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THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

R E P O R T

relating to the proposed erection of a

RADIOPHYSICS LABORATORY

for the

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION

at

EPPING, N.S.W.

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PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS

RADIOPHYSICS LABORATORY FOR THE COMMONWEALTH SCIENTIFIC
AND INDUSTRIAL RESEARCH ORGANIZATION AT EPPING, N.S.W.

R E P O R T

By resolution on 23rd March, 1965, the House of Representatives referred to the Parliamentary Standing Committee on Public Works for investigation and report proposals for the erection of a laboratory for the Division of Radiophysics of the C.S.I.R.O. at Epping, N.S.W. The Committee have the honour to report as follows:-

GENERAL

1. The Committee received statements from the Department of Works and the C.S.I.R.O. and heard evidence from representatives of these organizations. Plans and a study model of the proposals were made available for Committee examination. We inspected the site of the proposed work at Epping and the existing accommodation and facilities in the grounds of the University of Sydney. The Committee considered at some length a recommendation from the Council of the Municipality of Parkes, N.S.W. for the siting of the laboratory at Parkes.

HISTORICAL

2. Establishment of the Division The Division of Radiophysics was set up in 1939 as a result of an approach by the British Government to the Australian Government to carry out research and development in the then secret field of radar and to act as a centre for work in the Pacific area in the event of war. Substantial additions were put in hand to a building then under construction in the grounds of the University of Sydney for the C.S.I.R.O. National Standards Laboratory. The Division began work in this building early in 1940.

3. The demands of the work quickly outgrew the space available and several temporary wooden structures were built adjacent to the main building to house the workshop facilities required for the manufacture of experimental and prototype models of radar equipment. The University agreed to the erection of the temporary buildings on the condition that they were removed at the cessation of hostilities.

Despite this they are still in use. The University maintains constant pressure on the C.S.I.R.O. for the removal of the buildings but the facilities in them are essential to the Division's activities and no alternative accommodation is available. One objective of the current proposals is to allow these buildings to be demolished.

4. War-Time Achievements The Division had a creditable record during the war both in the development and manufacture of radar equipment and in the training of personnel in the new techniques involved. One of the most outstanding achievements was the development of a light weight air-warning radar of high performance. Its special feature was that it could be broken down into units small enough for transport in aircraft or for use by troops in the field. It played a significant part during the island hopping stages of the Pacific war.

5. Post-War Activities The title "Division of Radiophysics" was originally selected to disguise the fact that the Division was engaged on military work. It was an apt choice because radiophysics, a field between radio engineering and physics, is that in which the Division has since been working. The fields in which the Division is currently working stem directly from war-time research into radar and the radio and electronic techniques that make radar possible.

6. Attention was first directed towards the application to peace-time uses of the knowledge and techniques acquired during the war. One of these was the provision of improved navigational aids for aircraft and in particular of the device known as "D.M.E." (distance measuring equipment) which provides a pilot with an indication of his distance from selected points on the ground. This device was taken from the stage of basic invention through development, flight test and introduction to service prior to 1950. At that time it was adopted by the Department of Civil Aviation and made compulsory on passenger aircraft in Australia. A new multi-channel transistorized version of the airborne unit also developed in the Division is now being introduced.

7. The equipment has given a good record of service and has been an important factor in the good safety record of Australian commercial aircraft. The Committee noted that this equipment pre-dated corresponding development overseas by about ten years.

8. A second line of development which also followed from the use of pulse techniques was in the field of electronic computers. The first electronic computer of modern design to operate in Australia was developed in the Division and although it has since been superseded by more recent equipment, the original unit was operating satisfactorily until recently. The Division did not proceed further in this field but the experience gained provided a valuable background to the planning for a computing service in the C.S.I.R.O.

FUNCTIONS OF THE DIVISION

9. The present work of the Division is concerned almost entirely with two modern fields of research in the physical sciences - radio astronomy which is the study of the universe by radio waves, and the physics of cloud and precipitation.

10. Radio Astronomy The radio astronomy programme began after the war as an exploratory study of the sun and parts of the celestial sphere. It was known that radio signals could be received from these regions but little was known about the generation of signals or the detailed distribution of intensity around the sky.

11. Interest in the subject was intensified when the Division verified that unusually strong signals from the sun were coming from active sunspots and when it was found that certain celestial objects were emitting radio signals of comparatively high intensity. It was clear that a new tool for investigating the universe was available and an intensive programme was started covering both solar and galactic studies.

12. Studies of solar radio emission pioneered by the Division have given a comprehensive picture of the physical process by which radio waves are generated in the sun and a virtually complete story has been obtained for one complete cycle of solar activity. Research

has been characterised by remarkable instrumental developments and by the physical interpretation of the many phenomena on the sun which give rise to radio waves. Solar studies have been carried out in different overseas countries but in none has the results compared with those of the Division. Officers of the Division have played prominent parts at international conferences of this subject.

13. The work of the solar group is now entering a new phase of instrumental development with the construction of the radioheliograph at Culgoora near Narrabri, N.S.W. This instrument is intended to give second to second radio pictures of the sun and will give information on the movement of radio sources comparable with the optical data available. The construction of the radioheliograph and the installation of equipment is nearing completion. In addition to the work of the Division at Culgoora, the Division of Physics will carry out optical observations of the sun at the same site. Culgoora, when completed, is likely to become a world centre for solar research.

14. The Division has also pioneered research on many aspects of galactic astronomy. Since the early post-war years work has included the construction of ultra-sensitive receivers, the application of interferometer techniques and instrumental developments. New data from the southern sky has been compiled comparable in volume with overseas achievements.

15. About 1955 it was decided that in order to exploit the subject to the full, a first class telescope would be required. This was met by the completion in 1961 of the 210 foot steerable telescope at Parkes, N.S.W. This instrument, acknowledged to be the most refined and powerful instrument of its type in the world, has been giving new and exciting results on objects which extend from the nearer planets to the most distant reaches of the universe. The stream of overseas scientists who are observing the work carried out at Parkes is expected to continue for many years.

16. During the next few years the facilities at Parkes will be supplemented by a 60 foot "dish" on railway tracks making an interferometer pair with the main "dish".

17. Cloud and Rain Physics The cloud physics programme was initiated at the end of the war when the Division was able to exploit its ground and air borne radar equipment for studying the formation and growth of precipitation elements in cloud. It was clear that many processes were going on which were quite different from those suspected and about this time came the discovery in America of the possibility of artificially stimulating clouds to produce rain by means of dry ice and silver iodide. In view of the practical possibilities of this discovery to Australia, the Division turned to an intensive study of the subject.

18. Present research embraces studies of convective processes in cloud and of the formation of precipitation elements, studies of the naturally occurring freezing nuclei which play a vital part in initiating the rain forming process and investigations into the artificial stimulation of rainfall. These experiments have been carried out mostly in south-eastern Australia.

19. Significant progress has been made in the understanding of the processes leading to the formation of cloud and of rain. This has led to the opening up of a new field of study, viz. that of the naturally occurring freezing nuclei, and novel instruments have been developed to measure their characteristics. Studies of variations in their concentrations have led to the discovery of extra-terrestrial effects on rainfall. A broad picture has emerged of the types of clouds most likely to give increased precipitation and of the areas in Australia where existing methods can be satisfactorily exploited. Generally, maritime regions appear to be unfavourable because, if clouds form, they are likely to rain naturally in any case. Continental regions are more promising, particularly those on the western slopes.

20. Advice on Australian rain making techniques has been given to overseas countries and overseas scientists have been trained by the Division in cloud physics research and the techniques of artificial stimulation of rainfall. Surveys of cloud seeding possibilities in other countries have also been carried out.

21. In view of the importance of water for Australian agriculture and industry, research into this field is continuing. It is intended that it will take the form of studies of the water cycle in the atmosphere, with particular reference to the precipitation process.

22. During the course of his evidence the Chief of the Division of Radiophysics told the Committee that during the recent bushfires, the Division undertook some cloud seeding which, it is thought, was instrumental in inducing rain in Victoria at a critical time. Similar efforts in New South Wales were not successful. The seeding done was carried out only after the Division had been approached and after the fires had been burning for some time.

23. The Chief of the Division stressed that C.S.I.R.O's function is confined to the development, through research, of rain making techniques and that the practical application of proven methods is the responsibility of another authority.

EXISTING FACILITIES AND ACCOMMODATION

24. The Division, since its inception, has shared a building in the grounds of the University of Sydney with the C.S.I.R.O. Divisions of Physics and Applied Physics, which together comprise the National Standards Laboratory. The sheet metal and carpenters workshops, portion of the electrical workshops, and the electrical and raw material stores are located in temporary buildings adjacent to the main building. The gross floor area occupied by the 163 staff of the Division of Radiophysics is 28,804 square feet, an average of 176 square feet per person. The accepted space per person for research and development work is 350 square feet.

25. Many alterations have been carried out to the present space to provide rooms of a size and shape suited to the Division's needs. However, it has not been possible to provide enough smaller rooms for use by research personnel as study offices. The Committee saw cases where three or more research officers occupy the same room and

noted the inconvenience and inefficiency that the overcrowding causes.

26. Open spaces which are traditionally associated with radio laboratories do not exist at this site. These conditions are necessary partly to ensure an absence of interference and partly to provide working areas in which experimental aerial systems can be erected free from obstructions which might affect their performance and the various measurements carried out. The Division is concerned with the development and use of extremely sensitive radio receiving equipment and highly directive and specialised aerial systems and requires a site where man-made signals generated by electrical devices are minimised or can be controlled. It has thus been necessary to establish field stations where aerial systems can be erected and equipment tested. This, of course, results in loss of time and additional travelling costs. Furthermore it is impracticable to duplicate at such remote sites the range of facilities available at the laboratory. The present proposals provide open space and an insulation from interference designed to overcome these problems.

27. The Divisions of Physics and Applied Physics also are working under serious disabilities because of overcrowding. There is, therefore an urgent need, not only to provide adequate laboratory and other accommodation and open space for the Division of Radiophysics, but to relieve the overcrowding problems of the National Standards Laboratory.

28. The Committee agrees that the best solution will be provided by moving the Division of Radiophysics to a new site with a proper environment for its radio investigations.

THE SITE

29. An area of about $14\frac{1}{2}$ acres fronting on Vimiera, Pembroke and Crimea Roads, Epping, a north-western suburb of Sydney, was acquired in 1957 as a site for the re-establishment of the Division of Radiophysics. It is about 10 miles from the Sydney G.P.O., one mile from the Epping Railway Station, and is near the site of the proposed Macquarie University.

30. The site is in an attractive setting and has substantial areas of clear and flat land suitable for testing aerials and cloud physics research equipment. The land slopes from east to west across the site. The main frontage is to Pembroke Road.

31. Representations from Parkes Council The Committee received a well prepared submission from the Council of the Municipality of Parkes, N.S.W. recommending the establishment of the Division at Parkes. The Council pointed out that as the radio telescope is at Parkes, the location of the Division there would have administrative and functional advantages. The Committee were told that there are a number of suitable sites at Parkes which would meet the requirements for clean air essential to cloud physics research and absence from electrical interference necessary to the radio astronomy programme.

32. Assurances were received from Public Health authorities that the Epping area does not, and is not likely to, suffer from air pollution in either the short or long term. The advice given was that the air at Epping would be closely comparable with that expected in a wholly rural community. An important factor in this connection is that the prevailing winds will carry pollution from existing and proposed industrial zones away from the proposed site, rather than towards it.

33. The Committee were also assured that under the present green belt zoning of areas adjacent to the proposed site, the Division's work is not likely to be prejudiced by radio interference from industrial sources. Likewise, we were satisfied that the light industries expected to be developed in association with the nearby Macquarie University will not be a source of interference.

34. Local government legislation enables a change in zoning to be made so that there can be no irrevocable assurance that adjoining areas will continue to be zoned as they are now. However, a large measure of protection is provided by high quality residential development adjacent to the site. The Committee feels, furthermore, that there is an added safeguard in the appeal provisions in the

legislation to enable the Division to preserve the amenity of its site and installations.

35. Probably the most important factor in support of siting the laboratory in the metropolitan area is the proximity of it to centres of research and other laboratories where comparable work is being carried out and to sources of supply of special components and raw materials. Overseas experience with the siting of research laboratories in this particular field strongly supports a location in a university city.

36. We were most sympathetic to the case submitted by the Council but felt that the weight of evidence favoured the Epping site. The Committee therefore recommend the re-establishment of the Division at Epping.

37. Representations from Ryde Municipal Council As the site at Epping forms part of the Municipality of Ryde, the Committee sought the views of the Ryde Council on the proposed development. The Council approves the development but mentioned to the Committee the high proportion of non-rateable land in its area. The Committee were informed that non-rateable land in the Municipality represents some 23% of the total area and that the Council is disturbed at the large loss of revenue that this represents.

38. Expansion Space We were told that C.S.I.R.O. have no plans to expand the functions of the Division of Radiophysics in the immediate future and that the site is thought to be adequate for present needs.

39. That the C.S.I.R.O. is anxious to safeguard the Division's future activities against overcrowding is evident from the fact that since the reference was made to the Committee an agreement for the acquisition of over an acre of adjoining land is being negotiated. It is understood that negotiations have almost been completed for the acquisition of the remaining two acres of land which will give the site a continuous frontage on Pembroke and Vimiera Roads. The Committee supports this action.

THE PROPOSALS

40. Main Building Complex The two-storey Administration wing provides office accommodation for executive and clerical staff of the Division, a conference and lecture room with projection facilities, a library, first aid and rest room, PAW, stores and toilets. Space is also provided for visitors, individual laboratories and a publications office. An observation platform high enough to be clear of visual obstructions where Cloud Physics scientists can install instruments, has been included. This has been achieved by locating a tower at the junction of the Administration and Laboratory wings.

41. The Radiophysics, Cloud Physics and Photo Test laboratories are each located in a single-storey wing, providing office and laboratory accommodation designed to suit the individual requirements of each group. Drawing office facilities, printing, staff and dark rooms, toilets and stores associated with each group are provided. The three laboratory wings will form a courtyard which is to be landscaped. A reflecting pool in the courtyard, as well as being a water feature, will function as a cooling pool for the air conditioning plant.

42. The buildings described above have been orientated on an east-west axis so that the maximum amount of consistent natural light will be available to the laboratories on the south side of the buildings. Most individual offices have a northern outlook. The width of the overhanging eaves on the northern facades has been adjusted for summer and winter conditions protecting the offices from the strong summer sun and allowing for sun penetration during the cooler months.

43. A canteen is in a separate building designed to provide a limited light meal service. It comprises lunch room, small kitchen and store.

44. The main building complex contains about 48,300 sq. ft. of gross floor area.

45. Ancillary Buildings A building centrally located in relation to the main building complex accommodates boilers, mechanical plant and the electrical sub-station.

11.

46. The fall of the land near the workshops allows them to be built with external access to two floor levels. The lower level accommodates the garage and sheet metal and carpenters shops. On the upper level, space is provided for an experimental machine shop, main store and electrical transformer room.

47. The ancillary buildings, which will provide a total of 22,300 sq. ft. of space, have been located to the south of the main building complex so that future expansion of the main buildings will not be hampered. They have been arranged to screen the staff car parking area from general view.

48. A three-bedroom caretaker's cottage designed in accordance with Commonwealth Standards of Accommodation is to be built in the north-west corner of the site. It will be of brick construction.

49. Finishes and Fittings All buildings will have external walls of face brick. On the main building the walls will be relieved with porcelain onamel spandrel panels. Windows throughout will be framed in aluminium and the roofing will be aluminium.

50. The internal corridor walls and permanent partitions of the main building and laboratory wings will be brick with a plaster finish. Suspended acoustic ceilings will be provided to the library, conference and lecture room, and executive offices. In the remaining rooms the ceilings will be suspended fibrous plaster.

51. Floors will be finished with vinyl tiles, except in the toilets and the stores where mosaic tiles and granolithic respectively will be used. Walls of toilets will be ceramic tile carried to door height.

52. Internal walls of the canteen will be face brick except in the kitchen where they will be treated with tile or rendered. The floors will be covered with vinyl tiles and the ceiling will be fibrous plaster.

53. The internal walls of the boiler and plant house will be face brick. Floors will be granolithic and the ceiling finished in asbestos cement. Internally the walls of the workshop will be face

brick except in the garage where the brickwork will be haggled. Floors are to be granolithic except in toilets and offices where ceramic and vinyl tiles respectively will be used.

54. Laboratories will be fitted with standard benches and special racks for storing equipment. They will be served with hot and cold water, gas and compressed air and electric power as required. Electrically screened rooms will be provided in two laboratories and protective construction will be included for one laboratory accommodating radio-active material. One laboratory is to be insulated for conversion to a cold room. Three laboratories will be provided with dust free conditions.

55. Construction The Administration wing will have a reinforced concrete frame with columns on a 12 foot grid supporting concrete beams, which in turn support a suspended concrete first floor slab. The ground floor will be concrete on fill. The concrete columns will continue to roof level to support the steel and timber roof structure.

56. The single storey laboratories and canteen will also be framed in reinforced concrete. The ground floor in each case will be concrete supported by the frame. The boiler and plant house will have brick load-bearing walls and steel roof trusses. The floors here will be concrete on fill. The workshop has been designed with reinforced concrete columns and steel roof trusses. The ground floor slab will be concrete on fill and the first floor will be a suspended reinforced concrete slab on reinforced concrete beams.

57. Engineering Services Electricity will be supplied by high voltage underground cables from the Sydney County Council's mains to a transformer sub-station at the boiler house. The Council will supply the sub-station equipment. Reticulation of electricity from the main switchboard will be underground.

58. Artificial lighting will generally be fluorescent with levels of illumination according to the approved code. Area and security lighting will be provided. There is to be a generous provision of general purpose power outlets together with some facilities for direct

wiring of equipment. An electrically operated service lift of 500 lbs. capacity with a speed of 65 feet per minute will transport equipment to the observation tower.

59. Offices, laboratories, the library, the conference and lecture room, the canteen and the instrument and coil winding rooms of the workshop will be air conditioned. Other parts of the workshop building will be provided with warmed air heating. This service will provide mechanical ventilation during summer months. Mechanical services will also include hot water to laboratories and toilet areas and gas and compressed air to the laboratories and workshops.

60. An automatic thermal fire detection system will be provided throughout the Administration, laboratory and canteen blocks. The workshop block will be fitted with an automatic fire sprinkler system. The alarms from both systems will be connected to the local fire station. Fire extinguishers, hydrants and hoses will be installed in accordance with the standards of the Commonwealth Fire Board.

61. About 1600 feet of 8" water pipe will be laid to connect the site reticulation to the main so that an adequate supply of water can be obtained for fire fighting purposes. The mains pressure is too low for fire fighting needs and a booster pump, to function automatically when the thermal detectors or sprinkler systems operate, will be installed to provide pressure for hydrants and sprinklers. The mains pressure is adequate for domestic water requirements without boosting. Sewerage and wastes will be delivered to the local carrier sewer.

62. Stormwater will be taken by underground pipes to the Council's stormwater system. About one mile of pipe, ranging from 6" to 36" will be needed to drain the site and buildings of stormwater.

63. Roads and parking areas will be bituminous surfaced and designed to carry cars, light trucks and occasional heavy trucks.

64. Clearances from State and Local Government Authorities The Committee noted that sketch plans of the proposals had been cleared with the State Planning Authority, the Ryde Municipal Council, the Sydney County Council, the Metropolitan Water, Sewerage and Drainage

Board and the New South Wales Board of Fire Commissioners. There had been no objection to the proposed development.

65. Future Development No large scale expansion of the facilities planned is envisaged, although at a later date some extension of the laboratories may occur. This has been allowed for in the design of the building complex.

66. The Committee recommend the construction of the buildings and services as proposed.

PROGRAMME

67. It has been estimated that from the time an approval to proceed is given, the completion of contract documents, tendering and the letting of a contract will occupy 12 months. The contract period has been estimated to require 21 months.

COSTS

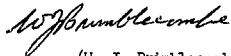
68. The estimated cost of the proposals submitted to the Committee is £800,000 made up as follows:-

Building work including Administration and laboratory complex, workshops and garage, boiler house, caretaker's cottage, covered ways, fencing and gates.	£ 505,000
Internal engineering services to buildings including mechanical, electrical, hydraulic and fire protection.	£ 196,500
External engineering services including electrical supply, water supply, fire protection, stormwater and sewerage reticulation.	£ 68,500
Roads and parking areas.	£ 30,000
	<hr/>
	£ 800,000
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RECOMMENDATIONS AND CONCLUSIONS

69. The summary of recommendations and conclusions is set out below. Alongside each is shown the paragraph in the report to which it refers. Recommendations appear in bold type.

- | | Paragraph |
|---|-----------|
| 1. THERE IS AN URGENT NEED NOT ONLY TO PROVIDE ADEQUATE LABORATORY AND OTHER ACCOMMODATION AND OPEN SPACE FOR THE DIVISION OF RADIO-PHYSICS, BUT TO RELIEVE THE OVERCROWDING PROBLEMS OF THE NATIONAL STANDARDS LABORATORY. | 27 |
| 2. THE COMMITTEE RECOMMEND THE RE-ESTABLISHMENT OF THE DIVISION AT EPPING, N.S.W. | 36 |
| 3. The Committee support the action being taken to acquire the remaining land which will give the site a continuous frontage on Pembroke and Vimiera Roads, Epping. | 39 |
| 4. THE COMMITTEE RECOMMEND THE CONSTRUCTION OF THE BUILDINGS AND SERVICES AS PROPOSED. | 66 |
| 5. The estimated cost of the proposed work is £800,000. | 68 |



(W. J. Brimblecombe)
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18th May, 1965.