he neglected to mention in his specification the square rockets, triangular rockets (remember those triangular mailing boxes from CMR?), infinite hexagons, flying outhouses — heck, come to think of it, a Rotoroc helicopter model would make a darn good bit of prior art — that others had done before. Nevertheless, the rockets look cool, and the price is attractive: only ten bucks. There's more details on Stellar in the *Sprocketry* article.

AMT/Ertl had the box art for their beautiful 1/72 scale XB-70 Valkyrie kits, in both regular issue and Limited Edition. This really whetted my appetite for a project. The kit is now in the stores, and I've acquired one of each. Unfortunately, the engines are small (partially compensated for by the presence of six of them), about BT-5 or so in diameter. I don't think this would be a great option for PMC, though I'm sure one of you jokers will make a monkey out of me for saying so. Buy the kit and build it for show; it's beautiful.

The Rosemont Convention Center is, apparently, an enterprise of the municipality of Rosemont itself; I've heard residents (who live in what could be described as a secure compound) don't pay much in the way of municipal taxes because the town makes all the dough it needs from its businesses. The food at the center itself is the usual convention-center lousy fare, but eating establishments are just beyond the River Road L station. You can also get a train to the Loop (though the ride was about an hour last time I took it); O'Hare airport is the next stop, though. If you ever go, keep this in mind.

Deep dish pizza, a Chicago favorite, was on the menu two nights — first at Gino's East, next night at Giordano's, both in Rosemont, both times with friends. Unfortunately, both places use soft, virtually gluten-free flour and little (if any) yeast, so the crusts

tasted more like a biscuit than a pizza. I have been assured that there are places in Chicagoland that know how to make good Chicago-style pizza, but they'll have to wait until next time . . . .

I am indebted to the Brydges family, who were kind enough to be my hosts in the City of the Big Shoulders; Bullet Bob Kaplow, who got more than he bargained for when he wound up taking me for an unscheduled and round-about ride through Des Plains and Arlington Heights; and Steve Weaver, who invited me to represent the magazine at the show.

In other Manufacturer News: Edmonds Aerospace products (the Ivee and super-easy-to-build Deltie gliders) are available at MJ Designs, just north of Marketplace Mall on Hylan Drive.

➢

December Meeting

Notes by Bill Owens

Committee Reports

Range Equipment - Lloyd Wood: The club currently has no launch control equipment. *[We still have the old MARS system, which will work for model rockets — Ed.]* Club high-power pads are being built. Several people offered the use of their pads as needed.

In order to address the pressing launch controller issue, an *ad-hoc* committee was formed to come up with a design. People interested in serving on this committee should see John Viggiano.

Pratt battery packs will be available at cut rate for a possible bulk buy, both for the club and individuals.

New Business

Jay King suggested a donation of rocketry-related materials to the Library, which was approved.

The club approved using an outside group to run concessions at the Geneseo launches, and splitting the revenues with them. Lloyd knows of some candidate groups.

Rich Savory offered the use of his business answering machine for a launch status line: 315-926-5864 outside business hours (10-9 M-F). The message will be available 2-3 days before the launch.

The January and February schedule was accepted as given, and Jay confirmed all the club meeting nights for 1997 with the library. The club officers will refine and select the remainder of the calendar and present it in January/February.

The suggestion was made that volunteers should have gold cards for pad access and a special raffle at club sport launches.

A new meeting schedule was approved:

1800-1900: Committees
1900-2000: Business meeting
2000-2100: Program presentation

Elections

New officers were elected:

President: Andy Schecter
Vice President: Patrick Finan
Treasurer: Ferenc Roka
Secretary: John Viggiano

➢

January Meeting

Notes by John Viggiano

Committee Reports

Range Equipment — Lloyd Wood: Jim Sekol is completing the second Honkin' Big Launch Pad, with an azimuth adjustment. He will rework the first so it provides azimuth, as well. Jim is also making a batch of smaller pads: 2/3 the size (which is still plenty big), about 1/3 the cost.

Lloyd also reported on a proposal-in-process from Ray Halm for a new Launch Controller. Ray has secured a donation of some parts from DuPont — switches, etc. His proposal is for a $300 system, with an end of March delivery date.

The *ad-hoc* Launch Controller Committee also presented a proposal. There was some confusion as to why two proposals were being discussed. Bill Owens pointed out that this issue was not a matter of life-and-death, and people should keep it in perspective. The club voted 5-3 to empower the Officers to review a detailed proposal (schematics, features, materials, plans) from Ray on 26 January (Super Sunday), and make a yes-no decision on this plan. All MARS members are welcome to review the design.

Treasurer's Report: Ferenc reported a cash position of $1595.10. The club also voted to keep all monies on deposit at Rochester Community Bank in the checking account.

1997 dues were set at $12 for Seniors (18 and over), $6 for Juniors / Leaders, with a monthly pro-rating for new members.

Old Business

The Calendar was accepted with the addition of a 16 November Building Session at the Library. Andy will forward the proposed Geneseo dates to Austin Wadsworth for his final written approval.

The meeting was adjourned at 8:19.

Program

John Ritz and Andy demonstrated some Adept products, including an ALTS-2 Recording Altimeter. Using a sports drink bottle, rubber stopper, and tube, John was able to simulate the pressure drops associated with a rocket flight. One flash bulb lit close to "apogee" (maximum vacuum); the other fired at the pressure corresponding to 250 feet above ground level. Afterwards, the altimeter's report of 1862 feet provided testimony the the efficacy of John's lung power. That corresponds to a vacuum of about 1500 pascals, by my reckoning.

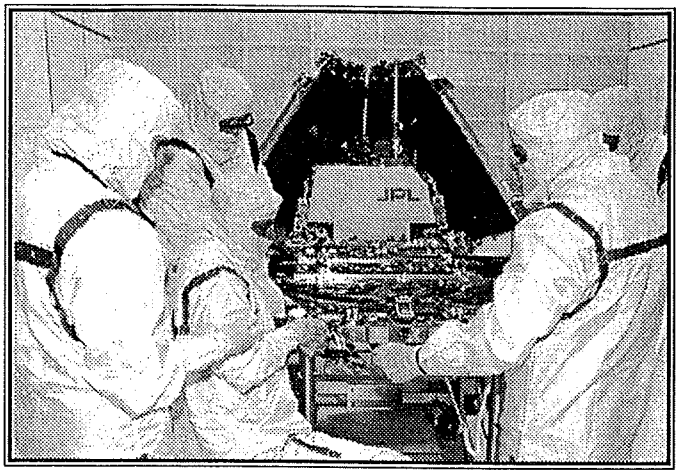
Interested parties adjourned to Denny's for a snack, while John Ritz caught his breath.

Respectfully submitted,

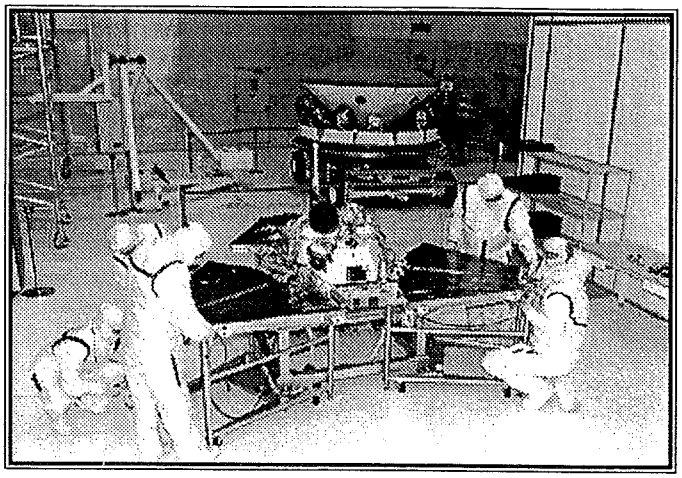
John Viggiano

➢

News About that "Other" Mars Pathfinder

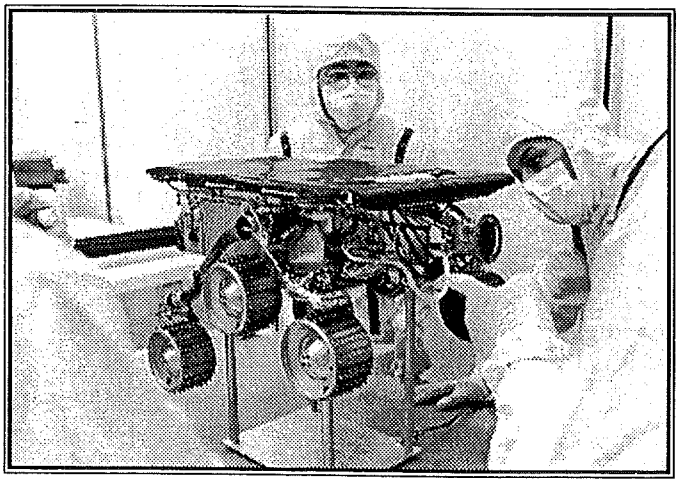


LANDER CHECKOUT — At the SAEF-2 spacecraft checkout facility at Kennedy Space Center, engineers from the Jet Propulsion Laboratory prepare to open the petals of the Mars Pathfinder lander to begin its checkout. NASA Photo KSC-96PC-991. ➢

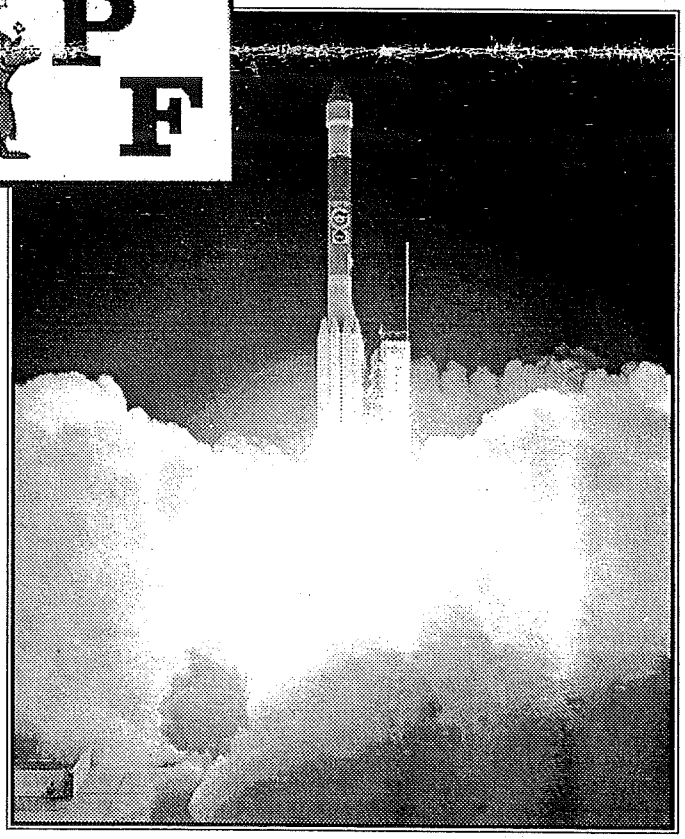


KENNEDY SPACE CENTER, FLA. — At the SAEF-2 spacecraft checkout facility at Kennedy Space Center, engineers from the Jet Propulsion Laboratory begin checkout of the lander portion of the Mars Pathfinder spacecraft. Later the small rover known as "Sojourner" will be integrated with the lander before it is enclosed in the aeroshell and mated to the cruise stage (background) for the journey to Mars. NASA Photo KSC-96PC-989. ➢

The Mars Pathfinder will travel on a direct trajectory to the Red Planet, arriving there in July 1997, during NYPOWER International. Mars Pathfinder will send a lander and small robotic rover, Sojourner, to the surface of Mars. The primary objective of the mission is to demonstrate a low-cost way of delivering a science package to the surface of the Red Planet using a direct entry, descent and landing with the aid of small rocket engines, a parachute, airbags and other techniques. In addition, landers and rovers of the future will share the heritage of Mars Pathfinder designs and technologies first tested in this mission. Pathfinder also will collect invaluable data about the Martian surface. The Jet Propulsion Laboratory manages the Mars Pathfinder mission for NASA's Office of Space Science. ➢



MARS SOJOURNER — The small rover for the Mars Pathfinder mission has been unpacked from its shipping container and is undergoing inspections. Called Sojourner, this compact, semi-autonomous six-wheeler will become the first vehicle to traverse the surface of Mars. Weighing just 22 pounds (10 kilograms) it will travel to the Red Planet inside the Mars Pathfinder lander. NASA Photo KSC-96PC-1011. ➢



LIFTOFF! — The Mars Pathfinder begins the journey to Mars with liftoff atop a Delta II expendable launch vehicle at 1:58 a.m. EST, Dec. 4, 1996, from Launch Complex 17B on Cape Canaveral Air Station. NASA Photo KSC-96PC-1132. ➢

ДВИНА *(continued from Page 1)*

PROLOGUE

On July 24, 1965, four USAF F-4C Phantom II aircraft took off from Ubon AFB, Thailand on a mission over North Vietnam. The aircraft were part of the 47th Tactical Fighter Squadron of the 15th Tactical Fighter Wing. The Phantoms were flying MIGCAP for an F-105 strike against the Lang Chi munitions plant, 55 miles northwest of Hanoi. [1], [3] This was another in a long series of Rolling Thunder missions designed to gradually escalate US pressure on North Vietnam.

As the Phantoms flew northeast toward the target area they were tracked by North Vietnamese long range search and target tracking radar stations (P-12, Spoon Rest and P15, Flat Face). [1] For the North Vietnamese, this was a special day. It was a day on which they were going to take a step towards equalizing the technology imbalance between their mostly outmoded air defense equipment and the modern technology air power of the US.

In earlier Rolling Thunder missions, North Vietnamese MiG aircraft had been a threat to the US flights. However, because of the number of MiG kills in recent months, the North Vietnamese had pulled their remaining MiGs back to airfields near the Chinese border. One of the Phantom pilots on this MIGCAP *[MiG Combat Air Patrol — Ed.]* mission, flying in number two position, was Capt. Richard P. Keirn, a 40 year old veteran of WWII. He and the other pilots were expecting a relatively quiet mission. [3]

As the US aircraft neared the target area, data from the search and tracking radar, including range, altitude, and bearing, were passed on to a recently activated SA-2 battery. This battery consisted of a star shaped arrangement of six launchers, set up approximately fifty meters apart, and a Fan Song engagement radar. [1] The launchers were loaded with Russian-made surface-to-air missiles, V-750VK Dvina (US designation SA-2B, NATO designation Guideline, Mod 1). These missiles were approximately 35 feet long and weighed 4,850 pounds including the booster. They could carry a 288 pound warhead at Mach 3.5 out to a slant range of 24-25 miles. The missiles were effective between altitudes of 3,000 and 60,000 feet. [2]

US U-2 aircraft had first detected a missile site being constructed in early April 1965, and had watched it and other sites as construction progressed. However, official US policy was to avoid attacking the SAM sites. Policy makers felt US attacks on SA-2 missile sites would send the wrong message to the North Vietnamese and possibly draw the Soviet Union more into the conflict. Soviet technicians were helping set up the SAM sites and train North Vietnamese personnel. US policymakers didn't want to risk any Soviet casualties from US attacks. In addition, they felt the SAMs were just a bluff and the North Vietnamese would not use them if they were not attacked. [3] On July 23, 1965, EB-66C electronic warfare reconnaissance aircraft picked up the first actual evidence of the operation of the Fan Song engagement radars of the SA-2 system. [1]

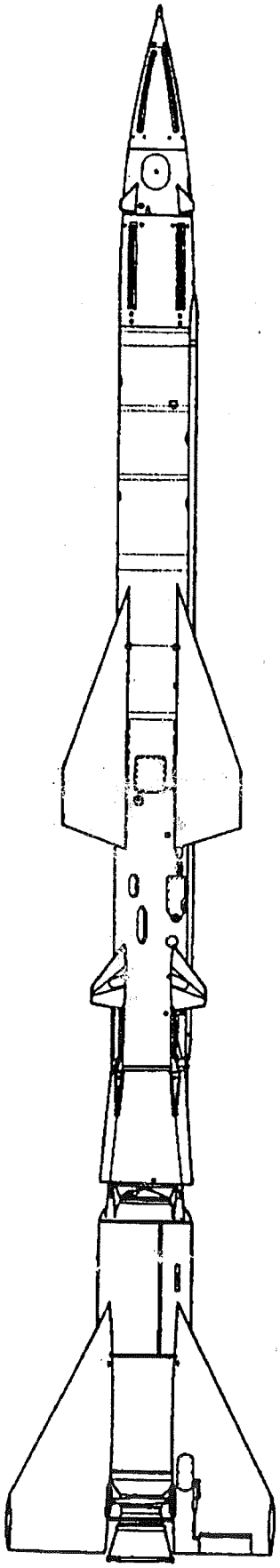
When the SAM battery was alerted, its Fan Song radar, operating in target acquisition mode, began searching for the target aircraft. It was cued where to search by the long range radar. Once the target was acquired, the radar began feeding target data on direction, altitude, and rate of closure to the fire control computer. When sufficient data for engagement were acquired the radar was switched to automatic tracking and missile guidance mode. [1]

The weather over North Vietnam was bad and visibility for the Phantom pilots was poor. When they reached their assigned MIGCAP area they were flying close together to maintain visual contact with each other. They began a preplanned flight pattern at high altitude 40 miles west of Hanoi. [3]

The SA-2 missile battery launched a three missile salvo against the target aircraft, each launch approximately six seconds apart. Ignition of the missile solid fuel first stage motors left a prominent white smoke cloud. Approximately five seconds after launch the solid fuel boosters burned out and the liquid fueled second stages of the three missiles ignited. As the boosters fell away, they removed the restraining arms from the control fins of the upper stages. Once the guidance fins were freed, the Fan Song radar began steering the missiles to the target. As the missiles closed on the aircraft the command computer turned on the missiles' proximity fuses. [1]

Because of the clouds and poor visibility, the Phantom pilots could not see the characteristic smoke plume and trail of the SA-2 launches. Their first indication of danger was when one of the Phantom pilots saw something like a "flying telephone pole" rising through the clouds at them. A moment later one of the planes erupted in a yellow ball of fire. The missile either exploded on contact with the number two plane or exploded by proximity fuse in the middle of the tight four plane formation. [4] The other three planes were damaged by the blast, but maneuvered to avoid the explosion and narrowly escaped the other missiles. The second two missiles exploded a few seconds after the first, either by proximity fuses, or radio command detonation. The three damaged aircraft managed to return safely to base. The pilot of the aircraft that had been hit was Capt. Keirn. (I don't know what happened to his back-seater; he may have been killed but I have found no mention of that in the references I've checked so far.) Capt. Keirn ejected safely, but was captured and imprisoned in North Vietnam for approximately seven years. It was ironic that twenty years earlier he had survived a shootdown over Germany and spent the remaining months of that war as a POW. [3] While policy makers were left to ponder why the North Vietnamese had actually used their missiles and why they hadn't understood our messages, US pilots had to ponder how to survive the new threat.

This was the first shootdown of a US aircraft by an anti-aircraft missile in the Vietnam War. It was a significant event in US history, in the history of warfare, and in missile technology. The SAM threat to aircraft over North



Vietnam drove the development of new tactics and technology to counter it.

NARAM 37:

Thirty years (and three days) later on July 28, 1995, on the other side of the world, another SA-2B was about to be launched. This was a 7.4:1 giant sport scale model of the original, and it was mine. I watched anxiously as the countdown proceeded, 5, 4, 3, ...

There was no radar or warhead involved, but my low tech electronic staging circuit was complicated enough for me. I had flown this model successfully twice before, although the upper stage had been almost entirely rebuilt for NARAM. Now I had last minute electrical continuity problems in the second stage firing circuit. I needed some time to properly diagnose the problem and correct it, but it was late and the range was about to close. I had to make my sport scale flight or risk losing my static points. With a good flight I hoped to finish in position for a trophy. I made some adjustments that appeared to correct the problem and decided to attempt the flight.

...2, 1, Ignition, I was relieved when the missile fired straight up in a cloud of smoke and fire as the three black powder D engines appeared to ignite simultaneously. That was the first step in the low-tech, but relatively complex process, required for a successful flight of my model missile. I had spent many hours constructing this model over the past year and many more hours researching the SA-2 for scale data over the past two years. I didn't want it to malfunction, not after all the work I put into it, and not in front of all those people on the last day of NARAM. *(To be continued.)*

COMING NEXT:

In the next issue we cover the continuing saga, including my visit to the Smithsonian National Air and Space Museum to find the real missile, a product review of the Launch Pad's SA-2 Plan Pak, a description of some of the construction details of my giant sport scale model, and scale details of the SA-2B.

NOTES:

1 Steven J. Zaloga, *Soviet Air Defence Missiles, Design, Development and Tactics*, (United Kingdom, Jane's Information Group, 1989).

2 Kenneth P. Werrell, Archie, *Flak, AAA and SAM, A Short History of Ground-Based Air Defense*, (Maxwell Air Force Base, Alabama, Air University Press, 1988).

3 John Morrocco, *The Vietnam Experience, Thunder From Above, Air War, 1941-1968*, (Boston, Boston Publishing Company, 1984).

4 Larry Davis, Wild Weasel, *The SAM Suppression Story*, (Carrollton, Texas, Squadron Signal Publications, 1993).

OTHER SOURCES CONSULTED:

Edgar C. Deloma, Jr., *The Vietnam Experience, Tools of War*, (Boston, Boston Publishing Company, 1985).

John Morrocco, *The Vietnam Experience, Rain of Fire, Air War*, 1969-1973, (Boston, Boston Publishing Company, 1985).

Bill Sweetman and Bill Gunston, eds., *Soviet Air Power*, (New York, Crescent Books, 1978).

Chris Bishop and Ian Drury, eds., *The Encyclopedia of World Military Weapons, The World's Armies and their Equipment*, (New York, Crescent Books, 1988).

➢

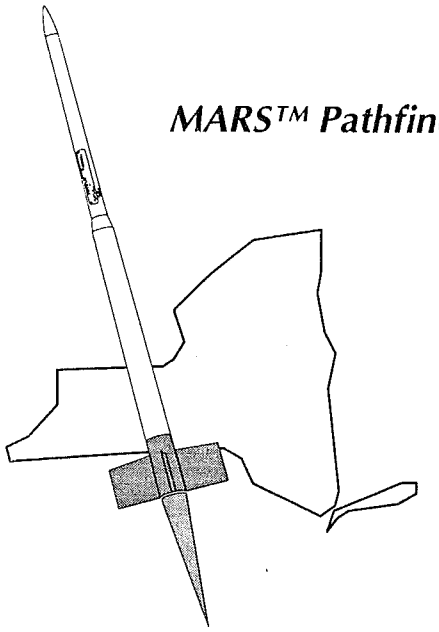
Official MARS™ 1997 Calendar

Jan	1	Colby Farm	Sport Launch
	14	Library	Regular Club Meeting
	19	Library	Building Session & Test Fly
Feb	11	Library	Regular Club Meeting (Pay yearly dues!)
	16	Library	Building Session & Test Fly
Mar	11	Library	Regular Club Meeting
	16	Colby Farm	Sport Launch
Apr	8	Library	Regular Club Meeting
	12-13	MD	ECRM-24
	12-13	NJ	RATS launch
	19-20	Geneseo	Sport launch (rain 26-27 Apr)
May	13	Library	Regular Club Meeting
	17-18	Geneseo	NYSPACE '97 (State Championships)
	24-25	Dallas	NSL
Jun	7-8	Geneseo	Sport Launch
	10	Library	Regular Club Meeting
	14-15	PA	RAMTEC-5
Jul	4-6	Geneseo	NYPOWER International
Jul	8	Library	Regular Club Meeting
	20	Livonia	Sport launch
	25-Aug 1	Tucson	NARAM
Aug	7-10	Denver	LDRS
	12	Library	Regular Club Meeting
	17	Livonia	Sport Launch
	30-31	Geneseo	Labor Day Sport Launch
Sept	9	Library	Regular Club Meeting
	20-21	Geneseo	FLFC 7 (rain 27-28 Sept)
Oct	14	Library	Regular Club Meeting
	19	Livonia	Sport Launch
	25-26	NJ	RATS launch
Nov	9	Library	Building Session and Test Fly
	11	Library	Regular Club Meeting
	16	Library	Building Session and Test Fly
Dec	9	Library	Regular Club Meeting

MARS Meetings begin at 7:00 PM (6:00 for committee meetings) and are held at the Henrietta Public Library, Calkins Road (just south of Marketplace Mall).

➢

MARS™ Pathfinder
c/o John Viggiano
35 Mickens Bend
West Henrietta, NY 14586



MARS™ Pathfinder