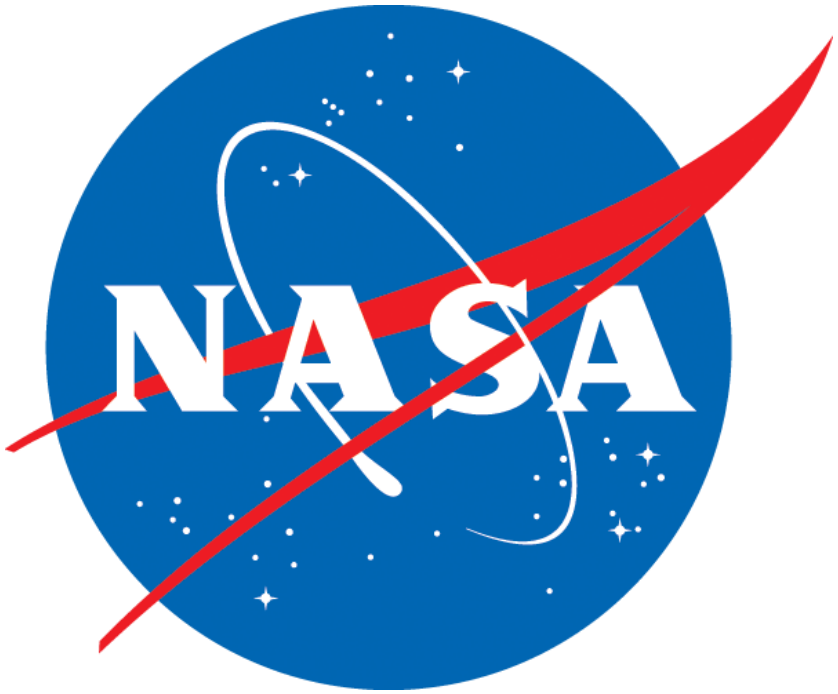
HONEYSUCKLE CREEK

GOES DEEP SPACE

an essay by

HAMISH LINDSAY



"...the entire crew of DSS-44 should be commended for their total professionalism in the tasks they performed."

Andre Caticchio, Network Operation System Support Group, JPL

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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:

Cover illustration: Original photo by Hamish Lindsay. Sky extended and colourised by Glen Nagle.

Laurie Turner (left) at the Ops console, Paul Mullen at Servo, and Terry Hearn on Receivers. Photo: H. Lindsay

The USB (Unified S-Band) and Operations Room at Honeysuckle Creek in the Deep Space era.
Photo: Hamish Lindsay. Scan: Colin Mackellar

HONEYSUCKLE CREEK

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We had quite a lot of experience with deep space tracking before joining the Deep Space Network (DSN) full time, as we had often helped the Deep Space Station DSS42 at Tidbinbilla in between the manned space missions and Skylab passes.

After the activity and intense pressure with the Manned Space Flight programs it was like a holiday to join the leisurely (to us) long-term projects of California's Jet Propulsion Laboratory's (JPL) Deep Space Planetary Programs.

Human lives were no longer at stake – there was much less hype and media attention if a robot spacecraft was lost in space, and the tracking procedures were much simpler and low key.

For a start there were no voice communications or medical data to worry about. The critical tracking times were during planetary encounters, when the data had to be received in real time. If it was lost there was no second chance.

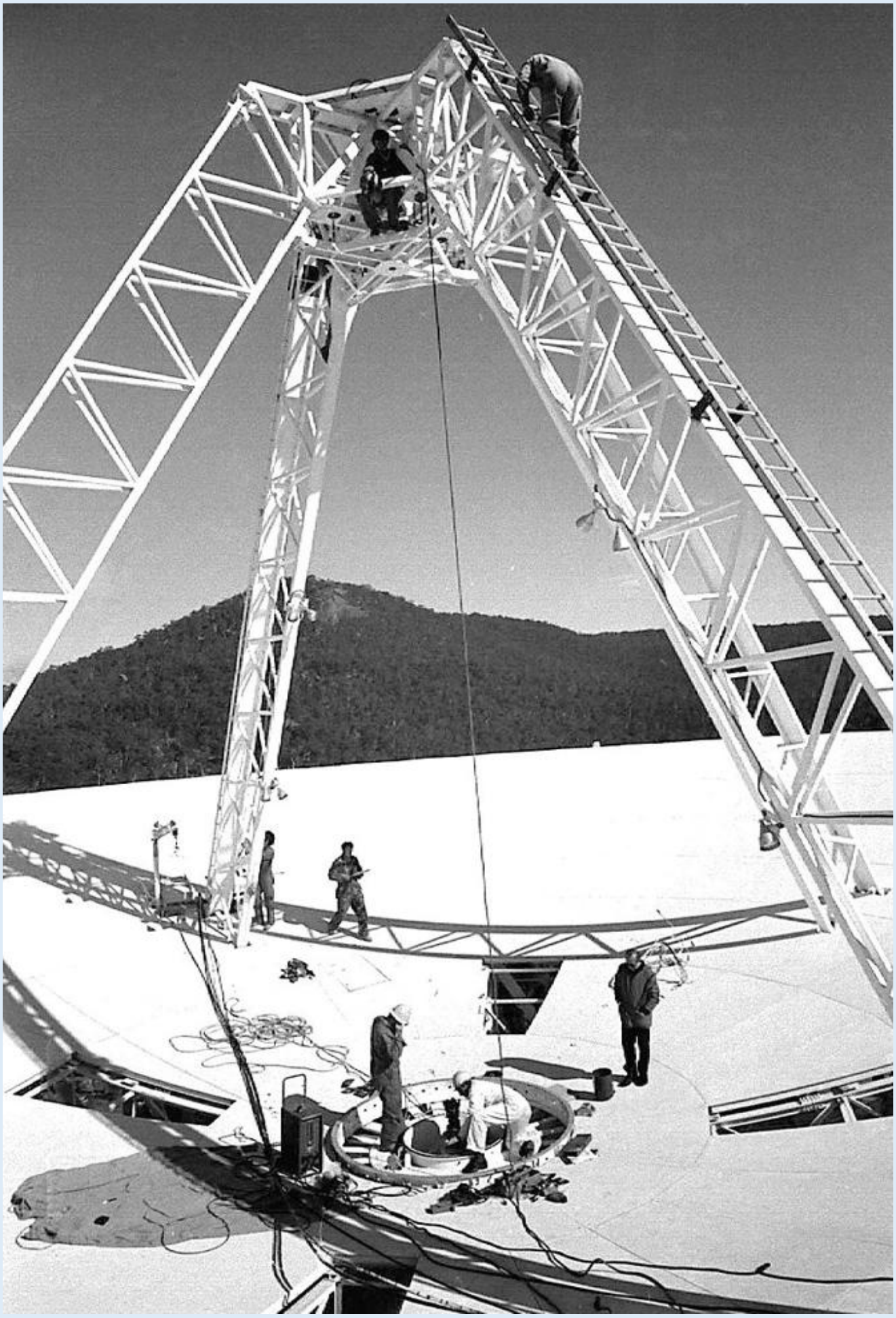
After Skylab was abandoned for the last time, Honeysuckle Creek left the Manned Space Flight Network (MSFN) in 1974 and was completely gutted of MSFN equipment, except for the antenna and servos, and replaced with deep space tracking equipment.

I was put in charge of the dismantling and shipment of all the MSFN equipment and then responsible for all the station drafting for the new configuration, and of course we all pitched in to install the equipment when it arrived.

Our staff was reduced; all the managerial and administration functions were carried out from the Tidbinbilla tracking station – we became just part of their shift teams.

I took over the Station Director's office and began working on a Canberra Space Centre for the public. I lost my Technical Support Section and staff of five but now had three desks and phone

Removing hardware on the 26-metre antenna. Photo: Hamish Lindsay. Scan: Colin Mackellar



Modifications to the sub-reflector quad-legs and main reflector (dish) surface. Photo: Hamish Lindsay

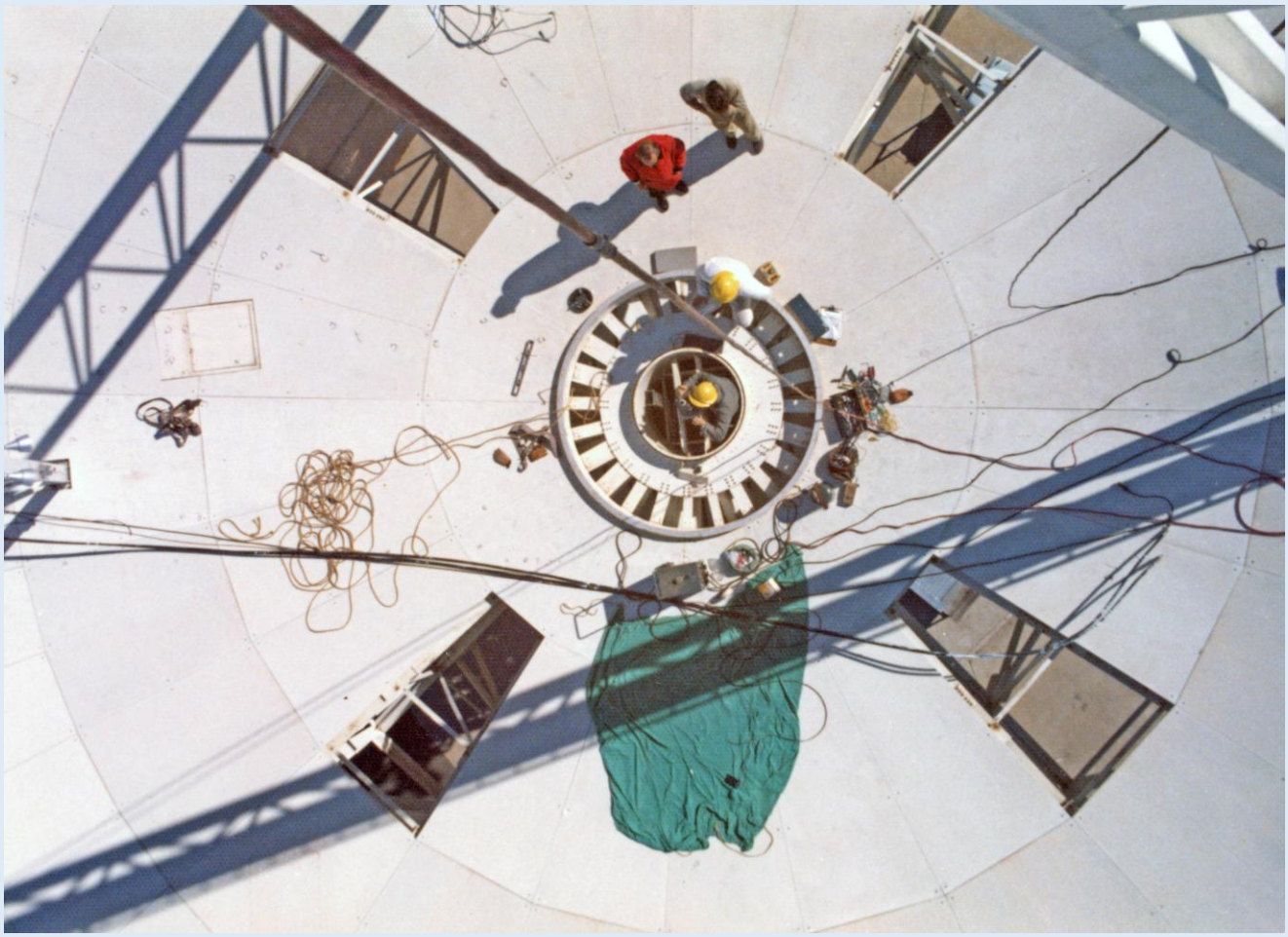


Photo from the Apex looking down into the dish. Photo: Hamish Lindsay. Scan: Colin Mackellar
John Hart with the theodolite (centre) and Tony Salvage (in the white overalls)

extensions – one for the Space Centre, one for operations, and the photographic darkroom. I also took on the role of public affairs officer and gave lectures and media interviews.

HSK Station Refit

The decision to add Honeysuckle to the Deep Space Network as Deep Space Station number 44 (DSS-44), involved a major refit of the station.

Mike Dinn recalls –
"A lot of the DSN equipment came from DSS41 – Woomera – Island Lagoon as it closed down."

And John Saxon adds,
"Some of the other DSN equipment came from the Deep Space Network site [DSS51] *at Hartebeesthoek in South Africa."*

Hamish Lindsay (the author) writes – *"In 1974 we adjusted every antenna plate to 5 – 10 thousandth of an inch to make a true parabola for maximum signal direction to the sub-reflector for the Deep Space era. The feedcone was removed and my theodolite was bolted to a special bracket (photo below) to measure the four corners of each plate."*

John Hart with the theodolite.

JPL's Deep Space Operations Control Center circa 1976. Image: NASA/JPL

The Jet Propulsion Laboratory

Occupying 58.7 hectares (145 acres) beside a sand and boulder strewn dry riverbed at the foot of the rugged San Gabriel Mountains in California, JPL was formed in October 1936 by the Caltech graduate students as a rocket research laboratory. The less esoteric title of Jet Propulsion Laboratory was chosen for the institution.

On 3 December 1958 JPL contracted to NASA and shifted from military rocket research to scientific spacecraft development and promptly began a comprehensive planetary exploration program.

Just before JPL joined NASA, it kick started the whole American space program with the Explorer 1 spacecraft on 31 January 1958.

Once it had teamed up with NASA, JPL supported the Apollo Program with the Ranger, Surveyor and Lunar Orbiter programs and initiated the Deep Space Program to explore the planets.

JPL beat the Russians to send the world's first spacecraft to successfully rendezvous with another planet when Mariner 2 reached Venus in December 1962 after a four month journey from Earth.

I visited JPL located in Pasadena, California, in 1990 and was shown over the establishment by Bob Latham, whom I had met on his trips to Australia.

It was interesting to see TRACK that I had spoken to over the communication links so many times over the years. TRACK was the operations centre for the JPL tracking network that organised the scheduling and details of the various spacecraft's tracking periods, issued all the acquisition and handover procedures, and in return soaked up our data from the spacecraft.

We would call the operations centre at JPL in California *"Track"* and when calling the center would say *"Track, 44"* and they would answer *"44, Track."*

'Track' at the Jet Propulsion Lab. Image: NASA/JPL

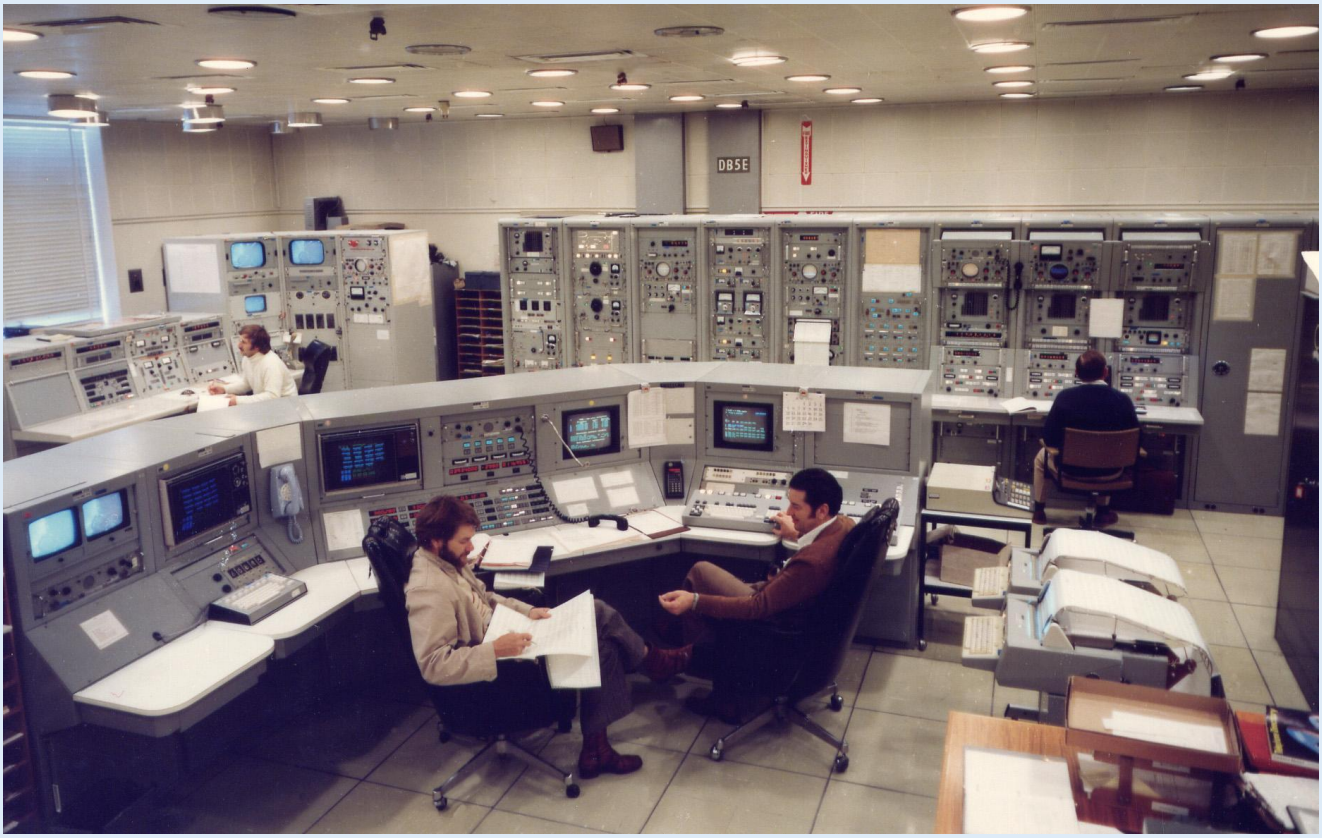
Above: The DSN reconfiguration underway in this photo taken on 134 September 1974.
The Servo window is behind the camera, with the Receivers seen on the left.
Images: (above) Photo/Scan: Phil Maier, (below) Photo: Hamish Lindsay. Scan: Colin Mackellar
Below: The same view as above after all the new systems were in place.

Above: Stirling Finlay (USB) and Charlie Collins (Comms), standing on a completed section of the underfloor cable and air conditioning plenum in the USB area.

Hamish notes: *"After we left the Manned Space Flight Network the station was stripped completely bare of all the equipment and cables, except the antenna servo console seen looking lonely by the window."*

Photos: (above and below) Hamish Lindsay

Below: The expanded Operations console in its new location.



Kevin Gallegos and Les Hughes at the HSK Operations Console in the foreground.
Alan Vonthethoff (far left) at the Servo Console, and Terry Hearn (far right) on Receivers.
Photo: Hamish Lindsay. Scan: Colin Mackellar

Deep Space Tracking Experiences

When Honeysuckle Creek became Deep Space Station DSS44, a companion to DSS42 and DSS43 at nearby Tidbinbilla, it embarked on the most exciting era of planetary exploration – a string of 'first-evers' to our planetary neighbours.

It continued the golden era of space exploration begun by Mercury, Gemini and Apollo to which I was a privileged participant.

My friends at Houston told me they were quite envious of my being a part of the deep space program as there was no way they could participate from Mission Control in Houston.

Honeysuckle was a home to me – I spent many hours on shift tracking the trailblazing spacecraft such as Helios circling the Sun, Pioneer 12 to Venus, the Mars Viking landers, and the Pioneer and Voyager probes to the outer planets.

Radio Astronomy

From time to time, Honeysuckle Creek was called on to help with radioastronomy.

Hamish Lindsay writes –

"During the Deep Space era HSK used to fill in time helping Dick Manchester of the CSIRO to track the Vela Pulsar. To us this was very easy tracking because it was only a downlink, so it was all within the USB section.

PSR 0833-45, or Vela, was a pulsar in the Gum Nebula with a period of 89.3 milliseconds. The Gum Nebula is the remnant of a supernova that occurred over 10,000 years ago with a diameter of 2,300 light years."

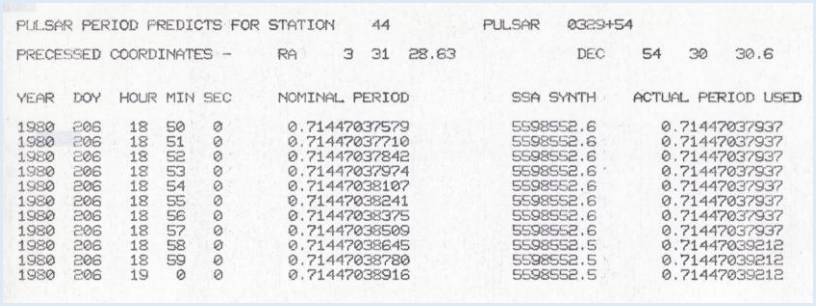
The nebula is named after Australian astronomer Colin Stanley Gum (1924–1960), who worked at the Mount Stromlo Observatory.

Radio Astronomer Dick Manchester writes –

"Timing the Vela pulsar is interesting because the period has unpredictable 'glitches' every few years, where the period suddenly decreases by about a part in a million. This is actually a huge change by the standards we measure pulsar periods to. The details of the glitch and its recovery give information on the interior of the neutron star.

The NASA stations were ideal for this as you need regular observations (at least weekly) *with a stable system.*

It was difficult to get that at Parkes as it is scheduled in bigger blocks (with bigger gaps between pulsar sessions) *and has different receivers at different times*. (Actually, we can now change receivers quickly with a translator system, so that is not such a big problem.)*"*



PULSAR PERIOD PREDICTS FOR STATION 44 PULSAR 0329+54

PRECESSED COORDINATES - RA 3 31 28.63 DEC 54 30 30.6

YEAR	DOY	HOUR	MIN	SEC	NOMINAL PERIOD	SSA SYNTH	ACTUAL PERIOD USED
1980	206	18	50	0	0.71447037579	5598552.6	0.71447037937
1980	206	18	51	0	0.71447037710	5598552.6	0.71447037937
1980	206	18	52	0	0.71447037842	5598552.6	0.71447037937
1980	206	18	53	0	0.71447037974	5598552.6	0.71447037937
1980	206	18	54	0	0.71447038107	5598552.6	0.71447037937
1980	206	18	55	0	0.71447038241	5598552.6	0.71447037937
1980	206	18	56	0	0.71447038375	5598552.6	0.71447037937
1980	206	18	57	0	0.71447038509	5598552.6	0.71447037937
1980	206	18	58	0	0.71447038645	5598552.5	0.71447039212
1980	206	18	59	0	0.71447038780	5598552.5	0.71447039212
1980	206	19	0	0	0.71447038916	5598552.5	0.71447039212

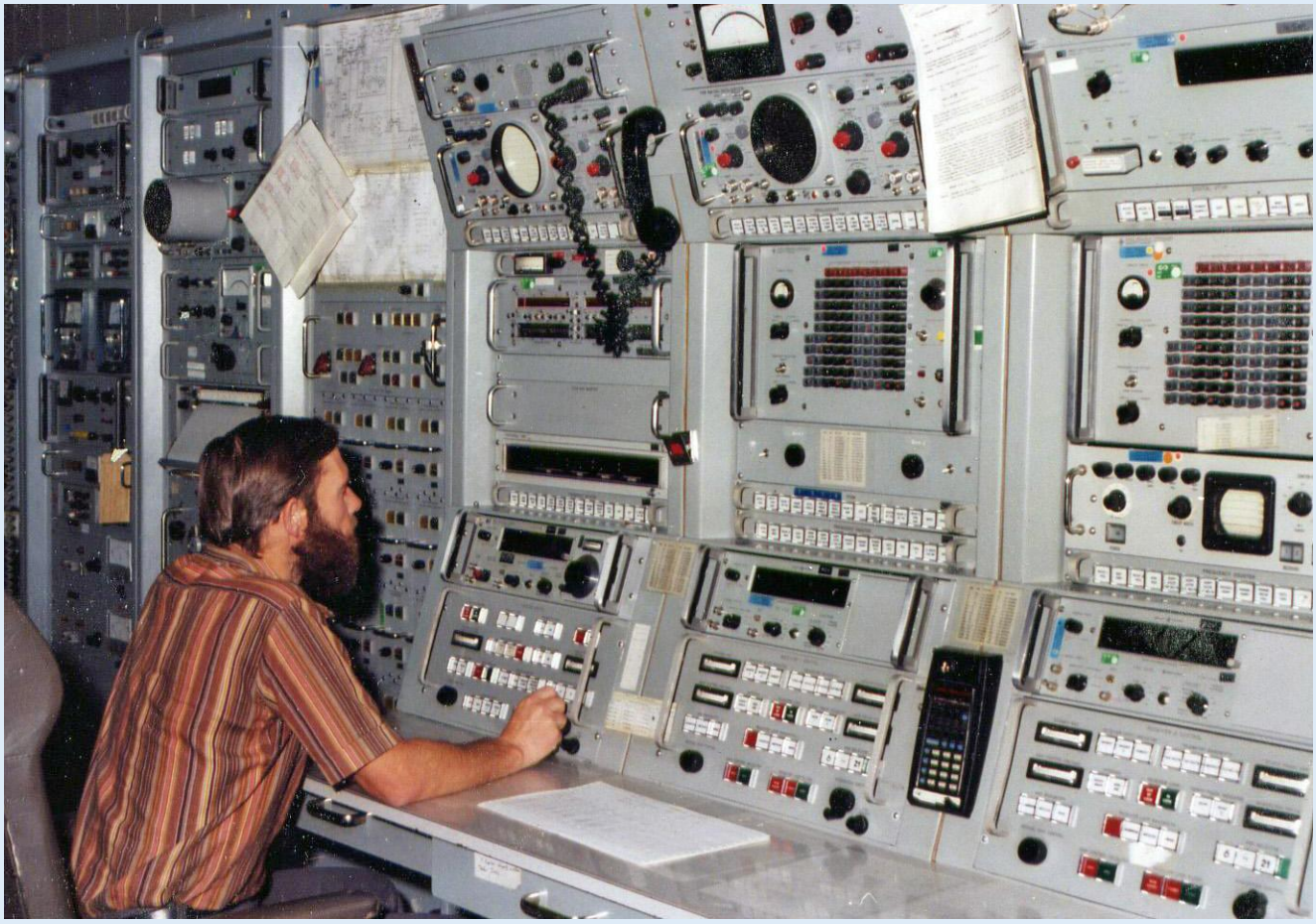
Extract from a computer printout of Pulsar predicts for PSR B0329+54 approximately 5,300 light-years away in the constellation of Camelopardalis. It completes one rotation every 0.7145 seconds and is approximately 5 million years old.

Preserved by Geoff Ruck. Scan: Colin Mackellar

DEEP SPACE MISSIONS SUPPORTED BY HSK/DSS-44

* Launched before HSK joined the Deep Space Network

Mission	Launch to End of Mission	Description
Pioneer 6*	16 Dec. 1965 – 8 Dec. 2000	Pioneers 6, 7, 8, and 9, formed a ring of solar weather stations spaced along Earth's orbit. Measurements were used to predict solar storms for commercial airlines, power and communications companies, military organisations, and entities involved in surveying, navigation, and electronic prospecting.
Pioneer 7*	17 August 1966 - 31 March 1995	
Pioneer 8*	13 Dec. 1967 – 22 August 1996	
Pioneer 9*	8 November 1968 – 1983	
Pioneer 10*	2 March 1972 – 23 January 2003	Jupiter (4 Dec.'73) flyby
Pioneer 11*	6 April 1973 – 24 November 1995	Jupiter (3 Dec.'74) and Saturn (1 Sept.'79) flybys
Helios 1	10 December 1974 – March 1986	Mission to investigate phenomena such as solar wind, magnetic and electric fields, cosmic rays, and cosmic dust in regions between Earth's orbit and the Sun.
Viking 1 Orbiter	20 August 1975 – 7 August 1980	Viking 1 was the first of a pair of complex deep-space probes that were designed to reach Mars and collect evidence on the possibility on life on Mars.
Viking 1 Lander	20 August 1975 – 11 Nov. 1982	
Viking 2 Orbiter	9 Sept. 1975 – 24 July 1978	Viking 2 mission consisted of a lander and an orbiter designed to take high-resolution images, and study the Martian surface and atmosphere.
Viking 2 Lander	9 Sept. 1975 – 12 April 1980	
Helios 2	15 January 1976 – 21 March 1980	Mission to investigate phenomena such as solar wind, magnetic and electric fields, cosmic rays, and cosmic dust in regions between Earth's orbit and the Sun.
Voyager 1	5 September 1977 - present	Jupiter (5 Mar.'79) and Saturn (12 Nov.'80) flybys. Now on interstellar mission beyond heliosphere.
Voyager 2	20 August 1977 - present	Jupiter (9 Jul.'79), Saturn (25 Aug.'81), Uranus (24 Jan.'86) and Neptune (25 Aug.'89) flybys. Now on interstellar mission beyond heliosphere.
Pioneer 12	20 May 1978 – 8 October 1992	Venus Orbiter conducting radar and ionospheric measurements.
Pioneer 13	8 August 1978 – 9 Dec. 1978	Venus Multiprobe mission deploying three probes to enter and study the Venusian atmosphere.



Hamish Lindsay at the Transmitter controls, turning the tuning knob to capture the spacecraft's transponder. The downlink from the spacecraft was fed from the antenna to the receivers to his right.

Hands on tracking

Like the early days of the manned space flights, it was rudimentary tracking in those days when we first joined the Deep Space Network.

Of course, we didn't think so at the time – we were up there with the latest technology doing things that had never been done before.

One example was capturing the spacecraft's downlink. We would switch on our transmitter and send a signal out to the spacecraft, sometimes simply acquiring a freewheeling downlink, or sometimes taking over from Goldstone in California, when both stations had to follow strict procedures so as not lose the spacecraft signal.

We didn't know what the rest frequency of the spacecraft transponder would be, so we had to tune our uplink signal from the lowest point to the highest point of the spacecraft's spectrum.

In those days we had to turn a knob by hand, carefully counting one and a quarter turns of the knob for each second, reading from a clock using Nixie tube numerical displays.

I remember one morning during a Pioneer 11 track at about 0700, at the end of an all-night shift, I had to turn this knob one and a half turns each second for 35 minutes, wait for a minute, then turn it back for another 10 minutes – 1,800 turns without falling asleep at the end of a midnight shift!!

If I had jerked the knob, or changed the speed too much I could lose the spacecraft, and have to get Track at JPL in Los Angeles to recalculate a new set of figures, and go through the whole acquiring procedure again. I never did lose a spacecraft, I don't think any of us did.

Later Tidbinbilla and our team tried to couple an electric motor to the knob, but it wasn't very successful; then as electronics developed JPL designed a very sophisticated box called a POCA (Programmed Oscillator Control Assembly) which did the whole acquisition procedure electronically to accuracies of millionths of a second.

It wouldn't twitch, get tired, or fall asleep, but could develop faults, and in its early days we could dial in the wrong figures.

Experience counts

One morning we were driving to work, and as we came around the hill I saw the antenna was still down on the collimation tower. They were supposed to be well into the day's track. My first thought was something's seriously wrong with the equipment. I went straight to the USB ops area and asked Martin Geasley, the shift supervisor, what was wrong.

"We can't find the spacecraft. We've double checked all the figures, tried everything. Track (JPL) can't come up with any answer."

"Did you add or subtract the doppler?" I asked.

"We added it, same as we always do," Martin replied.

"Well, you should have subtracted it, yesterday it reversed,"

I felt confident this was the problem.

They subtracted the doppler and promptly locked onto the spacecraft. Which just goes to show how such a simple thing as a plus or minus sign can make the difference between success or failure.

Essay by Hamish Lindsay, 2012-2014
With content from honeysucklecreek.net
created and developed by Colin Mackellar.
Unless specified, illustrations and captions by Hamish Lindsay, Colin Mackellar, and Glen Nagle.
PDF formatted by Glen Nagle.

Honeysuckle Creek in October 1980. This photo was taken by Bill Wood (Goldstone) on a Deep Space Network "flying clock trip" to provide a better time standard at all three DSN complexes.

Mike Dinn writes, *"The small dish* [on the right hand side of the microwave tower] *is pointing at the coll tower. In the later/last days, I think comms for ORR* (Orroral Valley) *and HSK* (Honeysuckle) *went via the coll* (collimation) *tower and a microwave link to Black Mountain. And towards the end, the last function at HSK was to keep a generator going to provide power to the coll tower for this."*

ABOUT THE AUTHOR

Hamish Lindsay (1937-2022) worked at the Muchae, 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.