Southeastern Space Supporter

Newsletter of HAL5 - the Huntsville Alabama L5 Society chapter of the National Space Society

Volume 4, Number 4 — July–August 1995

FIRST WORD

HAL5 Joins the Internet

(by Ronnie M. Lajoie, SSS Editor)

Thanks to a generous donation from new member Bob Ehresman, HAL5 now has direct access to the Internet and its own page on the World Wide Web. In exchange for a "contributing" membership, Bob has provided HAL5 with one-year free Internet access via his company Community Internet Connect, Incorporated (CICI).

The CICI account gives HAL5 a stable and easily memorable electronic mail address: "hal5@cici.com". HAL5 is already on the E-mailing lists of various space organizations, including the NSS, the Experimental Spacecraft Society (ESS), and *SpaceViews*, the NSS electronic newsletter. HAL5 members with E-mail capability should send messages and newsletter articles to the "hal5@cici.com" address.

(see Internet on page 11)

Project HALO Event

Project HALO Phase 0
Rocket Motor Test Day 7
and HAL5 Member Picnic

Saturday, August 12, 1995
Setup at 10am, First Firing at 12pm
HALO Test Facility at H.Pickens home
(see map provided in May-Jun issue)

All HAL5 members are encouraged to attend, and to bring interested friends and co-workers. Limited openings for the Press and public. Free admission.

PROJECT HALO NEWS

Quest for the Rocket Motor

(by Ronnie Lajoie, HALO team member)

Three more rocket motor test days were held since the release of the May-Jun issue. There were some good days and some bad days, with a mix of successes (see Figure 1), failures, and many lessons learned. On the whole, we have made progress towards finalizing the design of the HALO rocket motor. We have also made some changes to the Rocket Motor Test Facility which greatly improved safety and operational efficiency.

Rocket Motor Test Day #4

It was Saturday, May 27, and we were ready for a full day of rocket testing. We had plenty of rocket fuel/motors (both HALO and McDonnell Douglas) and plenty of nitrous-oxide (N_2O). The team had worked hard the previous week preparing for the tests. Tim Pickens and Steve Mustaikis had converted an old green 3000 psi tank into our new test stand oxidizer tank. The sturdier tank would allow us to safely handle it while under pressure and allow us to keep the tank pressurized between firings. A new 50-pound postal scale, purchased by HAL5 member Peter Ewing, would allow us to weigh the tank before and after each firing, thus enabling us to determine how much N_2O was used during the test.

And boy did we have a lot of firing . . . attempts! By the end of the day, Steve Mustaikis and Alfred Wright had become expert oxidizer tank fillers and weighers. Unfortunately, a new oxidizer injector, designed to increase the flow of N_2O into the motor chamber, did its job only too well.

(see Motor Testing on page 3)

Figure 1. Asphalt-and-aluminum motor fires during HALO Test Day #6.

Huntsville Alabama L5 Society

President — Gregory Allison
Day: 533-3700, Eve: 859-5538
Vice-President — Ethan Scarl
Day: 461-2747, Eve: 534-3993
Treasurer — Ronnie Lajoie
Day: 461-3064, Eve: 721-1083
Secretary — Larry Scarborough
Day: 881-1944, Eve: 881-4363
Membership — Philomena Grodzka
Day: 837-4287, Eve: 536-8638
Communications — Ron Creel
Day: 881-8016, Eve: 881-8016
Special Projects — Alfred Wright
Day: 876-8037, Eve: 420-6273

Southeastern Space Supporter
Volume 4, Number 4
July / August 1995

The Southeastern Space Supporter is a bi-monthly publication of the Huntsville Alabama L5 Society (HAL5), a not-for-profit 501(c)(3) organization devoted to the goal of seeing everyday people living in thriving communities beyond the Earth.

Any opinions expressed in this news-letter are those of the authors or of the Editor, and, unless expressly so stated, are not necessarily those of HAL5 or NSS.

Visit the HAL5 Web Page on Internet via:
http://www.cici.com/~hal5/index.html
Courtesy of Community Internet Connect.
Contact Bob Ehresman for info: 722-0199

HAL5 encourages its members to speak out on space-related issues, and welcome submissions of both fact and opinion articles of interest to HAL5 members.

Submit letters/articles to: Ronnie Lajoie
162 Kirby Lane, Madison, AL 35758
Day phone/message: 205-461-3064
Night/Weekend phone: 205-721-1083
FAX number: 205-461-2939
Electronic mail address: hal5@cici.com

Deadline for submittal is the last day of the following months: February, April, June, August, October, and December.

Preferred format for text is ASCII on a diskette or sent by E-Mail. Preferred format for text with graphics is Word on a diskette. Also acceptable are letters and articles sent by mail or faxed; however, the more retyping required, the less likely the acceptance. HAL5 is not responsible for receipt of mailed submissions; none will be returned unless sent with a SASE. Hand-delivered diskettes will be hand-returned. No compensation is paid for submissions.

TOPE Thanks HAL5

In May, HAL5 received the following "Thank You" letter from Susan Cameron, one of the elementary school teachers participating in the "Teaching Observation of Planet Earth" (TOPE) project.

"All of the teachers in TOPE wish to express our great thanks for HALO's support of our remote balloon lift project. The balloon itself is BEAUTIFUL and certainly is perfect for the task. Even on the windy day on which we piloted the program, it's size allowed us to carry out the lift. Also, we would never have made it without the invaluable help of many of your members that day. What a blessing!

Enclosed are some of the images which were taken from the lift. We were amazed that we actually photographed the grid we placed on the ground. Using enlargements and overhead projections made from the pictures, we have studied scale and digitizing. Results of our first attempt were presented at the HOPE (Helping Observe Planet Earth) Symposium held at UAH on Monday, April 24. At this event, TOPE schools presented various projects in which they are engaged. It is the first of what we hope will become an annual event.

Over the summer all of the teachers in TOPE will be trained in using the balloon and will take initial remote images of their campuses. We hope to raise the balloon to 500 feet, so that the images will include more campus area. Then in the fall we will begin a program where each participating school will make at least two lifts each year as a means of monitoring changes on their campus. We are working on additional applications of this basic concept, including using other types of film and sensors on the balloon. We will keep you appraised of our efforts and their results.

Again, thank you for your support.

Sincerely, Susan Cameron, TOPE" ☆

New Phone/Fax for Ron Lajoie

Ronnie Lajoie recently changed jobs within the Boeing Company. I am now working in the "Advanced Concepts" group under the management of Gordon Woodcock — finally, after 10 years! YAHOO! I am now in a better position from which to convince Corporate management to invest in commercial space activities. I will keep in you informed on my successes and failures in this area (so long as the information is not Boeing proprietary); and also of any job openings in this group.

My office phone number is 461-3064 and my (and HAL5's) FAX number is 461-3989. The HAL5 E-Mail address is still "hal5@cici.com", via CICI. ☆

****

Ed Stluka Needs Your Support

(by Ronnie Lajoie)

In April, Ed Stluka, a member and long-time friend of HAL5, suffered a stroke. I found out from Paul Paelian, a member of the Huntsville HAM radio operators club, to which Ed is a very active member. I spoke with Ed yesterday and he thanked me for calling. We spoke for a good half hour. Although he has been recovering from his stroke with the help of physical therapy, he has encountered some additional complications, and remains for the most part bed-ridden.

This is very tough on Ed, as he has been one of the most active members in the local community, especially when it comes to space-related educational activities. His latest project was setting up a HAM radio facility for Space Camp. Ed is also a member of HARA and a leader of the SOAR program.

I told Ed that HAL5 had been taking up a collection to get him a fruit basket, but he very generously insisted that we donate the money instead to HAL5. I am going to donate $100 in Ed's name; I invite others to do so, and also to pray with me for Ed to quickly recover. ☆

(Motor Testing, continued from page 1)

In "take" after "take", the N_2O flow rate was so high that it completely blew the still-burning igniter completely out of the motor. After four attempts with a HALO asphalt motor, we switched to one made by McDonnell Douglas' Dr. David Dean, also a HAL5 member. Since the same injector was used in the test casing, the results were not surprising. Two failed attempts later, with darkness rapidly approaching, we gave up for the day. We decided to switch back to the original smaller injector for the next test day.

Even in failure, more so perhaps, there are lessons to be learned. Herman Pickens grew increasingly apprehensive as he watched Steve and Al apply rather large wrenches to tighten valve fittings while filling and weighing the oxidizer tank. One wrong turn and a fitting might have broken, allowing sub-freezing N_2O to spew forth under high pressure directly at Al or Steve. After some discussion, the group agreed to go with a remote loading and weighing capability, which would be faster as well as much safer.

The Little Motor That Could

During the break between motor test days, HALO's Gene Hornbuckle, a member of the Huntsville Area Rocket Association (HARA), decided to build his own miniature hybrid rocket motor. Tim fashioned for him a motor casing about 6 inches long and 2 inches in diameter. Gene prepared the propellant and created the motor insert. Tim donated a small composite tank he bought surplus. Tim and Steve also created a "pyro-valve" they had been wanting to try out on the larger HALO motors.

After a number of successful component tests, the trio decided to test the new hybrid motor. Since it was small, they assumed they could test it in Tim's garage. They strapped it to Tim's very heavy hydraulic press, and trained a video camera on it. Soon after a successful, but very loud, ignition, the motor proceeded to push the press across the room! Hearing the roar, Tim's neighbor rushed over to make sure he was okay — which he was, albeit a little embarrassed. After the test, the group decided that maybe they should do the next test out at the test site in Gurley.

Rocket Motor Test Day #5

It was Saturday, June 17, and we were back for the full day of rocket testing we had missed previously. Through the hard work of Tim, Steve, and Gene, HALO finally had its remote loading and weighing capability for the oxidizer tank. This was greatly aided by the kind donation of a 50-pound-capable load cell from the Toroid Corporation, a local electronic parts manufacturer. Gene had also spent some significant time organizing and labeling the electronics to make it easier to maintain. A spare electronic signal pathway was converted for use as a telephone line, finally allowing us to talk quietly to each other between the barn control center and the test stand.

The first test went off beautifully (too bad I missed it!). During a lunch break, Steve reported that the new loading capability worked great and that the oxidizer tank had been filled in just minutes, rather than the typical tens of minutes. The igniter fired first time, and the asphalt motor burned well. Larry Larsen's data acquisition system worked great as usual and high quality data was captured and stored. Later analysis showed that the thrust averaged 161 pounds with a specific impulse (Isp) of 177 seconds, which was lower than the 200-lb thrust and 200-sec Isp desired.

After lunch, though, events took a turn for the worse. Our new remote loading system was unable to fill the oxidizer tank. After much experimenting, we reached the only reasonable conclusion — we were out of N_2O — again. This was the second time we could not perform a test for McDonnell Douglas due to an empty oxidizer supply tank. We immediately decided never to let this happen again. From now on, we would always have at least one full N_2O supply tank at the test site.

The day was not lost, however. James Prentice, of Hybridine Corporation in Georgia, had brought one of his hybrid motors to test using gaseous oxygen (GOX) instead of N_2O. Since we had obtained a tank of GOX just for this occasion, that test could still proceed. James used a piece of a solid motor for his hybrid motor igniter, which would be lit by a large squib. James' squib required more electrical power than the ones that we were using, so we ran an extension cord all the way from the test stand to Tim's generator, stationed behind the barn. Using the generator would also isolate the power surge of ignition from the data acquisition system equipment.

With all that power, the igniter lit as planned and the motor roared to life (see Figure 2). With a full tank of GOX to consume, the motor burned for a long time. The flame was bright and clean, although the thrust was not as high as desired. James was pleased with the results, and especially thanked Larry for providing some numerical data acquired during the test. Test Day #5 ended on a happy note.

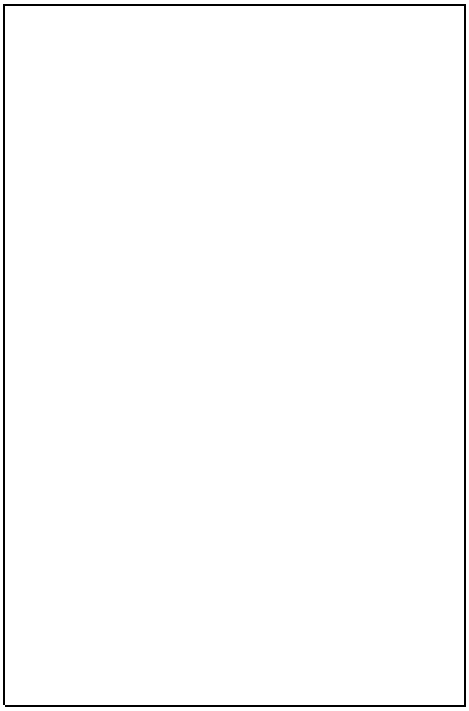

Figure 2. Hybridine motor fires.

Rocket Motor Test Day #6

It was Saturday, July 8, and we were back — yet again — for that full day of rocket testing we had missed now twice previously. This time, we had plenty of N_2O, two full supply bottles, which were now covered with a plastic tarp last used as a rain cover. Tim had made one last change to the oxidizer system, based on a concept developed by Herman Pickens. The "useless" gaseous N_2O cools as it is vented. Herman determined that we could take advantage of this cooling to keep the oxidizer tank cold. Tim wrapped 10 feet of the vent copper tubing around the green oxidizer tank, then encased it with insulation surrounded by duct tape. Now each time Steve vents the oxidizer tank, the tank gets colder, creating a pressure differential with the supply bottle; thus allowing more N_2O to enter the tank.

We also had plenty of hybrid motors. Gene had volunteered to pour and mix hybrid motors for Project HALO, as he was still interested in retesting his little hybrid rocket motor. During the break, Gene produced two all-asphalt motors, and two others containing 15% aluminum powder (by weight). Being a conductive metal, the aluminum would increase the heat transfer rate throughout the asphalt, thereby increasing the propellant burn rate, and hopefully increasing the chamber temperature and associated rocket thrust and density-impulse. We also had two more McDonnell Douglas motors left untested.

The only major change for the tests would be in the motor ignition system. Greg Warren of Advanced Concepts, supplier of squibs and Thermolite for HALO's igniters, joined HAL5 and volunteered to serve as the pyrotechnic safety officer for Project HALO. He persuaded Tim to abandon the wire-cylinder igniter insert in favor of a thick wafer of solid propellant sliced from a K-motor. The wafer would be placed on top of the motor like a rubber washer. A squib would be used to set off the wafer. The heat from the burning solid propellant would rush down the core as the oxidizer started to flow, causing ignition. Ron Creel did his usual excellent job of preparing the squibs and bonding them to the wafers.

A Very Good Day

Finally, all the hard work of the entire HALO Propulsion Team paid off. Unlike Test Day #4, when we "batted" 0 for 6, this time we "batted" 9 for 10! Three HALO motors, two McDonnell Douglas motors, Gene's hybrid motor, and three solid rocket motors (brought by James Mitchell and Rick Kauffmann of Tennessee) all were fired successfully between noon and sunset. It was a very good day for testing motors.

I arrived just prior to lunch. The only item I missed was the one failed attempt to fire Gene Hornbuckle's little hybrid motor, now placed in its own miniature wooden test stand. After lunch, we began testing in earnest — and did not stop until the cows came home (i.e., sunset).

First up was a HALO asphalt motor with a $1^1/_4$-inch core diameter. The remote oxidizer tank loading and weighing system worked like a charm, although the occasional POP-HISS of the release valve (to vent unwanted gaseous N_2O) made more than just a few of us jump. After the Safety Officer verified that the range was clear, the countdown commenced: 5–4–3–2–1–Ignition! The familiar "snap" of the squib was immediately followed by the new "poof" sound of the solid motor igniter, which released a small cloud of smoke at the base of the motor. As in the old TV show "I Dream of Jeannie", the "poof" was soon followed by the release of the genie — but ours was a roar of flame instead of a beautiful woman (too bad) — or even Robin Williams! The test was stopped at exactly 3.0 seconds; the motor yielded an average thrust of 162 pounds and an Isp of 167 seconds.

The Aluminum Motor Fires

Next up was one of the HALO asphalt-and-aluminum motors with a 1-inch core diameter. Preparations began well, the stage was set, the "director" said "Action!" (or was it "Ignition!"?) — but nothing happened. Closer inspection revealed that the squib failed to fire. We confirmed among ourselves that we would be using two squibs on the flight motor. We would not want a $1000 flight ruined by a $1 part!

With a new squib, ignition went off perfectly, and the motor fired for 3.0 seconds before Steve's sequencer automatically cut-off the oxidizer flow, ending the test. The motor yielded an average thrust of 163 pounds and an Isp of 168 seconds (see Figure 1 on page 1).

This was not much performance improvement compared to the previous test. Steve believes the less-than-desired results were because the oxidizer-to-fuel (O/F) ratio was not optimized for the asphalt-and-aluminum propellant. He recommended that we not fire the second aluminum motor until after he had time to study the data.

Although the external differences were hardly noticeable, the internal differences were anything but! The aluminum did indeed increase the heat transfer, for the propellant had clearly regressed much faster than we had previously seen. The propellant burned axisymmetrically, but ripples were noticed all the way down the length of the unburned core. Steve found a layer of aluminum-oxide coating the nozzle, but fortunately found no damage once it was removed. The group agreed that more tests would have to be performed before a final determination could be made on the benefits of adding aluminum to asphalt.

Success After Success

Next up was a McDonnell Douglas motor with a 1-inch core diameter. After a successful ignition, the motor burned for 3.0 seconds before shutdown. Herman Pickens remarked

that he could clearly see the Mach cones in the very clean exhaust plume. Dr. Dean smiled and replied that he "designed it that way". The motor yielded an average thrust of 157 pounds and an Isp of 167 seconds.

Next up was a HALO all-asphalt motor with a 1-inch core diameter. Another successful 3.0 second test yielding an average thrust of 154 pounds and an Isp of 162 seconds.

Next up was a McDonnell Douglas motor with a $^3/_4$-inch core diameter. This test would be an intentional repeat of the first M-D motor back in May, when gaseous N_2O was used due to a low supply bottle. Again, another successful 3.0 second test; this one yielding a low average thrust of 97 pounds (as expected) but a high Isp of 204 seconds (as hoped).

The Little Motor Roars

Next up was Gene's little hybrid motor, back for a second attempt. Gene placed his miniature test stand against the concrete firewall and I laid bricks in the lower portion to keep it from moving. While the rest of the group struck the test stand, Tim and Steve borrowed the 50-pound load cell (used for weighing the tank) to use as a thrust-monitoring device for the test. After setup, most of us moved our cameras up closer for this "little" rocket motor firing.

Upon ignition, we realized that maybe moving closer was not necessarily a smart idea. The little motor roared to life, producing a very clean (and very LOUD) thrust, which the load cell claimed was close to 125 pounds (see Figure 3)! The motor continued to burn for about 6 seconds, until its little oxidizer tank was depleted. It was definitely one of the highlights of the day. The sound was so loud that a neighbor from miles away called to check on us. Chris Pickens assured her that it was "just those rocket guys". The 50-pound load cell was damaged by the high thrust. Paul Paelian of Toroid agreed to see if he could repair it for us.

Three Solid Motors Fire

The last tests of the day were three solid-propellant motors custom-made by James Mitchell of Tennessee. The three sizes of motors were said to be equivalent to J, K, and L type motors. Due to the sizes of the motors, we decided do the tests with the motors horizontal rather than the usual vertical. The heavy steel rocket motor holder was placed horizontally across two bars of the test stand. For each test, a solid motor would be bolted to the holder aimed such that, if it broke loose, it would strike the firewall first.

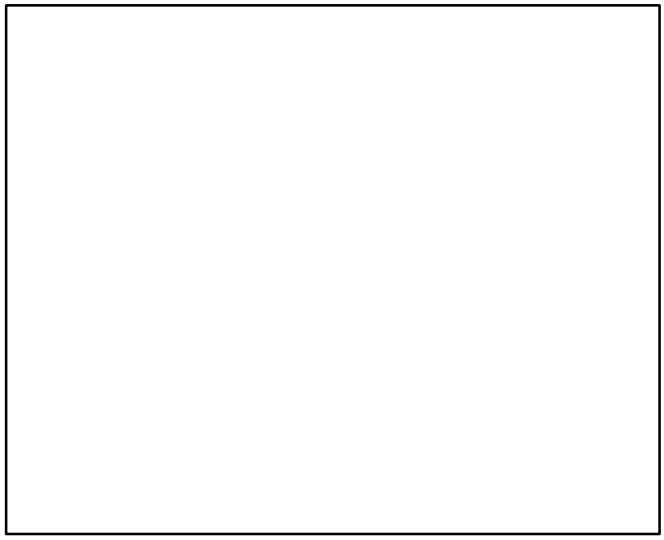

Figure 3. Gene's motor: the little mouse that roared.

As James and Rick Kauffmann prepared the J-motor, those of us with cameras returned to our original more distant locations. I saw David Dean setting up his tripod out in the open and reminded him that we were about to test solid motors. He said "OH!" and (knowing more about the dangers of solid rockets than me) proceeded to retreat farther back.

After Steve shouted "Ignition!" there was a multi-second delay before the J-motor actually lit. When it did, though, it was powerful and short-lived, about 2.4 seconds. The thrust averaged 95 pounds, but peaked close to 140 pounds. Isp was 194 seconds, the second highest of the day.

James and Rick removed the J-motor and bolted into place the larger K-motor. Chris Pickens road up to the front of her property to monitor the noise level from a distance. Upon "Ignition!" the only delay was while the K-motor "revved up", a sound like someone taking a deep breath. This was immediately followed by a loud roar as the motor set out a large plume of white-hot flame. The motor burned for 2.3 seconds, yielding an average thrust of 151 pounds, and a peak close to 230 pounds. Isp was 181 seconds.

James and Rick removed the K-motor and bolted into place the even larger L-motor. Chris was still monitoring the noise level from a distance. Upon "Ignition!" the L-motor "revved up" with a sound like a fire-breathing dragon taking a deep breath! This was immediately followed by a very loud roar as the motor set out an even larger plume of white-hot flame. The motor burned for 2.6 seconds, yielding an average thrust of 268 pounds, and a peak close to 380 pounds, the largest recorded thus far at the HALO test facility. Isp was 183 seconds.

The motor holder showed no sign of wear, giving us confidence that it would hold even larger motors. Chris returned and reported that the noise sounded like "distant thunder" from her remote vantage point.

End of a Good Day

The final test equipment was removed and the group retired to the home of Herman & Chris Pickens, where we were treated to dinner and videos of our rocket motor tests. It was the end to a very good day at the HALO Rocket Motor Test Facility. The next test is scheduled for Saturday, August 12. ✯

HALO Vacuum Testing, Part 1

(by Alfred Wright and Ronnie Lajoie)

HAL5 is not the first group to propose and implement a high altitude launch vehicle. A group from North Carolina attempted to launch a rocket from a balloon a few years ago. Unfortunately, it failed due to a lack of ignition in the rocket motor. Not wanting to repeat their failure, HAL5 decided to perform some tests of our igniter components prior to our first launch.

Igniter Test on Balloon Fails

On March 18, HAL5 attempted to test a prototype igniter on a balloon at an altitude of 20 miles, where it would be above 99% of the Earth's atmosphere and the temperature of what's left plunges well below freezing. Unfortunately, the igniter's squib (an electronic match) failed to ignite due to a cold 9V battery. Even had the battery worked, some questions also have been raised about the ability of the Thermolite wick to burn in a near vacuum.

Ground Tests Quicker and Cheaper

It was therefore decided to perform some ground tests in a vacuum chamber as it is much quicker and less costly. The tests are to determine whether or not squibs and Thermolite can ignite in a near vacuum and, if so, how long/fast do they burn.

The testing was planned in two phases. First vacuum testing at room temperature; then, by adding dry ice, vacuum testing at sub-freezing temperatures.

Tim Pickens quickly assembled a vacuum chamber using a small metal box with a one-way valve opening in the top. The valve connects to a small vacuum pump. A rubber O-ring glued to the box allows a large glass jar to be sealed against the box once the air inside is evacuated. Two wires topped with alligator clips run into this chamber through a small hole in the box. A 9-Volt battery inside the box provides the power to fire the squib.

Zero'th Tests Not Promising

After setting up the equipment, the last 7-inch piece of green Thermolite was used to make sure everything worked. The Thermolite was strategically taped to a short stick wrapped in aluminum foil, then placed next to a test squib hooked to the alligator clips. The glass dome was put in place and the vacuum pump was turned on. The pump was able to draw 17 mm of mercury (mm-Hg), equivalent to 0.43 of a standard atmosphere. (At 20 miles, pressure is down at 0.01 atm.) Once the pump was turned off, our little vacuum chamber kept its vacuum very well.

When the switch on the side of the box was thrown, the squib glowed bright orange, then the Thermolite slowly burned its way along its length. The Thermolite did not spark at all. (Sparks are required to transfer heat to the rocket fuel.) Since this was the first "zeroth" test, we forgot to time it, but we estimated the burn time at 4–5 seconds. A yellowish sooty cloud deposited itself on the glass walls. This gas raised the pressure inside the jar by 2 mm-Hg, but the pressure lowered again as the gas cooled.

We decided to repeat the test at normal atmospheric pressure. We cut a 7-inch length of the new yellow Thermolite and, once the glass jar was wiped clean, repeated the test. Alfred took photographs while Ronnie threw the switch and timed the event. The igniter flashed and Thermolite burned very quickly (in 3.0 sec). It also sparked furiously, leaving black spots on the glass jar (which did wipe off). The burn rate was estimated to be 2.3 in/sec.

Based on these early results, we were starting to get worried. If Thermolite would not burn well at 0.43 atm, would it burn at all at 0.01 atm?

Battery Problems — Again

For our next "real" vacuum test (Test 1), we cut a longer 10-inch strip of Thermolite, and pumped the chamber back down. The squib fired, but the Thermolite did not ignite. We assumed that the squib was not close enough to the Thermolite. We corrected this and tried again; this time the squib failed to ignite. This could have been caused by a short in the wires. After the third failure, we checked the battery.

The voltmeter showed the 9V battery with only 7V (meaning a weak battery). The squib packaging suggested using either a 6V or 12V lantern battery. (Current matters more than voltage for igniters.) Ronnie scavenged his flashlight for a 6V lantern battery which, unfortunately, could not fit into our nice little metal box. We ran the rest of the tests with the side of the box opened. This did not affect the vacuum seal, which depended on the top of the box.

One of the failed squibs was sacrificed to test the new battery, and it promptly went up in a flash of light and smoke. **Lesson learned — have a good strong battery on board to fire the igniter!**

Final Tests Yield Positive Results

A switch to lip gloss (vacuum grease not being at hand) allowed us to raise the vacuum pressure to 17.8 mm-Hg (equivalent to 0.41 atm). Vacuum grease and a flatter O-ring may help the seal, but we believe a stronger vacuum pump is needed to achieve much lower chamber pressures.

The next two tests ran like the clockwork, resulting in burn times of 4.7 and 5.0 seconds, respectively. The average burn rate (for 0.4 atm) was estimated at 2.1 in/sec. This time, the Thermolite sparked almost as furiously as it did in a normal atmosphere. It is possible that the first piece we tested was bad. **Lesson learned — have a good piece of Thermolite in the igniter!**

Next Step — Cold Vacuum Testing

On July 29, Alfred and Ronnie returned to vacuum testing with a stronger vacuum pump and some dry ice. At 3% atm, Thermolite still burns, albeit half as fast (about 1 inch/sec). A full report will be printed in the next SSS issue. ✯

HAL5 CALENDAR OF EVENTS

July 1995

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
16	17	18 **HALO Technical Team Meeting** 11:30a at Ponds	19	20 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	21 **Artemis Conference** Marriott Hotel	22 **Artemis Conference** Marriott Hotel
23 **Artemis Conference** Marriott Hotel	24	25 **HALO Technical Team Meeting** 11:30a at Ponds	26 **No HAL5 Program**	27 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	28	29
30	31	**Project HALO Rocket Motor Test Day & Picnic Saturday, August 12, 1995 at the Pickens Home**				

August 1995

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 **HALO Technical Team Meeting** 11:30a at Ponds	2 **Project HALO Design Review** 7pm at T.Pickens	3 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	4	5
6	7	8 **HALO Technical Team Meeting** 11:30a at Ponds	9	10 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	11	12 **HALO Motor Test and Picnic** 12pm in Gurley
13	14	15 **HALO Technical Team Meeting** 11:30a at Ponds	16	17 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	18	19
20	21	22 **HALO Technical Team Meeting** 11:30a at Ponds	23 **TBD Program** 7pm at Library	24 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	25	26
27	28	29 **HALO Technical Team Meeting** 11:30a at Ponds	30	31 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	1	2

September 1995

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
3	4	5 **HALO Technical Team Meeting** 11:30a at Ponds	6	7 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	8 Inputs to HAL5 newsletter due	9
10	11	12 **HALO Technical Team Meeting** 11:30a at Ponds	13	14 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	15	16
17	18	19 **HALO Technical Team Meeting** 11:30a at Ponds	20	21 **HAL5 Executive Comm. Meeting** 11:30a at Ponds	22	23

SPACE TALES

My 1995 ISDC Vacation

(by Ronnie Lajoie, HAL5 member)

The following is a tale of four HAL5 members who journeyed to the 14th annual International Space Development Conference (ISDC) and returned bearing an award, a new job, some good contacts, and two sheets of paper holding the key to HAL5's future.

At noon on Thursday, May 18, Greg Allison, Ron Creel, and I rented a car and drove 12 hours to the 1995 ISDC, held this year in Cleveland, Ohio. I took the first shift while Greg and Ron calculated mass fractions and balloon lift capacities for Project HALO. Ron took the second shift while Greg studied his Board of Directors (BOD) packet and I inserted HALO photographs into a newly purchased photo album. We made it all the way to Cincinnati before the rain finally caught up with us — and it was a real gully-washer! We stopped for dinner at a Bob Evans restaurant and waited for Mother Nature to calm down.

Greg drove us the rest of the way to Cleveland through a light rain while Ron counted the "hundreds" of trucks on the road. We arrived at the motel (the ISDC hotel was full) at 1am EST and paired off. I joined HAL5 member Peter Ewing, who had driven to Nashville and then flown to Cleveland.

Rockets and Satellites

Friday, May 19. Even though we could have used more sleep, we got up in time to register and attend the morning programming at 9am. On the way to grab a quick to-go Danish breakfast from the hotel, we met Paul and Holly Swift, chairs of the previous year's ISDC. We comrades-in-arms agreed to meet up for lunch. Greg remained with the Swifts while the rest of us attending the session on "Nuclear Propulsion". Stan Borowski of NASA Lewis gave an enthusiastic lecture about a "revolutionary" concept for a LOX-augmented nuclear thermal rocket (LANTR). A LANTR uses a LOX "afterburner" to jack up the thrust of hot hydrogen shot through a nuclear heat source. By throttling the LOX flow, the LANTR can adjust its thrust while letting the NTR part run at a steady optimized output. Plus it can refuel on the moon with lunar oxygen (LUNOX). (See me for copies of his paper.) The gleam in his eye showed that he was not kidding when he discussed the possibility of one-day trips to the Moon — for tourists! Now this is the NASA we always hoped it would be! Way to go Stan!

At 10am, we attending a session on mirrored, optical, "Robotic Telescopes on the Moon", which Ron Creel thought was "lunacy" due to the dust contamination problem. During a break I met Linda Sloan, President of the Experimental Spacecraft Society (ESS), a "cyberspace chapter" consisting mostly of NSS members who "meet" via the Internet. ESS is trying to design, build, and possible launch their own satellite into space. Some ESS members have been a rockoon program, so she invited us to their meeting later that night to discuss Project HALO and to share ideas.

Networking, Part I

Greg never did attend a session; he was "cornered" by various NSS members to discuss Project HALO and other topics. During lunch at a Mexican restaurant, Greg introduced me to several NSS members from our neighboring states of Tennessee and Georgia, including Greg Rucker and the new (or soon to be) NSS Southeast Regional Director, Chuck Schelmm. We discussed having a Southeast Regional Space Development Conference (SDC) and making the *Southeastern Space Supporter* more of the regional newsletter its name implies.

Commercial Space, Part I

After lunch, Ron and I attended the session on "Commercial Space Transportation". Dana Andrews of Boeing gave a very enlightening lecture on what it will really take to make money in space. Essentially, it will take lowering the launch cost to orbit from the current $4000-per-pound to less than $600. The question the aerospace industry is asking is: "If we build it — will they *really* come?" Below $600/lb, new markets might develop, especially, according to Dana, space business parks (commercial spin-offs of Space Station technology) and nuclear waste disposal on the Moon. The space business parks would make most of their money from materials processing, but each park would have a hotel to support "high-end tourism".

Following this X-33-type session was one on "X-34" by my former thesis advisor Antonio Elias, now a vice-president at the Orbital Sciences Corporation (OSC). Obviously, the "Forum on Private Launches" session at 1:30pm (which we missed) stirred up a bees' nest, because it was clear that Antonio was on the defensive, claiming that "X-34" was "just a name". OSC developed a concept for a partially reusable small launcher derived from Pegasus, but determined that they would need R&D financial support from NASA to make the venture worth-while. NASA, as it is prone to do, turn the "support" into a major study and dubbed it "X-34", since it was similar in nature to the larger X-33 effort (and therefore had a better chance of getting approved by Congress). The space activist community is crying "foul" because OSC's concept (the only winner of the X-34 bidding) is not "pushing the envelope" of technology as X-projects are supposed to do. Antonio returned to Virginia that Friday, but the X-34 issue was not resolved.

Space and Tornado Debris

The Friday night ISDC dinner featured United Nations Ambassador Edward Finch, also a member of the NSS Board of Directors. Years of practice and training prevailed; for, even among fellow NSS members, Ed Finch spoke as the monotone, slow/concise speaking Ambassador Finch. If you think your

work group takes a long time to show progress, listen to this. After six months of debate, the UN committee on space finally came to agreement on the definition of "space debris" — albeit in 7 languages. Don't expect UN-sponsored space debris management policy anytime soon!

After dinner, Ron reported he saw a TV report about 50 tornadoes that passed through Tennessee — while we were driving through it! (Fortunately it is a big state.) He also said that one that passed just north of Huntsville. Greg and I immediately dashed to the nearest phones to check on our families and homes. Since my phone machine answered, I knew that I had at least a phone and power — but that was more than Greg could determine. And to make matters worse, he soon learned that the Anderson Hills subdivision was directly in the path — and he lives only a mile away! After some more frantic telephone calls, he learned that his children were okay, but his ex-wife lost her windshield when she drove through a hail storm to get back home.

The HAL5/ESS Alliance

We passed up a John Williams "Space Concert" (sob!) to attend the ESS meeting. The meeting was well worth attending however, because HAL5 formed an alliance with the ESS. The ESS will concentrate its efforts on developing a satellite (currently an orbiting space telescope), while HAL5 will concentrate on developing a low-cost launcher via Project HALO. I spoke at length with ESS member Dennis Thurlow, a handyman on par with our own Tim Pickens. Dennis has built a rocket which he still wants to send into space from a balloon; but unlike Project HALO, Dennis plans on using existing solid rocket motors instead of developing a new propulsion system. Another ESS member, Dean Oberg, showed videos of his experiments with home-made hybrid rockets. This two-man team will give HALO some good competition, and help open the door to cheap-access-to-space.

Commercial Space, Part II

Saturday, May 20. Ron, Peter, and I got some real breakfast at a Bob Evans while Greg rushed off to his all-day BOD meeting. Around 10am, we moseyed over to the "Delta Clipper/X-33" lecture by Bill Gaubatz. He reported that the DC-X has been repaired and is now flying as the new DC-XA. (Will we someday see the DC-XD on *Delta Clipper, The Next Generation*?) He showed videos of the mishap during Flight Test 5 and the latest Flight Test 6. He discussed the new alliance with Boeing, but did not reveal anything because of the X-33 competition.

Ron and Peter remained for the next session on "Space Programs of Russia & China" by Dan Gauther and Dr. Tanya Smirnova, a beautiful Russian lady whom Ron fell in love (or lust) with. I was torn between attending the session on "Space Business Parks" versus the one on "Space Investment". Fortunately, so were both speakers, so they decided to merge their lectures into the same session. Chuck Lauer talked about making space business parks from extra Space Station elements (purchased, of course). He assessed it from the standpoint of a "real-estate venture" and concluded that it could be paid for via 10-year investment funds.

Alex Howerton, self-made investor, then discussed how people "like us" could invest in something like a space business park. He recommended that we save our money, start slow, and "build leverage". Most of us do not have the money required to "play with the big boys". Most new ventures do not go public and sell shares until after they are a success (read OSC's history). Thus us poor space enthusiasts are still more effective as indirect promoters than direct investors when it comes to the big commercial space projects.

Touring Downtown Cleveland

Since Greg did not need our support at the BOD meeting, Ron, Peter and I decided to take a long lunch in downtown Cleveland. After three years of living 6 hours from the beach, I had visions of strolling along a Lake Erie boardwalk and dining on the waterfront, as I had done long ago in Seattle and Boston. Well, Cleveland is no Seattle or Boston! We could not find *one* restaurant within a *mile* of the lake shore, let alone find a boardwalk. All we saw were signs foretelling the "New Cleveland" to come. We settled for an Italian restaurant deep within a mall, which did not even overlook the city. So much for my vision!

Networking, Part II

After we returned from lunch, we separated. Ron went job interviewing, Peter attending some more sessions, and I poked around the art exhibits and vendor tables. I renewed my membership to Spacecause and had a nice long conversion with officer Harry Reed from Tennessee. He said he was also interested in having a Southeast Regional SDC. I then joined ESS member Dennis Thurlow for a respite at Hardees while waiting for the Chapters Assembly meeting to start at 4:30pm. We spoke some more about how to open the space frontier to students and amateur rocket scientists.

Chapters Assembly Meeting

Peter was already present at the meeting when I arrived. I quickly paid our dues and, being a HAL5 officer, took over the reins from Peter. The Chapters Assembly (CA) started out as a "House of Representatives" type body to offset what was seen as the "Senate" type BOD. Most former CA-activists became members of the BOD or otherwise solved their grievances. The Chapters Assembly now serves as a forum for NSS chapters to share their ideas and activities, to discuss what works and what does not. It also assists the Chapters Coordinators in the management of large projects or studies involving many chapters.

Outgoing CA-chair David Anderman heard reports from the existing working groups, then asked for new ones. I

proposed the creation of a "24-hour Space Network Working Group" to get assistance in developing a concept I came up with back in 1993, but have not had time to research further. David agreed on condition that some progress is made by Labor Day. (See me or the HAL5 Web Page for more information.)

One of the more controversial moments of the CA meeting was when David presented slides listing various methods for "helping us get into space" — which he had labeled all failures. The slides included public education, which drew cries from the audience, including from Peter and myself. We argued that educational activities by the former L5 Society, the NSS, and other pro-space organizations have successfully convinced both the public and Congress to accept the idea that space is the next frontier for every person, not just trained astronauts. David agreed that some forms of space education are successful.

The last duties of David was to request a volunteer to be the Chair of the CA for the next two years. Ron, who was standing in the corridor, heard a "pregnant pause" and David woefully mentioned the possibility of dissolving the Assembly. Then I heard the words "I volunteer" and the room broke out in applause. I looked up to see a raised hand — with my arm attached to it! David promptly dubbed me the new Chair of the Chapters Assembly and told me that my primary job was "to make sure we get a room for next year's meeting"! He then pulled me aside to handle some CA business, including choosing the Chapter Activist of the Year. (See the HAL5 Web Page for more information.)

Awards and Speeches

David then told me that I would be presenting the Chapter Activist of the Year Award at the Awards Banquet — which was only an hour away! AH! I quickly ran back to the motel to change for the Banquet and made it back in time to join Greg at one of the tables. (Ron and Peter had decided that the dinner was too pricey for them.) While eating dinner, I sneaked moments to scratch down notes; then, after dessert, left the room to concentrate on writing a short speech. I returned in time to see Greg accepting an award certificate to HAL5 for the great space education programming we hosted in 1994.

My preparation paid off, for the speech was very well received — and I succeeded in totally surprising Greg, who had no idea I was the new CA Chair. Some lighthearted moments occurred when the chosen Chapter Activist, Allen Sherzer, failed to show up to claim his award, and I had to "sweeten the pot" with a $100 check for his home chapter of Ann Arbor. When even that failed, I sat down, only to stand up again when Allen arrived — and I had to do the whole presentation again!

Parties and Mishaps

After the Awards Banquet, everyone retired to party and network some more. I wanted to change first, but Greg stayed, and the others walked back to the motel. I drove the car instead, changed, and went back to party — but I never got past the parking lot. The car would not start! After a half hour of failed attempts, advice and complaints from disturbed neighbors, and a useless examination of the manuals and the car, I gave up and called the local Rental agency. This should not happen to a new car with less than 5000 miles on it! Nothing could be done; I went to bed.

New Car and Friends

The next morning, while I waited for the agency to bring a replacement rental car, Ron and Peter debated over who should wake Greg. When the car arrived, I tried to convince Ron to pretend to Greg that this white car was the same car we always had (the previous one was red). Unfortunately, Peter, who had gone to wake him, had already filled him in on the news.
By now, the car delay had caused us to miss the "Vertical vs. Horizontal" X-33 debate. Instead, we paid our bills, packed up the car, got some breakfast, and headed back to the hotel one last time. Peter caught a hotel shuttle to the Airport, and the rest of us attended more ISDC sessions or networked.

At 11am, I attended the post-debate session sponsored by the NSS SSTO Working Group. When the panel started ragging on NASA MSFC and its ill-fated X-33 report, I had to stand up to its defense. The group accepted my arguments that MSFC had good intentions and did not mean to plug the "wing-body" concept (it was just the first one analyzed); however, they continued to stand by their, and RLV head George Payton's, argument that MSFC has no business in providing industry with any information which could sway their research. (This has MSFC personnel baffled, since they see the X-33 Cooperative Agreement as a cooperative exchange of research data.)

Around 2pm, after some final good-bye discussions with fellow NSS members, Ron, Greg, and I piled into the car. Greg took the first shift in what turned out to be a direct reversal of driving shifts. Conversation focused mainly on assessing what happened at the ISDC; but, after dinner, conversation regressed into dirty jokes and stories. I must say though, that it kept me awake during my long late night shift.

Once in Alabama, however, we no longer needed jokes to keep us awake. All thoughts, and then eyes, turned to the post-tornado holocaust which once was the Anderson Hills subdivision.

Ron and I dropped Greg off at his home one mile north, where we could not see even so much as a blown-down twig in his yard. (His roof was hailed damaged however.) I drove Ron home and returned the car the next day.

Thus ends the tale of my 1994 ISDC vacation. Next year's ISDC is in New York City. Although I had a fun time driving, I think I will fly instead. ✯

Royalty at a HALO Test

(by Ron Creel, HAL5 member)

Yes, we really did have royalty at a recent HALO engine test firing! Ever since I joined HAL5 last summer, I have really enjoyed going to the weekly HALO meetings, making calculations of predicted HALO performance (please get that mass fraction up, gentlemen), and constructing igniters in Tim Pickens' garage (and really enjoying those luscious, thick, and chewy chocolate chip cookies which Mel, Tim's wife, makes).

But the real highlight so far (although the eleven hour fun drive each way to and from beautiful downtown Cleveland for the Space Development Conference runs a close second) was that royal visit out in Gurley.

Now, let me tell you the rest of the story. In between engine firings at the HALO test facility at Mr. Herman Pickens' farm, I had strayed up to the data acquisition center (which also doubles as Herman's mule barn). I was talking/pestering Larry Larsen, who was scratching his head and pursuing an annoying electrical gremlin. As I looked out the viewing port, something swung against my cheek.

I thought it was strange for this thing, which at first seemed to be a rope, to be brushing against me, and I thought "Where did that thing come from?" However, I didn't have any more time to think before Larry saved me by pushing me quickly away. As I'm getting more blind as I get older, and my bifocals don't help, I finally was far enough away from the swinging rope to see that it wasn't a rope after all — it was a royal visitor!

If you haven't guessed already, our royal visitor was what appeared, at first, to be a gigantic "king" snake. Further analysis determined that he/she was only about 4 feet long and was much more concerned about escaping from us amateur rocketeers than in being anything resembling aggressive. As my heart beat and breathing began to return to normal, some of the impatient test engineers down at the firing stand yelled (using our initial communication system, which is much improved now) for us to flip some switch or another and seemed quite oblivious to the life threatening incident we had just endured.

Oh well, I can assure you it was quite exciting at the time. And just another example of the great times we have working on the HALO project. Our alarm was soon forgotten when Chris, Herman's lovely wife, announced that her homemade ice cream was ready to be consumed by the hard working HALO crew.

My advice and invitation to all — come join the fun we are having on the HALO program. And maybe we'll have another visit from royalty.

****

(Internet, continued from page 1)

For the past three months, with Bob's help, I have been getting familiar with cyberspace and setting up the HAL5 Web page. The location of the Web page is as follows:

http://www.cici.com/~hal5/index.html

From this Web page, viewers can get general and specific information on HAL5 and its activities. There are also many links to take viewers to other Web pages associated with other space-related groups, both professional (e.g., NASA) and grass-roots (e.g., NSS).

Ron Creel, HAL5's newly elected Communications Chair, will be taking over management of the account. I will coordinate with him to post on the net back issues of the HAL5 newsletter; and information about the NSS Chapters Assembly, of which I am now Chair.

Use of the CICI account is free to all HAL5 members who need to do HAL5 business. For those members who want access to the Internet for reasons other than HAL5 business, Bob has very generously created special rates for HAL5 members (see sidebar). ✯

Special Offer from CICI

(by Bob Ehresman, CICI President)

Community Internet Connect, Inc. (CICI), host of the HAL5 Web Page, is proud to announce three special rate options for dues paying members of HAL5.

1. **Standard Access** — Unlimited dial-up PPP or SLIP access to the Internet for $25/month or $20/month on a 1 year contract commitment.
2. **Net Shell Access** — Shell access from elsewhere on the Internet for $8/month. Set up your own Web page!
3. **USENET Only Access** — NNTP access to my web server from the Internet address of your choice for $4/month.

For more information, send an E-mail message to Bob Ehresman at "ehresman@cici.com", or call me at home 345-3344, or at work 234-2343. ✯

HAL5 Elections Results

On Wednesday, June 28, an election was held at the HATS Office. A quorum was present. The following slate of nominees was elected:

HAL5 Officers

President — Gregory Allison
Vice-President — Ethan Scarl
Treasurer — Ronnie Lajoie
Secretary — Larry Scarborough

HAL5 Committee Chairs

Communications — Ronald Creel
Membership — Philomena Grodzka
Special Projects — Alfred Wright

Following the elections, while the group feasted on free pizza, Boise Pearson of gave a talk about the Artemis Society. He provided the following article. ✯

MOONBASE ARTEMIS
It's Not Just A Dream Anymore

(by Boise Pearson, District Liaison)

The Artemis Project

The Artemis Project is a privately financed commercial venture whose goals are to build a permanent manned base on the moon, to exploit lunar resources for profit, to demonstrate that human space flight is within the reach of private enterprise, and to bootstrap private industry for human space flight.

Artemis is unique among proposals for developing a moon base because it is a 100% privately financed commercial venture which will place the first element of the lunar base on the moon within the next decade, and because it will show a profit from the first flight to the moon. The project is sponsored by the Lunar Resources Company, a corporation based in Texas.

The Artemis Society

If you're serious about wanting to travel in space, you want to join the Artemis Society. The Society was formed in August 1994 to provide a way for everyone to participate directly in building the lunar base project. Less than 5% of the work needs to be done by rocket scientists, so you can make a significant contribution to your future in space even if you don't have a Ph.D. in astronautics. There are thousands of things you can do to help, so whatever your interests are, the project has a fun way you can contribute your time and talent to making it happen.

Right now the Society is operated as a non-profit service division of the Lunar Resources Company to give the project its common ground for sharing the fun as well as a great deal of volunteer labor and political clout.

For More Information

Send a SASE and $1, to help cover reproduction costs, to:

The Artemis Project
P. O. Box 590213
Houston, TX 77259-0213

On-line communication: The primary public forum for the project is on Genie, page 473, category 28. Our E-mail address is: artemis@LunaCity.com

To join our electronic mailing list, send E-mail to server@LunaCity.com with the body of your message being: join artemis-list. Our Web site is located at: http://www.access.digex.net/~dcarson/artemis.html

For more information, please contact me by phone at 205-881-8406 or by E-mail at: b.pearson1@genie.geis.com

Come help make it happen!!! ☆

****

HAL5 Membership Update

(by Ronnie Lajoie, Treasurer)

The following is a list of additions to the paid membership of HAL5. Membership now stands at **38**, which includes 23 renewals and 15 new members. (At this time last year we had 31 members.) We now stand a good chance of beating last year's record membership of **42** (not 41).

Herman & Chris Pickens (N)
Bentley Frink (N)
Greg Warren (N)
Larry Larsen (R)
William Axenroth (R)
J. Rick Kauffman (N)
Boise Pearson (N)

(N) - New Member
(R) - Renewed Member

Herman and Chris Pickens have generously allowed HAL5 to build the Project HALO rocket motor test facility on their property. Ben Frink was involved in the previous attempt to launch a private rockoon, and will be helping us with launch site planning and logistics. Greg Warren is head of the Student Experiment Payload Program and President of Advanced Concepts, from where we have been purchasing much of our pyrotechnic devices.

Larry Larsen, who joined last year, has been of tremendous value at the HALO test facility, risking his Mac and his video camera to capture quality data during each motor test. Bill Axenroth served as Treasurer during the many years planning and executing the 1993 ISDC. His printing skills helped HAL5 time and time again, allowing the 1993 ISDC, and now Project HALO, to look polished and professional. Rick Kauffman is the regional prefect of the Tripoli Rocket Association. Boise Pearson is chairman of the Board of Directors for the Artemis Society.

Welcome to all our new and renewed members! ☆

Special Announcement

Project HALO — Phase 0 Event

Rocket Motor Test Firing & Picnic

Saturday, August 12, Noon to 5pm

Call Ron at 461-3064 for info

Huntsville Alabama L5 Society
1019-A Old Monrovia Rd, Suite 168
Huntsville, AL 35805

Place
First Class
Stamp
Here