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Upwards from Downunder: Part II Learning to Fly

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A-1 (27th February, 1965)

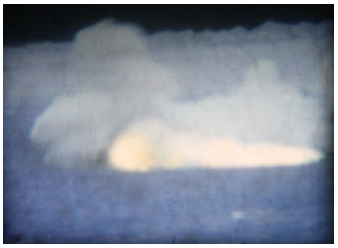
The A-1 was made from aluminium tubing with an inside diameter of one inch and outside diameter of 1.125". It was 15 ½" long with loaded weight of about 1.5 lb (1 lb rocket and 0.5 lb propellant). As stated previously it was designed to gather data on the rocket propellant, engine, and aerodynamic stability. The propellant consisted of zinc dust and sulphur in the ratio of 2:1 by volume. The nozzle and nose cone were made of aluminium and turned on our metal lathe. The four triangular fins were made of aluminium and screwed into the body tube. Four of these screws also held the nozzle in place. There were no launch lugs. The nose cone was attached by screws into the front end of the body tube. The rocket was painted the standard AMRA colours of white body with red fins and nose cone.

We needed a clear area to launch this rocket. My dad thought that an abandoned World War II emergency airfield just off the Pacific Highway north of Raymond Terrace would be suitable. Three of my friends (Phillip Archer, John Farrell, and Jeff Richards) and I took the finished rocket (unfueled) and rode with my father in his car. It took us close to an hour to drive there. We turned off the road and drove the length of the runway to the far end. We decided to use the Astron Scout model rocket to test our launching procedures. At this time we did not know about launch rods and lugs, so we just placed the rocket onto a round tin. We had the igniter hooked up to the car's battery through a firing switch. We were about to learn why model rockets use launch rods. We were standing about 20 or 30 feet away from the rocket. When Phillip Archer (Director of Timing and Firing) pressed the firing button, the rocket ignited, lifted about 6 feet off the ground and then flew parallel to the ground right towards us! We ducked and scattered as the rocket zoomed past us for about 50 feet before hitting a tree, which was undamaged (the rocket was destroyed).

Now it was time for the big rocket, the A-1. We fuelled it by the car by pouring the propellant through

A-1 prep: L-R: John Farrell, Trevor, Phil Archer

The Rocketeers L-R: Trevor, John Farrell, Phil Archer, Jeff Richards



A-1 shooting along ground

John & Trevor stomping out fire (it grew much larger)

Images from 8mm movie film

the nozzle. Passing through the nozzle into the propellant was a nichrome filament wire that was used an igniter (I think we used masking tape to hold it in place and keep the propellant from falling out). We placed the rocket on the twin wooden rails of the launching pad that was described previously. We then ran a pair of wires from the rocket igniter to a firing box and the battery of my dad's car.

Phillip Archer again pressed the firing button after the ten-second countdown. Immediately there was smoke and flame that shot out the end of the rocket, which moved up and down a few inches on the launch pad for several seconds, and then while still burning, fell over to the right and shot along the ground for about 40 feet and set the grass on fire. My friends and I ran over there and started trying to stamp out the fire. Dad recorded all this on movie film, but then realized that we needed help and put down the camera. He grabbed some gunny sacks (sugar bags) that he had in the boot of his car and using those we finally put out the fire after it had burned an area the size of a large room.

We decided not to let a minor set back stop us since the rocket was still in pretty good condition other than badly burned paint. After the rocket had cooled down we cleaned the residue out, then poured in more propellant. Once the igniter had been put in place we put it back on the launching pad. We did the countdown and just as Phil pushed the firing button, two jet fighters (F-86 Sabres?) from the Royal Australian Air Force (RAAF) flew directly over us at about 100 ft. altitude. The reason they were so low is that we were right next to the strafing range for the Williamtown RAAF base and they were on a practice strafing run. Fortunately, the rocket did not launch. If it had been one of our later successful rockets, it quite easily could have brought down one of the jets, especially from that altitude. Phil quipped to my dad, "You know, Mr. Sorensen, if we had shot down one of those jets, I could just see the newspaper headlines: 'SCHOOLBOYS SHOOT DOWN A QUARTER OF AUSTRALIA'S AIR FORCE!'" That might have been a slight exaggeration, but nevertheless I'm glad we had a misfire. In fact, the rocket propellant ignited but burned only very slowly (I think we got the mixture wrong), generating a lot of heat, and causing the rocket to once more fall over, but it did not shoot along the ground. It did, however, burn the paint even more and badly bent the fins.

A-2 (6th May, 1965)

The A-2 was similar in size to the A-1, except the length was increased to 16-1/2 inches. It also was made of aluminium tubing with aluminium fins, nozzle, heat shield, and nose cone. The A-2 also had triangular fins like the A-1. In this rocket we used zinc dust and sulphur in the ration of 1:2 by volume.

This rocket was launched at what was designated as AMRA Launching Facility Range #2, which was an empty field about a quarter mile from Wallsend High School. We hid behind my father's car during the launch. During the construction of the A-2 we forgot to screw the nose cone to the body, therefore at ignition the rocket blew the nose cone up a couple of hundred feet. The rocket was still on the launching pad basically undamaged, except for two fins which were bent when it fell over. The wooden launching pad was destroyed.

A-3 (19th June, 1965)

The A-3 was made from the A-2 with two new fins and a new heat shield. We again used the propellant in the ratio of 1:2 zinc dust to sulphur by volume.

The A-3 was also launched at the Wallsend range. We hid behind an old refrigerator lying on its side that was about 50 feet from the launching pad. At ignition the rocket exploded, sending the nose section more than 100 feet in the air and blasting the rest of the rocket out in the area surrounding the launching pad. Hiding behind the refrigerator, we heard some loud thumping sounds at the time of the explosion. When we emerged from behind the refrigerator, we saw some pieces of rocket shrapnel embedded in the side of the refrigerator facing the pad.

A-3 on pad with refrigerator shelter in background

The nozzle survived, but the rest of the rocket was completely destroyed, as was the launching pad. Most of the parts (pieces) of the rocket were found and the nozzle and nose cone were used in the next rocket (A-4).

A-4 (July, 1965)

The A-4 was the same size as the A-3 with some modifications. It was concluded (incorrectly) that the main reason that the previous rockets did not work was that they did not have a burst diaphragm. The function of the burst diaphragm is to momentarily shut off the combustion chamber from the nozzle at ignition and thereby allowing the pressure in the combustion chamber to build up before the diaphragm ruptures. In the A-4 the burst diaphragm was made of 0.002 inch brass shim stock.[1] The nozzle throat diameter was made larger, a wooden heat shield was used, and the propellant was zinc dust and sulphur in the ratio of 3:1 by weight (which was more accurate and consistent than measuring by volume). To avoid having to make a new wooden launching pad every time due to their continued destruction each launch, we built a new launching pad consisting

[1] In July 1965, in a back issue of *Scientific American* in the Amateur Scientist section I found an article about the activities of a real high school amateur rocketry club that built a series of rockets that they flew at night with a strobe light in a transparent nose cone to help them track the trajectory (on film). They described the burst diaphragm they successfully used, which we adopted as well. This article also gave details concerning the use of a pendulum switch, which we used to trigger the parachute ejection in the B-series rockets.

of a vertical steel rod welded to an iron plate. We screwed round lugs (clips) to the side of the rocket body. The rod slid through these launch lugs.

The A-4 was also launched at Wallsend. At ignition there was a small explosion which destroyed the bottom half of the rocket (except the nozzle) and sent the top half up into the air (again). After this failure it was concluded (correctly) that aluminium was not a suitable material for the rocket body. It was thus decided to use steel tubing in the next rocket.

A-5 (September, 1965)

The A-5[2] was similar in size and outward design to the A-4. The main difference was that we used a steel body tube instead of an aluminium body tube as in the previous rockets. However, there was still a concern about the weight of the rocket, so the steel tube with 1/16 inch thickness walls initially was thinned on my dad's metal lathe.

We screwed in a wooden heat shield that was ½ inch thick. There was a small space between the heat shield and the nose cone. Since we intended to launch the A-5 in the shallow Lake Wallis at Tiona, we drilled several ¼ inch holes in the chamber between the heat shield and the nose cone. In this compartment we packed some potassium permanganate crystals, which we hoped would act like a dye when the rocket hit the water, thus enabling its recovery. As it turns out, we decided to launch the A-5 on Tiona Beach instead of the lake. The propellant used was zinc dust and sulphur in the ratio of 3:1 by weight.

This launching was done as part of a Children's Camp being held at Tiona that week. John Farrell helped me with this launch and also with the model rocketry class I taught at the Children's Camp. The A-5 launch was during the normal recreation period on Friday afternoon when we launched all the rockets that the boys[3] had made. The rockets that the campers built were similar to the Estes Astron Mark, and some flew successfully. We also launched a slightly larger model rocket that had a clear plastic payload section. We thought it would be good to add a payload, and the only thing we could find that would fit in were some jumper ants (which can give you a nasty bite). This flight was also successful and the ants (which we named "Astro Ants") survived, but when we opened up the payload section, they were hopping mad and we left them alone while they escaped.

We finally launched the A-5. At ignition there was an explosion, which sent the top section of the rocket approximately 300 ft. into the air. It landed in shore break of the ocean, and we were able to retrieve it. The bottom section of the rocket was destroyed (except the nozzle which was only slightly burnt). The heat shield had blown out, but the nose cone was still attached to the top section of the rocket.

The cause of the explosion was determined to be due to the metal lathe cutting unevenly when we attempted to thin the body wall thickness, thus creating a weak section in the middle of the rocket.

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[2] Prior to the A-5 the rockets were designated as "X-", so we had X-1, X-2, X-3, X-4. After the X-4 we split the types of rockets into separate series instead of a single series. These first rockets were part of the A Series, so this rocket was the first designated in the new nomenclature: A-5. Retroactively we renamed the earlier rockets.

[3] There were no girls in that particular class, although at other camps we had girls make rockets.

John Farrell preparing a camp rocket for launch on Tiona Beach prior to A-5 launch

A-5 ready for launch on Tiona Beach, 1965

A-5 "launch" (note nose section)

A-6 (November, 1965)

In the A-6 we made a number of improvements. Firstly, the steel body tube was left its original thickness. Next, the aluminium heat shield was secured in the body tube by several long metal screws. A new nozzle and nose cone were also made. The nozzle was made of steel with a slightly larger throat diameter (0.5") than the A-5 and was secured by longer metal screws. The nose cone was made of aluminium with a thicker flange and secured by four long screws. The rocket still had aluminium fins that were attached to the body by screws, but this was the first rocket to have larger four-sided fins rather than the previous triangular fins. To make the rocket stable, a lead weight was placed in the nose cone. The overall length of the rocket was 17 ½ inches with a 1 inch inside diameter and 1.125 inches outside diameter. The propellant was zinc dust and sulphur in the ratio of 1:1.5 by volume (mixing it in the field we did not have a means to weigh the ingredients, so did not mix by weight). The rocket had been painted the standard white and red, but the white paint was not fully dry and some was lost during handling giving the rocket a mottled appearance.

A-6 on launching pad on Lake Wallis, Tiona in Nov. 1965

The steel launching pad (same as for the A-5) was placed on timbers sitting in the shallow water of Lake Wallis (this became AMRA Launching Facility Number 3) with ignition wires leading from the rocket to the firing box and battery on the shore, where we watched the launch from the cover of tree trunks. This was our first successful launching and flight. At ignition there was a whooshing sound and a cloud of smoke over the water surrounding the pad with a smoke trail going straight up to about 50 feet where it stopped. The rocket went far too quickly for any of us to see (much faster than the model rockets we had launched) and none of us saw where it landed. It was estimated that it had gone about 2000 feet in altitude at about 600 mph.

We spent about 90 minutes searching the lake for it, but without success. The A-6 did not have any dye in it to help mark its location. Despite not finding the rocket, AT LAST A SUCCESS!!! We broke out the soft drinks to celebrate our first successful flight.

A-7 (December, 1965)

Building on the success of the A-6, we constructed another rocket in the series, but with some modifications. The A-7 was also made of steel tubing with a steel nozzle,

aluminium nose cone and fins, and a ½ inch thick aluminium heat shield. It had the same dimensions as the A-6, but the main difference was that a small parachute was put in this rocket. It also included a small compartment with holes in the side that contained a dye to colour the water when it landed. There was no ejection system for the parachute. Instead, the nose cone was made to fit loosely in the body tube so that when the rocket reached apogee and tipped over, the nose cone would fall out, pulling the parachute with it (at least that was the theory). Because of time constraints, we did not paint this rocket. Propellant was zinc dust to sulphur 1:1.5 (volume).

The A-7 was launched at the same site as the A-6 (Lake Wallis at Tiona). Ross Johnson was my assistant for this launch. This time we put the launching pad on a box. The launch and flight were successful, although the nose cone was dislodged during ascent and when it separated, took the parachute with it. The nose cone with parachute floated down to the ground, but we failed to find it. We later found the rocket buried almost to its fins in the sandy bottom of the shallow lake in the vicinity of the launching pad. The nozzle was missing (and never found) and the dye had failed to work, but otherwise the rocket was in good condition.

Above:
Ross Johnson & Trevor prepping A-7 at Tiona

Above Right:
A-7 on launch pad

Left:
A-7 retrieval images from 8 mm movie film (Ross in red swimmers and Trevor with camera)

Right:
A-7 body in sandy lake bed minus nozzle

A-8 (January, 1966)

We used the A-7 body for the A-8. A new steel nozzle and aluminium nose cone were made since they had been lost. Otherwise, the rocket structure was the same except that the parachute was replaced by dye in the compartment between the heat shield and the nose cone. Holes were drilled in the compartment for the dye to work. The propellant mixture was also changed, with a ratio of zinc dust to sulphur of 1:1 by volume. We had time to paint this rocket in our standard AMRA colours of white body with red fins and nose cone.

A-8 launch

The A-8 was also launched on Lake Wallis at Tiona. The launching and flight were successful and although we saw the impact splash, the dye again failed to work and we never found the rocket. Based on what we have learned subsequently, I believe that the rocket completely buried itself in the sand on the lake bottom and we would have needed a metal detector to find it. We estimated that the rocket went over 2000 feet altitude at more than 600 mph.

Since the purpose of the A Series was to develop a reliable rocket that flew well, with three successes in a row, we decided it was time to move on to the B Series.

Having barely survived their early attempts in amateur rocketry, Trevor and his friends decide to build on the success of taming their steel rockets so that they actually fly. Now the challenge is to build even larger ones to develop and perfect a recovery system. What they in fact developed were some deadly weapons and in the process established an Australian and possibly world record for the flight of an amateur rocket. However, it is not a record for which they planned or were pleased. Read about it in the next and final installation of this series.