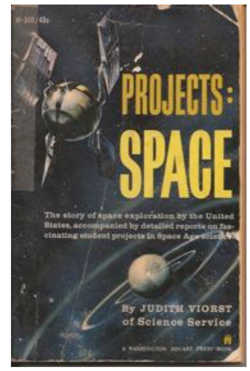
Journal of Space Operations
Vol. XI, No. 2, April—June 2014

Upwards from Downunder: PART III ARMED AND DANGEROUS

B-1 (August, 1966)

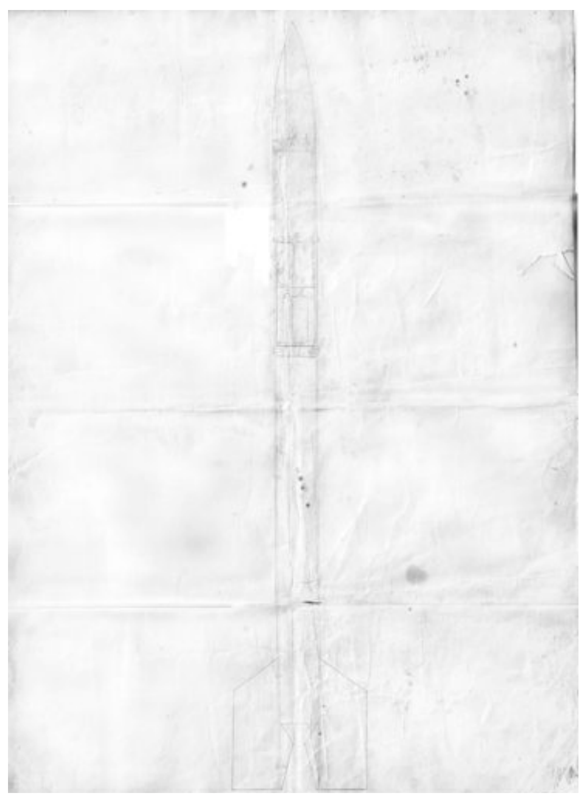
In early 1966 I came across another book which was to prove very influential in the development of the rockets of the B Series. This book was *Projects: Space* by Judith Viorst and published in 1962 by Washington Square Press. It had several chapters that were of interest. One chapter entitled "Rocket Propulsion System" by John S. Arrington, gave theoretical characteristics of micrograin propellant for the theoretically best mixture ratio of 2.04:1 (zinc dust to sulphur by weight). The rocket he built had 1-7/8" inside diameter (combustion chamber) and carried a total 11.58 lb. of micrograin propellant. He calculated a theoretical thrust of 1000 lb., but when he tested the engine it only produced 40 lb. thrust for 3 seconds burning time. In this same book was another chapter entitled "Ignition of Multi-stage Rockets" by Thomas A. Rickard of the Pacific Rocket Society. He used micrograin very successfully with the mixture ratio of 78% zinc dust to 22% sulphur by weight. Since this latter mixture ratio seemed to produce much better results than the theoretically best ratio, we decided to use it in our B-series rockets.



The B-1 was the first rocket of the B Series, the purpose of which was to develop a reliable parachute recovery system. These rockets were larger and more sophisticated than the A Series.

Technical Description

The B-1 was 28 inches long (compared to 17-½ inches for the A-8) and 1-½ inches inside diameter (compared to 1 inch for the A-8). It weighed two pounds empty and carried three pounds of propellant for a total weight of five pounds (½ pound empty, 1 pound propellant, 1-½ pounds total for the A-8). The casing material was steel, had a wall thickness of 0.0625" and was 24.5 inches long. The nose cone was made of cast aluminium and excluding the flange, was 3-½ inches long. A cylindrical cavity was machined from its centre to accommodate a small model rocket motor which was to pull out the parachute at the apex of the rocket's flight. The parachute was made of black plastic and was three feet in diameter. The shroud lines were made of cotton thread, ten being attached. To ignite the



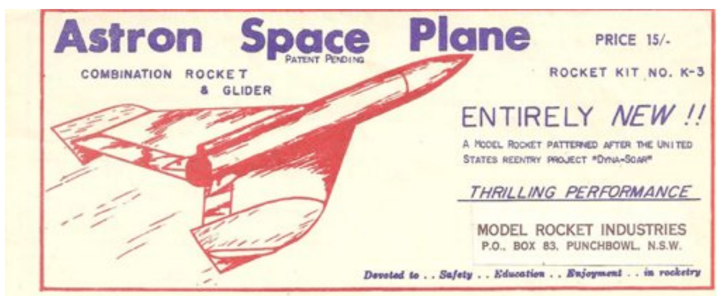
B-1 Construction Plans drawn by Colin Taylor (dirty from using in the workshop)

rocket motor just past the apex of the trajectory, we had a pendulum switch and four penlight batteries attached to a nichrome wire igniter in the rocket motor. The parachute and instrumentation section took about eight inches of the rocket length.

The heat shield was made of aluminium and was 0.375 inches thick. The nozzle was made of steel and was 3" long with a throat diameter of 0.5" and had a convergent angle of 24° and divergent angle of 12°. There were four aluminium fins which measured on the sides 5" x 1.75" x 3.75" x 2.1875" and each was mounted to the body by three metal screws, two of which also secured the nozzle. Two aluminium launch lugs were screwed to the outside of the body. Propellant was again micrograin with the ratio of zinc dust to sulphur 78% to 22% by weight. The propellant section was 12 inches long. The burst diaphragm was 0.002 inch brass shim stock. A nichrome filament wire igniter was used. The shock cord connecting the nose cone to the rocket body was made of tough rubber 36" long by 0.25" wide by 0.0625" thick.

Launch Activities

The B-1 was launched from our new launching range (AMRA Launching Facility Range Number 4) at Ash Island, just across the river from the B.H.P. steelworks. The steel launching rod was 0.5" in diameter and 8 ft. long, and was bolted to a steel base plate. For the Director of Timing and Firing (now Steven Dumpleton), we constructed a small bunker mad of heaped sand with some corrugated iron and some stones.



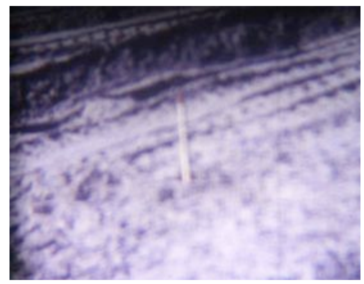
Before we launched the B-1 we decided to launch another model rocket with a biological payload. The rocket was an Estes Astron Space Plane kit that we had bought from Model Rocket Industries in Sydney. The Space Plane was a rocket glider and we were hoping for a good launch, then a gliding flight back to the ground and soft landing. We had a metal rod and stuck it into the ground as a launching pad. Prior to coming to the launch we had problems finding a suitable biological subject small enough to fit into the payload section of the Space Plane. John Masters was our Director of Biological Payloads (DBP) and had the responsibility of finding the subject. In the short time available the only one he could catch was a snail that we subsequently named Hermann the Astrosnail. John placed Hermann in the payload section and then we pushed the rocket down onto the launching rod, which was a bit of a snug fit.

At ignition the Space Plane took off, but took the launching rod with it. It only went about 20 feet into the air, then hit the ground hard with the rocket engine still burning. We raced over and after burnout we opened up the payload section. Inside was a green slime that used to be Hermann the Astrosnail. Since John was the DBP, it was his duty to scrape poor old Hermann out of the rocket. We then buried him nearby with full AMRA military honours. He had given his simple life for the advancement of science (or our craving for excitement??). This was the last biological payload we ever flew.

At ignition of the B-1 there was a mild explosion and swhooshing sound as the rocket soared up. The smoke trail was plainly visible for several hundred feet where it ended.

Up to that point the smoke trail was straight and right on course. A few seconds elapsed and when no parachute appeared we were about to start looking for the rocket when a loud whistling was heard for a few seconds (causing us to duck for cover), then ended abruptly. Although we searched the area thoroughly, we could only find the aluminium nose cone, which had lost its ejection engine. We believed that the pendulum switch worked, but the lines to the parachute broke when the nose cone was blown off by its rocket engine. We estimated that the B-1 went several thousand feet into the air at probably 700 mph. Based on later experiences, I believe this rocket body completely buried itself into the ground, which is why we could not find it (either that or it went into orbit).

B-1: L-R: John Masters, Colin Taylor, Trevor, Leo Pinczewski, Steven Dumpleton, John Farrell



B-1 on launch pad ready for ignition

Trevor's hand and B-1 nose cone as found on ground

Images from 8mm movie film

B-2 (7th December, 1968)

The B-2 was of similar design to that of the B-1. However, we had to completely construct a new rocket since only the nose cone of the B-1 was recovered. However, the nose cone was undamaged and we were able to use it again for the B-2.

Technical Description

An investigation into the failure of the B-1 recovery system revealed several design flaws in the parachute system and its construction materials, although it was assumed that the pendulum switch and ejection rocket functioned correctly. The main reason for the failure was found to be that when the nose cone was blown from the rocket by means of the ejection engine, the cotton thread shroud lines connecting the parachute to the nose cone broke, leaving the parachute in the rocket body. After burnout, the small ejection engine in the nose cone successfully blew itself free of the nose cone as planned by means of a small charge built into the engine. This decreased the weight of the nose cone allowing for a slower descent and landing. Both the nose cone and rocket completed their separate ballistic trajectories, unhindered by the recovery system, and impacted somewhere in the firing range. Only the nose cone was found.

It was also found that the parachute material (plastic) was too weak for the weights and forces involved; the means of connecting the shroud lines to the parachute was inadequate; the shroud lines themselves were far too weak; and an ineffective shock cord system was used. Also, a better protective method should have been used to protect the parachute from the hot exhaust of the ejection rocket.

These findings were taken into account during the design of the B-2, and as a result, a completely new recovery system was designed, which we considered to be more effective.

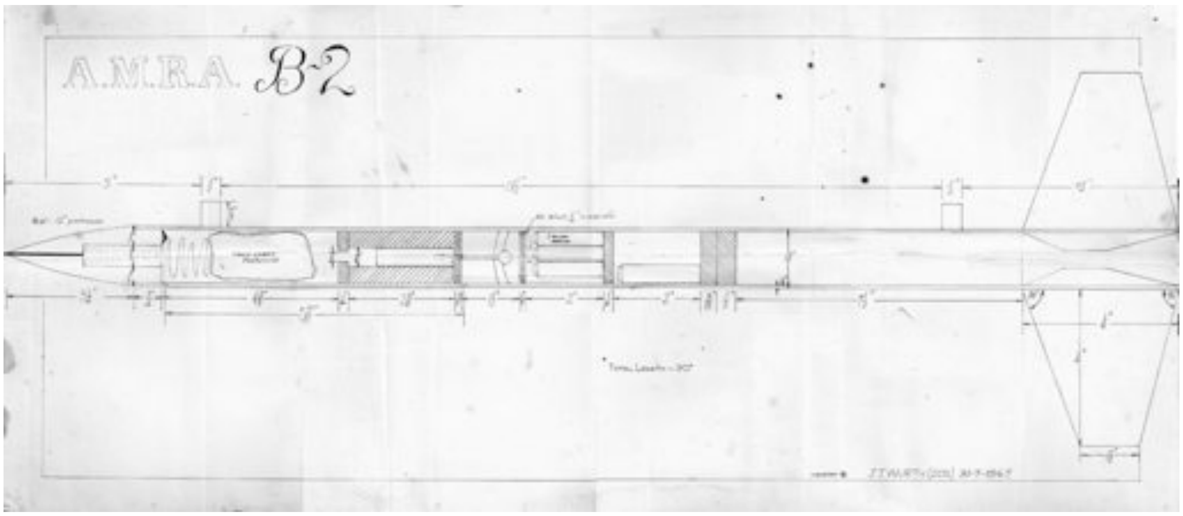
The pendulum switch seemed to work, so we again incorporated it in the B-2, with four penlight batteries being used to fire the separation system. In the B-2, instead of using a pulling ejection system like in the B-1, we used a pushing ejection system instead. This protected the parachute from the ejection engine exhaust gases. In this system, the ejection engine, instead of being in the nose cone and pulling the parachute out, was placed in a wooden piston below the parachute, and at the apex of the trajectory, was to push the nose cone off and parachute out. The parachute shroud lines were connected to the nose cone, which was connected by a strong nylon cord to the piston, which was in turn connected by means of a rubber shock cord to a half-inch thick wooden bulkhead secured in the rocket body by screws.

The pendulum switch was of a similar design to that of the B-1, with only a few constructional differences. The pendulum switch and batteries were constructed in the new module form, allowing ease of construction and mounting. This method was so successful that it was incorporated in all future rockets. The module consisted of three aluminium disks joined by three 0.125” diameter steel rods and spaced about two inches apart, the pendulum switch being in the top compartment and the batteries in the lower compartment. The upper section was enclosed by a sheet of aluminium, which acted as the ring material of the pendulum switch (brass or copper was used in later rockets because they are better conductors). Instead of using a stiff rod for the pendulum as in the B-1, a flexible ball-chain with a heavy brass ball at the end was used. This proved to be more versatile than the older pendulum. When the rocket was ready for assembly, the completed module was then just slipped down the body tube and the arming wires were fed out through a small hole in the rocket body. It was intended to use a small arming staple switch, but the technical difficulties involved were too great to be solved within the time available. The ignition wires from the pendulum switch were fed through the retaining bulkhead to the ejection rocket engine in the piston. Attached to the ends of the ignition wires was a small nichrome ignition filament which was sealed in the end of the ejection rocket engine by melted pitch.

A bungee shock cord system connected the piston to the retaining shield, and the nylon shock cord itself was about two feet long when fully extended. A foot length of nylon shock cord then connected the piston to the nose cone. The strong shroud line threads were also connected to the nose cone. The parachute itself was made of bright red nylon material and was three feet in diameter. The ten shroud lines were sewn to the parachute instead of the tape disks used in the B-1.

The steel nozzle was of the same size and design as that of the B-1 and had an identical burst diaphragm. However, in the B-2 the propellant section (combustion chamber) was only 8.25 inches long compared to the twelve inch section of the B-1. This was to lower the maximum altitude and thus improve the chances of recovery. The same propellant composition was used except that the proportions of the constituent chemicals (zinc dust and sulphur) were measured much more accurately and the resultant propellant was made much finer, giving a more efficient propellant mixture which left practically no residue when burned.

At the top end of the combustion chamber was a half inch thick aluminium heat shield which was secured to the body tube by four long 0.125” self-tapping screws. Above this was a half inch layer of Plaster of Paris, which acted as a sealant and an insulating layer between the heat shield and the batteries in the automated ejection module.



B-2 Construction Plans drawn by John Wurth (DDS) – some details are incorrect, such as the aerial in the nose cone and the length of the nozzle throat caused by incorrectly making the nozzle the length of the fins (it was shorter). Strap-on smoke rockets were added later.

A new fin design was used for the B-2 (and for subsequent rockets in the B Series). Four aluminium trapezoidal fins were made out of aluminium, each measuring 4” x 4.25” x 1.5” x 4” and attached to the rocket body by two self-tapping metal screws, which also served to hold the nozzle in place. The lower launching lug was the same as those on the B-1, but the upper lug was made of sheet steel and welded onto the body because protruding screws would have hindered the ejection piston and possibly snagged the parachute.

A completely new feature incorporated into the design of the B-2 was the use of two cylindrical tubes of smoke powder to aid in the tracking and recovery of the rocket. Each one looked like a typical booster rocket because of the wooden nose cone and was placed against the rocket body at the bottom between the fins. Each was attached with an aluminium clip to the rocket body. The overall length of each of these smoke rockets was 8.5 inches, with the nose cone being three inches long. The inner diameter was 5/8” and at the bottom end was a 0.25” thick wooden plug with a 0.25” hole in the centre. The means of ignition was the same as used for the main rocket, i.e., a nichrome ignition filament placed in the powder and connected to a 12-volt car battery. However, in the smoke rockets the ignition wire was held in place by melted pitch instead of the burst diaphragm as in the main rocket. The smoke powder used was one developed by our own research and consisted of zinc dust, sulphur, charcoal, aluminium dust, potassium nitrate, and fine sawdust. It was intended for these smoke rockets to burn for longer than the duration of the flight. The overall length of the B-2 was 30 inches and the weight was approximately five pounds, of which three pounds was propellant. The B-2 was painted the standard white and red, as were the smoke rockets.

Launch Activities

The B-2 was launched at a new location on Ash Island about a half mile from where the B-1 was launched. We took cover in some large steel drain pipes, except for the Director of Tracking and Recovery (Colin Taylor), who was about 200 yards away in a makeshift shelter to better enable him to follow the flight of the rocket. We also used a set of transceivers (walkie-talkies[1]) to communicate between the firing area and the DTR. They were tested successfully, but a malfunction occurred in one of them, preventing their use during the actual firing of the rocket. For the first time we also used a set of military surplus field telephones. However, they weren't needed since all the AMRA personnel were in the same general area (except for the DTR), but they were tested under actual launching conditions and functioned perfectly, proving their suitability for future launches when they might be useful.

Just before ignition of the main rocket, the two smoke rockets were ignited and went off with a thud and a fairly large cloud of smoke, which unfortunately did not last as long as we expected. This was followed by the firing of the main rocket engine, which resulted in a large explosion and billowing of smoke. We were not sure what had happened at first, but it definitely did not sound like a successful launching. Our fears were confirmed when the smoke cleared and revealed the rocket body still on the launching pad (minus the nose cone) and badly burnt in some areas. We noticed a parachute floating down by itself and quickly retrieved it after it landed. A closer inspection of the rocket showed that the heat shield and everything above it had been blown out (like a mortar), leaving the nozzle as the only component still in the tube. The rocket itself had actually gone about six inches backwards through the 1/16th inch steel plate of the launching pad and into the ground. The fins were badly mangled and sheared off the tube, as were the two smoke rockets, which were relatively undamaged except for their paint. The nozzle was undamaged. I believe we probably set at least an Australian record for the minimum maximum altitude achieved by a rocket (-0.5 ft.)!

After extensive searching of the area all the internal components of the rocket were found. The first object found was the aluminium heat shield, which was the cause of the failure as the screws holding it had been sheared off. The heat shield had then acted as a piston and ejected all the other components to a considerable altitude. The force of the propellant going up through the tube was sufficient for the rocket body to punch a hole through the steel plate despite the thrust coming out through the nozzle and the resistance of the fins and smoke rockets.

[1] These walkie-talkies were a present for my 17th birthday sent to me by Beth in the United States.

B-2 on launching pad – note smoke rockets

B-2 explosion – smoke to the right is from smoke rockets

B-2 after explosion – note recovered parachute in background

B-2 punched through steel pad – note hole in ground to right

Next to be found was the recovery system ejection module. The batteries were undamaged, but the section containing the pendulum switch had been squashed flat. The three steel rods from the module supports then had smashed through the half inch wooden retaining shield and hit the piston, which was relatively undamaged. The rubber part of the bungee cord connecting the piston to the retaining shield was burned through and the nylon cord was singed in places, but was still strong. The parachute shroud lines had all broken about six inches from the nose cone as they had been subjected to large forces during ejection, much greater than predicted to be encountered during a nominal flight. Only one section of the parachute was burned and it was easily repaired. The nose cone itself was undamaged.

B-3 (30th January, 1969)

The B-3 was of similar design to that of the B-2. However, again we had to completely construct a new rocket except for the nozzle and nose cone, which were recovered in relatively good shape from the B-2 wreckage. We used the same basic piston ejection system (which was not tested in the B-2), but allowed a couple more inches of the body tube for containing the ejection module and parachute. The total length of the B-3 was 32 inches compared to 30 inches for the B-2. The length of the combustion chamber was kept at 8.5 inches. The propellant mixture was also unchanged (78% zinc dust to 22% sulphur by weight). We decided that the attached smoke rockets of the B-2 had not performed satisfactorily, so until that problem could be solved, we would not use them again. Thus the B-3 did not have these “boosters”.

We launched the B-3 at the same location on Ash Island as we had the B-2, again using the large pipes with sandbags piled in front, as bunkers. This time the transceivers worked correctly. We slid the rocket down the 8 ft long launch rod and John Farrell, as the Director of Technical Engineering (DTE), who was responsible for the recovery system, armed the rocket’s recovery system prior to the connecting of the ignition wires. At ignition there was the satisfying sound of a successful launch, but because we had shortened the combustion chamber, the smoke trail only went about 50 feet into the air. From about 100 feet altitude we noticed the red parachute, nose cone, and ejection piston coming down, which we quickly retrieved. The DTR observed the descent of the rocket and got a general bearing, which enabled us to find the rocket fairly quickly. When we located the B-3 it was buried in the ground to its fins, and this was despite having a hollow tube several inches in length hit the ground instead of a nose cone. We had a shovel and I dug most of it out, but Leo Pinczewski finished and pulled the rocket out of the ground. The recovery module containing the pendulum switch was again squashed, as it had taken the full force of the ground impact.

We almost had a successful mission. In fact, this was the most successful flight of the entire B Series (there were to be two more launches after this one). Our investigation revealed that almost everything had worked as planned. The pendulum switch closed the circuit when the pendulum touched the ring, which ignited the ejection rocket engine that then propelled the wooden piston up that pushed off the nose cone and ejected the parachute. The problem is that this happened early during the ascent when the velocity was near maximum instead of after the apex of the trajectory. It was determined that the pendulum switch was more sensitive than expected and the lateral motion of the rocket during powered flight cause the pendulum to hit the side and the ejection to take place prematurely. The aerodynamic forces were much too strong for the parachute and shock cords, which snapped immediately upon exposure to the airstream. This didn’t seem to slow down the rocket much and it still had enough velocity and momentum when it hit the ground to bury itself over two feet. It seemed that all that was needed to correct the recovery system failure was to add a resistor of some sort (e.g., filament wire) to the pendulum switch circuit to prevent transitory contacts from firing the ejection system. It would thus take a second or two of sustained contact to pass enough current to ignite the ejection rocket in the piston.

Phil Archer holding the B-3

B-3 on launching pad

John Farrell arming B-3 parachute recovery system

B-3 on launching pad

Successful launch!

B-3 buried to fins

Leo Pinczewski and Trevor

B-4 (11th April, 1969)

Technical Description

Since the B-3 basic structure was relatively undamaged, we reused it for the B-4. This meant that we had to remove the fins, and remove the nozzle with gentle tapping on the body tube to help dislodge it. Using a wire brush we scrubbed out the combustion chamber and removed the residue from the nozzle. We remounted the nozzle on the metal lathe to polish it back up using Emery Paper so that it looked as good as new, except for some shallow scarring near the throat, which we were able to mostly polish out. The fins were cleaned up, and the paint was stripped from the rocket body and fins, then repainted with the AMRA colours, with the addition of two ½ inch red bands around the body, one of which was at the location of the heat shield, and the other at the forward bulkhead. When the paint had dried, the rocket was reassembled (except for the nozzle, which had to be inserted and secured after fuelling). A new brass burst diaphragm was soldered to the top of the nozzle and the two small wires leading to the nichrome filament wire igniter were poked through the nozzle so that several inches protruded from the rear, ready to be connected to the leads from the firing box.

The pendulum switch was damaged, but we were able to salvage most of the parts to make a new one. In attempt to prevent the premature triggering of the recovery system, we added about a one inch length of nichrome resistance wire to the pendulum switch wiring. It now required about a half second of continuous contact to trigger the ejection system, which should eliminate the chance of “rattling” during ascent to trigger the firing. The piston was undamaged except for some scorching from the ejection engine. The nose cone and parachute were undamaged. Once the pendulum switch had been repaired, new batteries were installed in the instrumentation module and the ignition wires from the pendulum switch were passed through two small holes in the retaining bulkhead into the nozzle of the ejection engine, which had been inserted in the wooden piston. The ignition wires were fastened to the model rocket igniter that had been held in place with some melted pitch. The whole assembly was then inserted into the body tube. The arming wires were fed out of a small hole in the side of the rocket and the retaining bulkhead was screwed into the body with several self-tapping metal screws. Before inserting the retaining bulkhead, the rubber shock cord (which was wrapped in aluminium foil to protect it from the ejection rocket exhaust) had been tied between the retaining bulkhead and the piston. On top of the piston in the end of the body tube, we placed the red nylon parachute that was wrapped in its nylon shroud lines. The shroud lines were connected to a screweye on the top end of the piston, while another nylon cord attached the piston to the nose cone.

We decided it was safer to fuel the rocket in our workshop rather than out in the range, so once the rest of it had been assembled, we carefully put the rocket in the bench vise (with padding to protect the paint), and then poured the micrograin propellant into the combustion chamber through a plastic funnel, while using a wooden rod to tap the side of the rocket to settle the powder and make it as compact as possible (we also used the rod for tamping the propellant down). Once we had reached the appropriate level, we carefully inserted the nozzle. To avoid a possible spark that could be caused by scraping a steel nozzle into a steel tube (with disastrous results) we first covered both surfaces with petroleum jelly, which also lubricated the nozzle insertion. Once in place and aligned, we screwed the nozzle and fins in place using metal screws.

Launch Activities

We transported the loaded B-4 out to the Ash Island Launching Range with the engine loaded. After preparing the bunkers (the large industrial steel pipes with sandbags in front of the ends) we set up and tested the equipment (field telephones, transceivers, etc.). The launching pad was assembled and Phillip Archer slid the rocket onto the launching rod. We then set it to the correct launch angle and secured the launching pad base plate with large rocks. John Farrell then armed the ejection system, and I connected the firing wires. Once everyone had taken shelter and everything checked out, we launched the B-4.

Once again there was the whooshing sound and smoke trail of a successful launch. However, this time we did not see a parachute and other objects coming down. We did hear and see the rocket itself rapidly descending on the other side of a large rock pile and heard a crunching sound upon impact. The bad news was that the parachute system didn't work, but the good news was that we quickly found the rocket. It was resting nose first in this large pile of rocks, and apparently had split a rock on impact. The solid aluminium nose cone was mangled, as was the front section of the steel rocket body, which looked like the end of an exploded cigar. Upon examination, it was determined that one of the wires in the ejection system had broken, and this was the cause of the rocket's failure to fire the ejection rocket.

Phil Archer sliding B-4 onto launch rod – Dad is holding it for him

This was the last launch of AMRA in Australia. Because this was our last year of high school and we were all working hard preparing for our Higher School Certificate, along with our other activities (e.g., rock band, surfing, wargaming, etc.), we never found time to start work on the B-5. Since I could not bring a whole rocket with me to America because of the weight, I cut off the rear section of the rocket body containing the nozzle, and brought that along with the mangled nose cone, and the wooden ejection piston with me to America (of course I still have these items).

However, the work of AMRA was not finished. I re-established it in America, and in 1975 we made three more rockets (the B-5, C-1, and GB-1) and launched two of them (we never finished the C-1), but that will be described in the last part of this chapter. The launch of the B-4 was also not the last rocket I made or launched in Australia. However, the other rockets were model rockets that we made at a youth camp in September, 1969.

B-4 post-mortem.
L-R: Leo, Trevor, Phil, Steven,Colin

B-4 in rock pile

Leo showing damage to B-4

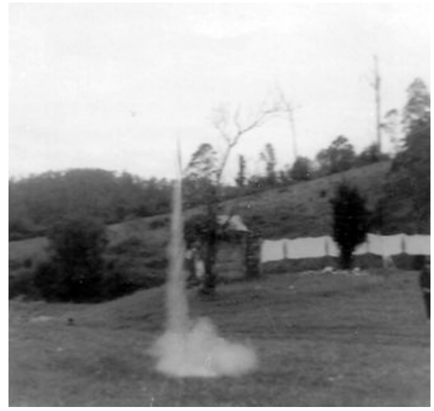
Camp Rockets (1965-1969)

When we in AMRA started making and launching rockets, there were two basic types: *amateur rockets* and *model rockets*. The amateur rockets, the A- and B-Series of which were just described, were made mostly of metal and used a rocket engine that we built ourselves from scratch. Model rockets were made mostly of cardboard and balsa wood and used commercial rocket engines. We used the latter type to learn the basics of rocketry, practice our launching range and launch procedures, and to have fun. They were also cheaper, and much easier and faster to make than our big amateur rockets. After making and launching several of these model rockets, my father realized that making them would be an ideal crafts activity for children and youth at our Church camps, where I was starting to assist my father instead of being just a camper.

Starting in September 1965 I would go to Church Children's Camps which were run by my father and assist him as a member of the staff or as a camper (for the older youth camps). I started by helping to organize recreation. My father was the one who actually suggested that I could teach a rocketry class at these camps, and I agreed to try. The advantages of model rockets as a craft for these week-long camps was that they were very cheap (cost about $2 each), relatively easy and fun to make, very safe, an excellent way to express creativity and artistic expression (in the design of nose cones, fins, and paint jobs), and fit well within a week from start to finish.

Typical camp rocket ready for launch

We decided to let the kids really make them from scratch and the only model rocketry components we bought were the rocket engines and igniters. We used construction paper and white glue for making the body tubes, using different diameter wooden dowels as wrapping aids. We had sheet balsa wood for making fins, blocks of balsa wood for making bulkheads and nose cones, cardboard rings for engine rings, metal screweyes for mounting the parachute shroud lines to the nose cone, rubber bungee cords for the shock cords, sewing thread for the shroud lines, straws for the launch lugs, and cut-up plastic bags for the parachutes. We used facial tissues for the parachute wadding.



Launch at Willow Bend, 1969

On the Monday I would give the class a brief introduction to the theory of rockets, describing how they were built and worked. Monday through Thursday the children made the rockets and finally painted them on Thursday (there were some very creative designs). On Friday, instead of doing recreation in the afternoon, we launched the rockets. Improperly made rockets provided some spectacular failures and flights, but most worked very well. Everyone in the camp (including staff) turned out to watch the launches. The kids had a lot of fun chasing the rockets down and (usually) recovering them. Although we started doing this at Tiona, we also made them at the camps held at Willow Bend near Bowraville on the North Coast.

Kids chasing model rocket descending on parachute (arrow), Willow Bend 1969

Although this concludes the series, Trevor is still writing his memoirs and he has promised us that we can publish the next section describing his exciting rocketry activities while attending university in the United States when it is complete. He promises that it will be equally full of danger, failures, triumphs, and humor as he takes steps closer to becoming an aerospace engineer working in the space field.