ROCKET MAN

Reminiscences of a career as a real life ***Rocket Man*** spanning over 15 years involved with the British National Space Programme

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Introduction

The recent series “Rocket Man” on television staring Robson Green about a fictitious spaceman evoked memories of my former career as a true *Rocket Man*.

In 1965 following a formal electronic engineering apprenticeship I joined the University of Leicester Space Research Group as a technician to assist the research scientists in their quest to observe cosmic events from outer space.

During the following fifteen years with the Space Group, eventually graduating to Senior Experimental Officer, my role was to act as engineering interpreter to the astrophysicists and participate in the design and build of unique instruments to be carried into space by rockets.

This “work” as it was called provided me with innumerable opportunities and experiences that have influenced and fulfilled my life beyond any expectations that I formed when I began a career in electronics. The background to these experiences can be better appreciated by an insight of the whys and wherefores of scientific research involving the use of rockets

The Science

The Space Group at Leicester was, and still is, primarily concerned with space physics (astrophysics) and in particular with studies of cosmic radiation. During the time of this early research, instruments sensitive to low energy x-rays were deployed to search and identify sources of radiation within our own and from distant galaxies, many light years away.

The strength or energy and intensity of the x-rays provides the astrophysicists with information relating to the source of the radiation regarding the temperature, age, size and many other features that would hitherto be unknown. Such characteristics are similarly applicable to our own sun, which is also a source of x-radiation. This branch of research is part of an ongoing international programme of astrophysics engaged in the investigations into the origins of the universe.

Fortunately for the animal kingdom the earths upper atmosphere absorbs the potentially harmful x-rays such that none can be detected on the ground.

The need for Rockets

With the atmosphere preventing any ground based measurements it became evident in the early 1960s that instruments could be placed outside or above the earth’s atmosphere where x-rays could be detected and measured.

It had been known for sometime that x-rays are emitted from the sun. Higher energy x rays had been observed from high flying balloons. An investigation of x-rays, thought to be reflected by the moons albedo, was then conducted by a primitive instrument launched into space. The results confirmed that not only was the sun a source of both low and high energy x-rays and other radiation but also other sources were seen in the constellations of Scorpios and the Crab Nebula. – A new science was born!

This emerging new science and the US “Man on the Moon” programme being pursued during this time fuelled interest by the British Government to embark on a British National Space Programme under the direction of the Science Research Council with funding support to embryo research groups in Universities throughout the country.

Research groups such as Leicester became recipients of grant funding to pursue space science and were provided with payload space on the recently developed Skylark Sounding Rocket to carry their instruments

above the earth's atmosphere. Essentially this is into space for a short but invaluable time to conduct measurements and identify new and exciting galaxies.

The Team of Scientists

Under the direction of Professor Ken Pounds, a vibrant group of scientist were aided and supported by a team of managers, engineers, technicians, and admin staff and pursued with unrivalled enthusiasm this cutting edge science. At its peak the Group was building and launching five or six rocket payloads per year.

For each "experiment" a senior physicist was appointed to oversee the scientific objectives of the mission, often supervising and aided by a post graduate studying for a Ph.D. The engineering aspects of the "experiment" were similarly provided by a senior engineer, such as me, to work with the scientist and put into practice the aims of the payload.

Following the successful launch and collection of data from the mission, another team of astrophysicists and astronomers deciphered the abundance of data collected during the flight of the "experiment" in space. Such post flight analysis often took months of work and occasionally, years, for the brief few minutes of observation afforded by the rocket whilst above the earths atmosphere.

The Rocket Vehicle

In nearly all cases the Skylark sounding rocket was used for the space vehicle (one or two missions however made use of the American Aerobee or similar type of vehicle.)

The Skylark sounding rocket was originally designed by the Royal Aircraft Establishment for the International Geophysical Year of 1957 during the Russian Sputnik era. Continuous development of this highly successful vehicle continued for the next 50 years with the 441st and last Skylark being launched in April 2005 see:-
http://www.ras.org.uk/index.php?option=com_content&task=view&id=755&Itemid=2

On presentation of a viable scientific proposal to the Science Research Council by the Leicester Space Research Group, payload space was assigned to conduct the experiment. Occasionally two or three different experiments shared the same spacecraft from competing research groups whereby friendly rivalry ensued throughout the preparation. In the early days two identical vehicles were assigned because of the likely event of failure – we were working with cutting edge technology with a high probability of mishap.

Later as the rocket and the experiments' build became more reliable we were assigned just one and more often than not, all to ourselves.

Skylark is a two stage solid propellant vehicle measuring some 18 inches diameter with a solid propellant casing measuring about twelve feet long. The payload section was attached on top of this making use of the nose cone section and a variable section payload bay. The entire length of the motor and payload head was up to about thirty feet. The whole assembly stood on top of a solid propellant booster measuring between 6 and 8 feet long, depending upon the type.

In keeping with the ornithological theme, the main Skylark motor was named Raven of various marques and the boosters Cuckoo or Goldfinch.

Being of solid state propellant the launch of Skylark, once initiated, cannot be stopped. The fuel starts to burn and enormous thrust is produced to take the vehicle away from the launcher and upwards. After about ten seconds the boost motor, spent of fuel, falls to the ground within about half a mile of the launcher. The Raven sustainer motor is automatically ignited to burn for a further sixty or more seconds, propelling the whole rocket through the earth's atmosphere and into the vacuum of space. The altitude achieved varied between about seventy miles and 300 miles dependant upon payload weight. It is interesting to compare the boost motors for the Space Shuttle are similar solid-state technology and once ignited they too cannot be extinguished - in essence they are controlled (sic) bombs.

Guidance whilst passing through the atmosphere is by simple ballistic techniques using three fins fitted at the base of the Raven motor. Once out of the atmosphere these however become ineffective and the whole vehicle can tumble in a random manner. To enhance the ballistic guidance whilst travelling upwards the fins were canted to induce spin stabilisation – just like a throwing dart!

On the more sophisticated experiments the payload head was separated from the motor and both pieces slowly drifted apart, falling to earth together. Similarly the nose cone and a side mounted door were ejected once in space to expose the instruments to the cosmic radiation and gather the relevant data.

As time progressed and the technology developed the payload head was made to point at the sun or the moon or a star by means of an Attitude Control Unit that used high pressure nitrogen jets to control the head in three axes as it sailed through its mission. De-spinning the head before engaging the ACU was simply achieved by releasing two weights tethered by a cord wrapped around the cylindrical payload. This maintained the conservation of momentum by slowing the spin rate down as they were deployed outwards – just like a ballet dancer spreads her arms to slow down when spinning! This method was known as the "Yo-Yo de-spin" because the weights and line resembled a child's yo-yo.

The whole flight time of the rocket lasted between about eight and twelve minutes, dependant upon the altitude achieved. Occasionally a parachute recovery system was fitted (at cost of altitude and observing time) such that the experiment could be recovered and re-used or any photographic film developed. Parachute recovery was at best only about 50% successful.

For further information on Skylark see <http://www.star.le.ac.uk/rockets/skylark.shtml>

The Payload

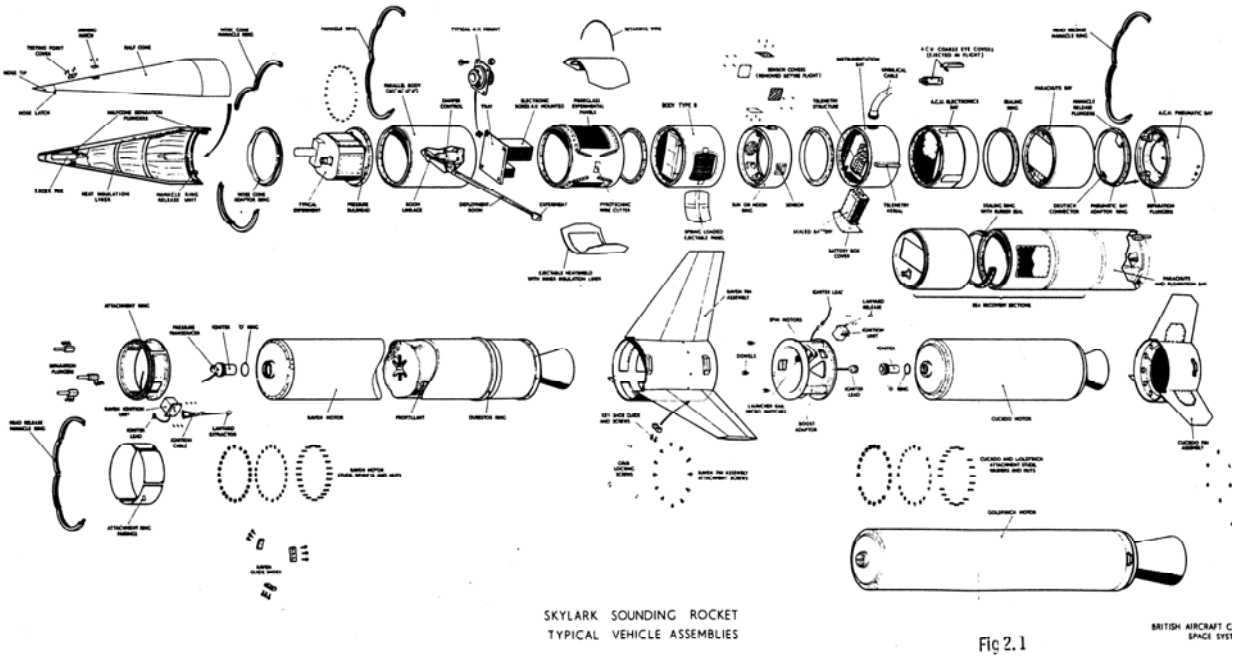
The section on top of the motor is the business part of the rocket where all the vehicle measurement devices, timing and attitude control systems are located together with the experiment instruments and the telemetry system that relays the data to the ground for recording and post flight analysis.

The design of the payload section, known as the "round", consisted of a number of standard length sections (bays) resembling oil drums. Each section was clipped together by a simple attachment device - a manacle ring - such that the round could be separated at any of the sections by simply removing the manacle ring. Typical payloads would consist of maybe six or eight "bay" sections, dependant upon the payload mission. The nose cone space was often used for the experiment and some types of nose cone could be ejected during flight to expose instruments located underneath, enabling observations to be made. Similarly a "type 8 Bay" had a removable door that was ejected during the flight to enable instruments to view sideways.

Power for the whole payload was derived from a couple of 28 volt batteries located in their dedicated bay.

The parachute – if fitted - was located at the base of the round between the instrumentation and the motor attachment section. This was deployed after the experiments had completed their missions and the round had re-entered the atmosphere. Free falling from it's apogee and travelling at supersonic speed, the re-entry into the earth's atmosphere slowed the round down to about 150 MPH causing local heating – just like the space shuttle.

In the parachute bay barometric switches closed at approximately 10,000 feet and the explosive bolts holding the parachute cover released the drogue and a shortly afterwards, the main 'chute to bring the round to earth softly in a safe and controlled manner. If no parachute was deployed the whole round was completely destroyed on impact.



The Experiment

The experiments on Skylark were many and varied and dependant upon the science or engineering being researched. The Leicester experiments began with simple x-ray film exposed when in space, then to primitive x-ray detectors known as “proportional counters”. In the latter period of the rocket missions comprehensive spectrometer instruments and imaging telescopes were flown. Their engineering and scientific complexity was a sight to behold.

My fist missions were centred on an x-ray detector that was flown in 1967. We had two vehicles assigned to us (the days of two for the price of one!) which were launched from Woomera, South Australia. The mission was to expose the x-ray detector during flight on an un-stabilised vehicle. The head was left attached to the motor to provide a larger moment of inertia such that the whole assembly would slowly tumble in space. The random nature of precession would yield a scan of the southern sky whereby any x-ray sources were detected and their characteristics measured. As we did not want the sun to “over-expose” the sensitive detector, the rocket was fired at night so that the only x-ray sources seen were outside of the solar system.

Several new sources were discovered and the experiment was deemed an outstanding success – enough for the Science Research Council to grant us Another pair of rounds to do it all again with bigger and better detectors!

These manifested themselves into two very large detectors, placed back to back in the shape of the nose cone profile. When in space the nose cone was ejected and a similar sky survey conducted to look for weaker x-ray sources. The results gained enhanced the mapping of the southern sky, which hitherto had not been attempted - we were pioneers in the game!

The round was fitted with parachute such that we recovered the instrument, dusted it off and a year later flew it again with even more successful results. The recovery of the payload this time however was not good – it was lost for about eighteen months until a passing recovery Land Rover came across it in the Australian desert. The round is now in The London Science Museum in all its glory, as found, with Australian desert dust and all!

Subsequent experiments became more sophisticated with mechanical scanning mechanisms to enable spectroscopy to be conducted on distant extra-galactic x-ray sources, thereby measuring the x-ray emissions to high resolution.

An experiment to establish the exact location of the x-ray source in the Crab Nebula constellation was derived whereby the instrument was placed in space by Skylark, at precisely the time that the moon occulted the source, thereby acting as a camera shutter. By sophisticated timing measurements the location of the x-ray source could be resolved to much greater accuracy than previously measured. This launch was from the El Arenosillo range in southern Spain. The window of firing was within 6 minutes on particular day in October 1974, the next opportunity being in eleven years time!.

The Crab Nebula Occultation Science team:-
Barry Giles - Post Grad', the Author, Roy Daldorph - Technician, Dr Jeff Hoffman - Astrophysicist.

My final experiment was an x-ray camera to measure in three axes the mapping of an x-ray source. The mission used an inertial attitude control unit - a pioneering development for Skylark - to point the camera at an x-ray star for the duration of the measurements. (It was for the engineering design of this payload experiment that I gained a higher degree in spacecraft instrumentation).

The Design and Build.

The conceptual science of the payload formed part of the presentation to the Science Research Council. Following mission approval by the SRC, Engineers were assigned to the projects and many hours of talks and sketches on backs of envelopes and other media ensued to translate the ideas of the scientists into practical hardware that we could build. Using our rocket "bible" the "*Skylark Users Hand book*" (I still have a copy!) the experiment instrument was designed to embrace and survive the rocket environment during its mission. Using standard features and facilities offered to the experimenter, the electrical and mechanical interfaces were accommodated such that when the integration of the experiment with the host payload occurred it would all work – maybeez!

The data expected to be gathered from the instrument when observing its target, dictated the multiplexing of the telemetry systems and careful design of the data marshalling was necessary.

One instance I remember most vividly was spending a full day with Dr Jeff Hoffman – a future Shuttle Astronaut, in the Charles Wilson building refectory, consuming copious amounts of coffee and wrestling with the telemetry system for a forthcoming round. Subscribing to the power of the subconscious, the

following day I spent ploughing a ten acre field for a farmer friend of mine. Once set up, the relaxing routine of ploughing enabled the design of the telemetry system to mentally flow. By the tenth acre the system was conceptually sorted; sufficient to realise a viable telemetry system for the particular experimental payload.

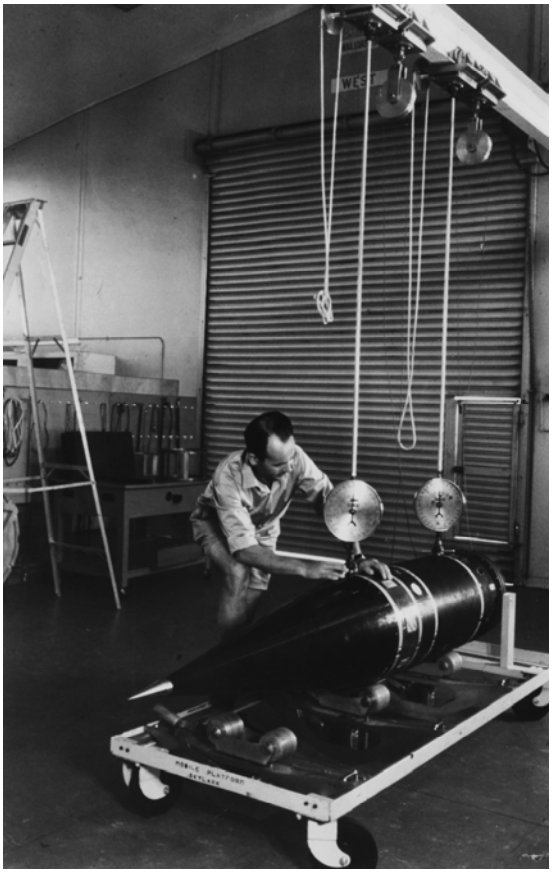
The mechanical aspects of the instrument were superbly designed and built by a team of engineers in the Physics Workshop generally under the guidance of Dave Watson, whilst the electronics and detector design and build progressed in parallel in the Physics Laboratories. Some months (occasionally weeks) later the experimental instrument was assembled and extensive testing was conducted (if we had time!). Building of a prototype was a luxury rarely seen – what we built first, we generally flew.

The Test and integration

As the funding for the experiment was apportioned to the respective parties involved in the build and launch of the rocket, the payload experimenter (Leicester Space Physics Group) could either have the instrument designed and built under contract, or design and build it in house. The latter was of course the more economical solution, not withstanding the fact that the instrument actually evolved as it was being built. Little specification could be supplied in the beginning - particularly off the back of envelopes!

During the build in the Physics department at Leicester the scientific performance was measured relentlessly together with the mechanics and electronics that enable the instrument to perform and radio the data back to the ground in flight.

A timetable for the build, integration, launch preparation and firing phases was agreed at the beginning of the project and in most instances this was adhered to, as best able, considering the innovative nature of the experiment.



Round in preparation with the integrator

When all tests and fine tuning had been completed, or in reality, compliant with the time scale the instruments was delivered to the rocket payload integrator – usually the British Aircraft Corporation, (soon to become British Aerospace) or the European Space Research Organisation (ESRO) now the European Space Agency (ESA).

A team if engineers and payload specialists appointed to the round completed the UK integration of the payload instrumentation to the experiment with representatives from Leicester (me or the scientist) for the duration of the integration phase.

After the integration tests were conducted the contractor was obliged to get signatures from the experimenter that the tests were satisfactory and that the round could be despatched to the launch site – usually Woomera in South Australia. As the “sign off” was somewhat academic - we often rebuilt the experiment after the round had been sent and the real experiment was actually transported in our “Spares” or tool box, which followed later with the personnel! The fun part of the ‘test record’ exercise was that they were signed off mid way between Bristol and Leicester, down the Old Fosse Way, over lunchtime, in an exquisite hostelry at Stow on the Wold…….

The Campaign

Phase 1 - Adelaide

Some weeks after the round had been despatched by air freight to Australia, two or three bods from the Space Group – The Senior Scientist, the post graduate and the Engineer (me) travelled on the Ministry of Defence Charter aircraft form Luton to Adelaide. In the early days we used a Bristol Britannia, four engine turbo prop' which invariably arrived with only three engines running!

As it was an MOD classified charter that travelled every two weeks, for years, between the UK and Australia, the number of passengers was generally no more than twenty, such that first class accommodation in the rear with top secret freight in the forward fuselage was the general arrangement, with a full crew of air hostesses on hand to pander to our needs.

My first trip out took five days landing in Aden, overnight in Colombo, set off from Colombo, turned around with an aircraft malfunction – another night in Colombo, continued the journey to Perth via the Cocos Keeling Islands (an atoll in the Indian Ocean) to refuel and thence to overnight yet again in Perth. The following day the final leg of the journey to Adelaide was to take about five hours. Two hours out I commented to my colleague passenger "Tell me, if Australia is in the southern hemisphere, why is the sun on the starboard side of the aircraft if we are travelling east? At which point a passing hostess was summoned to enquire of the flight crew – sure enough we had another malfunction and were returning to Perth. Most of the passengers by this time were getting irritated because of the delays. Having noticed another Britannia of the same airline, parked on the airfield, I naively suggested to the air crew that they "take the keys" as it was awaiting return to the UK. This aeroplane had just dropped off passengers emigrating to Australia on the £10 migrant scheme running at that time. We finally arrived in Adelaide as "migrants" having usurped the aircraft with our freight and baggage following on a day later!

The "launch campaign" then began. The first few campaigns were in two parts whereby the round was received by the Contractor at the Weapons Research Establishment in Salisbury, north of Adelaide, where all concerned worked on the various parts in preparation for launch.

WRE was a peculiar place that had been jointly established by the UK and Australia in preparation for atom bomb development and tests that first took place in the South Australian desert at Emu Hills and Maralinga. It was during this period that the missile test facility of Woomera was established for joint research and tests on the atom bomb, missiles and armaments during the Cold War. As the "War" thawed Woomera was made available for scientific research, hence our presence.

The WRE Salisbury facility was built similar to Farnborough, Aldermaston and other MOD sites in England from plans sent out from the UK. The buildings were constructed to plan, complete with snow guards on the roof – it never snows in Adelaide and the minimum temperature is never below freezing, but plans are plans!

The few weeks in Salisbury were rarely rushed with work starting around 09.30 and the day finished at 15.30. Transport to and from WRE was by "Commonwealth Car" - a Humber Super Snipe as I recall - with a fully uniformed driver to collect and take us back to our accommodation.

The Establishment

Pastoral care of "Visitors"- us and other MOD staff - was by the British Defence Research and Supply Staff who looked after our needs and arranged accommodation, transport etc., and saw to emergencies if they occurred. BDRSS were there to ensure that all was in order and that we had someone to discuss matters with if there were problems. In charge of the BDRSS office in Australia was the archetypal British Colonial Civil Servant, a wonderful gentleman, one Bruce Gordon who had been posted to this far flung corner of the

Empire. As his stint in the antipodes was to be for several years he had his faithful Rover 80 limousine shipped out. His visits to us experimenters were always fun and well announced by the Rover flying the Union Flag on its radiator cap! As for homesickness or other personal problems – not me, I was having the time of my life!

The few weeks in Adelaide soon passed and eventually the round was road freighted the 300 miles to Woomera for the final phase of the launch preparation.

Phase II - Woomera.

There are many references to Woomera (just type Woomera into Google) and I can only briefly outline this unique place and the atmosphere of a being part of a very British Establishment in a naturally hostile environment.

Developed in the late 1940s the village was originally surveyed by an Australian army surveyor Len Beadell as a living area for people engaged on the atom bomb and missile research and development programmes, jointly funded by the British and Australian Governments.

The name Woomera is derived from the aboriginal word for a "throwing aid" whereby a spear could be given much more impetus by attaching an extension to the end during the throwing action. The additional leverage gave a significant boost to the effectiveness of the spear to go further with more power and kill the prey more effectively. An appropriate name for a place used to launch missiles (spears).

The village is approximately one mile square supplying the needs of the employees and their families living in a desert environment. A Supermarket, Post Office, Police Station, and local shops etc., were established to present as normal a life as possible. The community has its own water supply and sewerage systems where the treated water is used to irrigate the trees, shrubs and plants growing within the confines of the village. This created an oasis like patch in the otherwise arid desert of South Australia.
see <http://www.totaltravel.com.au/guide/local/portaugusta/woomera-village.jpg >

As Woomera was run on semi-military lines there were three Messes (Accommodation, local pubs, clubs etc., for social and professional support) – Junior, Staff and Senior Staff Mess. When the European Launcher Development Organisation moved in during the mid 1960's they built a civilian mess that anyone one could join regardless of rank. This proved very popular, especially as they also built a swimming pool for the inhabitants to relax in during the evenings and at weekends.

Woomera is inside what is known as a "Prohibited Area" – whereby only those authorised by security clearance were allowed to be within. The prohibited area in this part of Australia still exists and covers a huge tract of land north west of the village. Although we were cleared to reside in the Senior Mess, security was ever present. After every meal security staff collected the napkins and burned them just in case any doodles or sketches had been made by the scientists or engineers during the meal. Signs abounded with anecdotal warnings like "idle chatter risks lives" and similar, reminiscent of WW II days.

One particular event relating to security issues happened when Jeff Hoffman, an American, was visiting Woomera. As a non-British Citizen, Jeff had to be escorted everywhere he went when at the Woomera ranges. Even in the Test Shop where he was the project scientist, he had his "shadow" with him at all times which he took all in his stride. During the campaign another Skylark was launched and at such times we all stood outside the test shop and watched the spectacular event – better than any firework display! On this day the countdown went smoothly and the rocket was successfully launched – out of the launcher and into the heavens. Jeff was shouting "Where, where, I can't see it!" at that moment the rocket – now well into the sky popped out of the top of a telegraph pole that was between Jeff and the launcher – hence he did not see the actual lift off!

After a few moments he remarked in his New York drawl "Gee the security here is something else!"

The Launch sites.

The “Ranges” where the actual missiles, rockets, etc were launched from were some twenty or thirty miles away from the village and subject to even tighter security. We were cleared to enter Range “E” thirty miles in a North West direction along a dead straight road that actually looked as it went to infinity. Transport to and from the range head was by “Commonwealth bus” (years later we were provided with a car giving greater independence, which was much exploited). We were not allowed to go to the other ranges unless by prior arrangement.

Range E was a hub of activity where not only the rocket launcher itself was located but all the attendant services for missile and scientific rocket firings that were deployed during the mission.
The explosives store, the assembly shops, the telemetry receivers, the radars and the kine-theodolites used to track the missile during flight, and host of other services.

Range E with the Skylark Launcher, the Test Shops and Lake Koolymilka in the background

The Launch preparation

We were housed in Test Shop 1 – a huge building where several Skylark Rocket payloads could be worked on simultaneously - and often were. Everything but the explosive motors was brought together in the Test Shop which was our home for the duration of the campaign, often lasting six or seven weeks.

The work schedule now took on a totally different ethos. The main reason we were there was to conduct scientific experiments in research of cosmic events. The universe and the rotation of the earth are connected but not to night and day and the normal regime of the human being. It was thus that we adopted our own time frame in which to prepare the experiment in readiness for a launch.
Celestial objects are antisocial in their optimum position! Our working “day” drifted into night whereby we arose from our sleep maybe in the evening , had breakfast at midnight, worked through to lunch at four in the morning and so forth. When we had called a launch slot, every endeavour was made to get the rocket into the launcher at the appointed time and send it on its way.

The Skylark launcher was the largest structure at Range E. Originally made in the UK and shipped out to Australia; it was manufactured from three large Bailey bridge sections formed into triangular shape, such that the rocket travelled upwards through the middle. The complete launcher was some 100 feet high with three tripod type legs – also of Bailey bridge section - that could be manoeuvred to aim the rocket down range and maybe achieve the predicted landing site. The location of the structure was in the middle of the same apron as other missile launchers used for more sinister trials.

Missile recovery

Australia operates a "clean range policy" whereby everything that was sent from any of the ranges was recovered – sooner or later. The actual range from Woomera technically stretches all the way to the Indian Ocean over the Great Western Desert.

As experimenters we had opportunity to go with the recovery crews in their Land Rovers and await the re-entry and landing of the rockets fired from Range E.

The prediction of where the vehicle may land is known as the dispersion circle and is derived from various aspects of the rocket's trajectory and the wind conditions. For skylark the dispersion circle was about 50 miles in diameter and it could land anywhere in this area.
The recovery crew waited at the centre of the dispersion circle and listened for the super-sonic bang of re-entry. With their trained eyes they could spot the round well before us. Once they had a line on where it had landed they drove their Land Rovers in a dead straight line towards it without deviating – bushes and small trees simply did not get in their way - an experience I shall never forget!

Koolymilka

Range E was served by a small village just outside the security gate where personnel dined in a huge canteen each day. Koolymilka was the village named after a "lake" where the buildings were located alongside. It had a canteen, a swimming pool and a small population of locals that would not have been out of place in the Australia's gold rush days – somewhat earthy and belligerent. On one of the campaigns we had the dubious privilege of staying at "Kooly" for a few days during the count down to a firing, to be closer and be more time efficient. The evenings were tempered by the local bar where the inhabitants congregated out of the sweltering heat. The landlord, a genial chap, dealt with the belligerence in his unique way by shooting the beer siphon in the face of the offending drunk!

The adjacent lake was dry for years with no sign of water. We were there just once in the ten years when it rained so hard the lake filled with water overnight. By midday there were fish swimming about in the shallows!

The "Off Duty" periods,

When we were stationed in Adelaide we had all of the trappings of a large city. With Adelaide being on the coast the metropolitan beaches were within a few minutes drive from where we lived. Evenings were often spent during the summer campaigns with barbecues on the beach and with gatherings typical of the younger generation, of which I qualified. At weekends more ambitious journeys were undertaken in an old car we had acquired.

I was also fortunate to have an aunt and her family who had emigrated some ten years previously and lived about thirty miles south of Adelaide. Again weekends in their company and on their beach were often passed in a very happy state.

On the odd occasions that we had long weekends or indeed a whole week off for one reason or another, we ventured even further, down to the Coorong - a large region of coastal lagoons at the mouth of the Murray River, where we spent sometime on a sheep farm, living in the shearer's quarters. On one trip a big end on the car threw some hundred and fifty miles from home. I spent a day under the car in a local vicar's garage, repairing the bearing with lead sheet I had scrounged from a local fisherman' weight box - when the devil drives resourcefulness prevails. The repair got us back home!

When we were at Woomera the desert beckoned and several desert excursions sowed the seeds of future expeditions into little know regions of the world. In latter years I was to embark on trans-Atlantic and Sahara desert crossings, diving for sunken treasure in the Caribbean, searching ancient Spanish Forts in Panama and Mayan settlements on Honduras. Little did I know at the time these small forays into the Australian bush would kindle my interest into the unknown.

The Countdown.

Essentially the countdown started the day we arrived in Australia. It became more meaningful the closer we got to the actually launch day. When we arrived in Woomera it was then becoming serious and all sorts of happenings came to our notice, along with officers and managers whom we had never heard of, wanting to know the ins and outs of what we were actually up to!

We never ceased to be amazed at the huge resources that were called in to play for our launch mission. Literally hundreds of specialists and operators were on duty for the event. From radar operators, film cameramen, telemetry monitors/recorders, range safety officers, canteen chefs and assistants, and many more.

On one particular occasion of a night launch, the whole of launch team were provided with a meal in the Kooly' canteen. My scientist colleague and I debated whether we should both stand up and take a bow to the assembled multitude. It was us that were providing the reasons for their evening's overtime pay!

When the experiment was ready it was handed over to the launch crew to finally assemble the round in preparation to installing it on top of the motors in the launcher. Strict safety procedures were invoked as whilst we were working on the final preparations for the readiness of launch, the motors underneath us were primed and ready for ignition, with only the safety keys removed.

Come the day of the launch, a large count down clock was started in the test shop and in the bunker underneath the launcher where the Officer In Scientific Charge (OISC) and the launch crew were stationed. We, the experimenters, were also stationed there and had the final say whether to proceed with the firing sequence.

The countdown clock showed the time remaining to the instant of firing - an eerie sentinel that we still hear to this day in our subconscious.

The final countdown came about twenty minutes before firing and was a most exciting time. After the last months and perhaps years of building, testing and calibrating the instrument it was finally about to seek its destiny. Up to the moment of launch some communication control of the operation of the payload was provided with commands passed to the instrumentation by a detachable umbilical cord attached to the side of the round. Once the firing sequence had started there was no further control or adjustment.

Count down; the interminable clock counted off the minutes and seconds to the final 2 minutes when all stations involved in the mission had given their go-ahead - only the Range Safety Officer and OISC had the final say in whether to proceed or not, consulting with us all the way to the last second. Up to that time the automatic firing sequence could be halted.

The final ten seconds was every schoolboys imagination of a space rocket countdown – the "tick-tock" box bleeping every second until the final zero – then an almighty bang followed instantly by the roar as the Goldfinch boost motor ignited and propels the 30 foot long, two ton missile through the launcher and upwards. Six seconds later the mighty Raven motor fires up with another enormous roar as it develops enough power to take the whole vehicle away from the Goldfinch and the pull of gravity. The burn lasts for about 150 seconds, sufficient to take it's payload out of the atmosphere and into the vacuum of space.

When the thrust of the burn is completed the whole vehicle is coasting upward towards apogee, during this phase weightlessness occurs and the payload is free to conduct pre- programmed manoeuvres and the experimental observations are carried out for a precious few minutes.
Re-entry into the atmosphere causes drag and buffeting and finally the round falls to earth and perhaps recovered if fitted with a parachute. The Raven motor now spent of fuel and detached from the payload head becomes ballistic and assumes the properties of a dart falling from one hundred and fifty miles. The terminal velocity and re-entry heating is sufficient to peel back the ¼" thick steel propellant casing like a banana until finally crashing to the ground whereupon it is totally destroyed.

Skylark at moment of launch

The Anti Climax

And then it is all over……

The preparations, no matter how long they have taken, have become part of your life and it is impossible to dismiss this fact. My job, apart from some post flight engineering analysis and the usual "ifs" and "buts" and so on was essentially over – until the next time….

The culmination of the many hours of head scratching, midnight oil burning and every aspect imaginable is suddenly gone - "With a Bang". Now what do we do?

BDRSS, bless them, were quietly aware of the huge build up of emotion and the stress that some experimenters and payload engineers encountered whilst on a launch campaign. BDRSS were in the background to provide solace and support where it was needed. Often family men, being away from home for weeks on end encountered domestic problems that could not be assuaged from twelve thousand miles away. Such distractions also contributed to the heat and stress of the moment. BDRSS did its best to alleviate concerns as best they could - they were professionals and we loved them dearly.

I well remember after one firing that the charter aircraft back to the UK was within a couple of days. I however was in no hurry to return, so BDRSS kindly informed the "UK" that a seat on the aircraft was not available and that I would be delayed for another two weeks before returning home – I would simply have to go on R & R and await the next "Charter" - South Australia in the early summer - dear me! They ensured I had transport and that I had sufficient funds and that I kept them informed where I would be, and bingo I was free to go anywhere I wanted. Such was life in the halcyon days of the British Empire…….

Epilogue

Woomera and the British National Space Programme gradually diminished in the late 1970's after the British Government, overnight, withdrew all support of the "Joint" programme leaving the Australians literally holding the baby of the Woomera rocket/missile ranges and all that it involved. The costs were unsustainable and the whole programme ceased.

Today Woomera is a tourist resort, a museum and until recently a holding camp for illegal immigrants.

As may other aspects in life, we were there at the best of times and we feel fortunate to have been part of it all.

Acknowledgements

The following list of colleagues and friends is no means exhaustive but I thank you all for enriching this period of my career. Without the help, intellectual stimulus, friendship and warmth extended in our day to day tasks the enjoyment of our profession would not have been. To this day I am honoured to have many as my friends and also colleagues again in the professional life I now pursue in a space related business. Without doubt however the Skylark days were the time of our lives!

Scientists

Professor Ken Pounds

Dr Brin Cooke
Dr Tony Janes
Dr Jeffery Hoffman
Dr Mark Simms
Dr Barry Giles
Dr David Smith
Dr John Pie
Dr David Adams
Dr Alan Wells
Dr Martin Turner
Dr Richard Griffiths
Dr Kenton Evans
Dr Alan Smith

Technicians/Engineers

David Johnson
John Dowson
Dave Watson
Harold Chapman
John Spragg
John Larard
Tony Keith
Tony Abbey
Arthur Rate
Chris Powney
Tony Howard
Roy Daldorph
Chris Whitford

Roger D Cooper
January 2006

Bibliography

Skylark rocket payloads assigned to the University of Leicester Space Research Group with my personal involvement outlined in red :-

SKYLARK	Experiment	Stabilisation	Year
SL 37	X-ray Camera	Unstabilised	1961
SL 40	X-ray Camera	Unstabilised	1961
SL 42	X-ray Camera	Unstabilised	1961
SL 45	X-ray Camera	Unstabilised	1962
SL 46	X-ray Camera	Unstabilised	1963
SL 47	X-ray Telescope	Unstabilised	1964
SL 83	X-ray Camera	Unstabilised	1961
SL 84	X-ray Spectrometer	Unstabilised	1963
SL 85	X-ray Spectrometer	Unstabilised	1963
SL 103	X-ray Spectrometer	Unstabilised	1963

SL 104	X-ray Spectrometer	Unstabilised	1963
SL 105	X-ray Camera	Unstabilised	1965
SL 106	X-ray Camera	Unstabilised	1965
SL 114	X-ray Spectrometer	Unstabilised	1962
SL 115	X-ray Spectrometer	Unstabilised	1963
SL 118	First X-ray Sky Survey	Unstabilised	1967
SL 119	First X-ray Sky Survey	Unstabilised	1967
SL 126	X-ray Camera	Unstabilised	1963
SL 127	X-ray Camera	Unstabilised	1963
SL 128	X-ray Camera	Unstabilised	1964
SL 129	X-ray Camera	Unstabilised	1964
SL 132	X-ray Camera	Unstabilised	1964
SL 133	X-ray Camera	Unstabilised	1964
SL 138	X-ray Camera	Unstabilised	1964
SL 301	X-ray Spectograph	Sun Pointing	1964
SL 302	X-ray Spectograph	Sun Pointing	1964
SL 303	X-ray Spectograph	Sun Pointing	1965
SL 304	X-ray Bragg Crystal Spectrometer	Sun Pointing	1966
SL 305	X-ray Bragg Crystal Spectrometer	Sun Pointing	1967
SL 306	X-ray Pinhole Camera	Sun Pointing	1965
SL 307	X-ray Pinhole Camera	Sun Pointing	1966
SL 403	Extra Galactic Survey of M87	Moon Pointing	1968
SL 404	X-ray Pinhole Camera	Sun Pointing	1969
SL 405	X-ray Pinhole Camera	Sun Pointing	1966
SL 406	X-ray Pinhole Camera	Sun Pointing	1966
SL 407	X-ray Pinhole Camera	Sun Pointing	1967
SL 408	X-ray Pinhole Camera	Sun Pointing	1968

SL 605	Bragg Crystal Spectrometer	Sun Pointing	1969
SL 723	Large Area Sky Survey	Unstabilised	1968
SL 724	Large Area Sky Survey	Unstabilised	1968
SL 802	Modulation Collimator Detector	Sun Pointing	1970
SL 804	Bragg Crystal Spectrometer	Sun Pointing	1970
SL 812	Survey of Norma X-1 & Cen X-3	Star Pointing	1971
SL 901	Bragg Crystal Spectrometer	Sun & Sco X-1 Pointing	1970
SL 904	Background Survey	Sun Pointing	1970
SL 972	Large Area Sky Survey	Spin Stabilised	1970
SL 1002	Lunar occultation of GX3+1	Sun & Sco X-1 Pointing	1971
SL 1010	Low energy survey	Sun Pointing	1973
SL 1011	Modulation Collimator Cir X-1 & Cen X-3	Star Pointing	1973
SL 1101	Bragg Crystal Spectrometer	Sun Pointing	1971
SL 1105	Low energy mapping of Vela	Magnetic & Moon Pointing	1975
SL 1112	Low energy interstellar gas abundance	Star pointing	1975
SL 1202	Lunar occultation of GX5-1	Sun pointing	1972
SL 1206	Bragg Crystal Spectrometer	Sun pointing	1973
SL 1304	Lunar occultation of Crab Nebula	Sun pointing	1974
SL 1306	Very large area mapping of Cyg X-1	Sun pointing	1976
SL 1611	Dust Halo 2-D imaging (cancelled)	Inertial Platform	1978

ESA PAYLOADS

S26	X-ray Spectroscopy	Unstabilised	1967
S41	Bragg Crystal Spectrometer	Sun pointing	1967
S55	Bragg Crystal Spectrometer	Sun & Sco X-1 pointing	1971
S69	Bragg Crystal Spectrometer	Sun pointing	1970
S89	Bragg Crystal Spectrometer	Sun pointing	1972

ROCKET MAN

Reminiscences of a career as a real life ***Rocket Man*** spanning over 15 years involved with the British National Space Programme

As a Senior Experimental Officer with the University of Leicester Space Research Group, engaged as an engineering interpreter to assist with the aims and objectives of scientists and astronomers by helping with the design and build of scientific rocket payloads.

The culmination of this work was to accompany the rockets to the launch sites in remote parts of the world and fire them into space for a few minutes of glory, during which they searched the heavens in their mission of investigating the cosmos.

Some personal and human recollections whilst engaged with over of a dozen rocket payloads, meeting and working with a future Space Shuttle Astronaut and becoming life long friends with some of the keenest brains in astrophysics in the UK.

The reminiscences cover anecdotal events whilst building the payloads, and recollections of the operations of a long gone era of a former “British Institution” when working in Woomera, South Australia between 1966 and 1978.

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