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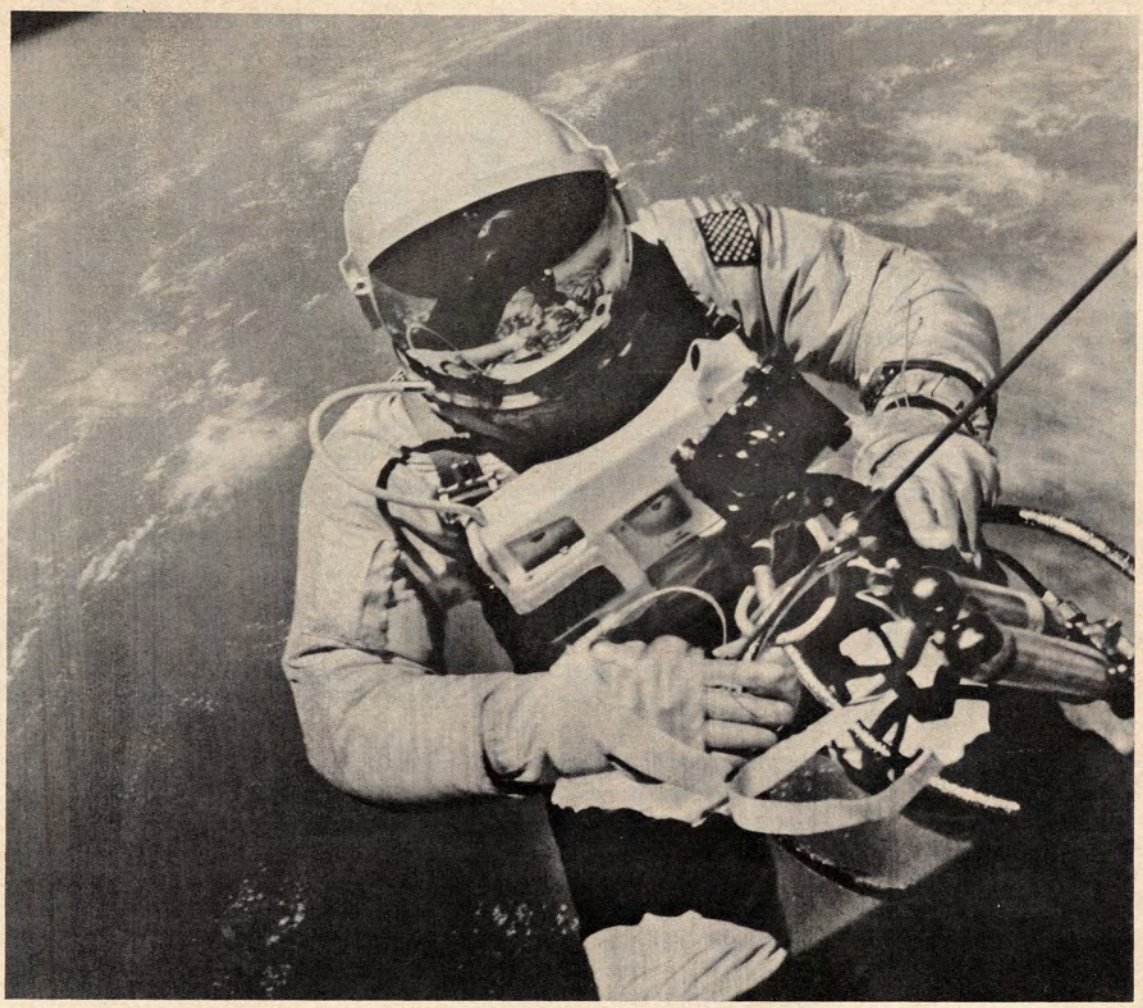

Astronaut Edward White space-walks from Gemini IV.

AND SPACE

by Gordon Sheldon

TWO HUNDRED YEARS AGO the Royal Society of London arranged to observe, in several parts of the world, an impending passage of Venus across the face of the sun on June 3, 1769. A year earlier Captain James Cook, about to embark on a voyage of exploration in the *Endeavour*, was appointed the Society's observer in the South Seas, where he planned to be.

Two centuries later, the Prime Minister of Australia, Mr. Harold Holt, opened a space tracking station at Honeysuckle Creek, near Canberra, which is destined to play a prime role in man's first landing on the moon. These are slender threads of history and geography linking the English sailor's visual probe into space on his way to explore unknown Australia and modern Australia's part in the fantastic space adventure of America's astronauts to explore the unknown moon.

Cook sailed into an uncharted world, bravely widening man's boundaries and forever seeking knowledge. He had no complex systems to help him to find out what that unknown world was like without actually going there. To-day, modern space explorers can first send their unmanned ships ahead to probe and examine and report back to earth before they venture forth. Yet even now, astronauts first embarking on a mission face unknown elements calling for the same questing courage which led Cook to Australia.

Space exploration began in 1957 and, with it, Australia's participation. Since then, Australia has continued to co-operate with the U.S. in all its space experiments. To-day there are six NASA space-tracking stations in this continent, more than anywhere else in the world except America. There is also a tracking station at Gove, Northern Territory, in support of the ELDO (European Launcher Development Organisation) programme carried out at Woomera.

Co-operation dates from the International Geophysical Year, 1957-58, when the United States sought Australia's permission to instal space-tracking equipment at the Woomera rocket range in South Australia. A "mini-track" station and a Baker-Nunn tracking camera were accordingly established there. The "mini-track" station was part of a network of radio interferometers spread across the world to measure orbital data of American satellites and to record data transmitted by them. The Baker-

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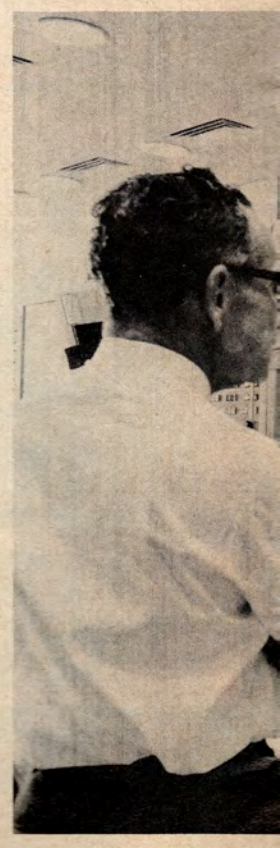
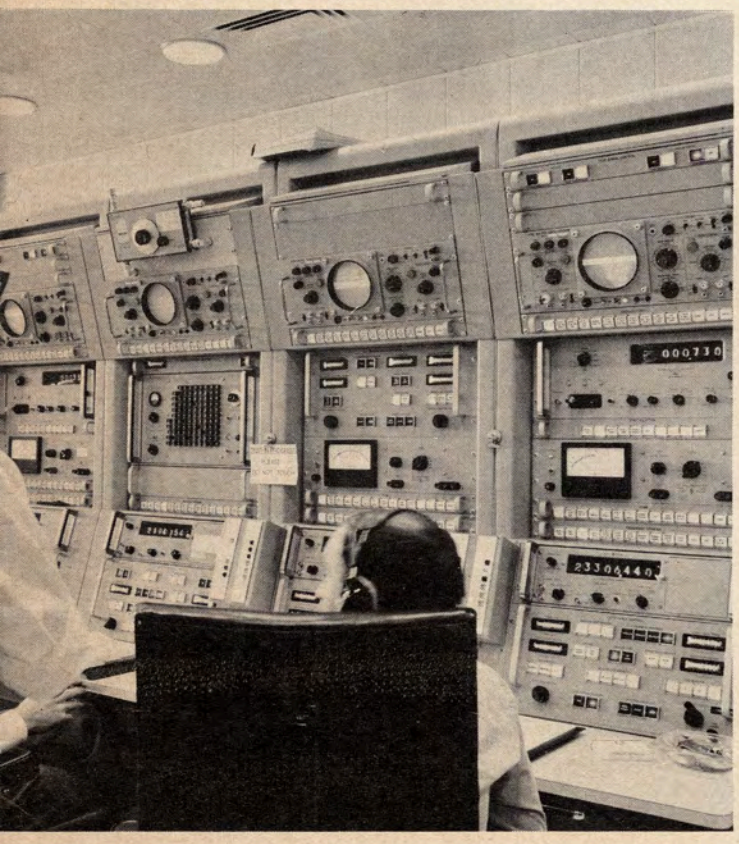
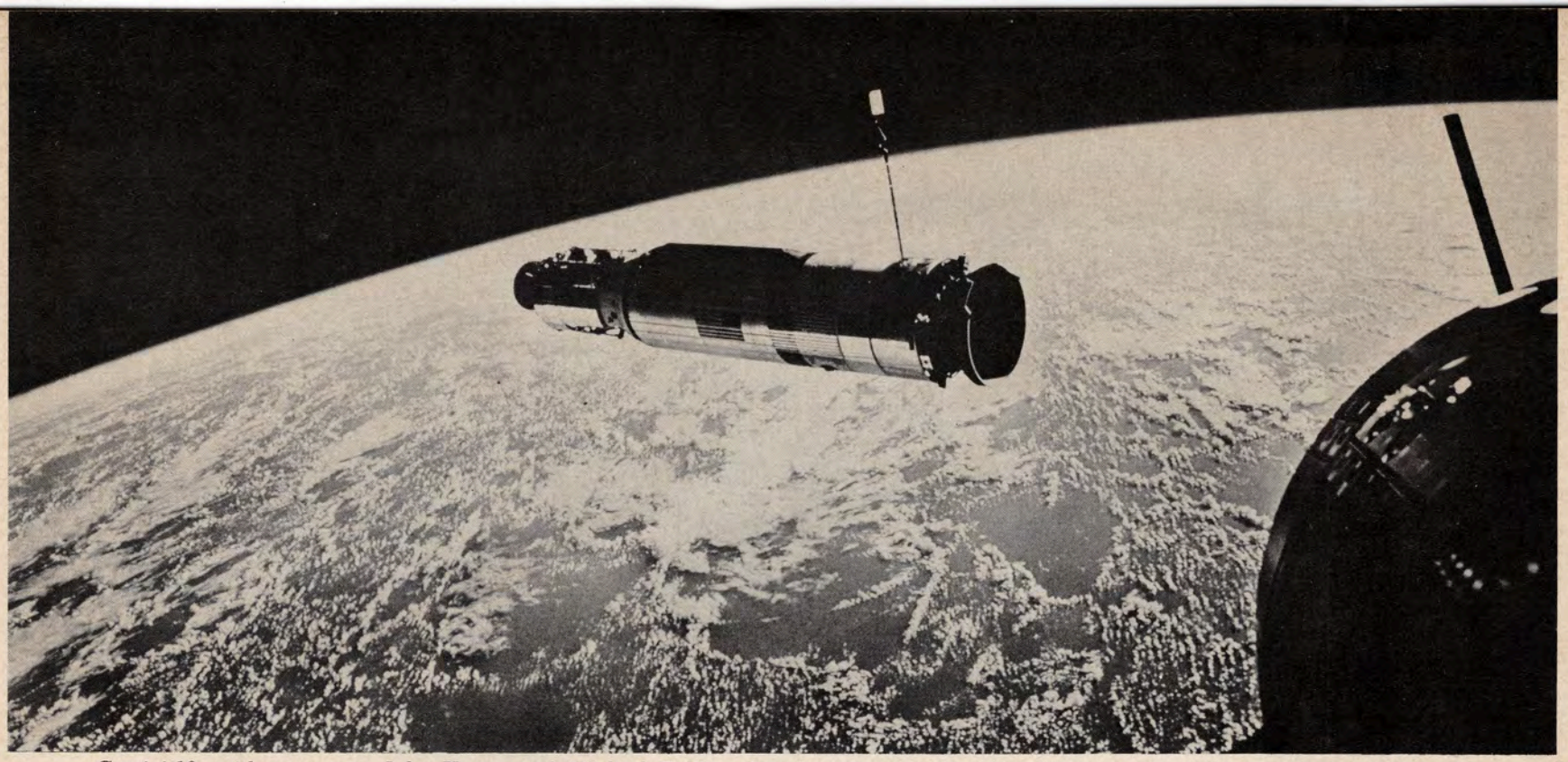


The 85-foot-diameter parabolic antenna of the deep-space-tracking station at Island Lagoon, Woomera, South Australia (above). Last month this station assumed the main rôle in Australia for Mariner V, launched in June to investigate Venus.

Complex control panels (below) at Honeysuckle Creek, A.C.T.



Control room at Carnarvon tracking station, Western Australia (below). Its voice communications system was used by the first Australian to speak to an astronaut during Colonel John Glenn's historic flight in February, 1962.



Gemini-10, with astronauts John Young and Michael Collins aboard, approaches the Agena-10 target with which a rendezvous was made nearly 200 miles above the earth in July, 1966.

CARNARVON IS VITAL CENTRE

Nunn camera made possible the accurate recording of small satellites at great distances. Because of the clear atmosphere around Woomera the camera's normal performance was considerably sharpened.

Eventually a deep-space station was built at Island Lagoon, about 14 miles from Woomera, to which the "mini-track" apparatus and Baker-Nunn camera were transferred. Island Lagoon was equipped with an 85-foot diameter parabolic antenna for deep space work.

Following the first successful unmanned earth-orbiting satellite programme came Project Mercury. In a series of missions, NASA (the U.S. National Aeronautics and Space Administration) put manned spacecraft into orbit to investigate man's reaction and his abilities in space and to recover safely both man and spacecraft. In support two more tracking stations were built in Australia; one at Muchea, near Perth, the second at Red Lake, near Woomera. On the completion of Project Mercury, in 1963, the Muchea station was replaced by a more elaborate installation at Carnarvon, Western Australia; the Red Lake radar equipment is still used in support of the manned space flight programme, for general range work and in support of ELDO firings.

The Carnarvon station has become one of the most important in the Australian network and is now closely involved with all manned space flights. The most remote of the stations, it is 612 miles north of Perth at the mouth of the Gascoyne River.

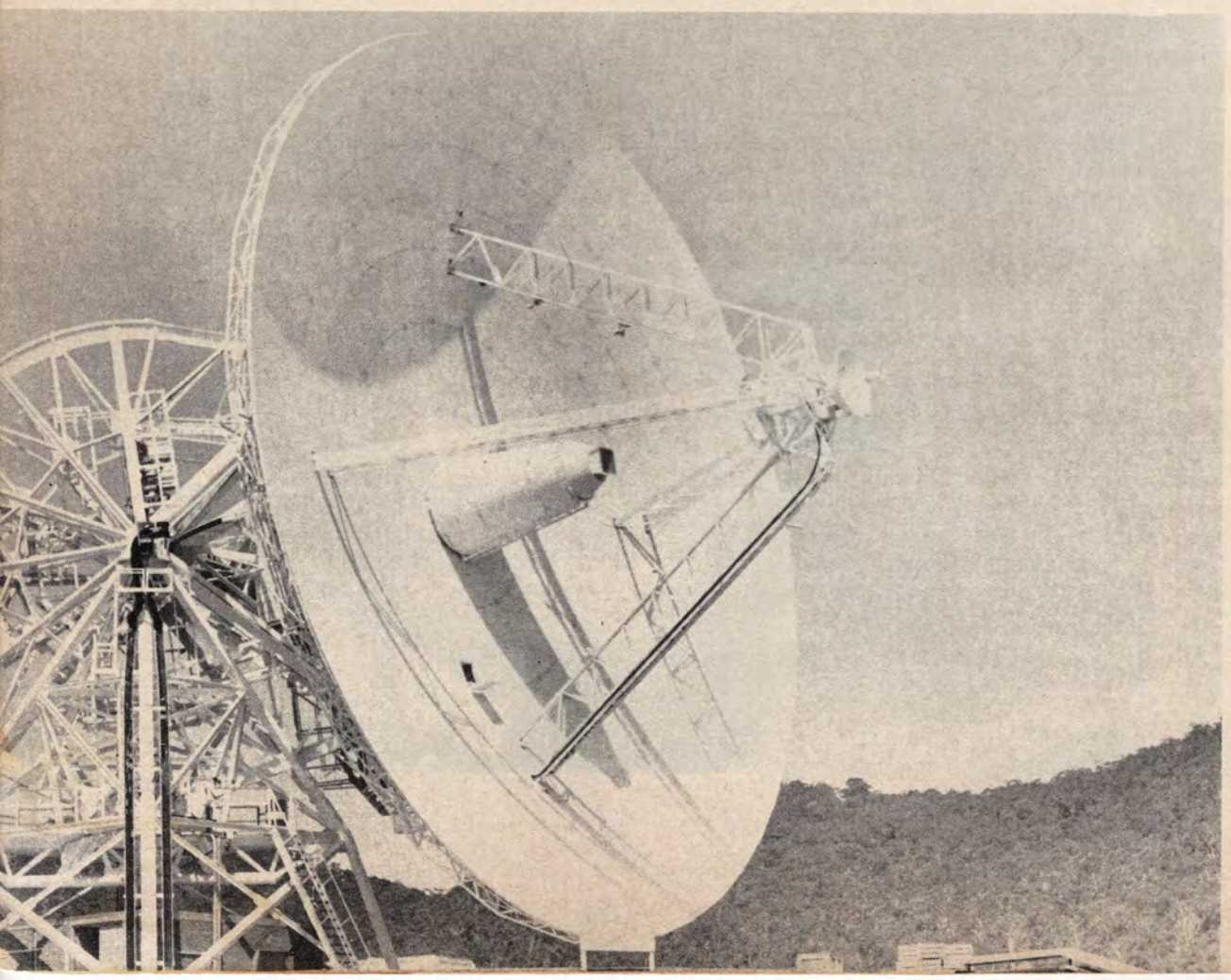
Carnarvon, first proclaimed a town in 1886, already had local importance as the port for the Gascoyne district, whose principal products are now fish, wool, sheep, bananas, vegetables and fruit. These are carried regularly by sea to Fremantle. There is also a thriving and increasingly important prawning industry employing up to 120 men and women in the peak season. Japanese fishing fleets have latterly been exploiting the abundance of tuna along the continental shelf.

To the town's population of some 2,000, the new tracking station has added scientists, technicians and administrators — people from all over Australia and from Britain, whose variety of accents are heard in Carnarvon's shops and homes. About 60 houses have been built for key staff of the tracking station, under lease from Carnarvon Council by the Department of Supply. More are to be built.

It was appropriate that the first live television broadcast between Australia and England, made possible by the communications satellite "Early Bird", should have originated at Carnarvon. Migrants from Britain were interviewed in the town's sunlit main street, and were seen in chilly London by their relatives, who, in turn, were televised back to Carnarvon.

The NASA tracking station itself was not used in this historic broadcast. The signals *viâ* the satellite were handled by a new Overseas Telecommunications earth station a little distance from the NASA installation. This station will be a vital link in ground communications during the manned flight to the moon.

American astronauts have tended to become sentimental about Western Australia, since Perth, on February 21, 1962, left all its lights on throughout the night, to cheer Colonel John Glenn, making America's first manned orbital flight, on his way overhead. Strong and reliable support, first from Muchea and now from Carnarvon, now adds to this feeling by spacemen.



Honeysuckle Creek's antenna (left) in its lowest position. Transmitters and receiver amplifiers are mounted close to the antenna microwave feed, from which signals are relayed to the control room.

PRINCIPAL APOLLO STATION

Each series of space missions mounted by NASA has been a logical step towards the fulfilment of Project Apollo, the plan for a moon landing and a safe return to earth before the end of the decade. After the Mercury missions, therefore, in each of which only one astronaut orbited the earth, Project Gemini began a programme of 12 flights. Ten of them, by two-man spacecraft, were of varying intent and complexity, with the main object of testing flight duration, rendezvous and docking techniques.

To bring at least one space flight down to earth for Australians, the capsule used in the tenth Gemini flight was brought to Australia at the end of March this year for a six months tour of capital cities and major towns. This capsule was flown by astronauts John Young and Michael Collins on an historic mission from 18th to 21st July, 1966, in which they achieved the first dual rendezvous in space, with the Agena-10 and Agena-8 rockets, and the manoeuvre after docking, using the propulsion system of another spacecraft (the Agena-10). The Agenas were unmanned spacecraft used as targets for these experiments.

In the rendezvous with the Agena-8, Young and Collins manoeuvred the docked Gemini-Agena-10 to what was then a record altitude of 475 miles. In all, Gemini-10 completed 43 earth orbits in 70 hours 47 minutes. During this time Michael Collins spent 72 minutes outside the spacecraft in various activities.

The capsule was first shown to the public at the official opening of Honeysuckle Creek tracking station in the Australian Capital Territory, and began its Australian tour at Canberra on March 30. The tour also includes Carnarvon, Toowoomba and Woomera, so that tracking staffs and local people may see one of the space machines that depend so much on the skill of Australia's ground stations.

Carnarvon tracking station, having operated in support of all the Gemini missions, successfully completed, at the end of 1966, will also do important work in Project Apollo. It will be joined by Honeysuckle Creek and a deep-space station at Tidbinbilla, about 30 road and 11 air miles from Canberra.

Tidbinbilla Valley is an ideal environment for such a station, because surrounding high ridges protect it against man-made interference, especially radio-frequency noise, which would seriously reduce the performance of the station's equipment. Nearness to Canberra also has an advantage in providing accommodation, communications, staff, and engineering and commercial services.

Tidbinbilla station was opened by Sir Robert Menzies 18 months ago. It is equipped with an 85-foot antenna and, during the final Apollo mission (the moon), will be complementary to Honeysuckle Creek, Australia's prime Apollo station. The two will be linked by microwave, and each will be able to communicate with the two astronauts on the moon's surface and with the third, who will remain in lunar orbit in the command module.

Besides the manned space projects, Australian tracking stations have supported two other programmes, Surveyor and Lunar Orbiter, both vital to Project Apollo, by Tidbinbilla and Island Lagoon respectively. In the Surveyor programme spacecraft are "soft-landed" on the moon to take and transmit photographs, together with other data about the moon's surface and atmosphere. The latest in the series, Surveyor III, was successful in its mission in April this year. Surveyor I, launched in 1966, sent back more than 11,000 pictures, many of them received at Tidbinbilla.

Lunar Orbiter spacecraft were put into low orbit around the moon to photograph possible landing sites for Project Apollo astronauts. The first in this programme, Lunar Orbiter I, launched in June last year, was tracked by Island Lagoon, which sent it instructions to perform vital manoeuvres during flight. Its photographs of the moon were transmitted back to Island Lagoon, and the first one to be taken on film and processed in a spacecraft was released to the world's press from that station. Previous space pictures had been transmitted direct by television cameras. There have, so far, been four Lunar Orbiter flights.

Other projects involving Tidbinbilla and Island Lagoon are deep-space probes to Mars, Venus and other planets to gather scientific information.

Two other tracking stations in Australia support unmanned, scientific space programmes. One of them, at Orroral Valley, in the A.C.T. (officially opened in February, 1966, by the Minister for Supply, Senator Henty), is part of the world-wide Space Tracking and Data Acquisition Network (STADAN) established by NASA to track and command unmanned scientific earth satellites and receive data from them by telemetry. Orroral Valley can cover at least four satellites simultaneously in this way. The STADAN programme includes many complex orbiting laboratories, such as the Orbiting Solar Observatory (OSA), the Orbiting Astronautical Observatory (OAO) and the Polar Orbiting Geophysical Observatory (OGO). The original "mini-track" station was moved during 1966 from Island Lagoon to Orroral Valley.

The second station, at Cooby Creek, near Toowoomba, Queensland (opened in October, 1966, by the Minister for Civil Aviation, Mr. R. C. Swartz), supports NASA's Application Technology Satellite (ATS) programme, which is intended to extend the scope of spacecraft technology in communications, meteorology, navigation and scientific observation. Satellites orbiting either at 6,000 miles or at 22,300 miles above the earth are used to send back information. At 22,300 miles' altitude the satellites are in geostatic orbit; that is stationary in relation to the earth's rotation.

Already a communication satellite is in geostatic orbit over the Pacific Ocean, and has been used to transmit television, both colour and black and white, from the U.S. and Japan to Cooby Creek. The live telecast, in June, of the Prime Minister from Montreal's Expo '67 during its "Australia Day", was transmitted *viâ* the satellite and Cooby Creek station to A.B.C. and commercial channels in the eastern States. Successful voice tests between Cooby Creek and a Qantas flight and even conversations with American civil aircraft flying over the U.S. have been held.

Arrangements for the design, construction, management, maintenance and operation of NASA space-tracking stations in Australia are made by the Commonwealth Department of Supply, as the local co-operating agency for all NASA activities. The Department calls either on its own or other departmental resources and those of private industry. Virtually all the capital and operating costs are met by NASA, whose capital investment in Australia is about $64 million — $52 million for equipment and $12 million for buildings, communication and roads. By the end of June this year the total cost of operating the Australian stations reached $33 million.

Economic gain is only one benefit of the space programme to Australia and probably, in the long run, not the most important. The strong co-operation between the two nations gives Australia opportunity to gain scientific and technological knowledge from the use of advanced electronic equipment and techniques. In addition, Australia is able to use that equipment for her own scientific research, as well as having access to the scientific data obtained from American space projects. On a more pragmatic and homely level, Australia shares the benefits of weather and communication satellites and navigation aids. Australia, in return, gives America the advantage of her geographical location, which is important in the siting of tracking stations, a stable political environment and reliable, trained engineers and technicians to operate the stations.

Although each station has a director who is an officer of the Department of Supply, operation and maintenance is let under contract to private industry. In all, about 1,000 Australian technicians and administrative staff are employed.

In three States and in the A.C.T., the huge antennae of 20th century exploration probe into space. Strange shapes of space-age electronic equipment appear oddly at home in Australia, whether in the soft, rich country of the Darling Downs, on the dry and red coast of the north-west, in the barren north of South Australia, or in the lovely ranges south-west of Canberra. Station buildings have been carefully and attractively designed and sit well in their aeons-old surroundings.

The tracking station which looks most at home is the Apollo station at Honeysuckle Creek, perched on a hillside, with huge granite boulders set naturally in the landscaped grounds around the station buildings. It is from here, within three years, that Australians plan to speak to American astronauts on the moon, some 200 years since explorer James Cook observed stars for the Royal Society and sailed into unknown seas to bring Australia into today's earth-bound but space-probing community of nations.