



GEMINI 5

VISUAL ACUITY EXPERIMENT

an essay by
HAMISH LINDSAY



Alternate mission logo

*“We saw Shark Bay – that’s the last thing we saw.
We were pitching up and then we saw the
smoke streams 300 miles past over our shoulder.
So, I am sure we would have seen it.”*

Charles Pete Conrad

GEMINI 5

VISUAL ACUITY EXPERIMENT

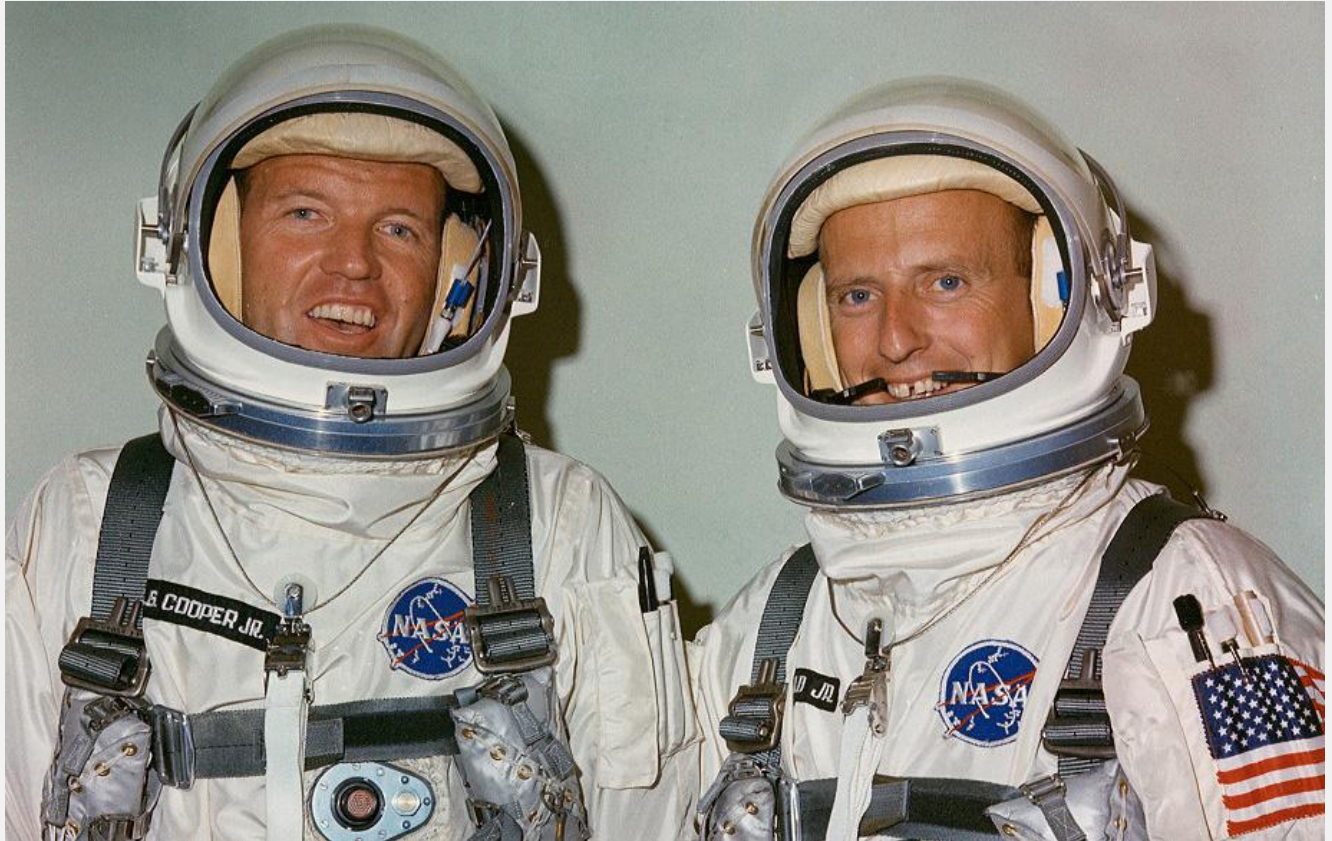
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HAMISH LINDSAY

Extracted from content available on the
Honeysuckle Creek Tracking Station
website, developed by Colin Mackellar
www.honeysucklecreek.net

Click or scan the QR code below to see the website's
Carnarvon Tracking Station section.



GEMINI 5 (GT-5)



Gemini 5 crew – L. Gordon Cooper Jr (left) and Charles 'Pete' Conrad Jr. Image: NASA

GT-5 Mission Fact Box

Launch

Launch Complex – 19, Cape Kennedy
Saturday, 21 August 1965
0859:59 US EST / 1359:59 UTC
[Sunday, 22 August 1965, 2359:59 AEST]

Spacecraft

Rocket: Titan II GLV, S/N: 62-12560
Capsule: Gemini SC5
Callsign: *Gemini 5*

Mission duration

7 days 22 hours 55 minutes 14 seconds

Distance travelled

5,242,682 kilometres

Earth orbital data

Orbits: 120
Orbital period: 89m 35s
Inclination: 32.61°
Apogee: 350.1 kilometres
Perigee: 161.8 kilometres

Splashdown

29 August 1965, 1255:13 UTC [2255:13 AEST]
Southwest of Bermuda, 29°47'N 69°45'W
Recovery ship: USS Lake Champlain

EDITORIAL NOTES

This description of the Visual Acuity Experiment comes from essays and content on the honeysucklecreek.net website, which is regularly updated with new content, including additions to the subject matter of this essay.

Indented & italicised quotes includes comments, interviews and air-to-ground communications.

- ONLINE CONTENT - AUDIO – VIDEO – WEBSITE

This essay contains additional content which includes audio, video and website material, available via the internet. Click the icons or scan the QR code using your phone or tablet.

An internet connection is required.

 LISTEN

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The Visual Acuity Experiment patterns located 175 kilometres SSE of Carnarvon, on Woodleigh Station.

Gemini 5

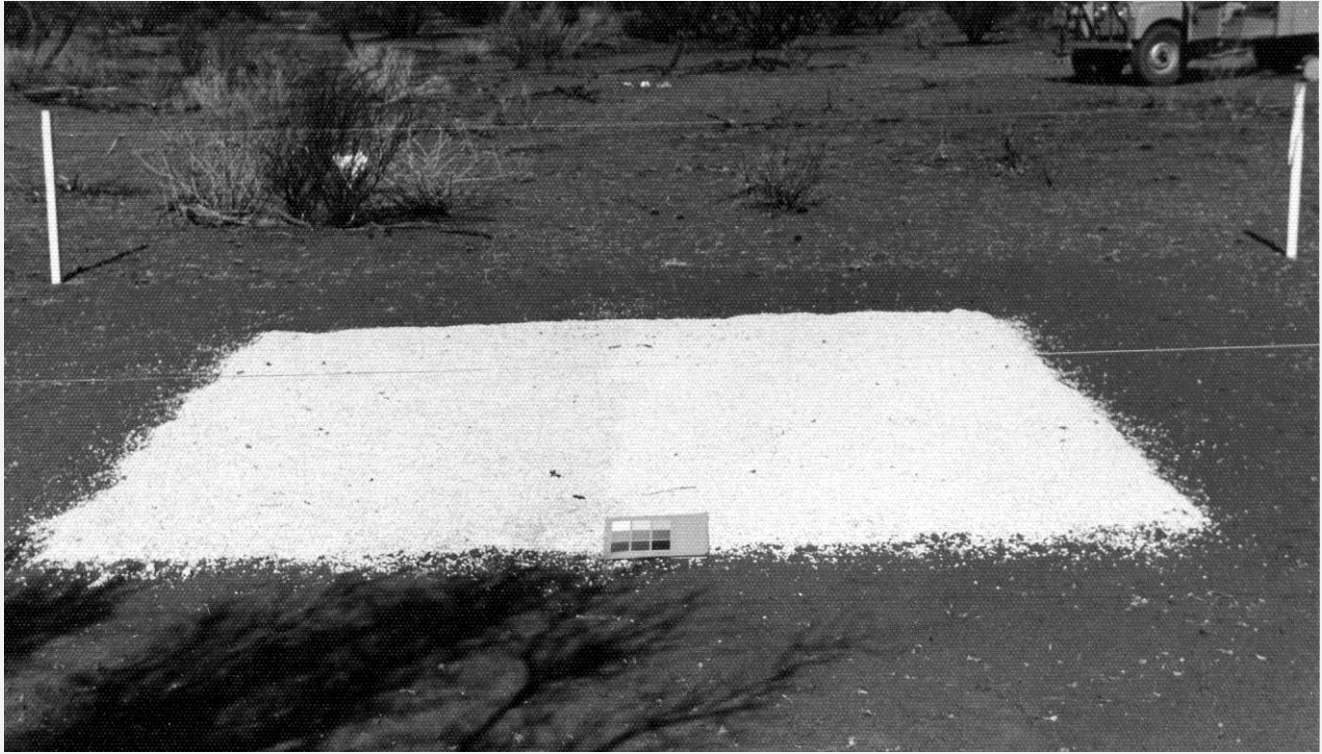
Visual Acuity Experiment

For the Gemini V mission, I had to take a series of photos looking for deterioration in different kinds of shells for the planned Visual Acuity/Astronaut Visibility Tests during the mission.

The area was located at a sheep station called Woodleigh about 175 kilometres south of Carnarvon where a bulldozer was going to push shells gathered from Shark Bay into patterns to see how well the astronauts could make out ground details, as it seemed the astronauts could see details better than expected.

The farmer pushed the shells into rectangles for me for the tests, and I would drive down preceding the mission and photograph the shells on a regular basis and I had to send the results to NASA. You can see my grey scale at the front. If your picture is good enough, you can just see the left half is slightly darker than the right side. Needless to say, I never saw any change in the whiteness of the shells.

In our discussions over the SCAMA they would insist on calling the place a "Ranch" and I would say "It's not a cattle ranch – it's a sheep station." They never gave in – it was always a ranch.



The small area of test shells. Photo: Hamish Lindsay

After establishing the photographic test procedures and ran a few trials I handed the regular task of taking the photographs over to Tito Teraci, from the Test Equipment section.



Tito remembers,

"I had to take over the visual acuity tests from Hamish. I did that for two or three months. I went down to Woodleigh station twice a week.

I had to water half the shell grit and take photographs of it into the sun and away from the sun. Then I would bring the camera back and Hamish would produce all the photographs."



Jim Gregg remembers the communication procedures at Woodleigh during the mission,

"We were keeping the link from Woodleigh back to the station alive. The link itself consisted of two old-fashioned valve type taxi radios driven by vibrators mounted back to back on top of one of the flat meters on Woodleigh station.

This equipment was powered from very large heavy duty tractor/truck batteries. One of these batteries was as much as two men wanted to carry.

These vibrators used a great deal of current, and we would drive down from Carnarvon in a Land Rover with these batteries on board, change the batteries, reload the used ones, and go back to Carnarvon, which would take a bit over half a day.

As there were no roads it was a sticky bit of driving, particularly with the heavy weight of the batteries in the back. It turned out the long-wheel-base Toyota Land Cruiser from the station security was a much better vehicle. We went down two or three times a week to change the batteries, bringing the used batteries back to the powerhouse to recharge them.

One day we collected the batteries from the power house and took them all the way down to Woodleigh and discovered they hadn't charged them.

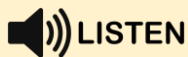
What was supposed to happen during the mission – the astronauts would come over and see on a nice brown salt pan an arrangement of glaring white shell grit from Shark Bay, arranged in patterns of various sizes and as soon as the spacecraft went over the horizon the boys would move in with earth moving equipment and change all the patterns."

In the end, the test was written off because, when the day for the tests came on 26 August 1965, the spacecraft was drifting along, powered down, unable to maintain a stable attitude with their fuel cell problems. The astronauts saw the smoke markers identifying the site but were unable to see the patterns.

A second attempt during the August 28 also failed due to cloud cover.

Listen to air to ground audio

GET 139:12:26 – First attempt with the Visual Acuity Experiment. Although the visibility is excellent, due to spacecraft attitude, only the accompanying smoke is seen. Mention of the swimming pool at the Port Hotel.
Preserved: Hamish Lindsay. Edit: Colin Mackellar



2.9mb mp3 file. Running time – 5m 51s



Editor's additional notes:

Here are some extracts from the NASA report, "Experiments on Visual Acuity and The Visibility of Markings on the Ground in Long-Duration Earth-Orbital Space Flight" by S. Q. Duntley, R. W. Austin, J. L. Harris and J. H. Taylor.

Read the Experiment report



3.6mb PDF file. Pages: 228



As well as describing the details of the experiment, it outlines the rationale, and looks at Gordon Cooper's observations from MA-9 (Faith 7) in 1963.

From the same report, this about the site selection visit –

"The site selection field trip was planned for early January 1965, but sundry delays caused its postponement until February. Furthermore, on the advice of the State Department, it was decided to visit Australia first, and to make a later and separate trip to Chile only if the Australian region proved unsuited to the experiment. Thus, it happened that our attention was converged upon Western Australia, and a visit there by the site selection team was arranged."

"Visits made to the region of the Gascoyne River and Jimba Jimba Station on 24 February all but eliminated these areas from further consideration. Unsuitable terrain, difficulty of access and support, and reluctance of the leaseholders (based upon the serious danger of later wind erosion) to cooperate, all mitigated against use of these areas.

The ground survey of Woodleigh Station, however, firmly established it as our preferred site. Detailed measurements of soil reflectance (described elsewhere in this report), flatness of the terrain, and the ease of clearing background squares all recommended the area east of the homestead, along an existing track.

Further, discussions with Mr. Fred Thompson, Woodleigh's manager, made it clear that he was happy to cooperate with the experiment. The 1,500 acres required for the site could easily be spared from the 695,000 acres of Woodleigh, and the removal of vegetation from the squares would greatly facilitate construction of a much-needed fire break subsequent to the missions.

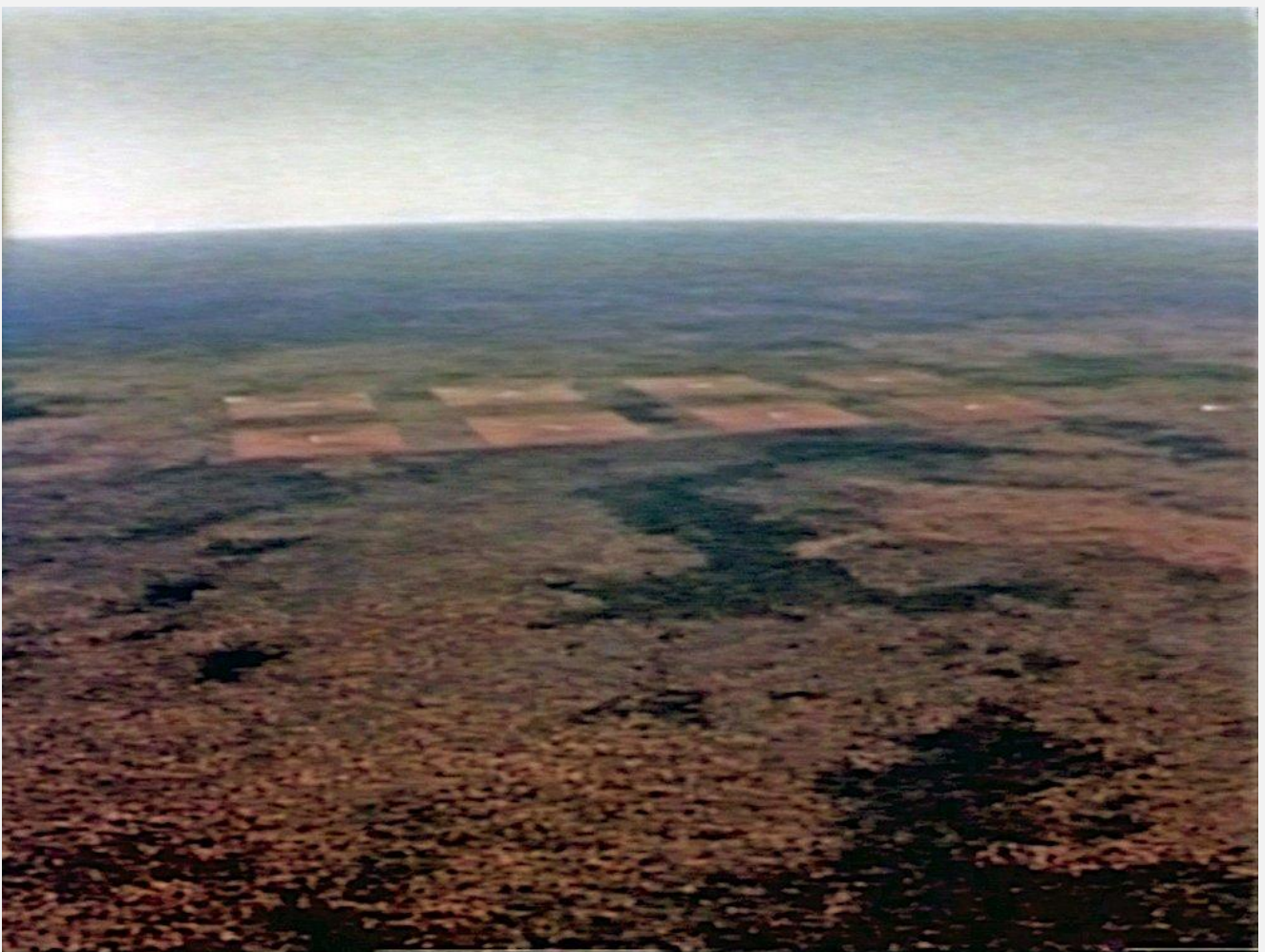
The remainder of the visit to Carnarvon was taken up with meetings, sample gathering, testing, and the preparation of tentative cost estimates."

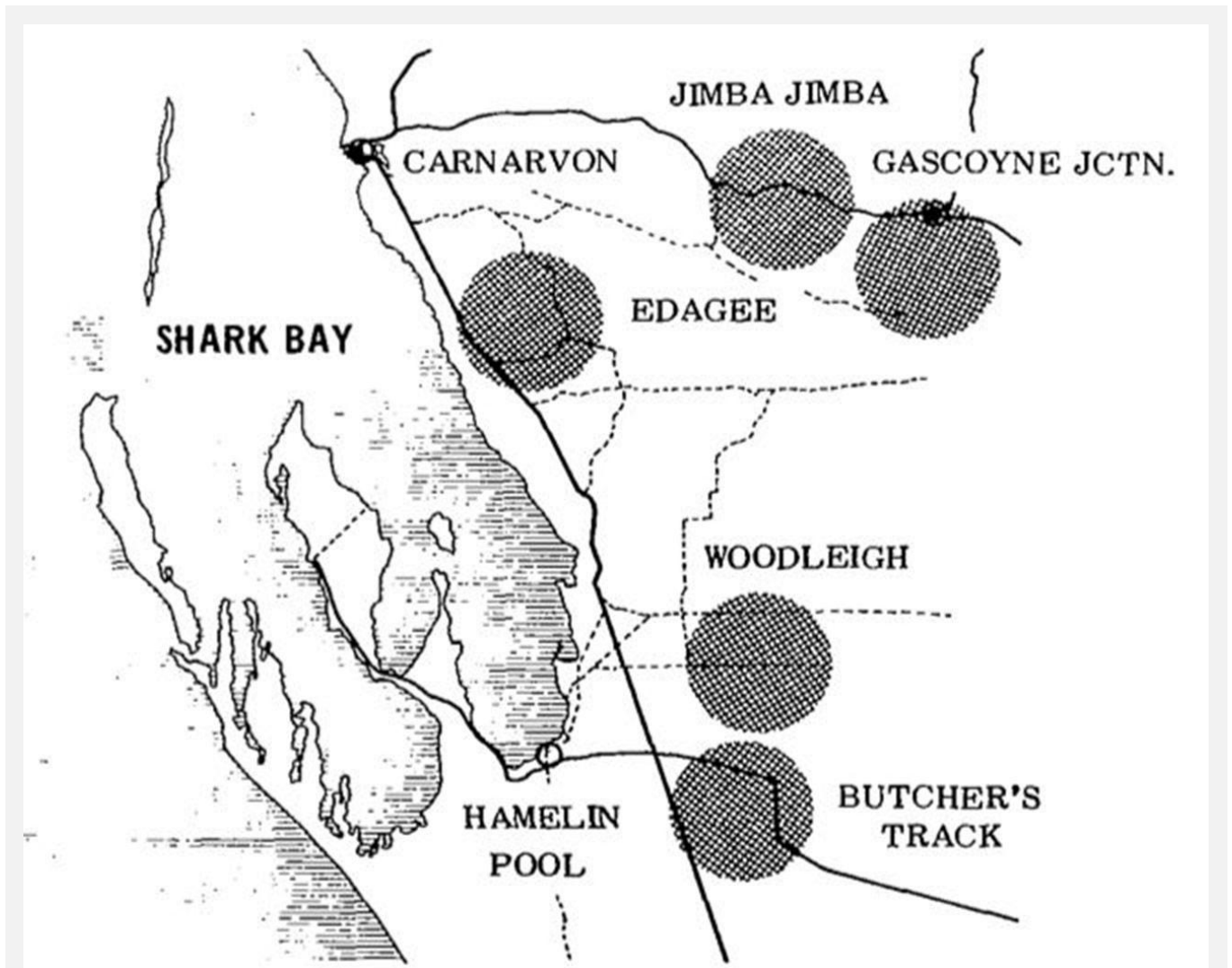
Site Preparation at Woodleigh

"The area chosen for the experiment in Western Australia lay ten miles due east of the Woodleigh homestead. This location had the advantages of uniformity of soil colour, flatness, relatively thin vegetation and ready access by an existing East-West track.



Above: An aerial photo of part of the pattern for the Gemini 5 Visual Acuity Experiment.
Images: (above) NASA report. (below) Dept. of Supply film.
Below: Aerial view from a light aircraft. Screen capture: Colin Mackellar, Dept. of Supply film





Candidate sites for the Visual Acuity Experiment. Woodleigh being the final choice.

The array of background squares was made so that the southernmost row was close to and parallel with the track; additional access tracks were made perpendicular to the main track. Sixteen squares were cleared, as shown in Fig. 4-13. Each square was 2000 x 2000 feet, with 1000 feet separating the squares in each of two eight-square groups. The east and west groups were separated by 6500 feet.

The stockpile of shell to be used for target changes, and the camp for the on-site team were midway between the two halves of the array close to the main track. Approximate distances by road from the camp were: ten miles to the homestead; twenty miles to the Northwest Coastal Highway; thirty-six miles to the shell deposits; one hundred twenty-five miles to Carnarvon. A map of the region is given in Fig. 4-14.

The steps performed in preparing the background squares were:

1. Survey of the area and laying out of the 16 squares.
2. Dragging of each square with a huge chain between two bulldozers, to uproot scrub growth.
3. Raking (bulldozers with rake blade) the resulting rubbish into piles which were then burned and buried on the spot by bulldozers.
4. Levelling, again with the chain. Ploughing of the entire square.
5. Center area (400x500 ft.) levelled by bulldozer, then by a road grader or dragbar.
6. Center area further levelled and compacted by multi-wheeled roller to provide a firm base for the shell.

This rather involved procedure resulted in there being no point-to-point height differences more than 518 inch.

All slopes were less than one degree.



Above: The shell deposits used for the experiment. Panorama of frames assembled from film.

Images: Department of Supply

Below: Handfuls of bright white sea shells suitable for the experiment.



Shell for the target bars was obtained from a location on the eastern shore of Hamelin Pool southwest of the Carbla (formerly Yaringa South) homestead.

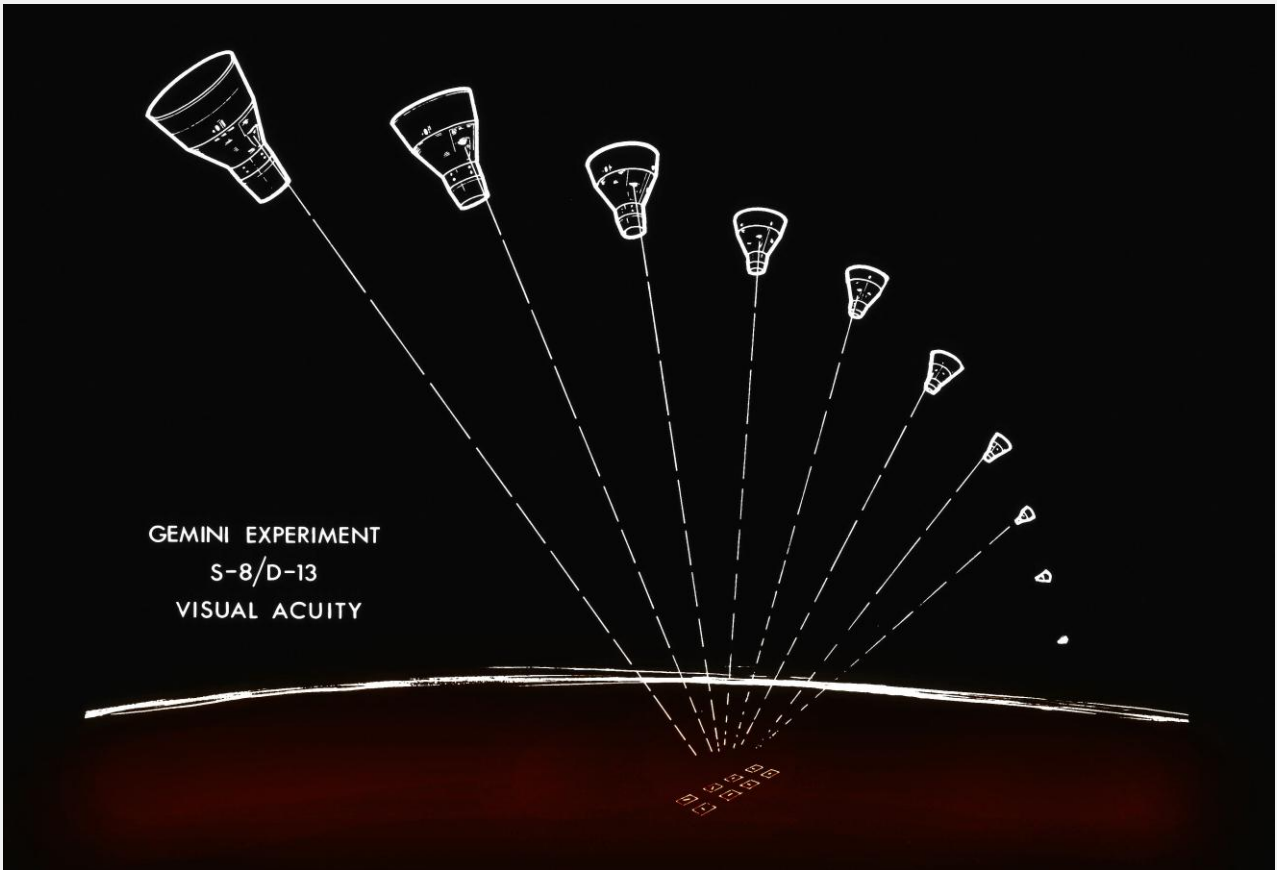
Considerable roadwork was required to render the existing track suitable for the heavy trucking operations, both on Carbla and Woodleigh stations.

It was found necessary to loosen the shell, since the older deposits had become partially compacted; this was accomplished by driving trucks over the shell windrows.

Sufficient shell was obtained for the initial target bars and for a stockpile which would suffice for the projected target changes between orbits.

Additional preparations of the site included improvements to the Woodleigh airstrip, erection of an antenna mast, and the establishment of a camp for the Department of Works party and the scientific team.

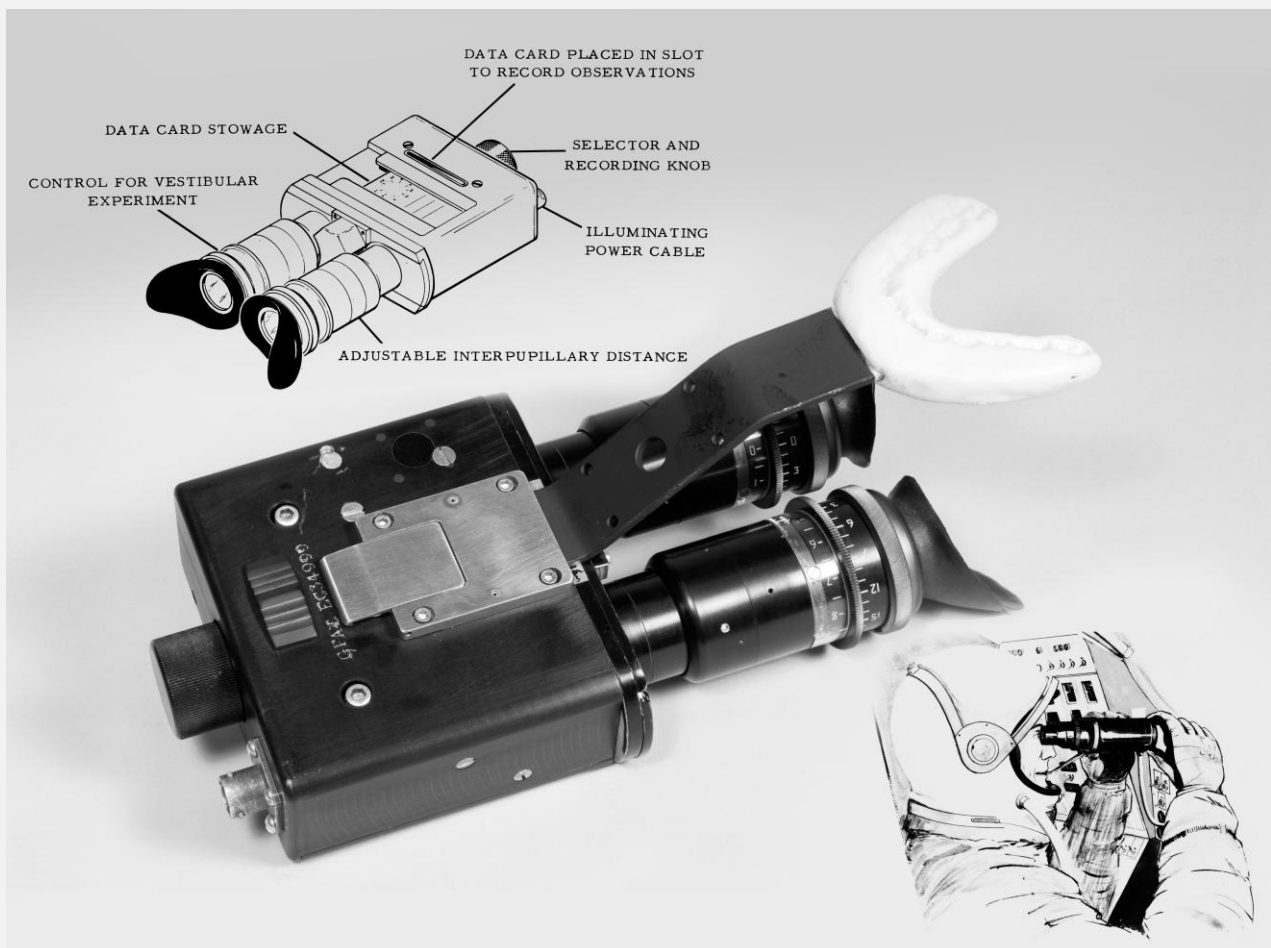
A radio relay station was constructed atop a hill at Gladstone so that VHF communications with the Carnarvon Tracking Station could be established.

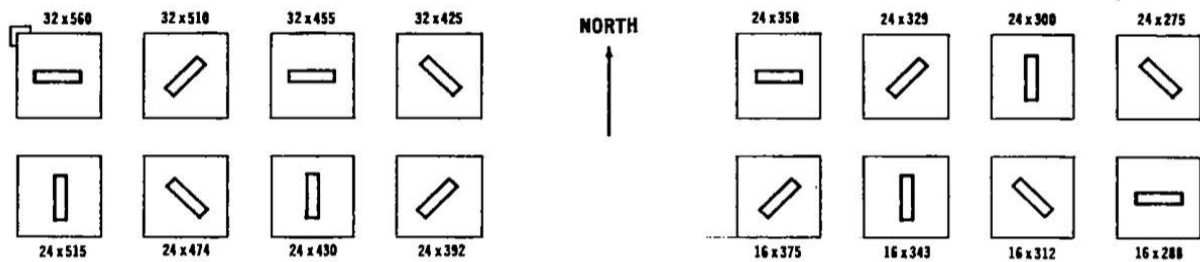


Above: Orientation of the Gemini spacecraft over prepared ground observation sites.

Images: (above and below) NASA graphics, adapted by Glen Nagle.

Below: Inflight Vision Tester used by the astronauts during the Visual Acuity Experiment.





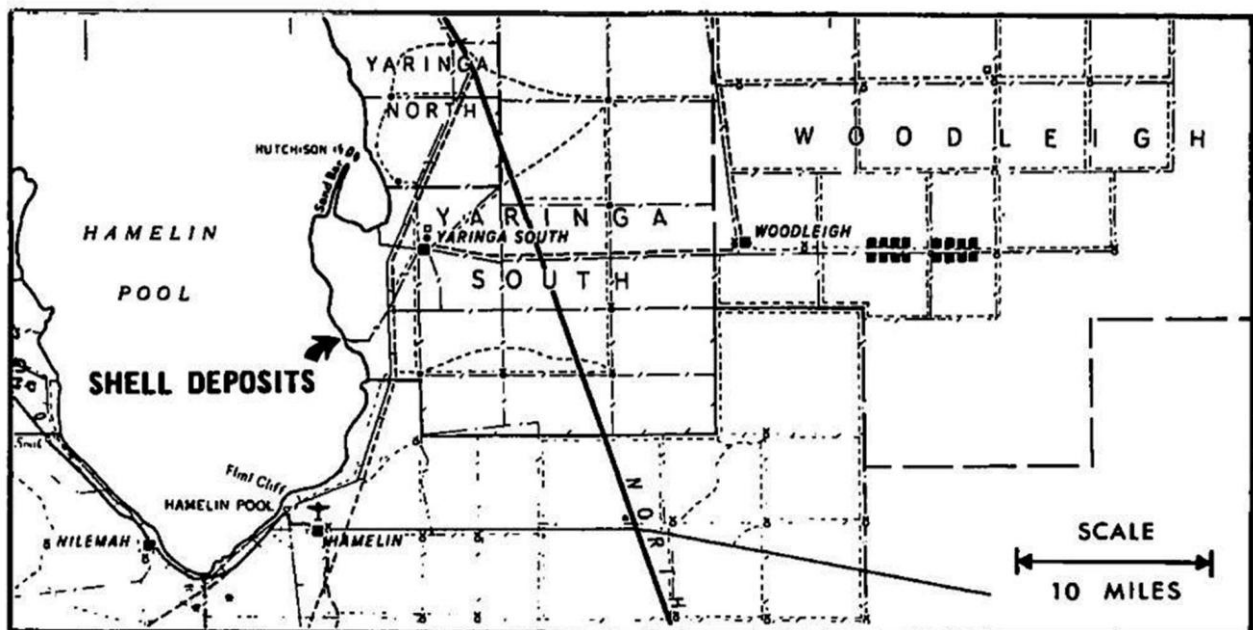
Above: Target array used a Woodleigh.

The bars are not to scale, but their real dimensions are shown by the numbers.

Images: NASA report

Below: Region of shell deposits and Woodleigh experimental site.

NB: Yaringa South homestead is now Carle.



The camp consisted of four vans with living quarters, one for communications and food preparation, power generators, battery chargers, water tanks, toilet and shower facilities, vehicles and supplies of petrol.

Although there were highly conspicuous and distinctive features of the coastline of Western Australia which would aid in initial acquisition of the Woodleigh array, it seemed prudent to provide additional aids to location and orientation of the site, especially if clouds should obscure the coastal contours. Accordingly, two further steps were taken in preparing the experimental area:

1. The northwesternmost background square was partially outlined by a white shell chevron embracing its northwest corner.

Each leg of the chevron was 250 feet long by 40 feet wide.

2. Chemical smoke pots, modified for electrical ignition, were placed in a line due west of the array. These had sufficient burning time so that they could be ignited in time to generate a long, low-lying plume of dense white smoke which could readily be seen by the astronauts during the overpass.

Site Operations

Operations at Woodleigh: Gemini V Mission

Although there were no successful sightings of the Woodleigh array during Gemini V, owing to the tumbling of the spacecraft and associated problems, it is desirable to describe, briefly at least, the operations at the site.



Carnarvon Station Director Lewis Wainwright with Gemini V Carnarvon Capcom Chuck Lewis. Image: DoS film

Experience gained on this occasion led to some changes in the plan for the Gemini 7 mission, and might have a bearing upon any subsequent experiments which may be planned for this nearly ideal location.

Logistics

Three cooperating units were involved in the Woodleigh exercise; the Carnarvon Tracking Station, a team from the Department of Works, and the scientific party.

The tracking station, under the direction of Mr. Lewis Wainwright, provided supporting communications with the spacecraft and the SCAMA network. In addition, they rendered assistance in all phases of the operation, provided vehicles for the Woodleigh site, and were outstandingly cooperative throughout the program. Mr. Charles Lewis, of NASA Manned Spacecraft Center, was Carnarvon Capsule Communicator for the flight.

The Department of Works provided a work team from Perth, under the supervision of Mr. Colin McWhaie. It was this group that prepared the site

initially, and performed the necessary target size changes for the mission.

The scientific party was composed of Dr. John H. Taylor (scientist-in-charge), Mr. Richard W. Johnson (engineer), and Mr. Kenneth W. McMaster (electronics technician); all from the Visibility Laboratory. Other members of this group were Mr. John A. G. Walton (Department of Supply) and Mr. Andrew Drummond (Carnarvon Tracking Station).

Because of the remoteness of the site from Carnarvon (125 miles) living quarters were arranged on location. The camp consisted of two caravans for sleeping quarters, a large van which served both as a galley and as communications center, a large water tank (all water had to be brought in by truck from the Wooramel River, some fifty miles distant), a radio transmitting tower, and a generator. Supplies of petrol were brought in for powering the vehicles and generator.

Food supplies were brought from Carnarvon, although locally procured fish, mutton, and kangaroo formed a significant part of the diet.



The University of California camp at Woodleigh. Image: Dept. of Supply film



Appears to be the road near Woodleigh Station. Image: Dept. of Supply film



Woodleigh Station homestead from a point NW of the house. Image: Dept. of Supply film

The Department of Works group had a similar camp, but (with characteristic Australian ingenuity) had improvised sanitary facilities, a laundry, and a hot shower, all of which the scientific party were fortunate to share.

Target changes were made by use of the equipment already mentioned. It was found best to remove the shell entirely when changes in orientation of the target bars were made; this was done by scooping it carefully with a skip-loader and hauling it away in trucks. (It was used to improve the surface of the track south of the array.) New shell had been stockpiled for target changes, so that it would not be necessary to make the long trip to the source.

Communications

Telephone lines to Woodleigh were judged to be inadequate for our purposes. The existing system uses a single iron wire, with earth return, serving several homesteads on a party line. Signal strength was low at the Woodleigh station, and

intelligibility variable, as was the use of the line by other subscribers. Cost estimates for running a special line from the PMG office in Carnarvon were prohibitive, and it was decided to use radio communication entirely.

Two radio links were established: one Redifon transceiver, Type GR 410, operating HF/SSV at 2-16 MHz/s, and one FM Carphone Type MR 20B operating VHF at 70-85 MHz/s were installed at the site as prime units, and a VHF relay was installed on a hilltop at Gladstone.

The location of the hill is actually on the Yaringah Hills, about 300m from the highway at 25.938279°S, 114.317491°E.



John Lambie writes,

“The north west coastal highway passes through these small flat top hills, the only change in the featureless landscape.”



A relay tower on a hilltop “at Gladstone”, is actually on the Yaringah Hills, about 300m from the highway.
Image: Dept. of Supply film



A closeup of the relay hut at Yaringah Hills. Image: Dept. of Supply film

The HF was generally too noisy for effective use, owing to teletype interference. The VHF was generally satisfactory, but required daily battery changes to be made at the relay point. Continuous battery charging was required from the generator at Woodleigh, and one man and one vehicle were tied up for approximately three hours each day, carrying batteries to and from Gladstone and making the necessary changeovers.

Three chargers were required to maintain the eight 240 Ampere-hour, 12 Volt batteries, operating for about 18 hours a day.

Two walkie-talkie transceivers were used to maintain communications between the CRM station in the field and the radio van at the camp. Arrangements at the van permitted active, two-way communications with the tracking station and over the SCAMA network, but only passive reception of spacecraft voice transmissions. Data from the on-board window scan photometer were telemetered to the tracking station and delivered to Woodleigh by courier."

Chronology

The Australian portion of the Gemini V effort began, excepting for preliminary work already described, on 27 July 1965 with the arrival of Dr. Taylor in Adelaide. On this and the succeeding two days discussions were at Weapons Research Establishment (WRE) headquarters in Salisbury, and final plans laid for activities during the mission proper. It was decided that Mr. Walton would join the scientific party later, as WRE's on-site representative. Dr. Taylor arrived in Carnarvon on 30 July, and the next few days were taken up with conferences at the tracking station. Arrangements were made for communications links (v.s.), living facilities on site, special weather forecasting for the Woodleigh area, and general support of the experiment. On 3 August the remaining U.S. members of the scientific party arrived in Carnarvon.

Preliminary inspection of the target array was begun on 4 August by use of Nor'West Air Taxis' Cessna. It was found that blowing dust had noticeably invaded some of the target bars, typically, however, to a distance of about six feet from the windward edge. It was decided that fairly extensive target refurbishment should be attempted before the mission.

A scientific briefing was held on 5 August at the Carnarvon Tracking Station for all involved personnel, including Mr. Lewis who was to act as Mission Controller during Gemini V. Final assembly of the locally-made platform tower was completed and it was mounted to a flat-bed truck.

The Woodleigh site was visited by the party on 6 August, and the need for refurbishing the targets was communicated to the Department of Works team. In addition, the Department of Works supervisor, Mr. McWhaie was apprised of the details of the experiment and the strategy to be used for target changes during the mission.

The Visibility Laboratory equipment arrived in Carnarvon on 7 August, and was checked over prior to moving it and the scientific party into the bush.

On 9 August the party moved to Woodleigh and began installation and checkout of the equipment. They also set up housekeeping for the three-week period on site. Mr. Walton arrived at the camp, along with Mr. Drummond, on 11 August, and in the succeeding days a full checkout of the Contrast Reduction Meter and the communications systems was made. The target bars were refurbished by the Department of Works team on 12 and 13 August.

At that time, it was decided that a considerably augmented stockpile of shell might be required, and Mr. McWhaie was able to find a private local contractor who had both the desire and the equipment to accomplish this, even though it necessitated working around the clock throughout the weekend.

Simulated data taking runs were made on 15, 16, and 19 August (Rain on the 17th and 18th prevented activity.) with the Contrast Reduction Meter mobile tower at Square 9.

On 20 August the Contrast Reduction Meter was moved to Square 3 in preparation for the mission.

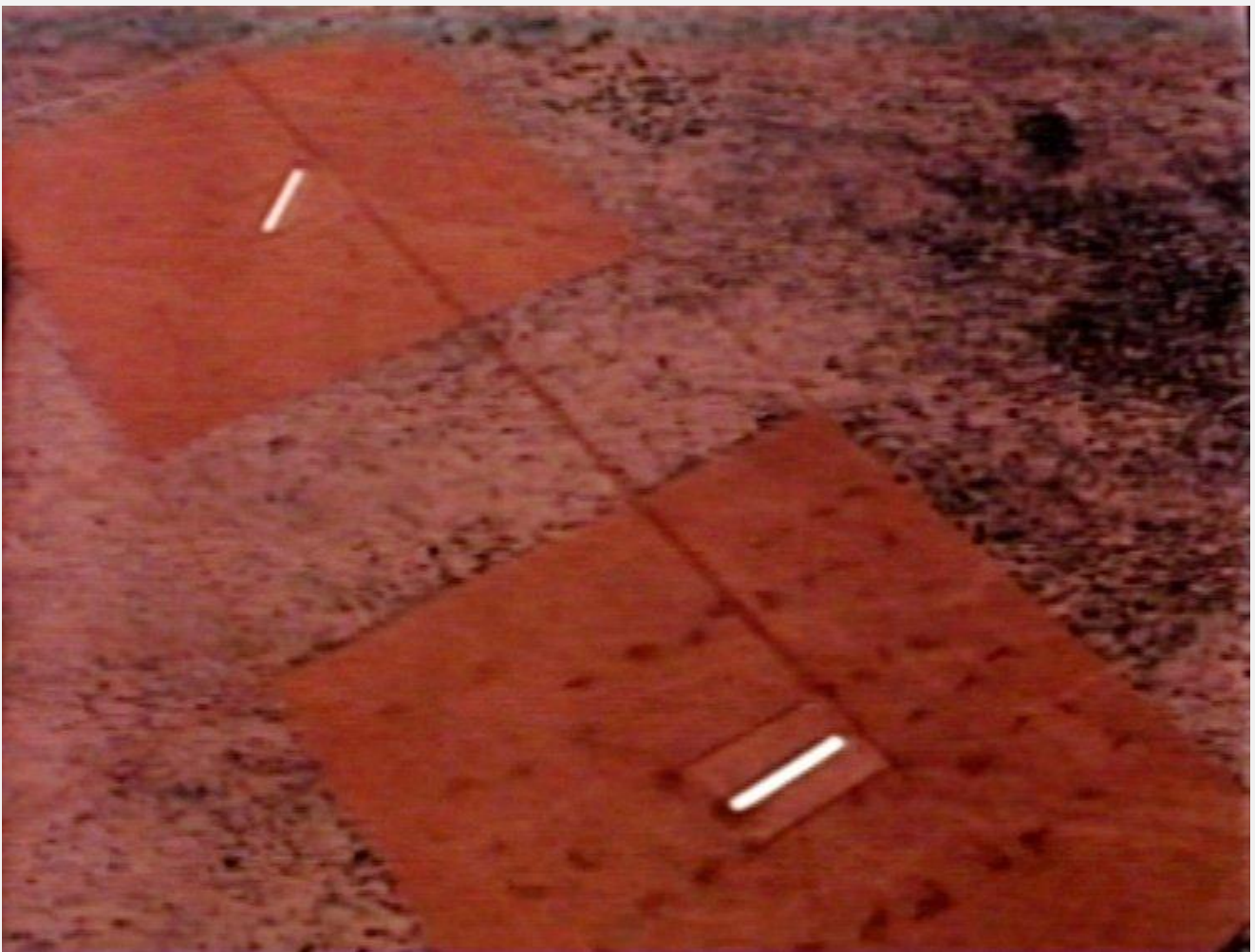
The target bar sizes and aspect ratios were radically altered on 22 and 23 August, in response to instructions from Dr. Duntley, based upon updated experimental data from the Visibility Laboratory.

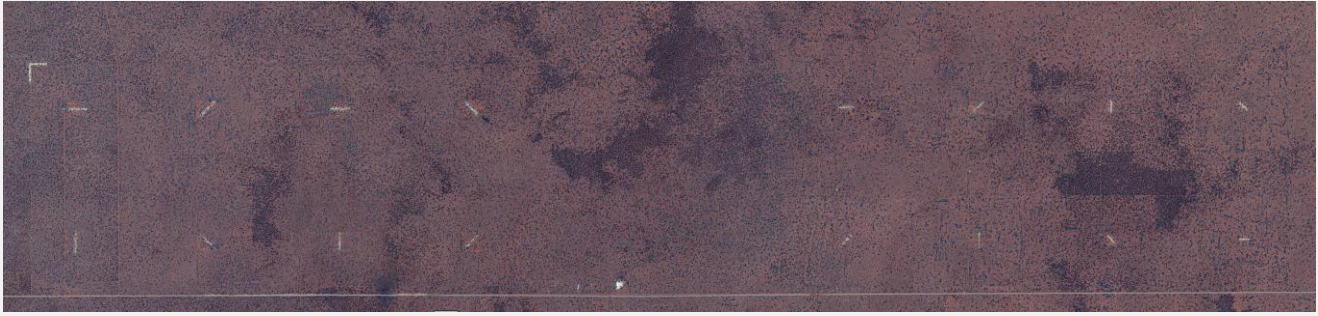
After the Gemini V launch on 21 August the Woodleigh team had little to do but anticipate the



Above: The Visual Acuity Test at Woodleigh Station seen from a light aircraft in late August 1965'
Image: Dept. of Supply film

Below: Looking down on two of the Visual Acuity Experiment targets at Woodleigh Station.





The pattern of shells is still clearly visible today. Each square is about 900 metres wide. The test area is 8.3 x 1.5 kilometres. northwestern corner marker is at approx. Lat -26.186°, Long 114.662° Image: Google Earth '26

first usable overpass on Revolution 73, 26 August. The local weather on that and the following day, during Revolution 88, was ideal, and although data were taken with the Contrast Reduction Meter and all local systems were fully operational, spacecraft difficulties with attitude control precluded observation of the target array by the astronauts. The same difficulty obviated sightings on Revolutions 118 and 133, but in these cases the local weather was unfavourable. The Woodleigh site was closed down and secured until Gemini VII, and the equipment returned to Carnarvon on 1 September.

Before departing Carnarvon, Dr. Taylor photographed the Woodleigh site and the landmarks along the coast which would aid in acquiring the target array from orbit during Gemini VII. Several hundred feet of 16 mm colour film was made using a camera borrowed from the Weapons Research Establishment, and by use of a chartered DC-3 aircraft belonging to Adastra Aerial Surveys Pty., Ltd., which had fortuitously, and almost literally, dropped into Carnarvon for repairs. This film found subsequent use in training the Gemini VII primary and backup crews.

Although the Woodleigh operation was thwarted by contingencies of the Gemini V mission and was eliminated from consideration for Gemini VII owing to orbital factors, several comments should be made regarding the site:

1. Acquisition of the site is aided by prominent coastal features of easily recognizable size and form. Astronaut Conrad was able to acquire these features and then to see the smoke pots even while in tumbling flight, and (by his estimate) at two or three hundred miles.
2. Should future use be found for the site, it would be a relatively easy matter to renovate the background squares (regrowth of native vegetation is very slow), and to replace the target array.
3. Proximity to the Carnarvon Tracking Station and the Northwest Coastal Highway, combined with a favourable latitude and good weather make Woodleigh a desirable location for this or related sorts of experiments.
4. Cooperation by all individuals and organizations involved in the effort was most outstanding and gratifying."

Further editor's note:

Even after more than 45 years (well, now 60 years), the patterns marked out by the shells are still visible from space. See below. (A second test area was marked out near Laredo, Texas.)

Essay by Hamish Lindsay, 2012-2014.

Images, illustrations and captions by Hamish Lindsay, Colin Mackellar, and Glen Nagle.

Unless specified, audio and video recorded, edited and encoded by Colin Mackellar.

PDF formatted by Glen Nagle.

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Note about images

Screen captures are from a Weapons Research Establishment / Department of Supply film taken in August 1965.

With thanks to Glen Nagle for a copy of the film from the CDSCC Archive, and to Ian MacKenzie for the transfer to digital format.

Also, NASA footage taken at about the same time, found in the National Archives of Australia. Footage identified and frames selected for the essay and website by Colin Mackellar.



ABOUT THE AUTHOR



Hamish Lindsay (1937-2022) worked at the Muehea, Carnarvon and Honeysuckle Creek space tracking stations between 1963 and 1981.

He wrote many essays on the history of human spaceflight, and was the author of the book, *Tracking Apollo to the Moon*.

