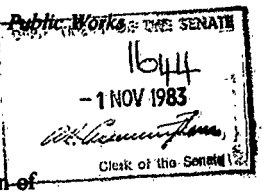
Parliamentary Standing Committee on Public Works



REPORT

relating to the construction of

THE AUSTRALIA TELESCOPE

New South Wales

(Fifth Report of 1983)

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA
1983

MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

(Twenty-Seventh Committee)

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PUBLIC WORKS COMMITTEE ACT 1969
ORDER UNDER SUB-SECTION 18(4)

I, SIR NINIAN MARTIN STEPHEN, the Governor-General of the Commonwealth of Australia, acting with the advice of the Federal Executive Council, in pursuance of Sub-Section 18(4) of the Public Works Committee Act 1969, hereby, by this order, declare that the public work described in the schedule be referred to the Parliamentary Standing Committee on Public Works for consideration and report.

SCHEDULE

CONSTRUCTION OF THE AUSTRALIA TELESCOPE
NEW SOUTH WALES

L.S.

Given under my Hand and the Great Seal of Australia on 13 July 1983

N.M. STEPHEN

Governor-General

By His Excellency's Command,

C.J. Hurford

Minister of State for
Housing and Construction

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C O N T E N T S

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

CONSTRUCTION OF THE AUSTRALIA TELESCOPE, NEW SOUTH WALES

R E P O R T

On 13 July 1983, His Excellency the Governor-General in Council referred to the Parliamentary Standing Committee on Public Works for consideration and report to Parliament the proposal for construction of the Australia Telescope, New South Wales.

The Committee has the honour to report as follows:

THE REFERENCE

1. The Australia Telescope project will provide a multi-element synthesis array of reflector antennas for radio astronomy observation of celestial objects and will essentially comprise:

- a Compact Array of six antennas at Culgoora, New South Wales;
- a seventh antenna at Siding Spring, New South Wales; and
- establishment of a Long Baseline Array in combination with the 64 metre radio telescope at Parkes, New South Wales.

The estimated cost of the proposed work when referred to the Committee was $30.7 million at March 1983 prices.

THE COMMITTEE'S INVESTIGATION

2. The Committee received written submissions and drawings from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Department of Housing and Construction and took evidence from their representatives at a public hearing in Canberra on 5 September 1983.

3. Written submissions were also received from the Australian Academy of Science, the Astronomical Society of Australia, and the Australian Academy of Technological Sciences. In addition, letters were received from the Australian National University and the Australian Bicentennial Authority.

4. On 3 August 1983 a Sectional Committee inspected the workshops and other facilities of the CSIRO Division of Radiophysics at Epping, N.S.W., and on 4 and 5 August 1983 inspected the sites for the proposed work and existing radio and optical telescope facilities at Parkes, Siding Spring and Culgoora. By courtesy of Aeropelican Airlines members of the Sectional Committee also viewed the three sites from the air.

5. The Committee's proceedings will be printed as Minutes of Evidence.

BACKGROUND

6. Australian Telescopes Astronomy in Australia is carried out using both optical and radio telescopes.

7. Large optical telescopes have been located in Australia since the Great Melbourne Telescope was constructed in 1858. Today Australia has a number of optical observatories including the world class Anglo-Australian Telescope at Siding Spring.

8. Radio astronomy is a more recent field and Australian scientists have been in the vanguard of its developments. CSIRO and university scientists conceived and built a generation of advanced radio telescopes during the 1960s. They were:

- the Parkes 64m telescope, completed in 1961;
- the 1.6 km Molonglo Cross array, completed in 1965;
- the Culgoora Radioheliograph for solar research, completed in 1967; and
- the Fleurs Synthesis Telescope, commissioned in 1973.

Many important discoveries have been made, and are still being made by these telescopes as they have been progressively upgraded.

9. CSIRO Division of Radiophysics Pioneering work in radio astronomy has been carried out by scientists of CSIRO since their wartime involvement in the development of radar. The Radiophysics Laboratory spent the years of World War II on research into radar for the allied forces in the SW Pacific.

10. After the war the resources of the Division were redeployed into a number of new research areas including aircraft navigation, digital computers and radio astronomy. For a quarter of a century there has been fruitful cross-fertilisation between these areas of research, with important contributions to space research and satellite communication.

11. Presently the major research activities of the Division of Radiophysics are in antennas, microwave devices, microwave systems, signal and image processing and radio astronomy. The Division can be regarded as both a technology division and an astronomy division, as it is conducting advanced research in both astronomy and the related technology.

12. For the past 20 years CSIRO radio astronomy has been carried out at two observatories in New South Wales - at Parkes and at Culgoora.

13. At Parkes the 64m diameter radio telescope has completed two decades of front-line research in astrophysics at centimetre wavelengths.

14. At Culgoora the 3 km diameter radioheliograph, which is a unique array comprising 96 telescopes, was used for the study of solar activity at metre wavelengths. This telescope operated through two sunspot cycles to support the US Solar Maximum Mission Satellite, but ceased operation at the end of the commitment in August 1983.

15. In 1980 the CSIRO Executive reviewed the Division and endorsed the view that radio astronomy should continue as part of a wider effort in radiophysics with application to community and industrial problems.

THE NEED

16. The need for the Australia Telescope must be considered in different terms from most other projects considered by the Public Works Committee. The need for most construction projects is established on the basis of the condition of existing facilities, and/or the requirement for additional accommodation or facilities for a particular function of government.

17. In this case the need may be expressed in terms of national prestige, international responsibility in astronomical research, and the impetus for introduction of new high level technologies in Australian industry.

18. Australia's International Standing in Astronomy Australia in general, and CSIRO in particular, has led the world in the development of the new science of radio astronomy.

19. Major advances in radio astronomy have frequently come with improvements of instrumentation. The Division's main instrument, the Parkes telescope, is now over 20 years old. It has been continually upgraded and is still making new discoveries.

20. However, the requirements of modern astronomy cannot be satisfied by the existing generation of Australian telescopes. For example, they cannot receive the high frequencies required to observe objects with the fineness of detail now being obtained by optical and space telescopes. New radio telescopes have been built in the northern hemisphere with these enhanced capabilities, and a new radio telescope, designed for future needs, is required if Australia is to maintain its reputation and position at the leading edge of astronomy, and if Australian scientists are to continue to make significant astronomical discoveries.

21. Overseas Telescopes The Australia Telescope will be a synthesis telescope. Radio signals will be received from an array of antennas directed at the same point in the sky. Using advanced electronics and data handling techniques they will be combined in such a way as to simulate the image received with a single antenna with a diameter equivalent to the largest separation of the components of the array.

22. There are presently two new synthesis telescopes in operation in the northern hemisphere. They are the U.S. Very Large Array (VLA) in New Mexico, and the Multiple Element Radio Linked Interferometer (MERLIN) in the UK.

23. The VLA is an array of twenty-seven 25 metre antennas in a Y-shaped configuration. The antennas can be moved on railway tracks and spaced to simulate a single antenna up to 40 km in diameter.

24. MERLIN, the UK telescope, comprises 6 antennas of various sizes separated by up to 134 km. There are plans to extend this telescope by adding further antennas to the array.

25. The Australia Telescope will complement in some respects and exceed in others, the capability of these two arrays in the northern hemisphere.

26. Responsibility to Study the Southern Skies Australia's location in the southern hemisphere is particularly valuable in astronomy because telescopes in the northern hemisphere cannot see many unique and important celestial objects in the southernmost part of the sky.

27. The southern sky presents Australian scientists with the opportunity to observe a range of unique and important objects, such as the nucleus of our Galaxy (which passes almost overhead in N.S.W.), the Magellanic Clouds (the nearest galaxies to our own), and the nearest radio galaxies.

28. The nucleus of our Galaxy is a strong radio source, a centre of great dynamical activity, and the location of a concentration of dense clouds of organic molecules. The energy source for all this activity is presently not understood.

29. The Magellanic Clouds are important in astronomy because the birth and death of stars can be studied better there than anywhere else.

30. International Obligations Australian astronomers have access to telescopes within Australia, and overseas, free of charge. Likewise, Australian telescopes are made available to overseas astronomers on a similar basis.

31. In astronomy, it is the world-wide custom to allocate telescope time on the basis of scientific merit and to charge users no more than the costs of accommodation and consumable items needed for their particular projects.

32. Through this system Australian astronomers have been allocated substantial time on overseas radio telescopes, including the VLA in New Mexico. In return for the use of overseas facilities, Australia has a moral obligation to the international scientific community to provide high standard facilities, not only for Australian astronomers, but for reciprocal use by overseas scientists.

33. The Australia Telescope will therefore provide Australian scientists with the means to honour our international obligations to participate in astronomical research on a global scale.

34. International Collaboration The performance of the Australia Telescope will promote fruitful collaboration with major world scientific centres, and allow Australian scientists to participate in joint experiments, including future experiments involving expensive satellite-borne instruments.

35. The Australia Telescope will therefore complement the new generation of satellite-borne telescopes to be launched in the near future. These telescopes are the Space Telescope (launch -

1986), the Space Infrared Telescope Facility (launch - 1990), the Advanced X-ray Astronomy Facility (launch - 1990), and Starlab (launch - 1990).

36. National Prestige Considerable national prestige will be associated with the Australia Telescope. This will come firstly from the innovation of the telescope design, then later from the quality of the research that will be possible with the instrument.

37. Industrial Relevance In its short history, radio astronomy has resulted in many improvements to communications and navigation. It is also anticipated that the Australia Telescope will continue to produce many local developments in high technology areas. The antenna, feed horn, panel and low noise receiver design, and fabrication skills that are being introduced, have an immediate application in satellite communications.

38. Other technological advances relevant to industry will be in the area of high speed digital techniques, particularly those involving optical fibres, and the development of very large scale integrated (VLSI) circuits which have an impact on signal processing techniques. The sophisticated image-processing techniques will have valuable applications in areas such as mining and medicine.

39. Technological innovation with application for industry has come from previous CSIRO telescope projects - e.g., the Interscan Microwave Landing System resulted from the radio astronomy work of the Division of Radiophysics. However, such developments are not necessarily foreseen when telescope projects are originally conceived and constructed. The full value of a radio telescope project, in terms of benefits to industry, may not be evident until some 10 or 20 years after the completion of the project.

The Australia Telescope may therefore result in significant future benefits to industry - benefits that are not presently foreseen.

40. Australia's Bicentenary The Board of Directors of the Australian Bicentennial Authority has endorsed the construction of the Australia Telescope over a six-year period, as a worthwhile project. The Board considered the proposal to be consistent with several of the objectives established for the Bicentennary - it will enable Australia to maintain its strong reputation in the field of radio astronomy and fulfil its international obligations in this field; it will provide a useful and enduring legacy of the Bicentennary; and it is cost-effective.

41. Summary Australia's existing radio telescope facilities have increasingly obvious limitations due to age and do not have the capability of the next generation of radio telescopes recently constructed in the northern hemisphere. A new high performance telescope is therefore required if Australia is to maintain its reputation as a leading nation in world astronomy, and if Australian astronomers are to continue to make significant astronomical discoveries.

42. Australia also has an international obligation to provide facilities for use by the world astronomical community, as well as by Australians; and by virtue of our location in the southern hemisphere, a responsibility to study the southern skies.

43. The Australia Telescope will be highly innovative and will also be a vehicle for international collaboration, particularly with the next generation of satellite-borne instruments.

44. The Telescope will enable Australian astronomers to maintain their place at the forefront of the science, and the technology developed will provide Australian industry with opportunities to develop a keen competitive edge in areas such as satellite communication.

45. The Australian Bicentennial Authority has accepted the Australia Telescope as a worthwhile Bicentennial Project.

46. Committee's Conclusion There is a need for the Australia Telescope to maintain Australia's high standing in world astronomy, to facilitate international co-operation and collaboration in astronomy, and to further develop Australian industry associated with the science.

THE AUSTRALIA TELESCOPE

47. General Principles of Radio Telescopes All celestial objects emit electromagnetic radiation over a range of wavelengths - including optical wavelengths, and radio wavelengths from as short as several millimetres, to several metres in length. See Illustration "A".

48. Radio telescope antennas are designed to receive radio signals at selected radio frequencies. When these signals arrive at the antenna they are channelled through its various components and associated electronics until processed and stored by a computer for later analysis.

49. In operation, a radio telescope antenna such as will be constructed for the Australia Telescope, is pointed towards a celestial object that is to be observed. Radio waves of all frequencies strike the parabolic precision antenna surface. They are then reflected to the sub-reflector which is supported on legs above the antenna surface, and then focussed to the feedhorn at the hub of the antenna dish. The feedhorn filters the radio signals and accepts only those of the frequency required. The signal is then channelled to the cryogenically cooled low-noise receiver where it is amplified and converted to digital form and then fed to a computer for storage and analysis.

50. The Synthesis Telescope Concept To probe the universe finely at radio wavelengths requires an extremely large radio telescope, far larger than can be built as a single structure. However, the synthesis telescope concept has been devised whereby a telescope of virtually unrestricted size can be built by linking many smaller telescopes together in an array. The simultaneous output of these telescopes are computer processed to produce a radio map equivalent to that which would be obtained from a single telescope, hundreds or thousands of kilometres in diameter.

51. In practice the Compact Array of the Australia Telescope, which will consist of six 22m antennas in a line 6 km in length, will be able to simulate a strip of antenna dish 6 km long and 22m wide. By taking advantage of the rotation of the earth, this array will sweep the sky and simulate a single large antenna.

52. Performance Requirements The purpose of the Australia Telescope is to provide an advanced tool for Australian radio astronomers of the 1990s and beyond. It will make detailed maps of radio emissions from celestial objects with an angular resolution comparable to or better than that obtainable with large land based optical telescopes or orbiting optical instruments.

53. The Australia Telescope derives from the Australian Synthesis Telescope proposal that was first put forward in 1975. With this telescope Australian astronomers will be able to tackle major unsolved problems of modern astrophysics, participate in future discoveries, and resolve the problems that such discoveries are likely to pose. In order to facilitate this work the telescope must have the following performance characteristics:

- Fine resolution of detail: The need to observe fine detail requires a telescope far larger than can be built as a single structure. A synthesis telescope is therefore the best means of achieving greater resolution of detail than is possible with the previous generation of radio telescopes.

- High sensitivity: The ability to detect weak radio signals depends on four factors - the collecting area of the array, reducing the thermal noise in the receiver components, a wide operating frequency bandwidth, and freedom from harmful radio interference.

- Particular operating frequencies: The proposed science requires operation at a series of bands between about 400 MHz and 50,000 MHz, with the ability to observe two frequencies simultaneously, and to change frequency bands rapidly. The bands must include the frequencies of the characteristic emissions of the most abundant interstellar atoms, ions, radicals and molecules, thus enabling the analysis of the chemistry of our galaxy, and of distant galaxies, that cannot be studied in any other way.

- Sufficient speed of operation: Simulation of a large telescope requires either many individual antennas or the moving around of a small number of antennas. The latter is the only economic possibility.

54. Configuration The proposed Australia Telescope will consist of two parts, a Compact Array and a Long-Baseline Array. See Illustration "B".

55. The Compact Array will consist of six identical antennas, 22m in diameter, located at the CSIRO Observatory at Culgoora in northern New South Wales. Five mobile antennas will be located on a 3 km rail track lying in an east-west direction, and will be capable of being moved between 40 set stations along this length. The sixth antenna will be located on a short length of track a further 3 km from the western end of the 3 km track. The maximum separation, or baseline, will therefore be 6 km.

56. The other part of the Telescope is the Long-Baseline Array. This will be created by linking one or all of the antennas of the Compact Array at Culgoora with a further two remote antennas. These antennas will be an additional 22m antenna constructed on a site owned by the Australian National University at Siding Spring Mountain (100 km from Culgoora), and the existing 64m radio telescope at Parkes. The Australia Telescope will therefore have a maximum baseline of about 300 km - the distance between Culgoora and Parkes.

THE PROPOSED WORK

57. Antenna Design The overall antenna design has been carried out by two consultants - Macdonald, Wagner and Priddle Pty Ltd of Sydney, and Ir B.G. Hooghoudt of the Netherlands.

58. The seven antennas to be constructed will be fully steerable paraboloids with an overall diameter of 22m. The highest point of each antenna will be approximately 25m above ground level. The antennas will be identical to each other so that errors due to thermal or structural effects will be the same. Each will be mounted on a 10m x 12m base and equipped with bogies for movement along a wide gauge railway track. During observations each antenna will be stationed on a set of concrete foundations to a precision of about a millimetre.

59. To perform well at high frequencies control of the antenna dish and movements due to wind and heat will have to be very precise. Each antenna must be able to point in a given direction to a precision of 12 seconds of arc (1/300th of a degree) under average weather conditions. The structural design has aimed at obtaining an average deviation from the ideal shape of 0.15mm, taking into account gravity and wind loading. The structure in the central region (to about 10m in diameter) will have even higher accuracy, permitting observations at millimetre wavelengths. A diagram of a typical antenna to be constructed for the Australia Telescope is at Illustration "C".

60. Antenna Surfaces The surface panels will be of a sufficiently high precision to allow operation at frequencies of at least 40GHz. The central 10m will be usable at 115 GHz. Although the panels will comprise a significant proportion of the cost of the antennas, the cost will be minimised by using simplified fabrication techniques and semi-skilled labour. The Division of Radiophysics has considerable experience in reflective panel design and construction, and the panels may therefore be constructed within the Division.

61. Servo Control Tracking System The design of the servo control tracking system will be undertaken by the Department of Electrical Engineering at the University of Newcastle under the general supervision of the Division of Radiophysics.

62. Operating Frequencies and Feedhorn Systems Seven frequency bands between 400 and 50,000 MHz are initially planned. Other frequencies will be added in the future. Normally, a separate feedhorn is required for each frequency band.

63. The innovative wideband feedhorns to be used in the Australia Telescope have been designed within the Division of Radiophysics. These feedhorns will be sensitive to two adjacent

frequency bands. This will make possible simultaneous observations in more than one frequency. It will also minimise the number of feedhorns that will be required on each antenna.

64. The feedhorn assembly will consist of a rotatable turret which will be a 2m high cone at the centre of the main surface of the antenna. The appropriate rotation, which is remotely controlled, will bring any of the feedhorns on axis as required.

65. Low-Noise Receivers Each antenna will be equipped with low-noise receiving equipment for operation within the seven required frequency bands. The Division of Radiophysics is developing new types of low-noise receivers which, except for the lowest frequency receiver, will be cryogenically cooled to reduce thermal noise in the receiver components. The receivers will be grouped in pairs, each packaged in a single low temperature vacuum chamber with a common refrigerator, for operation at a temperature of 20 degrees above absolute zero (i.e., - 253°C).

66. The receivers will be housed in the rotatable turret, with the feedhorns.

67. Signal Distribution in the Arrays For the Compact Array four channels containing receiver outputs will be available from each antenna. Transmission of signals to the control centre will be by optical fibre links. Other signals containing information about the operating frequency, telescope control and monitor data will also be transmitted to and from the antennas using a further three optical fibre channels.

68. For the Long Baseline Array, microwave links will be used. If frequencies between near 2,000 MHz are chosen, single 'hops' of 100 km are possible. Apart from small towers needed at each site, existing towers and facilities will be used where possible.

69. Digital Correlator At the control centre, the incoming signals from pairs of antennas are correlated. From the Compact Array alone, up to 6,144 million bits of information will reach the control centre every second. An innovate way of handling such high data rates is to convert the data into parallel streams, each with a data rate of only 10 million bits per second, which are then processed simultaneously. The circuitry to do this is based on the VLSI chip under development within CSIRO.

70. Computing Computing facilities at the control centre will provide control of the array, and also enable some on-site data processing, monitoring and editing to take place. The correlator output will be recorded on magnetic tape and further processing will then be carried out at home institutions of users or with facilities set up at the Division of Radiophysics. Considerable development of special purpose hardware will be undertaken to speed up data processing and reduce the computer load. Use will be made of various sophisticated image processing software packages which are currently available overseas.

71. Parkes 64m Telescope As previously mentioned the Parkes 64m telescope has been Australia's front line radio astronomy instrument for more than 20 years. Although it is still making new discoveries its limitations are becoming increasingly obvious when compared to newer radio telescopes overseas.

72. The decision to use the Parkes telescope as the anchor for the Long-Baseline Array has meant a new lease of life for this facility. By working in tandem with other elements of the Australia Telescope its capabilities will be considerably enhanced and its useful life substantially prolonged.

73. Construction Arrangements The Division of Radiophysics, which has expertise in electronics, has worked closely with a consulting engineering firm on the design - particularly with

regard to structural engineering, mechanical engineering and civil engineering. When specifications are developed various aspects of construction of the antennas will be let to tender. All of the work, with the possible exception of the surface panels, will go to tender, and it is expected that Australian firms will respond. The work has largely been designed to suit the capability of Australian industry.

74. Australian Content It is anticipated that Australian content of the Australia Telescope project will exceed 80 percent.

75. The 20 percent non-Australian content will more than likely include some of the large bearings, the sub-reflectors, some of the electronics, and the computer hardware and software.

76. Future Expansion There are many possibilities for expansion of the Australia Telescope, and for linking it with other telescopes to extend the baseline of the arrays.

77. Negotiations are already taking place to link the Australia Telescope with the NASA 64m telescope at Tidbinbilla. A microwave link will be established and the Tidbinbilla antenna will become part of the Long Baseline Array when required, and when time is available on that facility. This capability will be possible from the outset, on completion of the Australia Telescope.

78. The Division of Radiophysics is also keen to extend the Australia Telescope within its existing configuration soon after completion of the project in its present form. First priority would be the provision of an additional one or two antennas in the medium baseline between Culgoora and Siding Spring, and benefits could also be obtained by later adding a further antenna to the Compact Array at Culgoora.

79. Using atomic clocks and video tape recorders the Australia Telescope can be operated in tandem with other Telescopes without a physical link. Using this system CSIRO would envisage certain experiments in conjunction with existing antennas at Fleurs (near Sydney), Hobart, Alice Springs and Carnarvon - subject to successful negotiations with the relevant operating authorities.

80. On an even larger scale, and using similar techniques, the Australia Telescope will be able to participate in international experiments, and be linked to antennas in other countries, and even with satellite-borne instruments.

81. Summary The Committee was impressed with the apparent level of skill and expertise within the Division of Radiophysics in the design of the Australia Telescope and its components. There are many innovative aspects of the design - in particular the rigid structure antenna dish, the manufacture of the surface panels, the feedhorn design, and the optical fibre transmission links. Because of the innovative design and manufacturing techniques, the CSIRO believes that it has developed a telescope that will achieve better performance at a comparatively lower cost.

82. Construction of the Australia Telescope will introduce new high technology skills in Australian industry, and there will be a very high Australian content in the design and construction of the instrument.

83. Finally, the Committee is pleased to note that the Australia Telescope incorporates the existing Parkes 64m telescope and, thereby enhances the capability and substantially prolongs the useful life of that facility.

84. Committee's Conclusion The design of the Australia Telescope is satisfactory.

SITES

85. The location of the elements of the Australia Telescope have been determined by considering a number of factors. The Parkes 64m antenna is a fixed point. However, both scientific and financial considerations influenced the selection of sites for the Compact Array and the intermediate antenna.

86. From the scientific point of view sites were required that are suitably spaced for synthesis mapping, had good receiving capabilities and were free from interference. From the financial point of view, the existence of services on a site lead to considerable savings.

87. Culgoora The site at Culgoora is owned by the CSIRO and is the location of the radioheliograph. The radioheliograph has recently been closed so the site, which is fully serviced, is available for the Australia Telescope.

88. As well as the existing CSIRO land, it is proposed to purchase an area of land 150m x 70m on a property 3 km to the west, where the 6th antenna will be located. An easement will also be acquired between this parcel of land and the main CSIRO land, for the provision of an access road, and for laying cables to the remote antenna.

89. Siding Spring The site for the intermediate antenna between Parkes and Culgoora is at the Siding Spring Observatory near Coonabarabran. This site is owned by the Australian National University which has agreed to lease the land to the Commonwealth as the site for the antenna.

90. Committee's Conclusion The sites selected are suitable.

WORKS AND SERVICES

91. Building Works By utilising existing sites for the elements of the Australia Telescope, minimal building work will be required.

92. No new buildings will be required at Culgoora. The existing workshops and living accommodation is now available in its entirety with the closure of the radioheliograph.

93. A building, approximately $40m^2$ will be required at Siding Spring to house equipment for the antenna and laboratory space.

94. No construction work will take place at Parkes or at the Division's headquarters at Epping.

95. Roadworks and Other Services Some roadworks and the provision of certain services will be necessary at Culgoora and Siding Spring. These works, which will involve the Department of Housing and Construction, are as follows:

- Culgoora: A 5 km all weather sealed service road 8m wide and parallel to the antenna rail track, will provide access for service vehicles to the five antennas within the CSIRO site. This road will be connected to the existing site road system.

  All weather access for service vehicles to the remote sixth antenna will be via existing public roads and a 2.7 km all weather gravel road. This road will be constructed within the portion of the property to be acquired for the sixth antenna, and on an existing private road corridor.

A 3 km dry weather service track along the easement to be acquired will provide convenient access to the remote antenna. The track will be an extension of the 5 km sealed road on the CSIRO land. It will be lightly formed with sealed floodways, and designed to cause minimum interference to natural runoff patterns. This track will also delineate the route of the underground cables from the remote antenna to the CSIRO site.

An alternative road system to the remote antenna may be possible pending negotiations with affected landowners. Rather than a service track, a 3 km all weather road could be provided. This will provide permanent direct access and will obviate the need for a 2.7 km gravel road in conjunction with the route via public roads. This matter has yet to be resolved.

The remote antenna site will be fenced and gravelled to reduce the risk of fire.

The electricity supply to the existing radioheliograph will be upgraded, and electricity will be supplied to the remote antenna.

- Siding Spring: A 1 km all weather access road will connect the antenna and equipment building, and the microwave tower, to the existing sealed road serving the Siding Spring observatory. The antenna site will be protected by a man-proof fence.

  Electrical supply to the antenna and equipment building will be via a new substation connected to the existing nearby electrical supply.

LIMIT OF COST

96. The limit of cost estimate for the project when referred to the Committee was $30.7 million at March 1983 prices. This estimate is made up as follows:

	$m
Antennas	15.3
Electronics	7.9
Other Works and Services and Salaries	7.5
	30.7

ENVIRONMENT

97. Consultations have taken place with the Department of Home Affairs and Environment, and a Notice of Intention has been lodged with that Department. CSIRO was subsequently advised that an Environmental Impact Statement was not required to achieve the object of the Environment Protection (Impact of Proposals) Act 1974 provided that:

- the environmental protection measures outlined in the Notice of Intention are implemented;
- negotiations with Telecom for the use of its existing towers are successful;
- the microwave tower required at Siding Spring does not exceed 10m in height; and
- CSIRO continues consultation with the N.S.W. National Parks and Wildlife Service and relevant Shire Councils on matters of local concern, and that any appropriate environmental requirements of these bodies be met.

IMPACT ON THE LOCAL COMMUNITY

98. The Australia Telescope will have negligible impact on the communities of Parkes and Coonabarabran. Its main impact will be on the township of Narrabri, near Culgoora.

99. Employment At present there are 14 staff working at Culgoora in conjunction with the Radioheliograph. On completion of the Australia Telescope there will be 28 CSIRO staff based at Culgoora, most of whom will live in Narrabri.

100. The Australia Telescope will generate some local employment, but most staff will be scientists who will have to be recruited elsewhere.

101. The major impact on employment in the Narrabri community will therefore be through the multiplier effect on the towns businesses.

102. Tourism The visitors centre at the Parkes Telescope is a very popular tourist attraction (in conjunction with the telescope itself) and is evidence of the wide community interest in astronomy. The CSIRO believes that the centre is a very good promotional vehicle for CSIRO activities in general, and astronomy in particular.

103. The Australia Telescope will have an impact on the Narrabri community as an additional tourist attraction in the region. Although it is some distance from the main highway, the Australia Telescope at Culgoora should be of considerable interest to tourists. The CSIRO believes that it has a responsibility to the community to promote the Australia Telescope in a manner similar to its promotional efforts at Parkes.

CONSULTATIONS

104. The CSIRO has consulted widely in the planning for the Australia Telescope. The Australia-wide and international scientific community was consulted extensively throughout the planning stages, through the membership of various scientific committees and involvement as individuals.

105. In addition national, state and local authorities and organisations have been consulted on the proposal. The Coonabarabran and Narrabri Shires in particular, more than welcome the project.

PROGRAM

106. Substantial planning and design work for the Australia Telescope has already taken place. Major construction should commence in 1984, and the project should be completed and commissioned in September 1988 - Australia's Bicentennial year. The Australia Telescope is a Bicentennial Project.

107. Committee's Conclusion The Committee recommends construction of the Australia Telescope.

RECOMMENDATIONS AND CONCLUSIONS

108. The summary of recommendations and conclusions of the Committee and the paragraph in the report to which each refers is set out below:

		Paragraph
1.	THERE IS A NEED FOR THE AUSTRALIA TELESCOPE TO MAINTAIN AUSTRALIA'S HIGH STANDING IN WORLD ASTRONOMY, FACILITATE INTERNATIONAL CO-OPERATION AND COLLABORATION IN ASTRONOMY, AND TO FURTHER DEVELOP AUSTRALIAN INDUSTRY ASSOCIATED WITH THE SCIENCE.	46
2.	THE DESIGN OF THE AUSTRALIA TELESCOPE IS SATISFACTORY.	84
3.	THE SITES SELECTED ARE SUITABLE.	90
4.	THE ESTIMATED COST OF THE WORK IS $30.7M AT MARCH 1983 PRICES.	96
5.	THE COMMITTEE RECOMMENDS CONSTRUCTION OF THE AUSTRALIA TELESCOPE.	107

D.J. Foreman.

(D.J. FOREMAN)
Chairman

Parliamentary Standing Committee
on Public Works,
Parliament House,
CANBERRA

20 October 1983

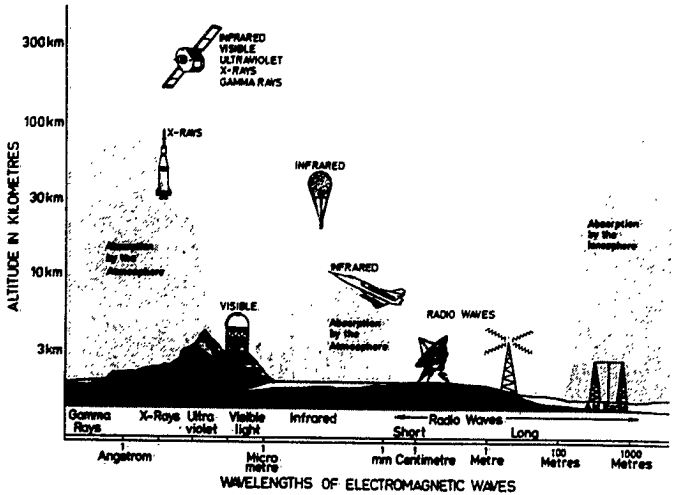
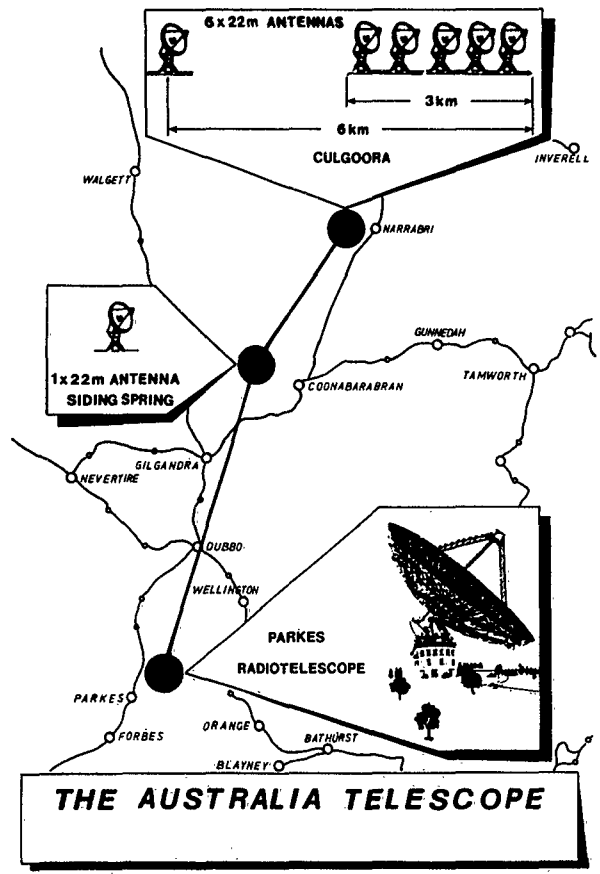
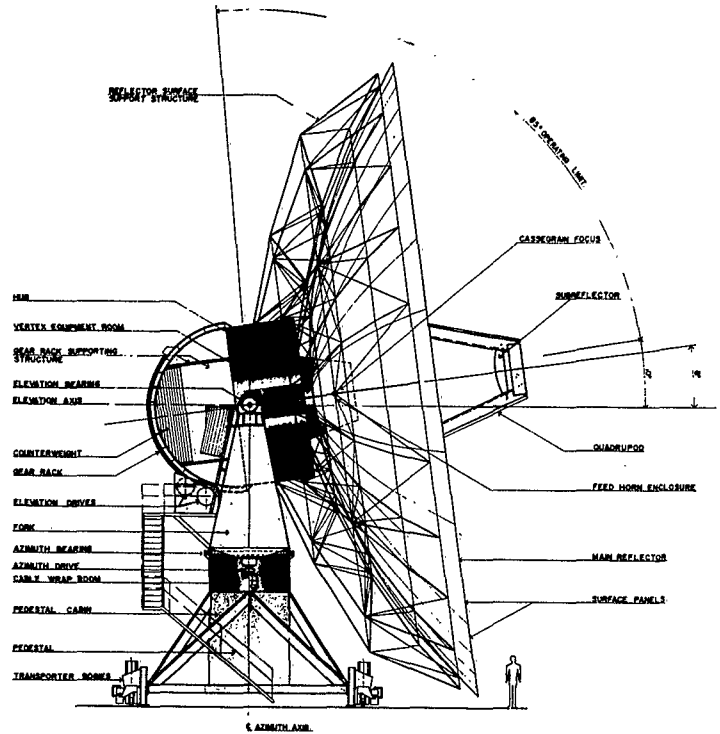


Figure A1:

Astronomical observations are made in a variety of ways, depending on the wavelength of the electromagnetic waves received from the universe. Visible light and radio waves can be received by ground-based telescopes. At other wavelengths the telescopes must be carried above the absorbing atmosphere by aircraft, balloon, rocket or satellite.



Geographic Locations of Components of the Australia Telescope



SIDE ELEVATION

Preliminary Design of AT 22 m Antenna