

## *Retrieving Woomera's heritage: recovering lost examples of the material culture of Australian space activities*

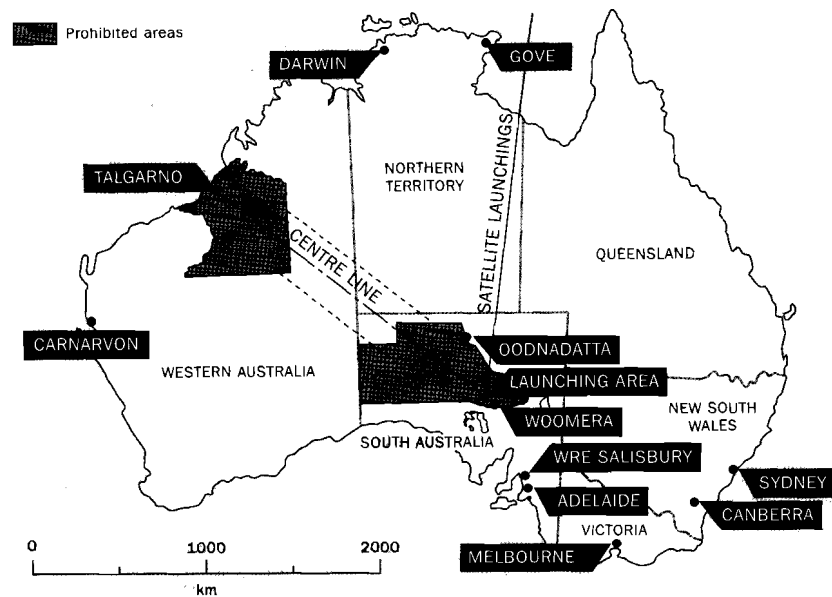
### **Introduction**

Woomera Rocket Range. Once it was a name to conjure with, carrying all the mystique of Cold War secrecy coupled with the excitement of space exploration. Yet today, the site where Australia joined the 'space club', where both Britain and Europe made their first attempts at developing an independent launch capability, is largely abandoned and virtually forgotten by younger generations of Australians, who associate Woomera only with a controversial US military tracking station<sup>1</sup> and, most recently, an equally controversial detention centre for illegal immigrants.<sup>2</sup>

Established in 1947 as the long-range weapons test facility of the Anglo-Australian Joint Project, Woomera was born out of Britain's Cold War desire to develop its own missile systems and nuclear deterrent. Unable to test such weapons adequately within the narrow confines of the United Kingdom and its surrounding waters, Britain sought a secure test range within the Commonwealth and ultimately selected a location in the remote outback of South Australia which offered huge tracts of virtually uninhabited desert over which to fly missiles, drop bombs and, later (though this was not immediately in the minds of the initial developers), launch rockets into space. Woomera, at its greatest extent, was the largest overland weapons test range in the Western world, and – at one point – the busiest. Over the lifetime of the Joint Project (1947–80)<sup>3</sup> more than 4000 British, European, American and Australian missiles and rockets and 3000 bombs and other weapons<sup>4</sup> were launched and tested there, for both military and civilian purposes (Figure 1).

Space-related activities carried out at Woomera during the Joint Project included sounding-rocket programmes (British, Australian and some European projects in the 1970s), the European Launcher Development Organisation's (ELDO) Europa launch-vehicle programme,<sup>5</sup> Britain's Black Arrow<sup>6</sup> independent satellite launcher project and the Wresat project, which enabled Australia to become the fourth nation to launch its own satellite.

Figure 1 Map of Australia, showing the location of the Woomera Prohibited Area, Woomera township and the launch area (actually several different launch sites spread around the Rangehead area). The downrange track used by Wresat and for the ELDO launches is also shown. (Redrawn from diagram supplied by DSTO/Australian Government Department of Defence)



### The material culture of space activities in Australia

In its broadest definition, material culture encompasses everything that can be seen, handled and used by human beings in the course of their lives. Every human activity generates artefacts of material culture and the exploration and exploitation of space are no exceptions: the 'material culture of space' includes all the hardware created to achieve access to space (launch vehicles) and do something useful once there (satellites, spacecraft, spacesuits, etc. and their subsystems and ground-based segments) and all the facilities created to design, build, test, launch and retrieve that hardware.

It might be assumed, therefore, that with the high level of activity at the Woomera Rocket Range during its heyday, and with the Range's reputation for being 'the best in the world',<sup>7</sup> a significant amount of material culture relating to these activities would remain in Australia. However, despite more than 30 years of missile and rocket tests and launches at Woomera during the Joint Project, very little of the material heritage of these programmes survives in the country today. Much of the physical plant on the Woomera Range – the launch sites, test facilities, workshops and staff amenities – has been lost: demolished, sold for scrap, abandoned to deteriorate, or used for demolition and target practice by the armed forces. Although other facilities relating to the activities at Woomera have survived in better condition (albeit with a change of role or focus),<sup>8</sup> since the end of the 1970s the Range itself has progressively lost more and more of its 'value' as the key site in the material culture of space activities in Australia.<sup>9</sup>

Similarly, because the majority of the hardware used at Woomera was manufactured in the UK (and Europe in the case of ELDO) and shipped to Australia for final testing and launch, the quantity of artefacts that has survived here is very low compared to the level of activity at the Range. When any particular programme was cancelled or wound down, hardware shipment to Australia would cease, the remaining stock at Woomera would usually be fired off in final tests and any surplus hardware would be retained by the manufacturer back in Britain. When the Joint Project was itself winding down, contractor subsidiaries in Australia also repatriated or scrapped most remaining stocks of material in this country. As a consequence of these practices, apart from the remains of spent rocket casings and failed firings littering the desert, very few examples of space-related hardware remained in Australia to find their way into museums, there to provide a tangible reminder to the community of this country's involvement in space projects.<sup>10</sup>

In the dying years of the Joint Project (the late 1970s), the Weapons Research Establishment (WRE), the agency of the Australian Department of Supply that managed Woomera on behalf of the Joint Project, began to amass a 'heritage collection' of rocket and missile hardware and other artefacts relating to programmes at Woomera, though there does not appear to have been any deliberate and consistent collection policy applied to the creation of this collection. It was, rather, a somewhat eclectic mixture of original artefacts (some never flown and some recovered or salvaged from the Woomera Range) and models or replicas originally created for public-relations purposes by the Weapons Research Establishment, the Department of Supply and the Department of Defence.

During this same period, the Woomera Board, responsible for the management of the township of Woomera (as distinct from the Rocket Range), decided to establish a community museum, to keep alive the memory of the rocket and missile activities undertaken on the Range. Locally funded and operated by volunteers, the Woomera Heritage Centre was established in a prominent part of the ever-diminishing township, close to the shopping centre and town facilities.<sup>11</sup> It was hoped that it would attract the tourists who, it was envisaged, would be curious enough to visit the town once it became an open facility, when security restrictions were relaxed as the Joint Project wound down to its close.<sup>12</sup>

A significant proportion of the WRE 'heritage collection' was made available to the Woomera Heritage Centre for display, becoming the nucleus of what is now the most significant collection of artefacts related to the history of long-range weapons development and space activities in Australia.<sup>13</sup> In addition to the WRE material, the Woomera Heritage Centre has acquired, by loan or donation, material from other sectors of the Defence Department and other government

agencies that have had association with Woomera, and from private individuals who lived and worked in the township and on the Range. The museum's collection thus encompasses material relating both to the technical and social history of the Range and township.<sup>14</sup>

In addition to the establishment of the Heritage Centre itself, the community volunteers, with the aid of the Lions Club service association, also created an outdoor 'Rocket and Missile Park', directly in front of the museum, to display examples of missile and rocket hardware too large to be contained inside the building. The artefacts on display in this park are a mixture of genuinely original hardware and 'recreated' items composed of amalgams of 'spare parts', material recovered from the Range and repaired/restored for display, and replica sections, included where necessary to provide a visually complete exterior finish for the object. The examples of space material on display in the Rocket Park fall into this latter category. Launch vehicles represented in the park include a variety of sounding rockets, a Black Knight rocket and a Black Arrow satellite launcher. None are entirely composed of authentic, original components, and, while visually complete, none contain their full internal fit-out with tankage and motors (Colour plate 6).

Like many local history museums in Australia run by volunteer staff, the Woomera Heritage Centre, until very recently, lacked the input of museum professionals or historians into the development of its collections and displays.<sup>15</sup> Its collection policy was, essentially, to acquire whatever Woomera-related material was offered to it; its display policy was to get as much of its holdings as possible 'on the floor' to present the many varied aspects of Woomera's history to visitors. Its approach to the interpretation of the collections was celebratory and nostalgic, reflecting the attitudes and feelings of the Woomera residents and former Range personnel who made up the Heritage Centre's staff, while issues of artefact integrity (i.e. maintaining the originality of an object) were superseded by the desire to present an externally complete, visually correct re-creation of major artefacts.

These comments are not meant to denigrate the work that the Heritage Centre's volunteer staff have undertaken; despite the limitations of their own experience and the constraints of budget and staff availability, they have brought passion and enthusiasm to their self-appointed task of preserving and presenting an important, and now frequently-overlooked, aspect of Australia's scientific and technological history. The strength of that desire to preserve the material culture of a past undertaking with which they had been associated, and for which they felt a strong personal affinity, would eventually motivate a major project to return to Woomera some of the most significant examples available of the material culture of its past activities.

Until the 1990s, conspicuous by its absence in the Woomera Rocket Park was any representation of examples of the Europa launcher, the

largest rocket launched at Woomera, and the Wresat Redstone, which was responsible for launching Australia's first satellite. This, however, would soon change with the inception of the Rocket Retrieval Group at Woomera and its space heritage recovery projects.

### The Wresat Redstone recovery

Australia's first satellite, Wresat (Weapons Research Establishment Satellite) was launched from the Woomera Rocket Range on 29 November 1967 (Figure 2). Developed by the WRE and the University of Adelaide as a successor to the Australian upper-atmospheric sounding-rocket programmes previously conducted at Woomera, Wresat was considered a remarkable achievement in its day, having been designed, built and launched in less than a year.<sup>16</sup> Its success enabled Australia to claim entry into the so-called 'space club' as only the fourth country to launch its own satellite.<sup>17</sup> The first stage of the launch vehicle was a Redstone rocket, the last of a batch that had originally been brought to Australia as part of the US Army's Sparta Project.<sup>18</sup> Following the launch, this Redstone stage fell into the northern part of the Simpson Desert, one of central Australia's major sandy deserts that even today is largely unexplored and difficult to traverse. There being no reason to retrieve the 'tried and true' Redstone for study after the launch, the discarded rocket was left where it fell. Wresat itself re-entered the atmosphere and disintegrated after successfully operating for about two months.

However, in 1989, Australian entrepreneur and adventurer Dick Smith, inspired by an article on the history of the Woomera Range, recognised the significance of the Wresat launcher in Australia's technological history and became determined to locate its remains.<sup>19</sup> As there had been no imperative to recover and/or examine the Wresat first stage after launch, its impact site had never been accurately determined. However, at Smith's initiative, the Defence Science & Technology Organisation (DSTO, the successor to the Weapons Research Establishment) allowed the Range Safety Officer from its Ranges Measurements Branch, Bruce Henderson, to undertake the determination of the probable location of the rocket's remains. Using original data from the Woomera Range's instrumentation records of the flight (such as telemetry, optical tracking records and radar data),<sup>20</sup> Henderson established a predicted impact location that was, within an error range of 8 km, 623 km north of Woomera and 255 km west of the outback Queensland town of Birdsville.

In August 1989, using these data, Smith established a base at Oodnadatta, on the southwest corner of the Simpson Desert: at approximately 250 km from the predicted impact site, it was an ideal location from which to begin the search for the Wresat Redstone. Smith was an experienced helicopter pilot<sup>21</sup> and used his own craft in the search, although fuel supply limitations contributed to an



*Figure 2 Launch of Wresat, Australia's first satellite. The launch vehicle comprised a Redstone rocket first stage with two small solid-propellant upper stages. The Wresat logo depicts a kangaroo over a woomera (throwing stick) and spear. (DSTO/Australian Government Department of Defence)*

unsuccessful initial attempt. After a re-examination of the available data, DSTO's Bruce Henderson produced a revised estimate of the impact location, making allowances for wind drift and atmospheric drag on re-entry. This identified a search area of about 85 km<sup>2</sup>.

To avoid a repeat of his fuel supply problems, Smith arranged for a fuel dump to be established at Peoppel Corner (the intersection of the Northern Territory, Queensland and South Australian borders), and then commenced a second search from Oodnadatta in early October 1989. This time the search proved immediately successful and the remains of the Wresat Redstone were located and identified. They were found approximately 10 km from the revised probable impact site.

Broken into three segments, but still largely intact, the Redstone was partly concealed by a large bush that had grown up through the remains. Although painted a brilliant white at launch, to facilitate optical tracking against the blue desert sky, the rocket's outer coating had weathered away in the Simpson Desert's harsh environment, revealing the Redstone's original American khaki livery, the words 'US Army' visible on its side. This green colouring blended with the vegetation cover (low scrub and spinifex) common in this part of the Simpson, making the rocket hard to distinguish (Colour plate 7).

Although, as discussed above, the most significant collection of surviving artefacts relating to space activities in Australia is that held by the Woomera Heritage Centre, that collection contained no original artefacts relating to Australia's first satellite.<sup>22</sup> While Dick Smith himself had been content simply to locate the Redstone's remains, in the weeks following his discovery discussions began at Woomera among a group of (mostly local) heritage-minded volunteers on the feasibility of recovering the Redstone rocket for inclusion in the Woomera Rocket and Missile Park. It was felt that retrieving the Redstone and returning it to Woomera would enable a much larger section of the Australian community to have access to the physical remains of an important milestone in Australia's scientific and technical history, than if the rediscovered rocket stage remained in its remote desert location. As a result of these discussions, the Redstone Rocket Retrieval Group was formed and set about planning for the recovery of the rocket.<sup>23</sup>

Plans were laid to mount a recovery expedition in April 1990, six months after the rocket was located. Travel in the extreme environment of the Australian deserts is never to be taken lightly and this was the first available 'safe' period for crossing the Simpson Desert, where summer temperatures (November–March) can rise to 60 °C. Consequently, excursions into the Simpson are normally undertaken in the winter period, between the months of April and October, but even during the cooler months, the harsh environment and difficult terrain make meticulous advance planning a necessity. Access and departure routes to the rocket impact site had to be



carefully planned, as the sand dunes in the region could only be crossed from east to west and were difficult to negotiate, being on average 18 m high and between 150 and 600 m apart (Figure 3).

Owing to the remoteness of the impact site, everything needed by the Retrieval Group volunteers – food, water, shelter and equipment – had to be carried by the expedition, requiring careful logistical planning. Supplies were needed for a 2800 km, 14-day round trip: although fresh food would last for the first half of the journey, Army ration packs were needed to provide the meals thereafter, while 2400 litres of drinking water had to be carried, and 5000 litres of diesel fuel and 8600 litres of petrol were needed for the vehicles. In anticipation of mechanical breakdowns, 600 kg of spare parts were also carried, particularly for the trucks. When the rigours of traversing the dunes caused the loss of a clutch plate on one of the expedition trucks, the team was able to remove and refit the gearbox and transmission and repair the clutch assembly in six hours, aided by cranes fitted to one of the recovery vehicles. Despite all the preparations that were undertaken, the difficult conditions meant that at least two days of the recovery journey would see only 4 km of travel.

In the event of a medical emergency, evacuation procedures were established with the Royal Flying Doctor Service and the Australian Army. The South Australian Police were also advised of the recovery exercise.<sup>24</sup> Because much of the Simpson Desert is designated as National Park or Reserve, permits to enter the region had to be

*Figure 3 Traversing a sand dune in the Simpson Desert during the Wresat recovery expedition. Difficult terrain and harsh desert conditions made the rocket retrieval operation potentially hazardous, requiring careful advance planning. (Bruce Henderson)*

obtained from the National Parks and Wildlife Service, which required the expedition to comply with regulations regarding the disposal of refuse while en route, travelling on unstable sand dunes and possible damage to sensitive vegetation. As much of the route to and from the impact site was rarely visited, the recovery team was also asked to carry out plant-identification tasks for various research groups, including the photography of examples of fauna and flora.

Accurate navigation was critical, but was accomplished mainly by hand-held compasses and odometer readings, due to the poor Southern Hemisphere coverage by navigation satellites at the time. Satellite navigation systems could, at best, only provide a position check, and although the expedition carried both Navstar and GPS receivers, the former required up to an hour to determine position fixes, while the latter frequently need to acquire fixes in the early hours of the morning.

As the Woomera Heritage Centre lacked any funds to support the recovery exercise, sponsorship funding was sought and approximately 40 major companies ultimately donated funds to the amount of Aus\$28,000, in addition to in-kind sponsorships covering fuel, lubricants, food, drinks, etc. The largest single donation was \$12,000 from the TRW Corporation, the original builders of the Redstone rocket.<sup>25</sup> A cook, camping equipment and a professional photographer to document the expedition were provided by the Australian Army, while Australia's national telecommunications carrier, Telecom Australia,<sup>26</sup> provided an Iterra mobile satellite ground station, allowing access to telephone, fax and television services that was otherwise unavailable in such a remote region. The Retrieval Group members themselves gave their time to the recovery expedition and its planning on a voluntary basis.

The recovery team would eventually consist of 22 people with 11 light four-wheel-drive vehicles, four International six-wheel-drive trucks and one six-wheel-drive heavy recovery vehicle, towing a Redstone transport trailer. This trailer, part of the original equipment used to transport the Project Sparta Redstone rockets from the US to Australia, had been fortuitously located in storage at Woomera.

The recovery expedition departed on 12 April 1990, taking seven days to reach the impact site. The Redstone was loaded onto the trucks the following day. Although the recovery exercise and the impact area were photographically documented, no provision had been made to perform any sort of archaeological survey and recording of the site, prior to the rocket's removal. However, a stainless-steel plaque engraved with the history of the flight and recovery details was left at the site to mark the impact location.

The return journey to Woomera commenced on the ninth day of the expedition. With the experience gained on the outward leg of the trip, the return journey progressed more smoothly, allowing the Retrieval



Group expedition to arrive back in Woomera on the evening of 26 April. The recovery of the Wresat Redstone attracted considerable media interest, both locally and nationally, although the tenor of the coverage tended to focus more on the adventure of the recovery than the heritage significance of the artefact itself.

Following its retrieval, a decision had to be taken as to how the Redstone should best be displayed, in order to maximise its potential for educational and tourism purposes. Recognising that its interest value to visitors depended as much upon its mystique of having been recovered from a fairly inaccessible part of the desert, as from its association with the Wresat project, it was decided to display the rocket in a re-creation of its impact site. Because there was little space available for such a re-creation at the original Missile Park, a new 'adjunct' Rocket Park was established literally across the road, on a cleared site beside the Woomera School. Here, the Wresat Redstone became the first exhibit of a new display area that has grown considerably over the past decade. The recovered pieces of the Redstone were laid out on a bed of desert sand in the same configuration as they were found in the desert, complete with a bush growing through the centre of the debris field, just as had occurred at the original impact site. To prevent small pieces being 'souvenired' by visitors, the entire display was surrounded by a vandal-proof enclosure (Figure 4).

*Figure 4 The recovered Redstone rocket on display inside its enclosure in the Woomera township. The presentation sought to re-create the rocket's original Simpson Desert location, complete with a bush growing through the remains. (Kerrie Dougherty)*



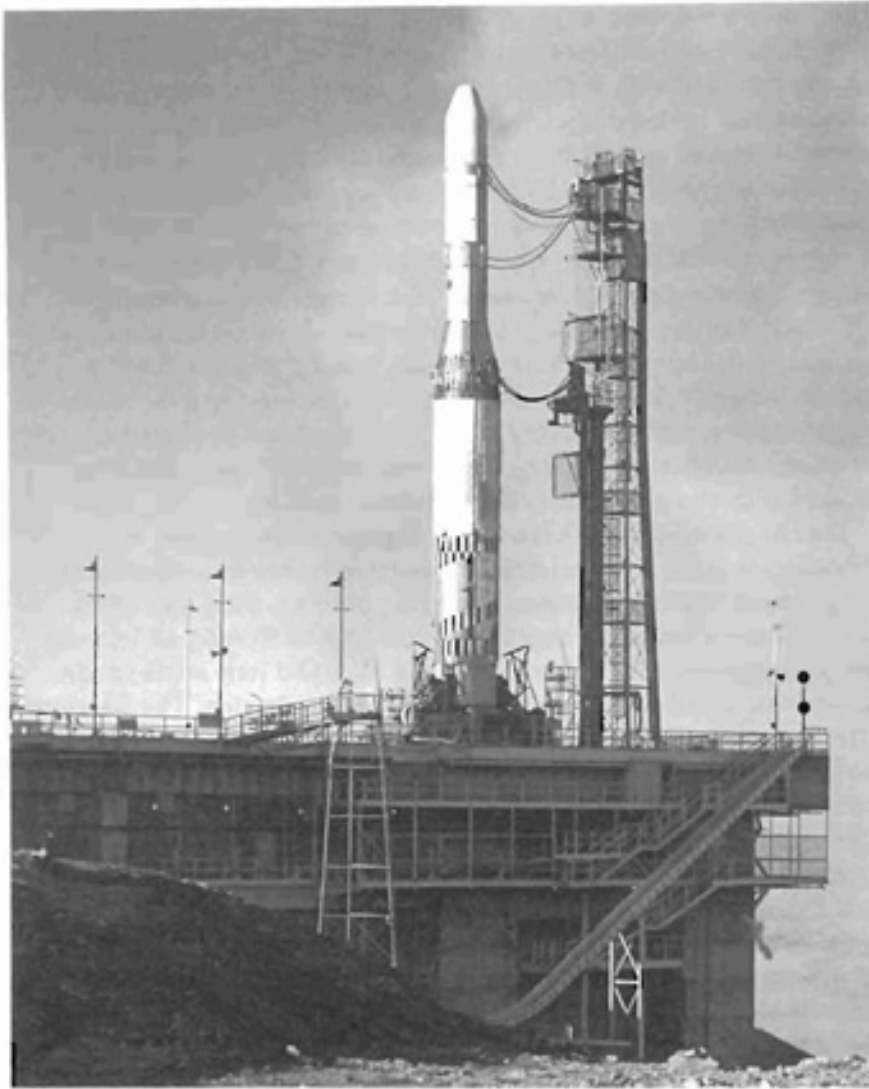
### **The Europa F-4 recovery**

With a successful recovery project behind them, the Retrieval Group was fired with enthusiasm to attempt further recoveries of astronomical heritage artefacts from the desert. While many rocket impact sites had already been discovered over the years (mostly to the north of the Simpson Desert, where access is easier), these had generally been disturbed, with material being 'souvenired' by their discoverers, local property workers or tourists. Since no-one asserted ownership over these rocket relics,<sup>27</sup> the owners of the properties on which they had impacted sometimes moved the rocket stages or engines to the homestead or some other 'public' location (such as a railway siding)<sup>28</sup> for display, with significant damage and deterioration occurring as a result. The Retrieval Group therefore preferred to direct its efforts towards recovering rockets that had not previously been located and whose sites were therefore undisturbed.

One of the most significant rocketry projects undertaken at Woomera was the European ELDO satellite-launcher development programme, with ten launches occurring between 1964 and 1970. Yet, despite its historical importance, the ELDO Europa vehicle was not represented in the Woomera Missile Park and only some small-scale models existed in the Heritage Centre's collection. The Retrieval Group therefore turned its attention to the possibility of recovering an ELDO stage and the Europa F-4 and F-5 vehicles were considered as likely candidates, as they were both known to be in the Simpson Desert but were still unaccounted for at that time.<sup>29</sup>

As the first two full-configuration Europa vehicles,<sup>30</sup> both F-4 and F-5 were considered significant. The F-4 flight had been controversially aborted by the Range Safety Officer only 136 seconds after launch due to an error on the flight predictor, which indicated that the rocket was deviating from its flight path. It was later shown that the apparent deviation was a radar prediction fault and that the rocket had, in fact, not strayed: the flight need not have been terminated. The subsequent F-5 flight was a repeat of the aborted F-4 mission and was fully successful. In both these flights, the upper stages of the Europa were inert dummies, filled with a liquid to represent the fuel weight. However, each stage carried all the necessary electronics and the dummy 'satellite' payload was equipped with telemetry electronics to record and send data back to ground tracking equipment (Figure 5).

As with the Wresat Redstone, there had been no requirement to recover the Europa vehicles after flight, so their impact sites had not previously been accurately determined. Therefore, Retrieval Group member Roger Henwood, together with Bruce Henderson, commenced research in the ELDO flight-trial archives, in an attempt to establish the likely impact locations for both vehicles. Over 14 months they researched telemetry data, aerial photographs, Landsat



*Figure 5 Launch of Europa F-5, the second full-configuration test of the ELDO Europa launch vehicle. Although virtually identical, Europa F-4 and F-5 met with very different fates, due to an equipment malfunction, which resulted in the termination of the F-4 flight. (DSTO/Australian Government Department of Defence)*

images and flight analysis reports to establish likely search areas.

The impact area for F-4 was deduced to be in the southern Simpson Desert, 473 km downrange from ELDO's Woomera launch facility.<sup>31</sup> The F-5 vehicle, which completed the full flight profile, impacted 780 km downrange. As it was the closer of the two rockets, the Retrieval Group planned to attempt the recovery of the F-4 vehicle first. It was initially hoped that, because of the way in which the aborted flight was terminated, with small charges used to vent the main propulsion tanks, the rocket might have pancaked down to the ground and survived largely intact.

With a probable impact area for F-4 established, two initial ground searches were undertaken in September/October 1991 by a small party of Retrieval Group volunteers using four-wheel-drive vehicles.

Although unsuccessful, these excursions indicated that any recovery operation would be more difficult than that for the Redstone, as the southern part of the Simpson Desert proved to be more difficult to traverse than its northern regions, with dunes up to 25 m tall and as close together as 200 m.

Undeterred, the Retrieval Group persuaded the Royal Australian Air Force to incorporate a broad-area search of the F-4 impact area into its GPS evaluation-trials programme in 1992. They found no sign of the rocket, nor did a subsequent aerial search in April that year, undertaken by members of the Ausroc amateur rocketry group (at that time preparing for the first launch of its small Ausroc 2 sounding rocket from Woomera).<sup>32</sup>

With the lack of success of both aerial and ground searches, concern arose that the F-4 vehicle may have been shattered by the ignition of its remaining fuel supply, when the explosive charges of the destruct system were activated. However, a new opportunity to locate any remains of the F-4 was offered by a South Australian remote sensing company, SciTec Pty Ltd, which wanted to demonstrate the effectiveness of its newly-developed satellite-imagery analysis software. As a research project, SciTech undertook the task of digitising and analysing a selection of aerial mapping photographs of the predicted impact area. SciTech claimed that their software could locate every artefact within an image and determine its location within 30 m, and the Retrieval Group hoped that it could pinpoint any large pieces of the F-4 that might have survived an explosive destruction.<sup>33</sup> Disappointingly, the quality of the aerial photography prints available was not high enough for successful scanning and flaws in the photographs gave false image readings that were mistaken for possible rocket fragments.

In August 1993 another attempt was made to search the probable impact area from the air, with the assistance of a US Air Force pilot from the tracking station at *Nurrungar*, near Woomera. He gave his time on a voluntary basis, while the five-day aircraft hire and fuel costs were partly sponsored. Three experienced observers from the Retrieval Group volunteered to be part of the search, meeting their own expenses for the exercise. Based at Oodnadatta (previously used as the Wresat search base) the team planned an intensive search of an area 80 km long by 7 km wide, covering a swath 3.5 km either side of the original flight path. This intended search area was 120 km from Oodnadatta. Two searches were conducted each day, with the plane returning to the town at midday for refuelling. Each search was carried out with the plane flying at an altitude of 500 feet, traversing the 80 km track along the flight path at half-kilometre spacings. GPS navigation, by now providing more comprehensive Southern Hemisphere coverage than during the earlier Redstone recovery, was used to assist the search.

Finally, on 13 August 1993, the searchers noticed what appeared to be a glint of metal struck by the low afternoon sunlight. After circling the area, they determined that they had, indeed, seen the sun reflecting off metal: in that remote desert area, it was likely to be remnants of the Europa rocket. Although the pilot attempted to take the plane down to 90 feet for a closer inspection, the 20 m-tall sand dunes in the vicinity made this too risky and the team returned, elated, to Oodnadatta. They flew back to the location of the sighting the following morning, in order to obtain confirmation of their discovery. However, to ascertain that the sighted metal was actually rocket debris, a ground expedition made a preliminary survey of the crash site in October 1993. Following this excursion, it was initially decided not to proceed with a recovery expedition, because the material found was in an extremely fragmented state, with debris scattered over a very wide area.

Despite this decision, within the Retrieval Group there was a growing momentum in favour of recovering the rocket remains and another survey expedition was finally mounted in May 1994 to explore the crash site further. In two light four-wheel-drive vehicles, this small team returned to the debris found the previous August: this was now determined to be the Europa F-4 dummy satellite, still attached to part of the third-stage transition mounting ring. The satellite had impacted about 1.2 metres into the ground, but despite the impact and 30 years in the desert sand, the team excavated several artefacts in remarkably good condition, including a quantity of telemetry equipment, two solid-state flight recorders and an endless tape recorder. Although the survey team searched on foot around the satellite impact area for the next few days, no further material was located.

Coincidentally, Dick Smith, who had originally located the Wresat Redstone rocket, was at Woomera while this expedition was under way.<sup>34</sup> After being contacted by the survey team, he flew up to their camp to aid the search using his own helicopter. Smith's assistance enabled an aerial search to be undertaken south along the flight path for 20 km, which succeeded in locating many smaller items of rocket debris. Each of these finds was logged and its position determined using GPS, for future investigation.

The success of this initial survey encouraged the Retrieval Group team to plan for a further ground search and the retrieval of material already located, to take place in late 1994. The 3/9 Light Horse, South Australian Mounted Rifles (APC) unit of the Australian Army, based in Smithfield, South Australia, volunteered its assistance to this retrieval task as an adventure training exercise, which it named 'Operation Blastoff'. However, to take advantage of the Army's offer of support, the recovery expedition would have to be carried out late in the 'safe' period for desert travel, which was a less than ideal situation: it was fortunate that temperatures did not climb beyond the mid-30s degrees Celsius during the retrieval operation. The joint Army/



*Figure 6 Members of the Rocket Retrieval Group and Army team on their return to Woomera following the Europa F-4 recovery. Roger Henwood is on the far left of the group. (Roger Henwood)*

Retrieval Group team would eventually consist of 26 people: 14 Army personnel and 12 from the Retrieval Group. The Army provided two trucks, two armoured personnel carriers (one fitted with a light crane) and several light four-wheel-drive vehicles. The Retrieval Group team travelled in six light four-wheel-drive vehicles (Figure 6).

After extensive logistical planning, similar to that undertaken for the previous Redstone retrieval exercise,<sup>35</sup> and ensuring that the necessary safety requirements and contingency plans were in place, the recovery expedition left Woomera on 3 October 1994, for a 14-day return journey. With travel to and from the planned camp site expected to take about four days each way, the remaining time could be devoted not only to loading material already located, but also to continuing the search for additional artefacts.

After arriving at the F-4 camp site, the team spent the first four days locating and retrieving many of the items charted earlier in the year. As had been suspected, the state of many of the recovered items indicated that the rocket had exploded in midair, shattered either by its termination charges or as a result of those charges detonating its fuel. Nevertheless, artefacts of significance were retrieved and returned to Woomera, including: the dummy satellite, one of the Blue Streak stage's two Rolls-Royce RZ2 engines, one of the first-stage turbo pumps, a number of electronic modules including a flight guidance computer, and a quantity of Lox valves, manifolds and piping (Figure 7).



Media interest in the Europa F-4 project was considerable, as it had been for the earlier Redstone retrieval, and the decision was made to display the recovered material beside the Wresat vehicle, similarly laid out on desert sand in another vandal-proof enclosure. Unlike the Redstone, the Europa F-4 display was a less accurate re-creation of the original site, insofar as the limited size of the enclosure meant that the retrieved artefacts could not be spread out to the full extent that they were scattered in the desert. Also, as no archaeological survey of the debris field had been carried out, the exact relation of all the small fragments to each other in the field could not be duplicated precisely back at Woomera. Nonetheless, the presentation at the Rocket Park certainly evoked the considerably more fragmented condition and scattered impact site of the F-4 when compared with the Redstone. The recovered contents of the dummy satellite were placed on display in the Woomera Heritage Centre, rather than in the rocket enclosure, so that visitors could better observe them at close quarters. Although it was not possible to retrieve any data from the recorders after more than 30 years, they were still considered valuable examples of the technology of the period.

The Europa display was undertaken as a project for the Woomera Rocket Range's 50th anniversary celebrations in April 1997, which brought many former Woomera employees and their families to the township. The strong, positive public response to the exhibit prompted

*Figure 7 Recovered debris from the Europa F-4 vehicle, indicating the level of damage resulting from the activation of the abort system. Unlike the Wresat Redstone, the F-4 remains were in a highly fragmented state. (Roger Hentwood)*

another reconnaissance expedition to the F-4 site in May 1997, to locate and identify additional material for future retrieval. After being put on hold until the completion of the Europa F-5 recovery, the final expedition to the F-4 site took place in 2001. During this trip, the second of the Europa F-4's RZ2 engines, which had not been retrieved previously, was returned to Woomera along with other material located on previous trips.<sup>36</sup>

### **The Europa F-5 recovery**

The successful F-4 recovery project encouraged the Retrieval Group to proceed with an attempt to retrieve the Europa F-5 vehicle as well. As it was identical in configuration to the F-4 vehicle, it was hoped that since the F-5 rocket had successfully completed its flight, its remains would be in a better state than those of the F-4; the only destruction that should have occurred would be that caused by the stage-separation charges and the actual impact with the ground.

While the Retrieval Group had been operating out of Woomera, another group of rocket enthusiasts based in the Northern Territory town of Alice Springs, which included Retrieval Group member Stan Spencer, had also carried out expeditions into the Great Sandy Desert of Western Australia to locate the (previously found and disturbed) remains of the Europa F-1 to F-3 Blue Streak flights. Enthused by these adventures, in 1997 they offered to assist the Retrieval Group in its search for the F-5 vehicle. With the predicted impact point for the F-5 located southeast of Alice Springs, only a day and a half travel time from that town, the Retrieval Group took the opportunity to enlist the Alice Springs enthusiasts' aid to conduct initial searches for the F-5 remains on its behalf.

After being provided with details of the predicted impact area, the Alice Springs Group made three sorties into the northern Simpson Desert in 1998, successfully locating several artefacts from the F-5 vehicle. Among the items they found were the dummy satellite, two of the four inert engines from the French Coralie stage and one turbine from the Blue Streak stage, in addition to many pieces of electronic equipment. Despite having split open on impact, the dummy satellite still contained all its electronics and telemetry equipment (Figure 8).

None of the material located on these expeditions was recovered until May 1999, when the Retrieval Group, still composed largely of the same team that had initiated the rocket retrieval programme in 1990, joined forces with the team from Alice Springs to search for and recover as much of the remains of the Europa F-5 vehicle as possible. This all-volunteer expedition was composed of 12 light four-wheel-drive vehicles, plus several trail bikes equipped for desert conditions. Travelling from Woomera, the Retrieval Group team had to plan for a round trip of nearly 4000 km and 14 days duration. Although the terrain of the far-northern Simpson Desert is not as difficult as the





dune area in which the F-4 impacted (the sand dunes averaged only 8–10 m in height and were much easier to traverse), none of the precautions and emergency backup procedures employed on previous recovery expeditions was ignored.

It took the team from Woomera four days to reach the base camp established by the Alice Springs Group at the search area. This camp, which would be occupied for five days, was located at a point near the impact ellipse where all the heavier debris was expected to have landed. Although the area was covered with low vegetation (Simpson Desert spinifex and sand-hill cane grass), this was not expected to impede the search for larger rocket fragments.

After an initial inspection of the vicinity, it was decided to conduct close-in searches along the ground track of the flight path by foot, while areas out to about 7 km would be searched by vehicle and trail bike. With average daily temperatures in the low 30s degrees Celsius, foot searches were undertaken in the cooler hours of the early morning and late evening. Searching at these times also offered the advantage of lower sun angles that would spark reflections off metal fragments, making them easier to detect.

The initial search and recovery effort focused around the previously-located dummy satellite, which was retrieved along with

*Figure 8 The Europa F-5 dummy satellite, as found. Although the casing had split open on impact, the contents were intact and in good condition. (Roger Henwood)*

its contents (the endless tape recorder and flight recorders) and other instruments fitted into the satellite base, such as telemetry equipment, transponders and accelerometers. Several canisters apparently pressurised by dry nitrogen were also recovered. In the same area, searchers also located one of the inert Coralie engines, a number of electronic panels from the Coralie (second) and Astris (third) stages and the boost separation motor providing first/second stage separation. The latter was in remarkably good condition. The rate of finds in this vicinity then slowed, with only skin sections, fuel pipe and some pressure cylinders being found over two days of searching.

As a result, the focus of the search was switched back into the area where some of the heavier debris had been located on the earlier expedition. An intensive foot search of this area with 12 people located several significant new artefacts, including both half sections of the first-stage engine platform, which were found 5.2 km apart. One section still had the Rolls-Royce turbo pump attached. The most exciting find was a complete Rolls-Royce RZ2 rocket engine, which had impacted into an area covered with dense desert mulga trees, about 2.5 m tall, which had screened the motor from previous searches.<sup>37</sup> The motor had landed at an angle of approximately 45°, its front section partly embedded in the sand, although the engine skirt had not touched the ground. It was in particularly good condition in comparison with the RZ2 engine previously recovered from the Europa F-4, which had considerable damage to the skirt.

The southernmost artefact to be found was the first stage/second stage transition bay, which was located 18.5 km from the dummy satellite, the northernmost item located. Between the two, the heavier components were dispersed only a few hundred metres either side of the line of flight, while the lighter fragments were much more widely spread. However, to the disappointment of the search team, the remaining two Coralie engines, Rolls-Royce turbo pump and RZ2 engine were not to be located: they remain undiscovered in the desert.

The expedition's finds were displayed for one day at the Central Australian Aviation Museum, before being shipped back to Woomera, where they attracted considerable media attention and resulted in a serendipitous incident: seeing the material on display, the manager of a cattle station (ranch) in the Northern Territory, situated along the flight line, offered the Retrieval Group an engine from a Europa Astris stage, which he had found in 1988. Believed to be from either the Europa F-6/2 or F-7 vehicles, this artefact may be the only surviving example of a flown Astris engine.

Following the return of the F-5 material to Woomera, the RZ2 motor was placed on display alongside the Europa F-4 debris, while the remaining material was either placed into storage or made available on loan to the National Museum of Australia for incorporation into its travelling space exhibition, 'To Mars and Beyond'.

## Conclusion

Because so little of the physical evidence of Australia's space activities remains, the recovery of material which still exists, but is located in inaccessible regions, is an important contribution to the material-culture record of those activities. Between 1990 and 2001, the search and recovery programme carried out by the Woomera Rocket Retrieval Group was instrumental in rescuing examples of significant space heritage artefacts from one of the harshest environments in Australia, the Simpson Desert. While these operations may not have been carried out with the full level of archaeological survey and documentation that museum professionals and technological historians might have preferred, they have nevertheless been responsible for retrieving material with significant heritage value for educational display and research use.

The activities of the Retrieval Group provide an excellent example of the way in which highly-motivated and well-coordinated volunteer groups can assist the professional astronomical history community in the preservation of the physical evidence of space activities and contribute to public knowledge and awareness of the history of space flight. Their efforts have enriched the accessible material-culture record of space-related activities in Australia, not only by contributing to the collection of the Woomera Heritage Centre, but also by providing a pool of material that can now be made available on loan to other museums around the country to increase community awareness of Australia's historical involvement in space activities.

## Acknowledgment

This chapter derives from a previous paper by the author, 'Recovering rockets from the desert: exercises in retrieving Australia's space heritage from the Simpson Desert' (IAA-99-IAA.2.1.06), which was presented at the 50th International Astronautical Congress in Amsterdam in 1999. That original paper used information kindly provided by Roger Henwood, the Logistics Officer for the Rocket Retrieval Group. A long-time Woomera employee, he is now the Range Activities Manager. His advice and assistance in the development of the original paper and this chapter are gratefully acknowledged.

## Notes and references

- 1 The Joint Defence Facility *Nurrungar*, operated by the US Air Force and the Australian Department of Defence. This station monitored the US Defence Support Program early-warning satellites and operated from 1971 to 1999.
- 2 The Woomera Detention Centre, located a few kilometres from the township, was opened in 2000 and closed in 2003. Housing illegal immigrants, many of them people displaced by the 'war on terror', detained while their applications for refugee or general-migrant status were determined, the centre was extremely controversial and frequently the site of protests and inmate unrest.

- 3 The official history of the Joint Project is presented in Morton, P, *Fire Across the Desert* (Canberra: Australian Government Publishing Service, 1989). A short history of Woomera up to 1992 can also be found in Dougherty, K and James, M, *Space Australia* (Sydney: Powerhouse Publishing, 1993).
- 4 Bardwell, H, 'Cold comfort', *The Australian Listener*, 17 (19–25 November 1988), p15
- 5 ELDO's Europa programme was intended to develop an independent satellite launch capability for Europe, to free it from reliance on the United States for launch services. The Europa vehicle consisted of a British first stage (Blue Streak), a French second stage (Coralie) and a West German third stage (Astris), with the satellite provided by Italy and other ELDO nations contributing telemetry and electronic equipment. The vehicle never successfully launched a satellite from Woomera and, after the programme was transferred to Kourou, was eventually scrapped. Despite their failure, ELDO and Europa paved the way for the later success of ESA and the Ariane launcher series.
- 6 Black Arrow was Britain's final attempt to develop an independent satellite launch capability after it withdrew from ELDO in the late 1960s. The first Black Arrow flight took place at Woomera in 1969; the fourth and last Black Arrow launch in 1971 successfully orbited Prospero, only the second satellite ever launched from Woomera.
- 7 James, M L, 'Into space from down under – the early days', *Journal of the British Interplanetary Society*, 41/12 (1988), pp539–54
- 8 For example the WRE Headquarters facility at Salisbury, South Australia, near Adelaide, which is now the home of the Defence Science and Technology Organisation, or the Aeronautical Research Laboratory, at Fishermen's Bend in Victoria, which is now the home of DSTO's Aeronautical and Maritime Research Laboratory.
- 9 It was not until 1999 that the Woomera Rocket Range was designated as a National Engineering Landmark by the Institution of Engineers, Australia, in recognition of the outstanding engineering and scientific achievements associated with the creation of the Range and the activities carried out there.
- 10 Apart from some early examples of surplus RTV test missiles, which can be found in a number of technological museums around the country, and a few examples of missiles tested at Woomera located in military museums, there are almost no artefacts relating to the Woomera programmes in the collections of museums outside South Australia – and even there, the number of examples is small. For almost three decades, the best display outside the Woomera Heritage Centre itself was that of the privately-owned Rohrlach Museum near Adelaide, which owned a collection of re-created sounding rockets (composed of relics recovered from the Woomera Range) and other examples of hardware salvaged from the Range after flight. Following the death of its owner and the closure of the Rohrlach Museum in 2001, the collection was dispersed at auction, with some of the more significant items of rocket hardware being acquired by the Powerhouse Museum in Sydney.
- 11 The Heritage Centre was originally located in the former St Barbara's Anglican Church, where it operated until the late 1990s. With the transfer of the Oasis Leisure Centre (built by the US Air Force as an amenity for its personnel working at *Nurrungar*) to Woomera Board control, as *Nurrungar* was shut down, the main display venue of the Heritage Centre was moved to its current location within the Oasis Centre. Although now physically separated from the Missile Park by a short distance, the two display venues of the Heritage Centre continue to complement each other in providing public education about the programmes carried out at Woomera. The old Heritage Centre building continues to act as a storage facility for parts of the collection not able to be displayed in the new, smaller Oasis Centre venue.
- 12 In spite of its remote location, Woomera was a 'closed town' from its inception, owing to the perceived Cold War security need to prevent espionage and sabotage: security passes were needed to access the township, with additional security clearance being required to access the Range. Casual visits to the town, by tourists or the curious, were prohibited under the Joint Project. Security restrictions were relaxed at the end of the Project – the

- author made her first visit to Woomera as a tourist in 1979 – and it was anticipated that tourists to the outback region would be interested in visiting the town once it was accessible.
- 13 The rest of the collection remained in storage at WRE/DSTO Headquarters in Salisbury, with material from it occasionally being loaned out for promotional exhibitions. The care given to this collection varied over time, depending on the interest of the officer tasked with its management. In the late 1990s, the bulk of the collection not at Woomera (mostly promotional models, replicas and some examples of recovered Skylark sounding-rocket hardware) was handed over ‘on permanent loan’ to the South Australian Aviation Museum.
  - 14 As well as covering the technological and social history of the Range and township, the museum has also attempted to address the ‘pre-Woomera’ history of the Range area, acquiring material relating both to the Aboriginal communities who originally occupied the region and to the pastoralists, raising sheep, who pioneered European settlement in the area from the 1870s.
  - 15 Some funding was made available in the 1990s to enable the collection to be catalogued and so that a collection management system could be established. In 2002 the new facilities management company for the Range, BAE Systems, with support from the local Regional Development Board and the South Australian Tourism Commission, funded the redevelopment of the Heritage Centre to improve its tourist potential. A heritage professional, freelance historian Geoff Speirs, was commissioned to provide professional input into the content development and design of a new exhibition for the Heritage Centre. This new display opened in March 2005.
  - 16 Details of the Wresat project can be found in both the publications cited in note 3.
  - 17 Prior to Wresat, only the USSR, USA and France had launched their own satellites independently. Australia’s position is anomalous in that, while it developed the satellite and launched it from a facility in its own country, it used a ‘donated’ US launch vehicle.
  - 18 Essentially a modified V-2, the Redstone rocket was originally developed by Wernher von Braun’s team in the United States as an intermediate-range ballistic missile for the US Army. It later became the launch vehicle used for the suborbital flights of the Mercury programme. Project Sparta was an American-led investigation into the physical effects of high-speed re-entry on missile warheads, using the Redstone to power various experimental warheads into the atmosphere at re-entry velocities.
  - 19 Hill, C, ‘Lost and found – one Redstone rocket’, *Australian Geographic*, 18 (April–June 1990), pp20–1
  - 20 These data had been documented and archived in the 1960s and were available for reference at DSTO Headquarters in Salisbury.
  - 21 A prominent Australian businessman, social identity and adventurer, Dick Smith can count among his many achievements the first solo helicopter flight around the world, carried out in 1982–83.
  - 22 The collection does, however, include two full-size cutaway models of the Wresat satellite.
  - 23 Alan Lockett MBE, the Area Administrator for Woomera, was appointed as Chair of the Retrieval Group. The Area Administrator was responsible for overseeing the activities of both the Range and the town.
  - 24 It is a standard procedure when travelling in the Australian outback to alert the police in local towns prior to undertaking desert travel. In this way, it quickly becomes noticed if travellers do not arrive at their destination within a reasonable time, so that a search can be initiated.
  - 25 A manager from TRW’s space-activities division joined the Retrieval Group for the recovery mission.
  - 26 Now renamed Telstra.
  - 27 Neither the WRE/DSTO, the Australian or British governments, nor any other entity with an interest in the original Woomera projects has so far asserted any rights of ownership or control over the remnants of rockets and missiles on the Range, or in the

- downrange flight paths. During the Joint Project, any hardware required to be recovered for research or other purposes was retrieved at the time by special teams from Woomera.
- 28 In the 1970s, a battered Black Arrow first stage was recovered from the Simpson Desert and placed on the railway platform at the Williams Creek station of the old Ghan Railway route as a tourist attraction. Although the Ghan service was re-routed in 1980 and the Williams Creek station fell into disuse, the Black Arrow remained on the platform until some time in the 1990s, when it was apparently hauled away for scrap. Another Blue Streak first stage from a Europa launcher was at one time established as a 'garden ornament' in front of the homestead at Tobermory Station (ranch) in the Northern Territory. It had been removed as scrap by 1979.
  - 29 When making his solo trek across the Simpson Desert in 1985, adventurer Denis Bartell came across an unidentified Blue Streak stage which may have been the F-5 vehicle.
  - 30 The Europa F-1 to F-3 flights were Blue Streak first stages only, which were launched in a northwesterly direction and impacted in the Great Sandy Desert of Western Australia.
  - 31 ELDO used the Launch Area 6 complex, on the edge of the Lake Hart salt lake. Originally established for the British Blue Streak missile programme, this facility was allocated for ELDO's use when Britain offered Blue Streak as the first stage of the Europa launch vehicle. There were two launch pads at the site, but only Launcher 6A was ever completed and made operational. Following the transfer of ELDO operations to Kourou, the Launch Area 6 complex was mostly demolished, except for the massive bases of the launch pads, which still remain today, albeit much scarred from being used for target practice by the defence forces.
  - 32 The Ausroc amateur programme was the precursor of the Australian Space Research Institute, a volunteer space engineering and education association which undertakes educational rocket-launch campaigns for school and university students, and provides experience for engineering students on its Ausroc sounding-rocket development programme and student satellite projects.
  - 33 Trent, D, 'Looking for a needle in the Simpson Desert', *Genesis*, 9/6 (December 1992), pp1-3
  - 34 He was filming Australian Army exercises for a TV documentary.
  - 35 For example, while vacuum-packed provisions formed the main food supply for the expedition, the team expected to supplement this with freshly-caught wild game, including rabbit, duck and wild pigeon, which was plentiful in this part of the desert at that time. Tinned food was also carried as a backup supply. Small vehicle refrigerators were used to keep food fresh in the high ambient temperatures.
  - 36 This engine was made available to the National Museum of Australia for inclusion in 'The Australian Connection' theme of its major temporary space exhibition 'To Mars and Beyond', displayed between 2001 and 2003.
  - 37 Search teams had travelled past the engine, and within 150 metres of it, without sighting it, during two vehicle searches of the area.