A History of Radio in South Australia 1897–1977

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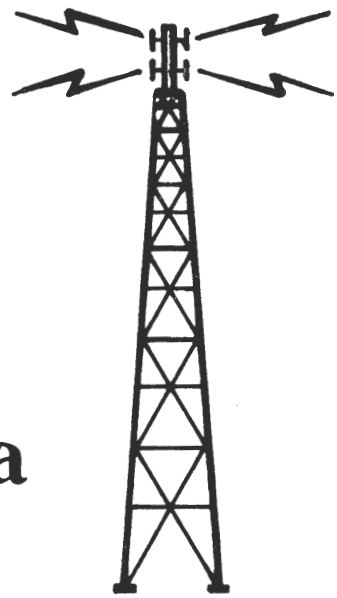

by

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Dedicated as a sincere tribute
to the pioneers
— professional and amateur —
whose combined efforts contributed
so much to the development
of wireless telegraph
communications and broadcasting.

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The material contained in this book has been accumulated from many sources and individuals and if there are omissions or errors of which I am unaware I offer my apologies.

17-7-78

PREFACE

The first public demonstration recorded in detail in Australia of the working of wireless telegraph apparatus was given at the University of Adelaide in September 1897 by Professor William Bragg.

In 1899 Bragg successfully operated a wireless telegraph spark system linking the Observatory on West Terrace with a temporary station at Henley Beach. It was a magnificent achievement at the time and put South Australia well ahead of experimenters in the other Colonies in the field of communication without wires.

South Australian pioneers participated in a world first exercise in 1921 when Greenwich time signals girdled the earth from high power transmitters in France and the United States to enable accurate fixing of the SA/WA border by wireless.

Fifty four years ago broadcasting commenced with the commissioning of 5DN and 5CL. It is doubtful whether any scientific invention so electrified the public imagination or sparked enthusiasm as did wireless — or radio as it is now called. People everywhere were enthralled by its magical power which permitted speech and music to be brought into their homes without any visible connecting medium. It seemed beyond the comprehension of the man in the street.

The carefully arranged programmes of today were unknown in the formative days of broadcasting. The night's entertainment was merely a broadcast of a talk or a concert by a few artists assembled in the studio. The techniques of the new art had not been evolved and to broadcast recorded music the microphone was placed in the horn of a hand cranked gramophone. The music, microphone hiss, needle scratch and extraneous studio noises reproduced in the earphones of a crystal set or by the ornate horn speaker of a magnificently styled console battery receiver were all part of the programme.

The history of the development of radio engineering is traced from the days of the spark transmitters and coherers before the turn of the century through the work of the amateur experimenters, the coastal radio service, the use of radio in aircraft and for surveying, the pedal wireless for the Flying Doctor Service, the establishment of commercial and national broadcast studios and transmitters to satellite communications and research.

Technical people today who have at their finger tips complex computers, integrated circuits, satellite repeaters, high power transmitting tubes and sophisticated measuring equipment may think of the early pioneers as men living in an age not far removed from smoke signals and drums. The greater the honour to these pioneers that their vision was crystal clear and they achieved so much with so little.

The publication of this record of 80 years of radio in South Australia fortunately coincides with the opening of the Radio Section of the Telecommunications Museum established in Electra House Adelaide and visitors to the Museum can see many items of antique radio equipment mentioned throughout the book.

IMPORTANT MILESTONES

September 1897 —	First recorded public demonstration in Australia of the working of wireless telegraph apparatus by Professor Bragg at the University of Adelaide.
May 1899 —	Successful experiment in the practical application of wireless telegraphy by Professor Bragg and Sir Charles Todd, Postmaster-General and Superintendent of Telegraphs.
July 1899 —	First wireless telegraph link established in Australia — Adelaide Observatory to Henley Beach.
October 1912 —	Adelaide Coastal Radio Station commenced operation.
April 1918 —	Time ball service using wireless reception introduced at Port Pirie Wharf.
September 1919 —	The South Australian Section of the Wireless Institute of Australia formed.
April 1921 —	First in the world longitude determination using wireless signals girdling the earth during fixing of SA/WA border.
June 1924 —	Experimental broadcast transmissions by 5DN.
November 1924 —	'A' Class broadcast station 5CL commenced transmission.
July 1925 —	The Very Rev. Dr. John Flynn successfully tested radio equipment in outback areas of South Australia.
December 1925 —	First Radio and Electrical Exhibition.
March 1927 —	Second metropolitan commercial station 5KA on air.
January 1930 —	National Broadcasting Service commenced in South Australia with acquistion of 5CL from Central Broadcasters Ltd.
August 1930 —	Third metropolitan commercial station 5AD on air.
January 1932 —	First country broadcast station, 5PI Pt Pirie, put into operation.
July 1932 —	Australian Broadcasting Commission replaced Australian Broadcasting Company as programme authority for the National service.
February 1937 —	Aeradio facilities established at Parafield.
March 1942 —	Adelaide Wireless Telegraph Station established at Parafield for RAAF.
February 1943 —	First full time frequency modulation public radio telephone system in Australia installed — Adelaide to Kangaroo Island.
March 1943 —	Radar stations installed by RAAF at Yankalilla and Wedge Island.
November 1948 —	First outback subscribers radio telephone service commissioned — Andamooka to Broken Hill.
March 1952 —	Public mobile radiotelephone subscribers service introduced in Adelaide.
October 1954 —	Port Augusta radio base station of Royal Flying Doctor Service opened.
September 1959 —	First television station NWS 9 on air.
September 1961 —	50,000 watt broadcast transmitter commissioned for 5CL.
November 1966 —	First broadland microwave radiocommunication link commissioned — Adelaide to Balaklava.
November 1967 —	WRESTAT satellite placed in orbit from Woomera.
February 1970 —	Ceduna earth station opened.
January 1976 —	F.M. Stereo broadcasting station 5ABC FM commissioned.
March 1976 —	Fourth metropolitan commercial broadcast station 5AA on air.
April 1977 —	Twentieth television station ABLCS 9 Leigh Creek commissioned.

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SECTION 1

THE SINGING SPARK

The Wireless Telegraph Pioneers

The first successful experiment in the practical application of wireless telegraphy in the Colony of South Australia took place on 10th May 1899 when Sir Charles Todd, Postmaster-General and Superintendent of Telegraphs of the Post and Telegraph Department and Professor William H. Bragg of the University of Adelaide established communication using Morse Code over a distance of about 200 metres. Considerable progress was made in improvements to the system during the following six weeks and on 23rd June the first wireless telegraph link in Australia was put into operation with a transmitting station at the Observatory on West Terrace in Adelaide and a receiving station on the sand hills at Henley Beach. Two-way communication was established on 15th July. This was a magnificent achievement at the time and put South Australia well ahead of the other Colonies in the new science.

From its earliest years wireless for maritime purposes was recognised as vital and the message became crystal clear with the tragic loss of 1517 lives during the sinking of the "Titanic" in the North Atlantic in April 1912. October 1912 marked an important milestone for shipping in South Australian waters with the establishment of the high power Coastal Radio Station VIA at Rosewater near Port Adelaide with its singing spark transmitter followed in 1913 by another station VIY at Mount Gambier.

The spark wireless telegraph era took in the First World War period when a notable contribution was made by the 22nd Signal Troop stationed at Mitcham. The men trained and experienced with the then up-to-date wireless equipment of spark transmitters and crystal receivers operated stations WAA and WAB.

The use of the tube transmission and reception did not come into general use until the early twenties by which time broadcasting services entered the frequency spectrum and indirectly ended the spark era. The early availability of tubes in Adelaide was due largely to the enterprise of certain wireless operators on ships from England and the United States who found a demand for the tubes amongst the experimenters of the day. Tubes used at the time included the de Forest Audion, the Audiotron, the Australian Expanse 'B', the French 'R', the Marconi V24, the Mullard ORA and Radiotrons. Simple regenerative receivers and low power transmitters became the standard approach in the early days of the tube sets with local experiments.

Broadcasting services were first licensed in 1924 and these became important early in 1925 when 5CL and 5DN were fully operational. The spark transmissions from VIA began to cause problems as the listening public could not tune out the interference. Tube transmitters suitable for Coastal Stations had been developed during the post war years to obviate this difficulty and one was installed at VIA enabling spark transmissions to be discontinued from October 1925. The broadcasting service expanded rapidly. A third metropolitan station 5KA commenced transmissions in 1927 followed by 5AD in 1930, 5AN in 1937 and 5AA in 1976. The first country broadcasting service went into operation with 5PI at Port Pirie in 1932. In the same year 5CK Crystal Brook went on air. Other country stations subsequently followed to bring the total throughout the State to nineteen.

And now, just over 100 years since South Australia was linked to the outside world through the Overland Telegraph line and submarine cable at Darwin modern science has provided a new world wide radio communication link through the Ceduna earth station and synchronous satellite — the electronic marvels of the space age.

How It Began

The starting point for the final development of a practical wireless system must be credited to the work of the Scottish physicist James Clerk Maxwell with the publication in the "Transactions of the Royal Society in England" in 1865 of his great memoir "The Dynamical Theory of the Electromagnetic Field". In this paper Maxwell treated the transmission of electric and magnetic forces through a medium in mathematical terms and concluded with the electromagnetic theory of light. He supposed statical electricity, electromagnetic attractions, induction, induction of circuits and diamagnetism to be produced by actions which take place in the surrounding medium as well as within the excited bodies and he explained the action between distant bodies without assuming the existence of forces capable of acting directly at sensible distances.

Maxwell applied his equations to the case of a magnetic disturbance through a non-conducting field and showed that the velocity of propagation was so nearly that of light that there is strong reason to conclude that light itself is an electromagnetic disturbance in the form of waves propagated through the electromagnetic field according to electromagnetic laws. Thus by contemplating the electromagnetic field and by accepting Ohms Law as a cardinal principle he established the elctromagnetic theory of light and deduced the laws of electricity and magnetism.

Not only did Maxwell define the laws which would govern electromagnetic waves if they existed but he predicted the properties they should possess and the speed at which they should travel. In the words of Sir Oliver Lodge "He legislated for them before they were born". His series of equations based on the experimental work of Ampere, Henry, Faraday and others placed the previous speculations concerning electromagnetism in definite terms and enabled others to build on the solid foundations that he had laid. Some 23 years later Heinrich Rudolf Hertz produced electromagnetic waves and proved Maxwell's theory to be correct.

In 1883 Hertz set himself the task of attempting to show experimentally the nature of the electromagnetic waves. First he had to create the waves by oscillatory electricity and then he had to find a means of showing their presence or detecting them. It was known at the time that electromagnetic oscillations could be produced by the discharge of a Leyden jar or other form of capacitor.

In 1886 Hertz was working at the Technische Hochschule at Karlsruhe and found in the laboratory storeroom a pair of parallel flat spiral coils insulated with sealing wax. He observed that a discharge from a Leyden jar through one of the coils caused a spark to pass across a small gap between the ends of the other coil. He also observed that sparks were produced in a neighbouring conductor. On further investigation he found that a neutral point existed along the conductor and he recognised that oscillatory discharges were taking place. Hertz then replaced his spiral apparatus with straight conductors. Two copper wires each one metre in length were placed in line, and supported by sticks of sealing wax. The two adjacent ends of the wires were terminated by highly polished metal balls and separated by an air gap. The far ends were terminated in large zinc spheres or plates to provide capacitance. The apparatus was connected to a Ruhmkorff coil to form what later became known as a Hertz Oscillator or Transmitter.

Hertz found that the receiver, or resonator as he called it, could be of the same general form but he preferred a metal circlet broken at one point with the ends fixed to metal balls separated by a small air gap with the air-gap distance being adjustable by a micrometer. Care was taken to ensure that the oscillator and resonator were in tune with one another. Other shapes besides the circlet were also used during the experiments and with these he surveyed space and found the positions of nodes and antinodes and the length and frequency of waves.

A study was then carried out on the reflection, refraction and polarization of electromagnetic waves. In the early experiments he used an induction coil 52 cm in length and 20 cm in diameter powered by six bunsen cells through a mercury interrupter. In later experiments he used a smaller coil which gave a spark of about 4.5 cm in length. During this work he was able to transmit and receive over a distance of about 12 metres. On close observation sparks could be seen to pass over the gap of the resonator in a dark room. He made no attempt to extend the range of detection. His purpose was to investigate phenomena and not to signal information. Hertz found that electric waves could be reflected, refracted, polarized and diffracted just as light could be.

His experiments on the reflection of waves were completed in March 1888 and set down in his historic work "Electromagnetic Waves in Air and Their Reflection". The experiments confirmed the fundamental hypothesis of Maxwell's theory of electricity and magnetism. Also, he was able to calculate the velocity of electromagnetic waves and arrive at a figure of about 300,000,000 metres per second, further confirming Maxwell's theory.

It soon became evident to those who began to study Hertz's work in depth that a more efficient means of detecting electromagnetic waves was needed. Subsequent workers endeavoured to improve the sensitivity by producing devices which depended on luminous discharges through a rarefied gass, depolarization of electrolytic cells, heat produced by electromagnetic currents and many others, but none gave any significant improvement at the time.

The Coherer

Professor Edouard Branly in France had been carrying out research into the behaviour of certain metallic powders or filings which had the characteristic of being able to change their conductivity whenever an electric spark discharge took place in their vicinity. Substances suitable for demonstrating this effect included filings of iron, copper, zinc, aluminium, cadmium, brass and antimony. He published an account of his work in La Lumiere Electrique in May-June 1891. However, it was not an original discovery by Branly, others had observed the phenomena sometime earlier. One of these was Professor Onesti in Italy. While working with copper filings placed between two electrodes in a tube he found that the application of a voltage across the filings caused them to stick together so allowing a current of electricity to pass through them. He was able to restore the filings to their original state by revolving or shaking the tube.

Branly had not considered his device for application as a detector of electromagnetic waves. It was Sir Oliver Lodge who conceived the idea. Branly had called his device a "radio conductor" but it is believed that it was Lodge who gave it the name, "coherer".

The coherer had the ability to increase the utility of Hertz's apparatus because it could act as a relay to operate a local circuit with other apparatus. The coherer however possessed a disadvantage. Once the metal filings conducted, they continued to do so until shaken free again. A single tap with a pencil on the tube would effectively shake the filings apart after the reception of each signal but for anything other than experimental working this was not satisfactory. The action had to be automatic so that immediately the particules cohered they were shaken apart.

The early decoherers were either electric vibrators of the bell type or mechanical ones depending on a clock driven cogwheel rubbing on a spring attached to the coherer or its stand. For iron filing types, alternating current magnetic fields were also sometimes employed. For the mercury/oil coherer a rotating steel wheel was used.

Electric Wave Telegraphy

In June 1894 Lodge gave a lecture in London at the Royal Institution on "The Work of Hertz" who had died some six months earlier. In his lecture, Lodge demonstrated Branly's coherer in a new and important role namely the detection of electromagnetic waves produced by a Hertz oscillator. Lodge had improved Branly's model and made it much more sensitive. He used iron filings in the coherer and a galvanometer to show that detection had taken place.

The lecture created so much interest that he was requested to repeat it when the British Association met at Oxford in September of the same year. On this occasion Lodge demonstrated how the apparatus could be used for signalling. A mechanical tapper was fitted to provide decoherence after the passage of a signal. The receiving apparatus consisted of a tube of metal filings in circuit with a battery actuating either a telegraph Morse recorder with tape or for better demonstration to the audience, a Kelvin Marine galvanometer. The galvanometer instrument was lent by Dr. Muirhead whose firm made cable instruments. The mirror in the box was so constructed that its motion was rapidly damped by the viscosity of the enclosed air. Thus it responded to signals sharply in a dead beat manner without confusing oscillations. The transmitting equipment was a Hertz oscillator actuated by an induction coil set in operation by a Morse key. This apparatus was in another room and was operated by an assistant.

When the operator in the other room held down the Morse key the spark coil maintained the wave production and deflected the spot of light in the receiving apparatus. The spot remained in its deflected position as long as the Morse key was held down. When the key was depressed only momentarily, a short series of waves were produced and the spot was deflected only momentarily. These long and short signals corresponded to the dashes and dots of the Morse Code. Some letters of the alphabet were transmitted and were identified by those in the audience familiar with the code.

At the time there was no obvious practical application of Lodge's apparatus to communication because receiving equipment was not sufficiently sensitive to operate on the minute signals over an appreciable distance from the transmitter. Also, a more powerful transmitter was required for a practical system.

It is of interest that Lodge subsequently visited South Australia as President of the British Association. He landed in Adelaide on 4th August 1914, the day war was declared and found the place full of enthusiasm, people and children walking about with small Union Jacks and recruiting going on vigorously. He visited the University where Professor Bragg and Mr. Rogers in 1899 had carried out wireless telegraph experiments with syntonic jars of the type Lodge had developed in 1897.

The Entry of Marconi

Guglielmo Marconi as a young man possessed remarkable inventive abilities and scientific insight. He was able to see the shortcomings of the apparatus used by others and quickly realised what was necessary to make a practical system of electric wave telegraphy.

As a youth Marconi attended lectures given by Professor Righi in Italy and studied papers on the theory of electromagnetic radiation. In 1894 while on a holiday and just before his 20th birthday he chanced to read a paper on the work of Hertz. The fact that Hertz had experimentally proved the existence of electric waves thrilled Marconi. On return from holidays he set to work immediately to build apparatus for the purpose of carrying out experiments. The equipment he used was similar to that used by others at the time and consisted of a spark induction coil, a Branly coherer and a Hertzian radiator.

Encouraged by his mother, Marconi was soon able to transmit and receive across the room he used as a laboratory. At first he placed his radiator and resonator at the focus of parabolic metal reflectors but it was not until he conceived the idea of using an

elevated conductor that he made much progress. He connected one end of the induction coil via a wire to an elevated metal cylinder fixed at the top of a pole and the other end to a metal plate buried in the ground. At the receiver, one end of the coherer was connected to a similarly elevated cyclinder and the other to an earthed plate. He then made an important discovery, the distance over which communication could be established was related to the size of the cylinders and their height above ground. He also found that even when the path between receiver and transmitter was obstructed by a hill, signalling could still take place.

Marconi introduced a Morse key to enable interruption of the wave for signalling purposes and made improvements to the coherer and the tapper. The Branly coherer was not dependable so Marconi improved the design. He narrowed the slit in which the metal particles rested to about half a millimetre and used a mixture of fine nickel and silver filings. Later he added a fine trace of mercury. The proportion was approximately 95 per cent nickel and 5 per cent silver. He exhausted the air from the glass container which was about four centimetres long. A telegraph Morse inker recorded the received signals on paper tape. The receiving apparatus was enclosed in a metal box to minimise interference from the spark.

By September 1895, he had the apparatus ready for practical use over a range of one to two kilometres and offered it to the Italian Government. They saw no future in it and declined the offer. In February 1896 Marconi and his mother sailed for England in an endeavour to interest the British authorities. On 2nd June 1896 while only 22 years of age he was granted the first patent in the world in wireless telegraphy. The complete specification was filed on 2nd March 1897 and accepted on 2nd July 1897 (No. 12039).

Marconi was successful in interesting Mr. William (later Sir William) Preece, Chief Engineer of the General Post Office. The War Office was also interested. The first official test took place in June 1896 between rooms at the house where Marconi was staying at Westbourne Park. During July and August he gave demonstrations between the roof of the General Post Office at St. Martins-le-Grand and the roof of the Savings Bank Department building in Queen Victoria Street. The 15 cm spark coil successfully bridged the 300 metre separation between the apparatus. He then arranged a more ambitious demonstration on Salisbury Plain. On 2nd September he signalled over a distance of nearly 6 km.

The first public demonstration of his apparatus was given on 12th December at Toynbee Hall during a lecture by Mr. Preece. The receiver in its black box was carried among the audience and when Mr. Preece on the lecture platform closed the transmitter circuit, a bell sounded in the receiver box which Marconi held in his hands. The demonstration received considerable publicity in the press.

In March 1897, Marconi gave another demonstration on Salisbury Plain and using kites or balloons to elevate the antennas successfully communicated over a distance of more than 7 km. The first test across a water path took place on 11th May. The transmitter which contained an induction coil capable of producing a 50 cm spark was located at Lavernock Point near Penarth. The receiver was installed at Flat Holm Island in the Bristol Channel some 5.6 km away. A week later Marconi and his assistant Mr. G.S. Kemp succeeded in signalling across the Channel to Brean Down in Somerset a distance of more than 12 km. By October he was able to demonstrate for the benefit of the Post Office engineers communication over a 56 km path between Salisbury and Bath.

Marconi formed the Wireless Telegraph and Signal Company Ltd on 20th July 1897 and on 1st November established a coastal radio station at Needles Hotel, Alum Bay on the Isle of Wight using a 40 metre mast to support a wire netting antenna. With receivers placed on board ships operating between Alum Bay, Bournemouth and Swanage Piers, telegraph traffic was passed to the ships for the full extent of their

journeys. It is of interest to note that the Governor of South Australia, Lord Tennyson visited the Alum Bay station and while there arranged for a message to be transmitted. It was received by the Bournemouth station and sent to its destination through the land line telegraph system.

From about July 1897 the relationship between Marconi and the British Post Office became rather less close. It was the view of the Secretary of the Post Office and his legal advisers that the Post Office could not spend funds on the development of a system, the patent rights of which were held by a public company.

During 20th-22nd July 1898 the Company carried out its first commercial task when it reported the Kingstown regatta in Dublin for the Dublin Daily Express from the steamer Flying Huntress. Some 700 messages were passed over the route with distances varying between 6 and 40 km.

In March 1899 the Company received permission from the French Government to erect a radio station on the French side of the English Channel in order to carry out tests across the Channel. A station had earlier been erected at South Foreland near Dover in connection with tests to the East Goodwin lightship and by 26th March a station was erected at Wimereux in France. The distance between the two stations was about 51 km and on the 27th with Marconi operating the Wimereux transmitter, the first message was transmitted across the English Channel.

Although the British Admiralty decided to install radio equipment in its war ships and placed an order in 1900, the commercial shipping lines were not satisfied with certain operational arrangements. It suffered a lack of selectivity and messages affected receivers for which they were not intended. Marconi solved that problem with his famous "Four Sevens" patent (No. 7777) taken out on 26th April 1900. He separated the two functions of frequency determination and radiation in a resonance circuit so that he could produce a sharply tuned transmitter which also possessed good radiating properties. He tuned both the transmitter circuit and the antenna to a common frequency. The same basic tuning arrangement was adopted for the receiver. The scheme removed the major defect and provided the basis for a truly commercial wireless telegraph system.

Pioneering Work in South Australia

The work of James Clerk Maxwell who predicted solely by mathematical reasoning the existence of ether waves had been followed very closely by staff at the University of Adelaide. In 1884 Professor H. Lamb when delivering the annual commemoration lecture explained that Maxwell had shown that all the known phenomena of electromagnetism were consistent with the hypothesis that they were not direct action at a distance but were due to the action of some medium. He then went on to say "This theory leads further to the result that electrical disturbances will be propagated through the medium in the form of waves with a velocity which can be calculated indirectly from experimental facts of a purely electrical nature. The velocity so found agrees with the velocity of light, as found by various astronomical and terrestrial methods, quite as closely as these different determinations agree among themselves. The theory, thus strikingly supported, that light is an electromagnetic phenomenon, or rather that light and ordinary electromagnetic actions are the same agency made manifest in different ways, seems destined to play a great part in scientific history". Professor Lamb was an applied mathematician of outstanding merit and in 1884 was elected to a Fellowship of the Royal Society. In the following year he was appointed to the Chair of Mathematics at the University of Manchester.

The announcement by Hertz in 1888 of his successful experiments in the existence of free electromagnetic waves created a sensation throughout the scientific world. The experiments were repeated in Australia in the Physics laboratory at the Sydney University in the same year. Professor William H. (later Sir William) Bragg at the

University of Adelaide soon took up the challenge. Bragg succeeded Professor Lamb in the Chair of Mathematics and Physics after graduating at Cambridge as Third Wrangler in the Mathematical Tripos. Although trained as a mathematician his interests turned to physics and his transformation from mathematician to skilled experimental physicist was helped by his great interest in devising demonstration and laboratory experiments.

For some time, Bragg had been interested in the energy of the electromagnetic wave and had written several papers on the subject. His interest led to experiments with the Hertz oscillator and in an interesting account of the period, it is recorded that Ernest (later Lord) Rutherford while on his way to England from New Zealand to become a research student at Cambridge, called in at Adelaide during August 1895 and paid a hurried visit to the University to call on Bragg. Rutherford found the Professor in a dark room trying to make a Hertz oscillator work. Rutherford had with him, to show Bragg, a magnetic detector which he invented while still a student at Canterbury College, Christchurch.

In 1896 when Marconi produced a practical system of wireless telegraphy, interest in the new science became very great not only among the scientific fraternity but among the general public as well. On 21st September 1897 Professor Bragg gave the first recorded public demonstration of the working of wireless telegraphy in Australia during a lecture meeting at the University of Adelaide. As reported in the Adelaide Observer a few days later:

> "Professor Bragg then delivered a lecture on 'Telegraphy without Wire'. He said there was an ether filling all space. By aid of forces transmitted through this ether the sun attracted the earth. The ether was also the medium through which waves of light and heat passed from a luminous body to other bodies. It must, therefore, be of an elastic nature like jelly, and yet a very impalpable jelly or heavenly bodies would be checked in their motion through it. Faraday by his experimental researches, and Maxwell by his mathematics, had built up a theory according to which electrical disturbances were also propagated through the ether and differed indeed from light only in degree, not in kind. They were in fact waves in the ether of all lengths. Light waves were simply those of a length ranging from about 25/1000 to the 50/1000 of an inch. Whilst most substances were opaque to the short light waves they were not necessarily so to the longer electric ones. Hence using them they could emit and receive signals without using wires, the waves passing freely through the majority of substances. Hertz first demonstrated in practice sending and receiving of electric waves. At first the distance to which signals could be transmitted was a few yards. By use of certain delicate relays that distance could be increased and the new work of Marconi was simply in the improvement of the detector or receiver of waves. It consisted mainly of a tiny glass tube containing some filings of nickel and silver. A battery was also tried to send current through the tube but found it difficult as the filings touched one another irregularly and loosely. When the wave was received the oscillation was made to swing through these filings. It slightly fused them together and the battery was then able to send through sufficient current to ring a bell. With the aid of that Marconi working with Mr. Preece of the General Post Office, London had transmitted messages a distance of 9 miles across the Bristol Channel. Marconi's apparatus was shown in action, a bell responding merrily in the lecture hall to an impulse sent from a vibrator in quite a different part of the building. After the musical part of the entertainment had concluded Professor Bragg entertained the visitors with several experiments with the instruments".

Mr. A.L. Rogers of University of Adelaide Workshops, who made first wireless telegraph apparatus 1897.

Following the lecture, the public watched experiments in the physics apparatus room and the laboratory by Mr. A.L. Rogers and Mr. A. Paton. Mr. Paton conducted syntonic vibrations of Leyden jars and other experiments illustrative of Professor Bragg's lecture.

Mr. Rogers a highly skilled technician and instrument maker had been making and testing apparatus for Bragg for some time prior to the demonstration. As early as 13th August 1897 he recorded in his diary "making Marconi's apparatus". Mr. Rogers came to Adelaide on 6th December 1881 after having worked with the Siemens company in England where he carried out tests on the submarine cable manufactured for laying in the Atlantic to link England with the United States. He was in charge of the Physics Department Workshops at the University of Adelaide for some 35 years from March 1889 and played an important role in the development of the first practical wireless telegraph system in Australia. He was offered a lectureship at the University but declined because of ill health and also so that he could devote full time to his first love — the running of the Workshops and the construction of scientific apparatus and instruments. After his retirement in 1924 Mr. Rogers continued his association with the University as a consulting technical expert until his death on 28th November 1939.

About this time the South Australian Government was becoming interested in the use of the new science for communication purposes to places not easily served by normal open wire or submarine cable means. The Althorpes Island lighthouse between Kangaroo Island and the southern tip of Yorke Peninsula was in 1888 connected to the mainland by a cable to enable passing ships to be reported to Port Adelaide. The unsuitability of the sea bed was constantly causing faults in the cable and in June 1898 the Hon. The Treasurer of South Australia drew the attention of the President of the Marine Board to an article in the English "Times" of the 20th April 1898, on Wireless Telegraphy as an alternative to the costly repairs of the cable.

The matter was referred to Sir Charles Todd and on 12th October 1898 he replied as follows:

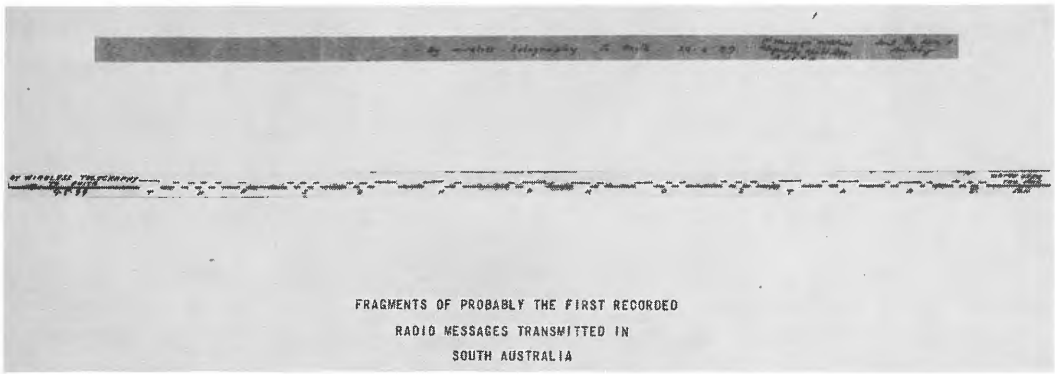
> "Wireless telegraphy is still in the experimental stage; but I have no doubt that we should be able to establish communication between the lighthouse on Althorpe Island and the mainland at Cape Spencer by Marconi's system; but it would require a skilled officer at the lighthouse and at Cape Spencer and a house would have to be built at the latter place. This would involve considerable annual expenditure which, judging from the little use made of the cable seems hardly justifiable.
>
> I have written to Mr. W.H. Preece of the General Post Office, London who is carrying out a number of experiments and to Professor Bragg who is in England for further information with respect to instruments etc."

The Marine Board had been closely watching the development of wireless telegraphy particularly in relation to its use for ship to shore communications. Both Commander W.R. Creswell and Mr. T.N. Stephens who was President of the Board were anxious to see a system installed. However, they were somewhat reluctant to make a strong recommendation for a system to Althorpe Island without the backing of Sir Charles. Commander Creswell was also interested in wireless telegraphy because of its possible use in the Navy. Creswell was commander of H.M.C.S. Protector and held that position from 1895 until 1900 when he resigned his command and went to Queensland where he played a major role in the development of wireless telegraphy for naval purposes.

The Government decided that an on-the-spot study of the latest techniques was necessary and on 7th April 1899 instructed the Agent General for South Australia, Doctor John A. Cockburn a former Premier, to inspect Marconi's installation at South Foreland where he witnessed the transmission and reception of messages during a raging gale of wind and rain.

Cockburn was able to obtain valuable information from the visit. The South Foreland station near Dover was set up by Marconi in December 1898 to communicate with the East Goodwin lightship some 20 km out to sea. In March 1899 the station was used to establish communication across the Channel between England and France. The station was a popular visiting place for scientists from all parts of the world who came to examine Marconi's latest developments.

In 1898 Professor Bragg was granted a year's leave of absence to visit England with a commission to inquire into matters of educational interest. He met Marconi and saw much of the work then being carried out. Immediately on his return he had discussions with Sir Charles Todd and it was agreed that an early trial should be made to see if a practical system could be developed to overcome the Althorpe Island communication problem. Bragg arranged with Rogers to make up certain apparatus.



Morse Code messages on paper tape made during wireless telegraph experiments April-May 1899.

During March and April 1899 various forms of coherers were being developed and working apparatus assembled and tested. Some fragments of taped messages are in existence from the tests of this period. One tape dated 20th April reads "By wireless telegraphy to Anita" and another dated 9th May reads "The sun and stars watch over you and son . . .". Both were transmitted by Mr. Rogers for the benefit of his wife, Anita. It was Mrs. Rogers who made multicoloured satine flags used in some of the early experiments across the Torrens River at the back of the University. The flags were used to semaphore signals between the receiving and transmitting parties to indicate when apparatus was ready or in relaying the results achieved.

On the 10th May, Bragg and Sir Charles Todd participated in the demonstration of a practical system when they established communication over a distance of some 200 metres with the transmitter installed at the Observatory on West Terrace. As an alternative to the usual method of "decohering" the coherer by using a vibrating tapper, the glass tube containing the filings was rotated by a clockwork mechanism. Following adjustments to the apparatus, successful communication was again effected three days later when messages were sent over "a measured mile" from the Observatory to a receiver on the South Road. Several messages were transmitted and received on paper tape. The first message was "Adelaide Observatory". Sir Charles Todd who was with the receiver presented pieces of the tape on which the messages were received to interested spectators as a memento of the successful trial. The messages, in Morse Code, were recorded by a standard telegraph Morse Inker instrument. A lever which was moved by the armature of a relay carried on an extension arm an inking wheel which normally dipped into an ink trough and was raised against a slip of paper as the armature was pulled down. The slip of paper was moved forward continuously by clockwork so dots and dashes were marked as such on the paper tape.

The success of the tests and improvements which Rogers and Bragg were able to make with the apparatus spurred them on to even greater achievement. By the end of May the working distance had been increased to 4 km and major improvements had been made in the sensitivity of the relay and the recorder. The nickel coherer had also been made more sensitive by improved methods of making the nickel filings or shavings. The coherer consisted of a small glass tube about 5 cm long into which two small plugs of silver were tightly fitted and separated from one another by a space of about one millimetre. The space was filled with a mixture of very fine filings of nickel and silver. The materials from which the filings or shavings were made were obtained from the Chemistry Laboratory. The induction coil had been enlarged and was capable of producing a powerful spark of considerable length.

Todd was very pleased with the result of the tests at this stage and on 8th June a letter was sent to Dr. Cockburn in London asking him to purchase apparatus to the following specifications:

"(a) Two Induction Coils of the very best and latest construction. Must be thoroughly damp proof and capable of giving a strong and continuous discharge of sparks between secondary terminals of ten or twelve inches length when using a current of nine amperes at fourteen volts pressure. The secondary terminals should have points at one end and brass spheres of one inch diameter at the other. Apps coils are said to be the best. The secondary must be wound in sections to avoid difference of potential.

(b) Two dozen Coherers of the most perfect pattern and suitable for long distance working.

(c) Four Relays as used by the Wireless Telegraphy and Signal Co. Ltd at their stations.

(d) Four Choking Coils as actually used by the Wireless Telegraph and Signal Co. Ltd.

(e) Four Small Induction Coils as specified in Marconi's Patent 5881/99.

(f) Three hundred Hellesen Dry Cells — M Type.

(g) Two sets of E.P.S. Accumulators — Q type — each consisting of seven cells of 21 plates in each box. Capacity 70 Ampere hours.

(h) Two dozen Incandescent Lamps, B.C.P. 12 volts".

On Saturday 8th July arrangements were set up for a major test between the stations. Mr. Rogers operated the transmitter in a galvanised iron shed which had been erected at the Observatory near the seismograph building to house the wireless apparatus. The tin shed was still on the site until about 1940 when the Observatory facilities were shifted north to a site on Glover Avenue and the buildings demolished to make way for the Adelaide Boys High School. Professor Bragg took charge of the receiving apparatus at the Henley Beach terminal with the receiver connected to the antenna wire supported by a tall pole.

Meanwhile tests were continuing in Adelaide and decision was made to attempt communication btween the Observatory and a temporary station on the sand hills at Henley Beach. On 20th June, the apparatus was prepared for the test. On Friday 23rd June 1899 during a very wet and uncomfortable day Mr. Roger's diary records "Wave signals sent to Henley from the Observatory". An iron filing coherer was used for the test. The following day improvements were made with the apparatus to improve its performance. Mr. Rogers was not happy with the coherer and made some tests using a hydrocarbon type and various other types using iron filings. Because of the absence of communication back to the Observatory, tests were carried out to a prearranged programme. Initial signalling employed dots and dashes together with various combinations of long and short sparks on the induction coil. They then developed to the stage where complete words could be sent and received.

The signals printed out on the paper tape at Henley Beach were so good that the Professor rushed away to the local telegraph office and sent Mr. Rogers a congratulatory telegram. The copy book transmission and reception of messages over an 8 km path was a great achievement at the time and the South Australian pioneers were well ahead of experimenters in the other States in attempting to develop a practical system of wireless telegraphy. At that stage communication was one way only, but on 15th July Mr. Rogers fitted up a second wireless installation to give two way communication.

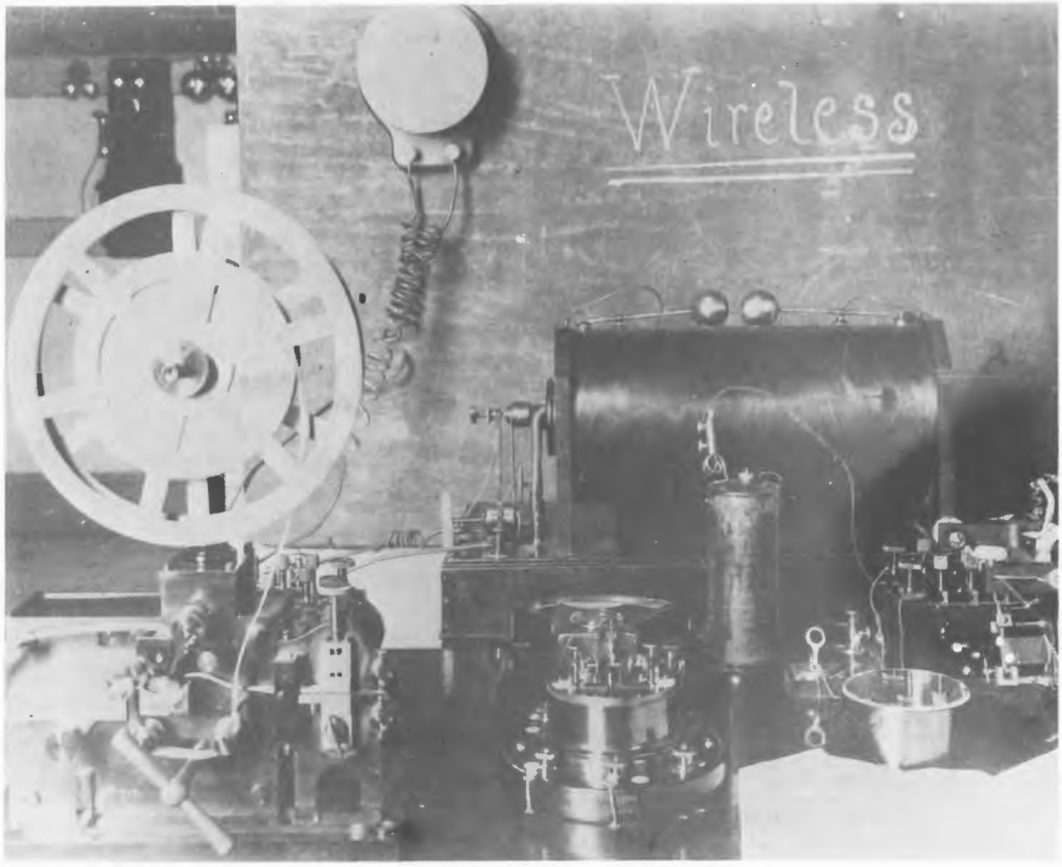
Improvement in the apparatus was being continually made and the performance improved. News of the success soon reached the local press. The Adelaide Observer of Saturday 19th August reported as follows:

> "For some time Sir Charles Todd and Professor Bragg have been making experiments in wireless telegraphy with a view to its utilisation for communication with the Althorpes and other outlying stations. During the past few weeks many messages have gone to and fro between the Observatory on West Terrace and the temporary station at Henley Beach. The sending and receiving instruments, including the coherers, made after Marconi's pattern, have been gradually improved, until now long sentences can be sent through with very few mistakes. One of the first successful messages was sent nearly a month ago, from the Observatory to Henley Beach, telling Professor Bragg, who was at the station there, that Sir Charles Todd was just leaving the Observatory for the Beach. On Sir Charles's arrival he was greatly pleased to find that he was expected. It is intended shortly to carry out experiments in the Gulf, and good results are hoped for, as it is said that it is easier to transmit messages by sea than by land. A curious and interesting effect was observed on Thursday. Messages from Henley Beach were being received at the Observatory. In the instrument fitters room at the Post Office Mr. Unbehaun was making some improvements to his receiving set, and as an experiment he connected it to the Henley Beach telephone wire. He was surprised to find that he could get some of the signals. Apparently the telephone wire had picked them up and guided them into the Post Office. The telephone wire was at the time being used for ordinary business. We have seen several specimens of the messages transmitted from Henley Beach to Professor Bragg on the wireless system, and reported at the Observatory in ink in the Morse signals. They are as mechanically perfect as those transmitted by the ordinary system of telegraphy. The coherers were made by Mr. Rogers at the University of Adelaide.".

The message sent to Professor Bragg telling him that Sir Charles was about to leave the Observatory for Henley Beach was transmitted by Mr. E. Bromley an assistant in the Physics Laboratory. Mr. Bromley subsequently became the Divisional Meteorologist in South Australia.

The Post Office was also co-operating in development work under Sir Charles Todd. Mr. C.A. Unbehaun, Electrician and Inspector of Telephones played a leading part in the work. He commenced with the Post Office in 1877 as an Instrument Fitter and in 1904 became an Electrical Engineer. He subsequently left the Post Office to become partner in the firm Unbehaun and Johnson.

Considerable local public interest was shown in the work being carried out and the University of Adelaide decided to run a course of three extension lectures and experiments on the subject of wireless telegraphy to be conducted by Professor Bragg. In a newspaper advertisement it was explained that the lectures would consist of a brief account of the Theory of the Electric Wave and of the work of Maxwell, Hertz, Lodge, Preece, Marconi and others. The lectures were to be illustrated by experiments and fee for the full course was 3/-.



Early wireless telegraph equipment at Observatory, West Terrace.

The first lecture of the courses was given at 8 p.m. on 13th September 1899 and as reported in the Advertiser the following day:

> "A large audience was attracted to the lecture given in the University library on Wednesday evening by Professor Bragg on 'Wireless Telegraphy' and the discourse was intensely interesting. The lecturer said that wireless telegraphy depended upon ether and wave motion. Ether was an important thing in nature, filling all space and permeating all bodies. By it light, heat and energy came from the sun and without it this world would be a dead globe. Since it was the carrier of light it was our usual means of intercommunication and therefore it was no surprise that in wireless telegraphy it should be made use of.
>
> Professor Bragg explained the different properties of wave motion, illustrating his remarks by means of a ripple tank and a torsion model. Light waves were very short, whereas waves used in wireless telegraphy were long. Light waves being short, moved forward in straight lines and could hardly bend around obstacles, but the long waves used by Marconi could easily swing around great obstacles, so that for example it was possible to signal around or over a hill. These waves were incapable of going through metal or any conductor of electricity, so that none could penetrate a sheet of metal, though they might go around it. The lecturer intimated that in the next lecture he would discuss the way in which large ether waves were produced, and how they were detected while in the last lecture he would show how signalling without wires could be accomplished.".

The second lecture held a week later attracted an even greater audience. The Advertiser reporter on 21st had this to say:

> "On Wednesday evening Professor Bragg delivered the second of his course of lectures on 'Wireless telegraphy' at the University to an even larger audience than attended the opening lecture. Continuing his subject he said the ether waves might be of all sizes — the short ones producing light, while the larger ones were employed in wireless telegraphy. Light waves could be stopped by the thinnest of vapour but the longer ones would pass around even such large obstacles as hills, and that was why they were so useful for telegraphing purposes at times when the heliograph was useless.
>
> He explained how the large waves were produced and said that Hertz was the first to demonstrate their value. There were some points about these waves when first discovered which might have led people to think they resulted from electric induction, but Hertz sent his waves along a room and had them reflected again by a large sheet of metal at the other end and he also obtained stationary waves. This point was well illustrated by the lecturer by a couple of models. Later experiment fully demonstrated their analogy to light waves. Professor Bragg showed two conductors so adjusted that oscillations took place in them at exactly the same time and then showed that the waves were produced in the ether by means of vacuum tubes in response to the incident wave.
>
> The most wonderful apparatus however for detecting these waves was the coherer which was really in use in the seventies when Professor Hughes the inventor of the microphone, used one for telegraphing without wires over a distance of 500 yards in Great Portland Street, London.
>
> He gave a full description of this wonderful instrument of which he showed various types, the most humorous of which was a horse's curb bit which makes an excellent coherer. The lecture was absorbingly interesting, and was illustrated by a number of beautiful experiments all of which were followed with great interest.".

The final lecture held on the 27th September was devoted mainly to experiments with one of the interesting highlights being the transmission of a message from the Observatory on West Terrace and reception on apparatus installed in the lecture room. Mr. Rogers assisted the Professor with the demonstrations.

During September considerable advancement was made with tuning apparatus, and on the 25th, tests were successfully carried out between the Observatory and the University using syntonic jars of the type developed by Sir Oliver Lodge for tuning purposes. In 1897 Lodge had discovered how to tune circuits to a definite rate of oscillation for transmission and reception. The arrangement enabled stations to work on different wavelengths simultaneously without interference taking place. The principle was known as syntonic telegraphy.

Experiments were also being performed at the University on the reflection and refraction of electromagnetic waves. In a diary entry dated 25th September 1899, Mr. Rogers records "refraction and reflection of the etheric waves for the first time". During the Physics Historic Exhibition held during 1974 to commemorate the Centenary of the University, a sulphur prism used by Professor Bragg was on display. It was thought that the prism was used either for the study of the refraction of X-rays or of Hertzian waves or possible both.

The apparatus which Dr. Cockburn had been asked to purchase in June was not easy to obtain. In fact those items which were to be obtained from the Wireless Telegraph and Signal Co. were not available at any price. The company refused to sell them on the grounds that it might hamper their general policy. In any case they insisted on a royalty of £500 per year for the use of their instruments should agreeable renting terms be negotiated.

Marconi's apparatus had been patented in South Australia and the agent of the company was Mr. John Moule, 5 Australasian Chambers, Adelaide. However it was the opinion of Todd that the Patents could not prevent the continuation of experiments and the practical application of the system in the State.

Although Bragg and Todd's experiments had shown in their Observatory to Henley Beach trials that communication from Cape Spencer to Althorpe Island was practicable, the cost of establishing the facility was too great. A skilled operator would have been required at each end and unless communication was established via Cape Borda 40km away, a house would have to be erected at Cape Spencer. Annual operating cost on this basis was £500. This was not acceptable and the project was abandoned in February 1900.

Very little further development work was carried out in the State after that for some time. The Post Office apparently saw little commercial future in wireless telegraphy, probably as a result of the attitude of the British Post Office in refusing to provide financial support to Marconi's company for development and research activities. Preece was of the opinion that the system was of practical use only for ships and for military purposes and its slow rate of working, 10 words per minute, could not compete with the high speeds of line machine telegraph systems.

Another factor was that Professor Bragg started to take an interest in another field. He began investigations of the ionization produced by alpha particles and of their characteristic ranges in air and from then on he and his assistant Mr. Rogers apparently did no further work in wireless telegraphy.

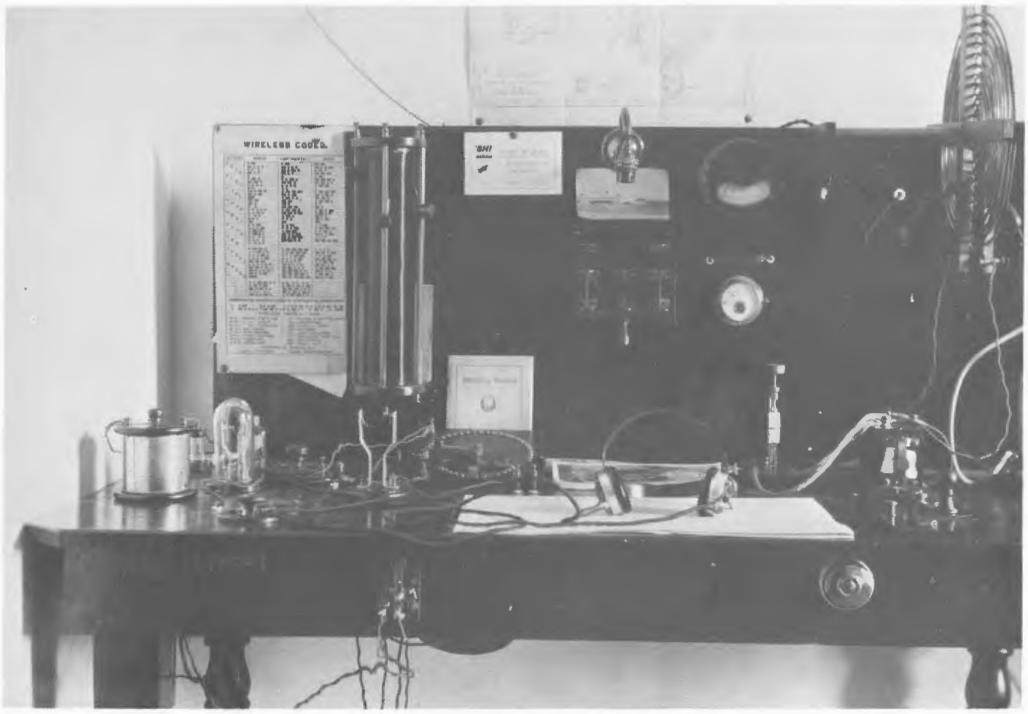
Fortunately there were others outside the Post Office and the University who maintained interest. Many people in South Australia had followed with keen interest the work of Marconi in England, and Bragg at the local University through reports in newspapers, scientific papers and magazines. Overseas papers and magazines which found their way to South Australia featured articles on the theory of wireless telegraphy and descriptions on how to build apparatus for experimental purposes.

From information available on the activities of early local experimenters including Mr. C.E. Ames, Mr. I. Banyer, Mr. L.C. Jones, Mr. W.H. Haire, Mr. E.R. Stanton and others, the first sets were very simple devices just capable of transmitting and receiving over short distances. The transmitter was usually an induction coil fitted with a spark gap with a couple of metres of rod or metal tubing attached to each side of the gap forming a type of Hertz oscillator. Similar sorts of conductors were used with the receiver. A coherer made according to instructions with glass tube and metal filings was connected across the rods. A telegraph relay, home made batteries and a buzzer or telegraph sounder completed the equipment. Initially, experiments were confined to working over a range of a few metres — usually from one end of the room to the other.

Experimenters who were able to make their appartus work, soon had a big following of interested friends and curious observers. The hardest unit to get functioning properly was the coherer and weeks would sometimes be spent in experimenting with filings from different materials and of different sizes. One enthusiast obtained best results with nickel shavings. Marconi and others had found that the sensitivity of the coherer was greatly increased by exhausting the air from the glass container. Mr. Rogers at the University was an expert worker in glass and also had facilities for producing a vacuum but these facilities were not generally available to the average home experimenter.

Those who were able to seal the tube then often had trouble in maintaining the vacuum because the difference in expansion properties between glass and the wire leads caused small cracks to develop in the glass. Even without the vacuum many experimenters achieved surprisingly good results.

When attempts were made to increase the range over which transmission and reception could take place the receiver was sometimes connected to an elevated wire but static made working almost impossible as the coherer could not distinguish between



Experimental Station XVQ Operated by Mr. I. Banyer 1913.

static and the sparks in Morse Code as the ear can. While some signals could be read, it was almost impossible to obtain an error free situation. The coherer, certainly the filing type, was seldom satisfactory — and it was a great day when one of the ships which arrived at Port Adelaide bought the latest in coherers — the mercury or disc coherer. One of these coherers has been preserved in the Adelaide Telecommunications Museum. It had originally been used by Mr. Stanton in his early experiments with his station XVN. This type was developed by Muirhead and Lodge and consisted of a globule of mercury in a cup with a thin film of oil on the surface of the mercury. A sharp steel wheel about 1 cm in diameter was adjusted by a micrometer screw until it just touched the oil film. The wheel was turned by an insulated pulley wheel by a clock-work mechanism. It was one of the most sensitive coherers made. The radio frequency voltages broke down the oil film while the rotation of the steel wheel ensured decoherence by reinsulating the disc on the completion of each passage of oscillation.

The next improvement which experimenters were able to make was to replace the coherer with a Fessenden electrolytic detector. Details of the construction soon filtered through via ships working from the United States. Mr. C.E. Ames and Mr. I. Banyer were among the first to make this type of detector. It required a battery and a potentiometer to render it sensitive and consisted of a small cup containing dilute sulphuric or nitric acid into which dipped a very fine platinum wire. It was a troublesome device with its glass battery, acid and potentiometer but once set up and adjusted, it was very sensitive and a great improvement on the coherer. The platinum wire was adjusted by a screw to barely touch the surface of the electrolyte. The battery voltage was adjusted by the potentiometer just below the point where the oxygen bubbles were destroyed. When a wireless signal was introduced into the circuit, the oxygen bubbles broke down and a signal was heard in the headphones following the dots and dashes of the transmitted signal. The electrolytic detector was generally non-sensitive to jarring but very sensitive to overloading.

The introduction of the crystal detector about 1910 made a great impact and very soon replaced all other forms. It remained supreme until the development of the vacuum tube. This detector used the non-linear conductivity property of certain crystals placed in contact with each other or a suitable metal. When it became known that galena and iron pyrites were good detectors, local experimenters were able to get materials from local sources. Another crystal sought by experimenters was molybdenite. Mr. E.J.G. Bowden who retired in 1957 as acting Supervising Engineer, General Works in the Adelaide Post Office recalled having been given a large piece of molybdenite when a young experimenter in Tasmania in 1910. Using a silver spring, the crystal was very sensitive and gave sterling service for many years.

In the early days, the experimenters had to generate their own transmissions in order to use their receiving apparatus. There were no Government stations and only a few ships carried wireless. Those that did were seldom on the air as there were no coastal stations in operation in Australia until 1912. Keen listeners would spend night after night searching for a signal but sometimes might be rewarded by picking up a ship at a range 3000 km or more.

The number of people interested in wireless gradually increased and more and more spark signals could be heard on the air each week. The power limit for transmitting purposes was fixed at 250 watts but some Adelaide experimenters were still able to work others in Sydney and Melbourne using only a crystal set as a receiver.

The first tuner used with many receivers was a single slide tuner followed soon after by a loose coupler. The loose coupler was a marked improvement over the older types of tuners and remained popular even into the broadcasting era.

All private experimental work ceased with the outbreak of the First World War and sets had to be dismantled and handed in to the nearest Post Office. After the war things changed considerably. Great improvements had been made in the development of wireless to meet military needs and the Defence Authorities and the Government became heavily committed in the use of radio as a means of communication. The activities of experimenters were closely controlled by legislation but with the great number of men returning to civilian life after having received training in the Forces in wireless telegraphy a new lease of life was given to experimental activities.

Early Work in Other Colonies

Pioneering work in wireless telegraphy was also being carried out in the other Colonies before they became States following federation on 1st January 1901. Although New South Wales appears to have been the first to experiment in the new science when Hertz's experiments were repeated at the Sydney University by Professor Richard Threlfall in 1888, the same year that Hertz's paper was published, it was many years before a practical system was constructed. From records available it has been possible to put together a brief outline of some of the early works in other places.

New South Wales

On 10th August 1899, Mr. P.B. Walker, Engineer-in-Chief of Telegraphs of the Post Office in Sydney supervised experiments in the laboratory of the Telegraph Department before a group of people, including representatives from the press. All of the apparatus used in the experiment was made by Post Office staff.

The purpose of the experiment was to demonstrate to officials and the public that wireless telegraphy was a practical fact and that the Post Office had the know-how and facilities to operate a system. The Post Office had however no plans to develop the system for commercial application as there was some doubt about its practicability in a built up area like Sydney where interference had been experienced from the tramway overhead electric cables. Also, opinion was that considerable technical improvements would have to be made before it would supersede telegraphy by wire.

In the demonstration, transmitting and receiving antennas were fixed at opposite ends of the building near the roof. The transmitting antenna was connected to a spark coil with a telegraph key inserted in the battery circuit of the primary coil. The receiving antenna was linked to a coherer consisting of a small glass tube about 5 cm long. Two silver plugs were inserted in the glass tube separated by a small gap. The gap contained a mixture of very fine filings of nickel and silver. The coherer was connected to a standard Morse inker set which recorded the signals corresponding to those made by the transmitter, on paper tape.

Although the Post Office at the time saw little future in the system, this did not deter other experimenters. Several were soon making crude transmitters and receivers and some of the equipment has been preserved in the Museum of Applied Arts and Sciences Sydney. Apparatus in many cases was novel but effective. One of the early experimenters was Mr. F.H. Leverrier who began in 1900.

Western Australia

The Telegraph Branch of the General Post Office in Perth carried out the first wireless telegraph experiments in the Colony when it set up a system to ascertain the practicability of establishing communication between Rottnest Island and the mainland.

On 11th October 1899 Mr. G.P. Stevens, Manager and Electrician of the Telegraph Branch, assisted by Mr. W. Knox, Inspector of Telephones, Mr. Phillips, Batteryman and Mr. A.G. Rosser of the Mechanical Branch carried out tests on the Swan River. The apparatus which was locally made in the workshops consisted of a keyed 15 cm spark coil as a transmitter and unexhausted coherers as receivers. Facilities were not available at the time for securing a reliable vacuum with the coherers.

A shore station was established at the Royal Yacht Club and the antenna was attached to the flagstaff giving a height of about 12 metres above the water level. Other apparatus was installed on the Police launch with a temporary mast being used to support the antenna. After the launch left the berth, communication was established when it was about 190 metres off shore. The launch was then put under slow steam and the distance from the shore station gradually increased. Communication was maintained right up to the 1240 metre mark but beyond this point the coherer failed to respond. Despite trials with various length of spark from the transmitter, the coherer could not be made to respond beyond this distance. When the launch turned round and headed back to shore the coherer again responded to the signals on reaching the 1240 metre point and the Morse Code signals could be easily read.

Experiments were also carried out to determine the distance at which communication could be maintained with various heights of the antenna. The conclusion was that other things being equal, the distance over which it was possible to signal, varied with the square of the height of the vertical conductors used as antennas. From this, it was calculated that to establish communication between Rottnest and the mainland and with the apparatus available in the Colony at the time, masts at each station would have to be nearly 70 metres high.

Tasmania

The earliest wireless telegraph experiments in Tasmania were carried out by staff of the Post Office including Mr. W.P. Hallam, Chief Operator Telegraph Department, Mr. F.W. Medhurst, a Mechanician and Mr. F.P. Bowden Superintendent of Telephones and Telegraphs who conducted tests early in 1900. Many were highly successful. Sometimes the party operated from a boat in the harbour near Hobart and established communication with a shore-based station. Mr. Bowden was also editor of the well known communications journal of the period, the Tasmanian Post and Telegraph Journal which was later called Key-Note.

On the occasion of the visit of the Duke and Duchess of York in the RMS Ophir on 3rd July 1901, the escorts were the warships St. George and Juno, and successful two way communication was established between the St. George which was fitted with Marconi wireless telegraph apparatus and a shore station. Mr. Hallam supervised the setting up of the shore station at One Tree Point at the Long Beach light known as "Blinking Billy". Mr. Medhurst assisted with the operations.

A 25 metre mast comprising a 19 metre bush pole with a 6 metre top mast was held in position by wire guys. The apparatus was installed in a small room under the light, normally used for oil storage. A bare copper conductor well insulated from the mast was attached to the top as an antenna and a metal plate immersed in nearby water served as an earth. The transmitter comprised a coil with a 15 cm spark capacity, with a telegraph key placed in the primary power supply of six accumulators. The detector was an unsealed coherer using soft iron filings resting in the gap between two copper plugs fixed in a glass tube. The hammer of an electric bell was used as a decoherer by rapping lightly on the glass tube.

Transmissions from the shore station commenced when the warships passed the Derwent lighthouse some 16 km distant. Shortly after the St. George came in sight of the light it transmitted "S.G." in response to the signals it received. Communication was then maintained between ship and shore station right up until anchorage. The first message sent after receiving "Good Morning" from Lieut. Trousdale who was in charge of the apparatus on the St. George was "Tasmania sends wireless greetings to the Royal Yacht Ophir and escort".

While the ship was in port, further tests were carried out from time to time with a working speed of 10 to 12 words per minute being achieved. When the St. George departed final communication ceased after the ship had moved about 11 km from the shore station.

Victoria

One of the leading early wireless experimenters in Victora was Mr. H.W. Jenvey, Chief Electrical Engineer in the Victorian Post Office. He operated an experimental wireless station at Red Bluff near Elwood.

During the Easter period in 1901 he established a temporary station at Point Cook and exchanged messages with it from Red Bluff, a distance of 16 km. A kite was used to suspend the antenna. Following the success of the test he suggested that a station be set up for the purpose of welcoming the Duke and Duchess of York by wireless telegraphy.

Approval was given by the Postal authorities to establish a station at the Queenscliffe lighthouse on the western head of the entrance to Port Phillip Bay. Two way communication was established with the escort St. George in May 1901 when the RMS Ophir brought the Royal party to Melbourne. Balloons and kites were tried to raise the antenna but proved unsatisfactory. The antenna was finally tied to the top of the signal mast. The Royal yacht did not carry wireless and the messages were passed between the St. George and the Ophir by normal semaphore signalling methods.

The communication with the St. George was one of the first recorded occasions of wireless telegraph communication between ship and shore stations in Australia. A coherer was used as a detector in the receiver and the messages were printed out by a Morse inker on paper tape.

The ships remained in Melbourne for some days and Mr. Jenvey continued to maintain communication with transmissions from his own experimental station at Red Bluff about 5 km from the point where the St. George was anchored. His equipment was connected to a 50 metre high antenna and when the party departed on 18th May he maintained communications over a long distance. About 15 km off Cape Schanck, transmissions from the St. George ceased when trouble was encountered with the ship's

antenna. The coherer used in this historic communication has been preserved in the Science Museum of Victoria.

Queensland

The Naval authorities were among the earliest experimenters in wireless telegraphy in Queensland. Tests were carried out between the Naval Stores at Kangaroo Point and HMCS Gayundah in 1900. Little is known of the facilities used and results achieved in the first tests but it is known that the spark transmitter at Kangaroo Point was powered by accumulators and the antenna on the Gayundah was attached to a long bamboo fox top mast. It is of interest that Mr. H. Taylor now retired in Adelaide after service with VIA served on the Gayundah as Signalman in 1916. No wireless telegraph equipment was fitted at the time and all signalling was performed by lamp and flag semaphore.

Records of the 1903 period show the Kangaroo Point facilities as being installed in a galvanised iron shed in the grounds of St. Mary's Church with a 40 metre high wooden mast supporting the antenna. The site enabled good communication to be maintained with gunboats cruising in Moreton Bay. Many long despatches were transmitted from the Gayundah to the shore station.

The Post and Telegraph Department took a keen interest in the work and the Naval authorities received valuable assistance from Mr. J. Hesketh, Chief Electrical Engineer of the Department and Mr. Smith Chief Machinist of the Electric Telegraph Office.

The driving force behind the early Navy experiments and tests was Captain W.R. Creswell who commanded HMCS Protector in South Australia from 1885 until his transfer to the Queensland Squadron on 1st May 1900. Captain Creswell had had a colourful career in his early life with the suppression of Pirates off the Spanish and Portuguese coasts. Before he retired in 1919 after being knighted in 1911 he was Rear Admiral and First Member of the Naval Board.

Other early activities in Queensland included a public lecture on 26th March 1902 by Mr. E.C. Barton at the Brisbane Technical College. The lecture was demonstrated with a practical operation using a locally constructed set of Hertz radiators and a Branly coherer for detection purposes.

SECTION 2

HULLO CQ!

— The Wireless Institute

WIRELESS INSTITUTE OF AUSTRALIA (S.A. DIVISION)

The first organised group of wireless experimenters in Australia was the Wireless Institute of Victoria formed in 1909. Another group about the same time formed the Amateur Wireless Society of Victoria. In the following year the Amateur Wireless Society of Victoria disbanded and members transferred to the Wireless Institute of Victoria. In Sydney, through the efforts of Mr. George A. Taylor, the Wireless Institute of New South Wales was formed. These two institutes expanded their activities to form the Wireless Institute of Australia and whilst remaining autonomous became one of the earliest national amateur radio societies in the world.

Mr. C.E. Ames made the first move to establish an organised group in South Australia when he convened a meeting in his home in Carlton Parade Torrensville on 10th September 1919. The provisional office bearers were: —

President	:	Mr. A. Mather
Vice Presidents	:	Messrs. R.S. Lee and J.W. Hambly-Clark
Secretary	:	Mr. C.E. Ames
Committee	:	Messrs. D.A. Smith, D.G. Malpas, C.J. Poole, R. Whyatt, R.M. Dunstone and H.C. Coles.

The group was called "The South Australian Section of the Wireless Institute of Australia" and pending the drawing up of a Constitution the rules governing the New South Wales Section were adopted.

In addition to the provisional office bearers, Messrs W.J. Bland and J.M. Honnor became members at the meeting. Also, Messrs. A.B. Cox, C.J. Spencer, C. Barlow and W. Jenkinson were elected in Absentia.

Two weeks later on the 24th September a second meeting was held at which six new members were admitted. On 15th October the Council met at the office of Mr. R.O.C. Matthews, Grenfell Street, Adelaide for the purpose of drafting a Constitution. Mr. Matthews was one of the new members admitted on 24th September.

The First Annual General Meeting was held on 5th November at the office of Mr. R.M. Dunstone in Alfred Chambers, Currie Street and the Constitution as drawn up the previous month was adopted. The following office bearers were elected at this meeting: —

President	:	Mr. J.W. Hambly-Clark
Vice Presidents	:	Messrs. R.S. Lee and J.M. Heagney
Hon. Secretary	:	Mr. C.E. Ames
Hon. Treasurer	:	Mr. R.O.G. Matthews
Councillors	:	Messrs V.R.P. Cook, D.G. Malpas, D.A. Smith, W. Harrison, H.C. Coles and R.M. Dunstone.

The Rules and Regulations of the South Australian Division set down that "the object of the Institute was for the purpose of encouraging the scientific study of wireless telegraphy and telephony and to promote the intercourse of those interested in the subject and to aid them with advice and instruction". This object was quoted on the official letterhead of the Institute until at least 1962.

Experimenters had been active in South Australia for many years before formation of the local Division. All the early pre war transmissions were carried out using spark transmitters while reception required a wide range of devices including mercury and metal filing coherers, electrolytic cell, magnetic and several types of crystal detectors.

There were many well constructed experimental stations in operation including those belonging to (a) Mr. L.C. Jones of Hawthorn with call sign XVB, (b) Mr. A.H. Evans of Mile End with XVD, (c) Mr. E.R. Stanton of Enfield with XVN, (d) Mr. W.H. Haire with an installation at the Empire Theatre in Grote Street, (e) Mr. C.J. Othen of Glanville with XVT, (f) Mr. J.W. Hambly-Clark at Kent Town with XVX and (g) Mr. A.W.J. McArdle of Kilkenny.

(a) Mr. Jones first began experiments in 1909 as a young man when living at Erskine Street, Hyde Park. He strung an antenna wire from a tall Norfolk Island pine tree to the house and built without assistance a complete receiver with a crystal detector. In 1910 he shifted to 22 Devonshire Street, Hawthorn and erected a mast 24 metres high to support an antenna. He constructed a large spark coil mounted in a box of approximate dimensions 37 cm square by 45 cms long and immediately began experimental work. In 1911 he was granted licence XVB, the second in the State. Progress was rapid and he was soon able to work ships as far away as Cape Borda using an iron wire coherer receiver and also to communicate with fellow experimenters in Gawler — a great achievement at the time with locally built apparatus. In February 1912 he was the first in South Australia to receive the newly commissioned Coastal Radio Station, POM in Melbourne. He also heard the Coast Station POP in Freemantle soon after it opened, the Pennant Hills high power station POS in Sydney working Macquarie Island and the Steamer Riverina when 12 hours out from Sydney. The work was unfortunately brought to a halt with the outbreak of the war with the prohibition by the authorities of all experimental activities.

(b) Just before the war, Mr. Evans' station was one of the most up to date in Adelaide using apparatus thought to be of American origin. It transmitted on 250 watts, the maximum power permitted and could be heard working experimenters in Sydney and Melbourne.

(c) Mr. Stanton had been employed by Gerard and Goodman from 1908 and besides working on electrical installations made it a home hobby which developed into an interest in wireless telegraphy. By 1910 he had constructed wireless telegraph apparatus and succeeded in transmitting a message. On 20th December, 1912 he applied to the Postmaster-General for a licence to experiment with wireless telegraph apparatus. The Secretary to the Postmaster-General replied as follows on 15th January, 1913: —

"With reference to your letter of the 20th ult., respecting a licence to experiment with wireless telegraph apparatus at Enfield, S.A., I am directed by the Postmaster-General to inform you that he will consider the question of issuing a licence provided that you will be so good as to furnish him with the information asked for on schedule 1, 2 and 3, attached hereto.

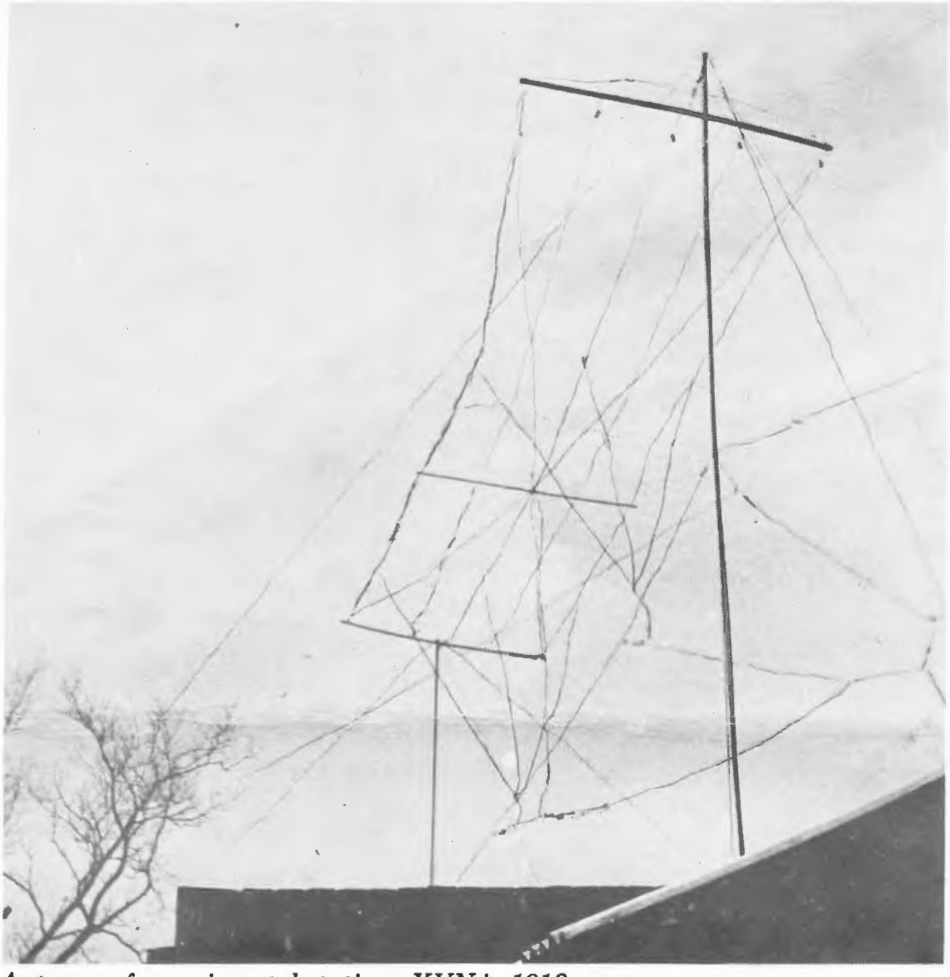
In connection with these schedules, I am to explain that in accordance with the regulations for the working of radiotelegraph stations in Australia, each applicant for an experimental station will have the option of employing any wave length between 100 and 250 metres; therefore, when filling in schedule 3 you should mention the wave length within these limits. The maximum power allowed to any experimental station will be not more than 1/4 kilowatt, and in all cases where licences are granted for experimental stations, all persons who will operate the station must be capable of sending and receiving messages at a speed of not less than 12 words per minute.

The licence provides that the apparatus used must be syntonised, but the following conditions will be regarded for the present as satisfying the terms of the licence when issued in this respect: —

(a) that in no case may more than two principal waves be emitted by the transmitter either simultaneously or alternately and that neither of these waves may differ from the wave length authorised by more than 5 per cent.

(b) that any harmonics of the authorised wave lengths or subsidiary waves must be extremely feeble when compared with the power of the authorised wave and must not exceed in degree of strength the relation of 1 is to 5, and must not be of such strength as to interfere with signalling on any wave length other than that of the authorised wave length.

As the insertion of small spark gaps in the air wire circuit tends to increase the damping, you are limited to a gap of not more than 1 millimetre, but what is commonly known as "plain air wire" circuit will not be licensed.



Antenna of experimental statiaon XVN in 1913.

The foregoing remarks as to syntony, etc, will be liable to modification from time to time at the discretion of the Postmaster-General whenever improvements in radio-telegraphy appear to justify such modication.

As your station will be licensed for experimental purposes only and to communicate with certain other licensed experimental stations, I am to ask that you will be good enough to append on schedule 1 the names of the stations with which you desire to communicate. For purposes of classification please sketch out on schedule 2 the general scheme of connections which you intend to employ."

Provisional authorisation to conduct experiments was granted on 10th February 1913 employing a transmitter power of 12 watts on 250 metres using call sign XVN.

Mr. E.R. Stanton operator of XVN 1913.

Mr. Stanton erected two antennas for his experimental work. By means of a switch they could be used separately or worked in parallel. The first was made up of five wires 8 metres long and two crosswires 9 metres long. There were six downleads 3 metres long and one of 5 metres length. The antenna and down leads were constructed with 16 SWG copper and the feeder with 10 SWG copper. The second antenna comprised two wires 40 metres long spaced about 70 cm apart with two three metre leads joined to a feeder 14 metres long. The wire in this antenna and feeder system was 14 SWG copper and the antenna was supported by a pole at one end and a tree at the other. In a subsequent change to the antenna system a multi-wire flat top type was constructed of square section copper wire and suspended between two masts 10 metres high.

The receiver consisted of an antenna loading coil comprising 19 metres of 22 SWG copper wire wound on a block 12.5 cm by 7.5 cm by 2 cm and connected to a coil of 45 metres of 22 SWG wire wound on a tube 25.5 cm by 7.5 cm with a variable slider arm. There were two other inductances. One comprised a coil of 37 metres of wire wound on a tube 24 cm by 6.25 cm and tapped at eight points with the tappings being taken to an eight position switch and the other comprised 31 metres of 26 SWG wire wound on a 25 cm by 4 cm tube, tapped off at two points. A variable condenser for tuning purposes was made with 12 fixed semi circular plates 10 cm in diameter and 11 movable plates 7.5 cm in diameter. A fixed condenser was placed across the headphones. A potential divider circuit was used in conjunction with the detector.

The transmitter used a spark coil and a rotary gap made from the drum of an eight day French Clock connected across the coil secondary. The tuning condenser in the oscillator circuit consisted of a pair of metal cylinders one of which was a larger diameter than the other. The two formed a concentric condenser arrangement. The outside cylinder was 17.5 cm in length and 7.5 cm in diameter.

The whole of the transmitter/receiver equipment fitted into a case 60 cm by 50 cm by 30 cm and was capable of being used in a field trial arrangement.

In subsequent changes to the transmitter, the antenna coil comprised 20 turns of copper wire wound on a former giving an overall baseplate dimension of 15 cm by 22.5 cm. A condenser was made from copper plates 10 cm square spaced 2 mm apart by celluloid spacers. The spark coil consumed 12 watts from a 6 volt battery and produced a 12 mm spark.

In his early experiments Mr. Stanton used second hand dry batteries obtained from F. Moller a dealer in Rundle Street. The 1.5V second hand cells were discards from Post Office telephones and were very popular with early experimenters. Normal practice was to stand the cells in a solution of sal ammoniac (ammonium chloride), after making a small hole in the body. The sal ammoniac replenished the original electrolyte and gave new life to the cell until the zinc was consumed.

Mr. V.R.P. Cook who now operates VK5AC was second operator at this station. The square section antenna copper wire and a spark coil have been preserved in the Telecommunications Museum and the Morse key was still in use at VK5AC in 1977.

(d) Mr. Haire was a well known experimenter. His XVA installation in the city used an antenna supported by two wooden masts on top of the Empire Theatre and it could be seen as a land mark from a long distance. Although the transmitter at first used only an ordinary car ignition coil, Mr. Haire was able to work ships many kilometres out to sea. These ignition coils were very popular with early experimenters. The core of the coil comprised a bundle of soft iron wires about one centimetre in diameter and about 12 cm long. The primary was about three to six ohms resistance and wound with several layers of double cotton covered copper wire of about 18 SWG. The secondary with a resistance of about 2000 ohms was wound with several pies of fine cotton covered wire in series and wound up to an outside diameter of about 5 cm. The configuration of the secondary varied according to the method of manufacture. The usual arrangement was for the coil together with a tin foil and paper condenser wired across the vibrator

contacts to be placed inside a wooden casing and the space filled with a bituminous compound. The vibrator was mounted on the top of the box. The contacts were made of platinum-iridium and a knurled screw with locknut allowed a fine adjustment to be made of the air gap spacing. The spark coil had a range of only about 16 km and Mr. Haire later modified the equipment to increase the radiated power. He powered it from the generator used to operate the theatre picture equipment. The plant was located in one of the rooms under the stage.

Mr. Haire was one of the first experimenters in Adelaide to obtain a De Forest Audion tube. He experimented with it for some time during 1912-13 but with little success. He passed it on to Mr. Stanton who carried on the work. Mr. Stanton placed a high resistance potentiometer with a sliding contact across the B battery. He was able to hear transmissions from VIA but at a level which was below that obtainable with his crystal. Although experiments continued for some time, little improvement was achieved. These very early tubes were soft types and ionization occurred whenever the B voltage was raised too high.

The most sensitive spot for the plate voltage was just below the ionization point or when a blue glow showed inside the tube.

(e) Mr. C.J. Othen built his first receiver while still at school after reading an article in Boys Own Paper, a popular boys magazine of the period. It was a crystal receiver using galena. He later replaced the crystal with a Fessenden electrolytic detector consisting of a very thin platinum wire with its end protruding from a glass tube into a cell filled with dilute sulphuric acid. In 1911 he became apprenticed to Unbehaun and Johnstone, electrical engineers and on 1st July 1913 while living at Glanville obtained a licence to operate a station with call sign XVT. The transmitter consisted of tuning inductance, condenser and spark coil operating on 110 metres with 90 watts output. The spark coil was from a Ford car ignition system and fed a rotary spark gap driven by an old fan motor. The receiver employed tuning inductance, condenser, galena crystal detector and 200 ohm telephone receivers. After the first world war when licences were again issued he obtained a licence on 5th July 1921 to operate with call sign S488 while residing at Manton St. Hindmarsh. He built a large spark coil about 25 cm in length powered by several accumulators and fed this to a four wire antenna 20 metres long and about 10 metres high. It was made from 14 gauge copper wire with 1 metre wooden spreaders and cleat porcelain insulators. The receiver was originally a crystal type but was modified a short time later with a Philips D1 tube as an amplifier. This tube together with some of his documents has been preserved in the Telecommunications Museum.

(f) Mr. Hambly-Clark became interested in radio as a young man in England where he lived at Ilford and observed with keen interest Marconi's experiments from 1896 until 1900 when he went to sea as a ship's engineer. He left the sea in 1910 and settled in South Australia where he soon became involved in wireless telegraph experiments. He erected two tall masts — one 27 metres high and the other 25 metres high — to support an antenna at Kent Town.

With a spark transmitter, coherer receiver and high resistance headphones he conducted experiments with call sign XVX. After the war he obtained one of the first R tubes to arrive in Adelaide. It cost £2.15.0 in 1919 but unfortunately the tube had a short life and he did very little experimental work with it.

(g) Mr. A.W.J. McArdle was one of the first experimenters to display wireless equipment in the Exhibition when on 23rd April 1910 he gave a working demonstration of communication by wireless telegraphy in the lower hall of the building. The transmitter employed a spark coil, Leyden jars and a Morse key in the primary battery circuit. The receiver had a call bell, a telephone receiver earpiece and a sensitive coherer of a type not previously used in Adelaide. The whole of the apparatus was made by Mr. McArdle.

The first major outdoor test was successfully carried out in July 1910 between his residence at Wilpena Terrace, Kilkenny where the transmitter was located and the Soap Factory at Dry Creek. The receiver was set up at the factory site with an antenna wire attached to the chimney. The spark coil was a gigantic piece of apparatus. It was of the order to 20 cm in diameter and well over a metre in length. Some 5000 metres of cotton covered wire went into its construction. It generated a powerful spark and on one occasion Mr. McArdle senior was thrown to the ground when he came in contact with the terminal while assisting with one of the tests. Six Leyden jars with tin foil inside and outside were used. Power for the spark coil was provided by six bichromate of potash cells with zinc and carbon electrodes in large bulbous shaped glass jars.

Just before the outbreak of the war Mr. McArdle built a portable set in a trailer attached to a bicycle. To generate power for the spark coil, the back wheel of the bicycle was lifted off the ground by a tripod arrangement and the generator rotated by means of a chain drive.

Although the Act of 1905 imposed a fine of £500 as penalty for the operation of an unlicensed station many experimenters were actively engaged and precise figures on the number are difficult to obtain. The first licences under the Act were issued in 1907. According to records tabled in the Senate on 4th October 1911 there were only 26 private wireless telegraph stations completed or in the course of construction and authorised by the Government. In this total there was only one operator in South Australia. Mr. McArdle of Kilkenny was listed with stations at Kilkenny and Enfield.

With the commissioning of the Adelaide Coastal Radio Station in October 1912 the number of experimenters increased rapidly. By 1914 well known licensed experimenters included:—

XVA	W.H. Haire, Grote Street, Adelaide
XVB	L.C. Jones, Hawthorn
XVC	V. Alderman, Glenelg
XVD	A.H.H. Evans, Mile End
XVE	J.J. McLaughlan, Semaphore
XVF	O.W. Judd, North Norwood
XVG	C.E. Ames, Torrensville
XVH	S.F. Howe, Exeter.
XVI	L.P. Anderson, Largs Bay.
XVJ	C.M. Reid, Hyde Park.
XVK	P. Stapelton, Mt. Gambier
XVN	E.R. Stanton, Enfield.
XVO	N.C. McClelland, Franklin Harbour.
XVP	W. Magain, Edwardstown.
XVQ	I. Banyer, North Adelaide
XVR	A. Longstaff, Alberton.
XVS	A.A. Cotton, Glanville.
XVT	C.T. Othen, Glanville.
XVV	A.G. Waterhouse, North Adelaide
XVX	J.W. Hambly-Clark, Kent Town.
XVY	A.H. Bailey, Unley.

Soon after the outbreak of the First World War the Armed Services conducted a vigorous recruiting campaign to secure the services of as many capable wireless men as possible. Many of the South Australian experimenters formed the basis of what grew to be a large signals organisation in the Army and the Navy.

The military authorities in particular had been following closely developments in wireless as a means of communication during war and they soon realised that wireless telegraphy had certain advantages over wire telegraphy for communication purposes.

Ordinary line telegraph communication was liable to be interrupted by cutting of the wire by the enemy or by the breaking of the wire by passing cavalry and artillery activities.

The portable wireless sets developed for military purposes were at the time considered to be marvels of compactness and lightness. The Marconi pack saddle type set which was used by South Australian troops weighed about 150 kg. The parts of the set were intended to be divided amongst four horses for transport purposes. However, in South Australia the set was transported by a cart drawn by two horses. It could be set up ready for operation within 10 minutes by five or six men. Once set up, two men were required to operate it. The set had a guaranteed range of 60 km but this distance was seldom achieved in practice.

The transmitter was a 0.5 kW rotary spark set driven by a Douglas petrol engine with a solid flywheel. The engine and alternator fitted on one side of the pack saddle 'A' frame and the spark discharger unit on the other. When set up for operation a square steel drive shaft linked the two units together. The shaft was spring loaded to enable it to be fitted and dismantled very quickly. The receiver employed a carborundum detector. The transmitter unit was located in the bottom section of the equipment case and contained the transformer connected to the alternator by a flexible cable, and tubular Leyden jars. The receiver, operating controls and Morse key were located on the top section. To deaden noise when the spark was in operation a metal cover was fitted over the rotary gap section.

The masts and antenna were of simple construction. Two masts of sectional steel tubes supported the antenna and could be erected and dismantled very quickly. They were broken down into a small compact package for transport purposes. The antenna was a single L type up to 100 metres in length. The earth system comprised copper gauze mats spread out on the ground. Each mat was about five metres long and one metre wide and they were rolled up for transport purposes.

22nd Signal Troop Mitcham Army Camp 1916 with spark wireless telegraph apparatus.

Two of these stations were located at Mitcham Army Camp in the present Colonel Light Gardens area during the 1914-18 War. The calls signs were WAA and WAB and were operated by the 22nd Signal Troop attached to the 28th Signal Company which had 100-150 men employed on all forms of signalling used at the time including semaphore, heliograph, etc. Included in the group of operators were Sergeant Major Waterhouse and Signalmen Spooner, Cook, Morcombe, Bean and Mullighan. Signalman Cook was an experienced Morse Code operator having received training in the Prospect Post Office.

During field exercises it was found that the stations worked satisfactorily when one moved out to a site near North Terrace but when it was set up near Gawler it was extremely difficult to maintain communication. Frequently the operators had to call on the Coastal Radio Station at Rosewater to relay the messages.

Shortly after the outbreak of the war, all civilian experimental wireless equipment had to be handed in to the local Postmaster who issued a receipt to the owner. On 27th February 1919 notices were sent out to the owners of equipment that they could collect it from the Postmaster upon application and the furnishing of the receipt. The Deputy Postmaster-General who sent out the notices warned however, that "the restrictions on the use of such apparatus still remain in force and a continuance of the prohibition against all private wireless experiments must be rigidly observed in accordance with the War Precautions Regulations".

At the time of formation of the WIA in South Australia all activities associated with wireless or radio as it was then being called were closely controlled by the Radio Service of the Department of the Navy. Mr. F.G. Creswell was Radio Commander in charge of the Radio Service. In 1919 the Navy began to issue "Temporary Permits to Use Wireless Telegraphy Appartus for the Purpose of Receiving Wireless Telegraphy Signals". One of these early permits was issued on 30th September 1919 to Mr. V.R.P. Cook (now VK5AC). The Permit which is still in existence is worded as follows:-

"This Permit is issued pending legislation on the matter of the issue of licences to amateurs and other for experimental purposes and is strictly limited to "receiving" stations. Permits for transmitting stations cannot be issued at present, except in special cases.

Unless specially endorsed, this permit does not extend to the use of "valves". Permission to use valves will be granted only to those who are certified W.T. operators or furnish satisfactory evidence that they understand the principle of valve working and can receive W/T signals efficiently at a speed of not less than twelve words per minute.

This permit will lapse with the introduction of new Regulations governing the issue of licences for experimental and instructional purposes, when the necessary forms of application for licence will be forwarded to the holders of permits."

On 7th July 1921 the Honorary Secretary, Mr. Clement E. Ames applied on behalf of the Institute to the Director of the Australian Radio Services in Melbourne for permission to establish a transmitting station in Adelaide for the benefit of members. A licence was approved on 6th September 1921 for experimental radio telegraph transmitting and receiving apparatus at the residence of the Secretary, 59 Carlton Parade, Torrensville. The call sign allocated was S519 but this was later changed to 5AV. The Institute at that stage and in fact for many years thereafter, did not have the financial resources to set up a station in its own premises.

The licence condition stipulated that the power of the transmitter was not to exceed 200 watts and the wavelength not to exceed 200 metres. The antenna used was a 4 wire inverted L type, the dimensions being 37 metres overall and having a height of 18 metres between the main horizontal section which was 28 metres long. The earthing system comprised a water-pipe and buried wires. The original transmitter was a rotary

spark gap type with a primary voltage of 10 volts a.c. and a spark coil which gave a 4 cm spark. The transmitting oscillator was a North Foreland type with a primary of 2 turns and secondary of 8 turns. The receiver was a crystal and tube amplifier type.

When Mr. Ames later shifted to 20-22 Grange Road, Hindmarsh the Institute conducted its experiments from these premises.

In 1922 Adelaide experimenters including Mr. V.R.P. Cook and Mr. C.R. Churchward participated in an interesting long distant radio telephone experiment. Mr. Cook was a friend of Glenn A. Whittington, Radio Operator on the American Ship "Donald McKay" and during discussions on 15th June 1921 when the ship was in Port Adelaide Mr. Whitttington revealed that the U.S. Navy had been conducting radio telephony tests for some time and he would endeavour to obtain some surplus gear from his Navy colleagues on his return to the United States. He was due to make another trip to Adelaide the following year in a different ship and arranged for Mr. Cook to keep watch for him on 600 metres. He gave Mr. Cook a spare tube and other components and a circuit to build a sensitive receiver.

A letter from Mr. Whittington indicated that he was due on the eastern coast about March 1922. From additional information contained in a local shipping newspaper Mr. Cook learnt that the ship on which Whittington was working, "Eastern Planet" was due in Sydney about 20th March. Mr. Cook listened carefully every night between 8.30 p.m. and 9.30 p.m. on 600 metres and on the 25th he heard a faint but clear cornet solo being played followed by Whittington's voice saying he was transmitting from the "Eastern Planet" and would be arriving in Sydney in two days time. Mr. Cook told Mr. Churchward who was his Chief in Customs and Excise Department at the time and they both listened the following night. Other local amateurs were also alerted. The local group of enthusiasts followed the tests right up until the ship berthed in Adelaide. It was a real thrill when they visited the ship to inspect the equipment. The transmitter was a 2 kW Poulsen arc type powered by a direct current generator. The circuit comprised two high frequency chokes in series with the generator to prevent the oscillations of radio frequency discharging back into the generator, an oscillatory circuit bridged by the arc, two electromagnets across the arc gap, copper and carbon electrodes and a key in the antenna circuit. The output from the microphone amplifier was coupled to the oscillatory circuit producing an effect similar to a modulated oscillator.

On 13th May 1922 the Institute sought permission to install and operate a CW transmitter using an R type tube for radiophone, CW and tonic train transmission. The power proposed was 10 to 50 watts with a wavelength of 1000 to 2000 metres. However, the authorities would not agree to the use of the wavelength sought, it being indicated that experiments should be confined to 200 metres.

Interest in the Institute activities showed a steady increase and in 1922 there were 58 financial members on the role. The office bearers at that time were:-

President	Mr. J.W. Hambly-Clark
Vice Presidents	Mr. J.M. Honnor
	Mr. H. Hawke
Hon Treasurer & Librarian	Mr. R.M. Dunstone
Hon Secretary	Mr. C.E. Ames
Hon Asst. Secty.	Mr. R. Edgar
Council	Mr. W.J. Bland
	Mr. H.L. Austin
	Mr. R.B. Caldwell
Vigilant Officer	Mr. K.J. Martin
Code Examiners	Mr. W.J. Bland
	Mr. J.M. Honnor
	Mr. V.R.P. Cook

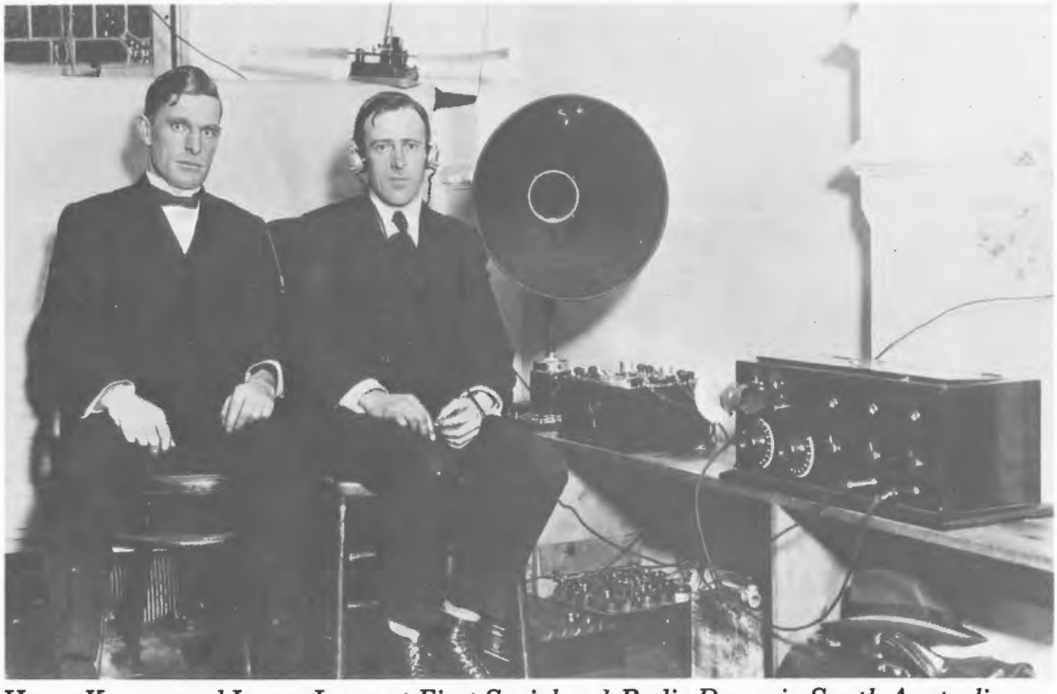
Weekly code classes were held to help members attain proficiency. Practical demonstrations and lectures were also held.

The role of the Vigilant Officer is of particular interest. He was to ensure that members conformed to the Regulations. As set down in the Rules, his duties were:-

"He will from time to time visit all members of the Institute who are in possession of experimental stations; such members will be required at all times to allow the Vigilant Officer access to their stations. He will see that all the Rules and Regulations as may be in force by the authorities and the Institute are properly observed and in the event of a member of the Institute failing to comply with such Rules and Regulations, he will furnish a report in writing not later than twenty four hours after the occurrence to the Hon. Secretary who will take the necessary action to bring the report to the notice of the Council".

In February 1923 Mr. Martin from the office of the Controller of Wireless in Melbourne spoke before the Executive Meeting and outlined a plan for the establishment of Honorary Radio Inspectors in each State to co-operate with Government officials. Mr. Martin explained that the number of amateur stations then in existence did not justify a full time Inspector in Adelaide. The Government had decided to appoint two Honorary Inspectors to be drawn from membership of the Institute. The men would make monthly reports on stations visited but would not appear in prosecutions. At the meeting Messrs. Honnor, Ames and Bland were nominated and their names forwarded to the Controller. In May advice was received that Messrs. Honnor and Ames had been appointed to the two positions. Mr. Ames resigned from the position in July because of family illness.

On 28th June 1923 the WIA held the first Social and Radio Dance in the State in the hall of the Royal Institution for the Blind, North Adelaide. The occasion was unique in that it was the first time that music for dancing was supplied to a large gathering per medium of radio.



Harry Kauper and Lance Jones at First Social and Radio Dance in South Australia 28th June 1923. [*Courtesy D. Darian Smith*].

The music for the dance was transmitted from Mr. Hal Austin's station 5BN located at Norwood and provided by records on a gramola concert machine. The receiving equipment was operated by Messrs Lance Jones and Harry Kauper and consisted of a three tube receiver with a two tube power amplifier and horn speakers. Harris Scarfe's Radio Department loaned speakers to ensure the music was distributed uniformly throughout the large hall.

In welcoming the guests, Mr. J.W. Hambly-Clark the President had this to say:-

"We are all individually honoured by being participants in an historic event of the first importance.

In the history of South Australia there have been many proud moments — for example, the first mail route, the first tramcar, the first train, the first telegraph wire, the first telephone, and these are each indelibly recorded in the archives of the State and pointed to with interest and pride as the milestones of progress. But all these achievements have been in long use in the world before their achievement here.

This milestone, a public wireless broadcasting demonstration under official recognition, assumes Gargantuan dimensions, for while eclipsing in wonder the relative scientific importance of many other things it comes here almost simultaneously with its appearance in the rest of the world, showing that this State is abreast of the times and has a place in the vanguard of progress.

The wonder of wireless broadcasting is that music, speeches, etc, made anywhere in the world may be heard by us in the same fullness as though we were at its source. Time and space are annihilated. The voices of those we love may come to us from afar as though by spiritualistic energy, without its indefinite and cloudy trickery. As if by supernatural energy just through the great void are the antipodes united.

The world knows nothing more wonderful at the present moment and we are here at the first public official demonstration, and we will dance to music coming to us through the skies. The services of many have been generously given, without which the demonstration would have been impossible.

Now we will listen to a selection and then dance to music from the skies."

At the fifth Annual General Meeting of the Institute held at the University of Adelaide on 5th September 1923, Mr. Hambly-Clark retired from the position of President. He had occupied the chair since foundation of the Institute and the regular monthly meetings had been held in his home. As an appreciation of Mrs. Hambly-Clark's kindly forethought in providing the members of the council with bodily sustenance in the form of supper at every meeting, the Secretary Mr. C.E. Ames on behalf of the members presented Mrs. Hambly-Clark with a magnificent gold bangle. Mr. R.B. Caldwell succeeded as President.

During 1923 many people prominent in the experimental, teaching and commercial side of radio were admitted to membership of the Institute. Included was Professor Kerr Grant of the University.

The Post Office became concerned late in 1923 about the difficulty being experienced in the equitable granting of Experimental Licences and observance of the law by licensees. The Chief Manager of Telegraphs and Wireless sought the cooperation of the Institute and Radio Clubs in explaining to all concerned the conditions under which Experimental and Broadcasting (Receiving) Licences were granted. About the same time complaints were received from VIA concerning interference to their operations by experimenters. The Post Office decided to issue no further licenses in South Australia until a Radio Inspector could investigate the matter and report on each application. Mr. H.W. Harrington of Sydney was appointed Radio Inspector in South Australia and took up duty in January, 1924. He immediately despatched letters to all applicants requesting them to call at his office to be interviewed for the purpose of assessing their qualifications and claims for an Experimental Licence.

At the time, there were two sorts of licences of interest to the general public — the Experimental licence and the Broadcasting licence. For receiving purposes the Experimental licence cost 10/- per annum and for both receiving and transmitting the annual fee was 20/-. In the case of the Broadcast receiving licence, the annual fee was 10/- to receive from one station only, and 20/- per annum to receive from more than one. In addition to the Government fee for broadcasting reception, an extra fee was usually charged by the broadcasting station.

Experimental licences were granted to bona-fide experimenters, radio clubs, institutes approved by an authorised officer and for instructional purposes of scientific investigation of wireless telegraphy or wireless telephony phenomena. The applicant had to indicate the nature and object of the experiments which he desired to conduct and to satisfy an authorised officer of his technical qualifications to conduct experiments scientifically and to adjust and control the apparatus he proposed to operate. If the applicant proposed to transmit he had to prove that he could send and receive the Morse Code at a speed of twelve words per minute.

It is of interest to note that an Experimental receiving licence for either a crystal set or tube receiver could be issued to any applicant who satisfied the authorised officer that "he could properly control his apparatus and had some definite and experimental object". The authorised officer was the South Australian Radio Inspector of the Post Office but as an alternative to an interview with the Inspector, the Post Office accepted a certificate of eligibility from the President and Secretary of the Wireless Institute.

In the case of a licence to listen to a broadcasting station a person went to a dealer and purchased a broadcasting receiving licence for the company or companies to which he desired to listen. The Post Office was becoming concerned with the large number of licences being taken out for experimental purposes compared with the number taken out for broadcasting receiving purposes and on 1st March 1924 sent the following circular notice to licensed expermenters:-

"In connexion with your Experimental Licence, your attention is invited to the fact that this licence is issued in accordance with the Wireless Telegraphy Regulations, the conditions of which should be understood, and are accepted by you in obtaining the licence. In particular, special attention is invited to the fact that the licence is issued to enable you to carry out the experiments set out by you in your application form. You may be called on to produce evidence to show that you are experimenting, and not merely listening in to broadcast programmes. The licensed receiver is for your own use and must not be used by other people or for their entertainment. Any contravention of the Regulations is an indictable offence".

Great public interest was being shown in the progress of radio and in order to meet the demand for knowledge, the University of Adelaide advertised its intention to hold a "Course of Wireless" beginning 6th September 1924.

The course was to comprise twelve lectures with a concurrent course of twelve hours laboratory experiments on "Wireless telegraphy and telephony". The hour for lectures was to be noon on Saturdays and the laboratory work could be taken either on Saturday mornings or on an evening to be arranged. The course was open to all persons over the age of 16 years. It was an outstanding success.

By 1924 the Institute's transmitter 5AV was one of many active amateur stations in South Australia. Those licensed at the time included:-

Call Sign	Name and Address
5AC	V.R.P. Cook, 37 Johns Road, Prospect.
5AD	A.R. Snoswell, Harris St., Exeter.
5AE	J.M. Honnor, Alpha Road, Prospect.
5AG	W.J. Bland, Bulla Tce., Alberton.

5AH	F.L. Williamson, Dequetteville Tce., Kent Town.
5AI	H.H. Lloyd, 15 Trinity St., College Town.
5AQ	Bro. Joseph, Sacred Heart College, Glenelg.
5AV	Wireless Inst. of Aust. S.A. Division (C.E. Ames) 20 Grange Road, Hindmarsh.
5AW	University of Adelaide, Physics Dept, North Terrace, Adelaide.
5BC	A.R. Clarke, 67 Elizabeth Street, Norwood.
5BD	F.E. Earle, 321 Fifth Ave., St. Peters.
5BF	F.G. Miller, Eleanor Street, Murray Bridge.
5BG	H.A. Kauper, 20 Gurney Road, Dulwich.
5BI	S.A. School of Mines and Industries, North Tce.
5BM	Bald Motor and Elec. Works, 31 Pulteney St., Adelaide.
5BN	H.L. Austin, 8 Parade, Norwood.
5BP	W.A. Caldwell, 53 Hughes St., Unley.
5BQ	L.C. Jones, Carlisle Road, Westbourne Park.
5BS	Bedford Park Sanatorium (W.J. Davey) Sturt.
5CM	E.N. Sagar, Railway Tce., Largs Bay.
5DA	S.R. Buckerfield, 4 Regent St., Parkside.
5DN	Adelaide Radio Co. (L.C. Jones), 146 Rundle St., Adelaide.
5DO	St. Peters College Radio Club, St. Peter's College.
5FT	J.S. Fitzmaurice, St. Andrew's Street, Nth Walkerville.
5CB	Newton, McLaren Ltd (W.H. Scott) Leigh St., Adelaide.
5GB	G. Bailey, Commercial St., Mt. Gambier.
5HR	H. Rhodes, 12 Goyder St., Kadina.
5RB	R. Bedford, Cottage Hospital Kyancutta.
5WA	W.K. Adamson, 25 Olive Street, Parkside.
5JC	John H. Chesterfield, 45 Goodwood Rd., Wayville.
5CK	S.C. Cusack, 54 Victoria Ave., Dulwich.
5RM	Rupert M. Barker, 49 Newton St., Prospect.
5KW	Kevin Wadham, 2 Elizabeth St., Parkside.
5SF	S.F. Ackland, 74 Johns Rd., Prospect.

On Thursday evening 16th October 1924, the Institute arranged a demonstration with the object of giving the public an idea of the possibilities of radio reception on trains. Nine receivers were set up on a special train to Hallett's Cove. The organisers had allowed accommodation for 200 persons but more than double this number stormed the Adelaide Railway Station before the 7.30 p.m. departure time. The organising committee, Messrs. R.B. Caldwell, T.A. Bagshaw, R. Barker and F.E. Earle arranged for a receiver to be set up in each of the compartments.

Before the train departed all sets were operating at full volume with programmes from 5AB only a short distance away. The receivers included a seven tube set operated by Mr. J. Ashwin, a four tube set operated by Mr. S.R. Buckerfield, which gave excellent performance throughout the trip, a five tube set owned by Mr. Barber, a four tube set operated by Mr. F. Williamson who was able to pick up Melbourne for short periods, and four tube sets owned by Mr. Caldwell the President of the Institute and Mr. J.P. Hale. Three tube sets were operated by Mr. C. Ames who used a de Forest reflex circuit and by Mr. H. Austin who operated a similar set.

The programmes received were broadcast by 5AB, 5 Don N and 5BS the Bedford Park Sanatorium transmitting station. From about 7.30 p.m. to 7.40 p.m. the tranmissions from 5AB were used, during the next ten minutes 5 Don N supplied the music and for the final 10 minutes before 8 o'clock, Bedford Park was the sender. From then on the various operators used either 5AB or 5 Don N to keep the group entertained.

By the end of 1924 broadcasting had been established on a regular basis and many listeners were being troubled by the transmissions of amateurs. Typical of the many letters discussing the problem at the time was the following:-

Dear Sir,

Thanks very much indeed for your prompt reply to my complaint re intereference to my broadcast reception but I am sorry to say it has had no effect. I have just come away from the set completely disgusted, after having received nothing but da dit da dit, Morse Code all the time. We can never get the pleasure of hearing a piece of music, speech or a song. It means that you live in perpetual hope, the operator may one day fall from the top of his wireless pole. Please don't think I am a crank of any kind but you asked me to let you know the effect of your letter.

Yours etc. etc.

Another irate listener was annoyed, about interference from spark experimenters and wrote to a local magazine as follows:-

Dear Sir,

I am penning these lines in the hope that wireless generally in and around Adelaide may be benefited — that is to say, be rid of the spark transmitter humbug. During the past eight days at least three individual 'Spooks' could be heard at any hour. It is almost impossible to work a set to any degree of satisfaction.

If this is to continue I will be compelled to give up. It appears that these spark fiends are local, as they almost drown 5CL. I suggest that through the medium of your well circulated paper you ask all those interested in this cause to be on the look-out, and report anyone who may be known to possess and work on one of these ether disturbers. This eveing they were very active. Many listeners-in no doubt blame the static but anyone with a knowledge of Morse Code can discern their scratchy attempts at Morse signals.

I hope this may lead to the unearthing of these annoying and lawbreaking persons; also that if they be detected, the heaviest penalty will be enforced.

Yours etc. etc.

The Wireless Institute encouraged radio societies and clubs to affiliate with the Institute. This secured the right for the society or club to elect one of its members to represent their interest on the Institute. Such members had all the privileges of a member of the Institute. The radio club was a big thing in the U.S.A. in the early 1920's particularly after the introduction of regular broadcasting and the authorities in Australia were so convinced of its value that they desired to see the same thing established here.

Many Clubs were formed throughout Adelaide and they soon spread to country districts. The aims of the clubs were to further the interest of radio, to investigate matters of interest to amateurs in the particular area in which the club was formed, to give advice and instruction and to encourage lectures. Another important aim was to ensure that the district experimenters did not cause unnecessary interference. It had been found in the United States that amateur clubs were the best means of regulating the activities of experimenters. Most clubs also kept a library of text books and periodicals for the benefit of members. Typical fees in S.A. were 2/6 entrance and 10/6 per annum for persons over 16 years of age and 1/- entrance and 5/- per annum for those under 16 years.

The Institute was keen to see that the interests of young boys were catered for and established a Junior Section, the first meeting of which was held at the University of Adelaide on Wednesday 27th February 1924. Mr. J.M. Honnor presided over the meeting and announced that the meeting was in the nature of a trial and if successful would be made a monthly event.

The object of setting up the Junior Section was to give beginners a course of elementary lectures, which they would all be able to follow. The first lecture was given

by Mr. F. Earle, Assistant Secretary on the "Elementary Principles of Radio Telegraphy". Other speakers included Mr. T. Bagshaw and Mr. F. Williamson.

Later in the year a meeting of Y.M.C.A. members interested in radio was held in the boys room Grenfell St., with a view to forming a radio club there. At a general meeting held on Saturday 4th October 1924, officers of the club were elected. Mr. T.D. Barber occupied the chair and a committee comprising Mr. L. Sims (Secretary), Mr. V.R.P. Cook (Instructor), Mr. Gower (Asst Instructor), Mr. T. Barber, Mr. W. Evans and Mr. E. Hooper were appointed. Mr. Hugh Bennett was elected to represent the club at the meetings of the Institute. The club was named the Y.M.C.A. Radio Club and a resolution was passed limiting the membership to Y.M.C.A. members only. A room was specially prepared by the Club and a two tube receiving set complete with A and B batteries and an Atlas loudspeaker together with a crystal set were presented by the Adelaide Radio Company.

One club of particular interest to College boys was the Sacred Heart College Radio Club at Brighton, run by Bro. Joseph, 5AQ. In 1925 there were about 20 boys of the College in the club. The club developed beyond the mere listening stage and by the end of a year's work every boy had constructed a crystal receiver and several had even made tube sets. Two boys had constructed five tube receivers and another a straight receiver comprising two stages of radio frequency, a detector and two stages of audio. St. Peters College Radio Club with their station 5DO were also a very enthusiastic group of College boys at the same time. Many of the boys of these clubs later became well known amateur experimenters and radio engineers.

Included in the major clubs around 1924-26 were the West Suburban Radio Club, the Southern Suburban Radio Club, The Blackwood Club, the North Adelaide Radio Society, the Port Adelaide and Suburban Club, the Wayville Radio Club, the Glenelg Radio Club and the Railways Radio Club.

The first meeting of the West Suburban Club took place at 44 King St., Mile End early in 1924. The office bearers elected were Mr. D.G. Malpas President, Mr. A.M. Issacs Vice President, Mr. V.K. Coombe, Hon. Secretary, Mr. J.T. Campbell Asst. Hon. Secretary, and Mr. J. Kilgariff Hon. Treasurer. It was decided as a temporary measure to hold meetings at the Secretary's residence on the first and third Thursday of each month. By the end of the year many meetings had been held and membership had increased rapidly. Plans were put forward for the club to have its own transmitter and for the start of a buzzer class. The buzzer keys were installed in July. At the July meeting which was the ninth general meeting, an Atlas loudspeaker was presented to the club by the Adelaide Radio Company.

The Southern Suburban Radio Club was formed on 15th June 1925, when a group of 35 persons attended a meeting at 67 Leicester St., Parkside. Mr. K. Wadham was elected temporary Chairman and Mr. J.E. Rowling temporary Secretary. Messrs. Wadham, Gurner and Rowling were elected to draw-up a constitution and the first general meeting was held on 29th June at Mr. W.B. Randell's premises. The executive elected for the year included President Mr. K. Wadham, Vice Presidents Messrs Roy Buckerfield and W.B. Randell, Secretary and Treasurer Mr. J.E. Rowling, Council comprising the President, Vice Presidents, Secretary and Messrs A.R. Selway, Reg. Gurner, W. Anthony and R. Holland.

By 20th July a well attended buzzer class was being conducted. On 27th July it was decided to carry out reception tests in a train. A train was requisitioned for 10th October and it departed at 2.35 p.m. for Belair but not until a second carriage had been fitted to accommodate the huge assembly which turned up. There were 15 sets working entertaining the 300 people on board. Programmes were received from 5CL, 5DN, 5RM and 5RG. On the return journey the train was halted in a tunnel to allow experimenters to try out their receivers.

At a meeting on 19th October the members decided to erect a 25 metre high oregon mast to support a large pennant. The mast served its purpose until 14th February 1926 when it collapsed during a storm. Some 3 metres was damaged and had to be cut off. The mast was re-erected on 27th February.

By the end of the first year the club had made good progress in building up membership. There were 73 members on the roll. In addition to talks by club members, talks during the first year were given by E.J.W. Gunner (5CL) R.M. Barker (5RM), H. Kauper (5BG), Lance Jones (5BQ). A.A. Cotton (Harringtons Ltd), Brother Joseph (5AQ) and W.J. Bland (5AG). The club carried out regular transmissions with its transmitter 5SR on 190 metres.

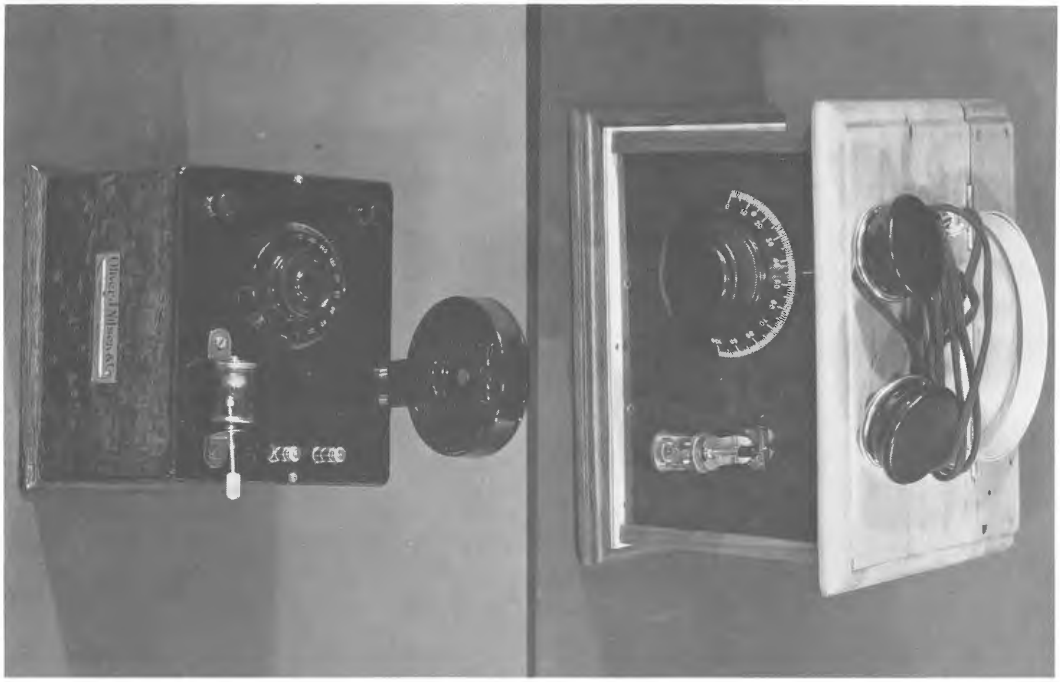
The Blackwood Radio Club 5BR was founded in 1923 and was affiliated with the Institute. It was a very active club and on 23rd January 1926 held its 87th meeting in the club room at Young Street, Blackwood with Mr. R.J. Lampe the President occupying the chair. The club forms were in use at this meeting for the first time and members agreed that they were well and strongly made. It was also at this meeting that the club was presented with a large quantity of radio apparatus by Dr. Crump. The apparatus included a 30 cm spark coil, helix, 60 volt accumulator, high tension dry battery, ammeter, radio frequency choke, battery charger and other miscellaneous items. One of the important annual events of the Club was the Radio Concert which was held regularly in the Boys Club Hall in Blackwood.

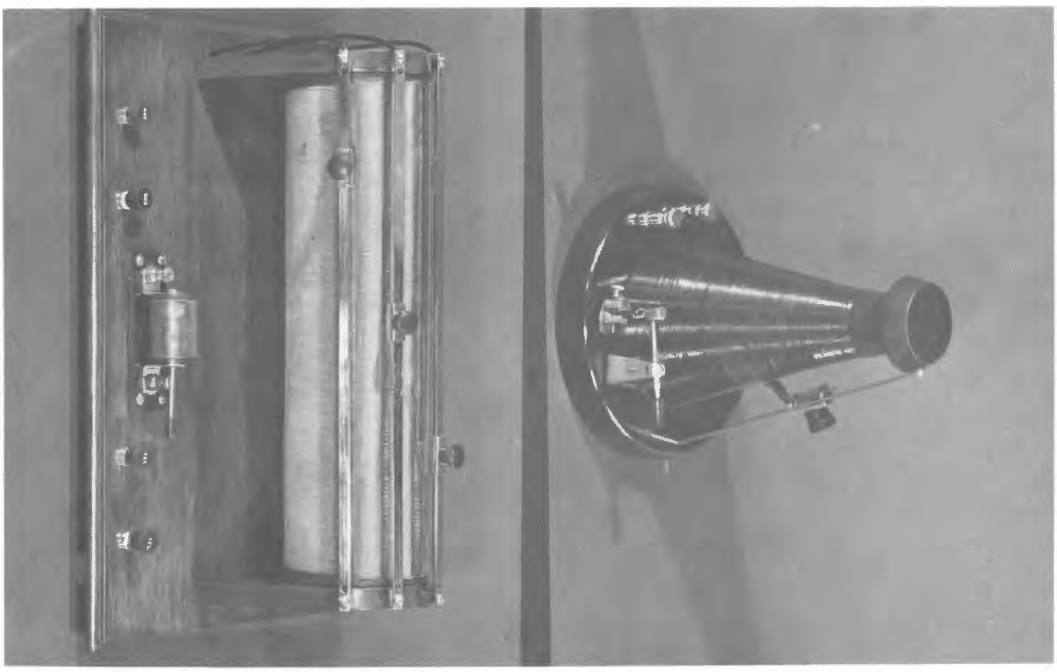
On 18th August 1923 a group of North Adelaide radio enthusiasts met to discuss the possibility of the formation of a radio club in the district. At this meeting rules and regulations were drawn up and finalised and the necessary officers elected. Mr. L.H. Whittington was elected as Secretary and the meetings were first held at his residence. The early meetings consisted of only five members but as the club came into prominence several more joined and the club began to develop into a very active organisation. By the end of 1923 a suitable room was placed at the disposal of the Club by one of the members. A crystal set was constructed and buzzer classes started immediately the new club room was occupied. By August 1924 the Club consisted of twelve local and five corresponding members.

At the first meeting of the Port Adelaide and Suburban Radio Club on 24th June 1924, some 31 radio experimenters were present. The officers elected were Patron, Dr. K. Bollen, Vice Patron Mr. A. Duffield, President Mr. A. Cotton, Vice President Mr. A. Duffield, Secretary Mr. Chas Barlow, Treasurer Mr. Murray, Trustees Messrs. H. McAulay, Denton and Grundy, Council Members, Messrs. Brown, Curry, and Dingle. Mr. Duffield generously leased the Club free of rent for two years, a shed on his property situated at corner Mundy St. and St. Vincent St., Port Adelaide.

The Wayville Radio Club was formed in September 1924 and was active for about 10 years before being disbanded. The first Secretary was Mr. R. Gallan of Davenport Terrace, Wayville. Broadcasts in the 200 metre band were conducted through 5WB by the President Mr. H.B. Wilson of 313 Young Street, Wayville. Other members, some of whom also held office included Messrs. C.E. Moule, R. Davies, A. Mines, J. Trembath, S. Dicker, E. Willoughby, T. Mitchell and C. & V. Lapidge. A Perikon crystal detector used by the Club has been preserved and is included in the fine collection of vintage radio apparatus collected by Mr. Jack Trembath of Belair and donated to the Telecommunications Museum.

On 11th December 1924 enthusiasts living in Glenelg formed a club following a meeting in the Primary Hall of the Congregation Church in Jetty Road, Glenelg. The attendance exceeded all expectations of the organisers. The office bearers elected were Patron, The Mayor of Glenelg, President A. Offler, Vice-President W. Playsted, Secretary S.S. Tee, Treasurer V.W.J. Skinner, Council Members Messrs. A.H. Gibson, R.A. Bruce and J.D. Wilson.





Crystal Sets 1924-28 [*Courtesy Telecommunications Museum*].

The Railways Radio Club which was a branch of the Railways Institute was formed early in 1925 and was a very progressive club. Meetings were held in the Cheer-up Hut at monthly intervals with Mr. R.B. Caldwell being in the chair for the early meetings. One of the outstanding achievements of the Club was the successful launching of the Radio Exhibition in December 1925. Mr. S.A. Johnson the Secretary of the Club was the organiser and the financial results of the exhibition exceeded all expectations. The net revenue was three times the expenses. Traders who exhibited were delighted at the results. Many sold out their complete stocks of receivers. One firm sold eight receivers including a superheterodyne. Later in the year a club was opened in Murray Bridge and was known as the S.A. Railways Institute Wireless Club (Murray Bridge Section). Two 12 metre masts were erected and Mr. Francis G. Miller well known amateur station operator carried out the transmissions using one of his old transmitters.

One of the early country clubs was the Quorn Radio Society. The first meeting was held at the residence of Mr. Blum in First Street, Quorn on 25th August 1924. The attendance was good and after resolutions covering the formation of the Society had been carried, the following officers were elected — Patron Mr. S.C. Chennell, President Rev. H.A. Williams, Vice President Mr. C.T.V. Noble, Secretary and Treasurer Mr. C.A. Blum, Council Messrs. J.W. Moate and W. Koepcke. Buzzer classes were introduced from October at the Secretary's residence and were well patronised.

At the March General Meeting of the Institute nominations were called for the position of three Radio Inspectors. Four names were submitted to the Controller of Wireless and on 1st April 1924 Messrs. V.R.P. Cook, K. Wadham and G.F. Crosby were appointed. Adelaide and suburbs were divided into districts and each Honorary Inspector was allocated a district in which to work. In the covering letter of authority received by each Honorary Inspector, Mr. Malone said:-

"As it is in the interests of experimenters that harmonious relations between all sections interested in wireless activities be maintained, it is hoped that you will act with desirable tact and judgement in carrying out your self imposed duties".

The scheme however did not last long. The Federal Convention of the Wireless Institute of Australia passed the following Resolution:-

"The Conference is of the opinion that the system of inspection of amateur stations by Honorary Radio Inspectors was no longer desirable and recommends that the system be discontinued. It considers that the appointment of Stipendiary Inspectors would prove a more satisfactory method of control".

In view of the resolution and of the fact that the system of Honorary Radio Inspectors was the outcome of acquiescence by the various Institutes, the appointments of Honorary Radio Inspectors were withdrawn and the system discontinued as from 12th August 1924.

By 1924 the work of the WIA was well known to both licensed amateurs and the public. There were very few local licensed amateurs who were not members of the S.A. Division and the public looked to the Institute and its members for advice and guidance as they were among the very few in the community knowledgeable in the practice of radio. With the exception of some specialised textbooks, practically all the publications dealing with radio were written by the amateurs. Radio had captured the minds of the populace to the point where unskilled people of all ages from boys to old men would 'have to go' at building a crystal set or a simple tube receiver from kit parts supplied by the many dealers in Adelaide and in some country areas.

Interest was so keen that a regular magazine began to appear on the bookstalls. The South Australian Wireless (Monthly) and Radio Magazine, the official organ of the S.A. Division of the WIA made its public appearance on 1st April 1924 at a cost of 6d per copy. The publishers announced that the magazine had come to stay and would develop into a real service for its readers and supporters in disseminating knowledge

and news of what was happening in the radio world. They were confident that radio had caught the imagination of the people and that the magazine would be popularly supported.

The response to the magazine exceeded all expectations. After only ten issues the proprietors decided to produce it as a weekly as from 6th January 1925, reduce the charge to 3d copy and at the same time simplify the name to The South Australian Wireless and Radio (Weekly). The proprietors also decided to increase its role as watch dog, particularly in so far as broadcasting was concerned, by a policy of more vigorous publicity in those areas where criticism was justified and to ensure the maintenance of good programmes and high quality transmission. The magazine subsequently became incorporated in the Modern Radio and Electrics but this ceased publication in April 1928 when the economic position of the State began to decline.

The very active executive of the Institute who held office during this very busy period of 1924 comprised President Mr. R.B. Caldwell, Vice Presidents J.M. Honnor and H.L. Austin, Secretary Mr. C.E. Ames, Asst. Secty Mr. F.E. Earle, Treasurer Mr. K.J. Milne, Council Members Mr. W.J. Bland, Mr. G.A. Miller-Randle and Mr. T. Morris.

A large group of people were entertained at the end of February 1925 when the Institute took the tugboat Robbie Burns on a trip down the Port River. Some 130 members and firms were on board. Three receivers were set up and the group was entertained by music from 5CL and 5DN.

A short mast was erected at the stern which carried a wire about 22 metres long and 5 metres high at the lower end. The earth was laid across the deck and down into the engine room, winding up in the bilge water.

Mr. Hal Austin with his four tube receiver near the antenna post used the overhead wire for reception. Mr. Harry Kauper operated a four tube reflex set using a loop on the top deck just outside the cabin. Mr. Fred Williamson bought along an eight tube superheterodyne set of considerable dimensions and gave loud volume using a loop antenna.

On 4th July 1925, the Institute applied to have its call sign changed to 5WI to bring it in line with the 'WI' letters of the New South Wales group. Approval was granted for the change shortly after the application was lodged. About this period prefix 'A' was added to amateur call signs so the station became A5WI. Prior to that '5' plus two letters was the official call sign for amateurs.

The members were keen to experiment in bands other than the one allocated and sought permission to extend their activities. Approval was subsequently granted to enable members to conduct experimental transmissions in the 8-10, 21-23, 32-37 and the 85-95 metre bands. Mr. S.R. (Roy) Buckerfield (5DA) was one of the first experimenters to achieve long distance success in the new bands. On 2nd February 1925 he worked station U6AKW in California on 90 metres employing 20 watts input to his transmitter. This was one of the first two-way contacts by South Australians with amateurs in the U.S.A. Harry Kauper (5BG) was another experimenter who achieved long distance success with short waves. On 26th November 1925 he contacted station U2APM on the east coast of the United States of America using a single 201A tube as a transmitter with an output of only 7.5 watts. The following day he contacted another station in the same area. The antenna was a single wire 10 metres high and erected over a single wire counterpoise. On the 29th he reduced power further to only 5.6 watts output and again contacted two stations on the east coast. The previous day he worked a station in California. The success of these experiments gave great impetus to activity in the short wave bands.

The Secretary again shifted residence and the Institute transmissions then took place from Barham St., Allenby Gardens. A few months later the activities were carried out from 6 Bakewell Rd., St. Peters the address of the new Secretary Mr. F. Earle. In 1927

the official address of 5WI was changed to Douglas St., Parkside, the residence of Mr. P.J. Brewer who operated 5JA. By that time Mr. A.A. Cotton had become Secretary. Mr. Arthur Cotton who operated 5HY was one of the early amateurs having started off with call sign XVS on 14th April 1913. He attended a course in the Marconi School in 1915 and was an interested member of the WIA practically since its inception. He was elected to the Council in 1920 and 1921.

During 1927 interesting evidence from the amateur's point of view was presented before the Wireless Royal Commission by Mr. Cotton, on behalf of the Institute. He said that there were some 400 amateur transmitters licensed in Australia and of these about 45 were in South Australia. Of the South Australian transmitters, 21 belonged to members of the Institute. The Institute suggested that the control of radio in Australia be vested in one body, not as at the time in several. This would ensure the uniformity of call signs and simplify the control of interference. They suggested that this body should be representative, if necessary. Amateurs asked also to be allowed to experiment on the broadcast wave bands during the hours the broadcast stations were not transmitting, so that data might be forthcoming on such subjects as fading, distortion, screening etc. They further asked that a power of 500 watts be allowed to all who passed the examination qualifying them to operate an experimental transmitting station without the necessity of applying for renewal every three months. Amateur operators asked that they be given more latitude in the manner of handling traffic. At that stage only matter of a purely experimental nature could be transmitted. They claimed that the handling of any matter of a non revenue earning nature would tend to promote the good fellowship of experimenters in general thus giving radio a good boost. It would also make them better operators and better able to provide a worthwhile service during a crisis. They cited an instance where three South Australian amateurs were able to keep up communication between Kangaroo Island and the mainland whilst the submarine cable which had broken in a storm was being repaired.

By 1928 the total membership stood at 66 of which 31 were licensed to operate transmitters. There were three clubs associated with the Division. At the annual general meeting held on 18th April, of that year, it was announced that members who had delivered lectures during the year included Brother Joseph, Messrs. H. Kauper, A. Traeger, C.R. Churchward, L.F. Sawford, D.R. Whitburn, P.J. Brewer, R. Edwards and W.E. Launder-Cridge. At the end of the year Mr. Whitburn took over the position of Secretary and 5WI was transferred to his residence at corner Cudmore and Sprod Avenue, Toorak Gardens. It was about this time that call signs for amateur stations were changed to the OA5 series so that the Institutes call sign became OA5WI. Two years later call signs were again changed and the station became VK5WI which it still retains.

Interest in amateur broadcast transmissions was increasing rapidly at the time and some of the members were becoming a little too enthusiastic and following representations from Radio Inspector Harrington the Secretary found it necessary to send a special circular to members. Issued on 25th July 1929 the circular included the following extract from the Radio Inspector's letter:-

> "I should be glad if you would inform your members that the Department must insist on the terms of the experimental licence being adhered to on all occasions and under all conditions. The broadcasting of general calls to broadcast listeners asking them for reports on transmissions and for requests for certain gramophone records to be played, together with message acknowledging the source of supply of gramophone records and replies to individuals cannot be allowed. It should be borne in mind by experimenters generally that their licences authorised communications only with other licensed experimental stations in regard to the particular tests being undertaken."

During the 1930 Exhibition, the Institute using its official call sign 5WI operated a low power short wave transmitter from Jubilee Oval. The transmitter which was crystal controlled had an input of about 3 watts and was designed and built by Mr. A. Traeger.

A group of well known experimenters assembled for a W.I.A. field day at Long Gully 17th November 1929.
Left to right: Marshal Hider, Roy Buckerfield, Morton McNaughton, Bob Parasier, Bill Pitchford, Frank Hill, Don Elliott, Harry Roberts, Doug Whitburn, Ray Snoswell, Ben Wilson, Cliff Moule, Joe McAllister. Boy not known.

By the middle of the year there were some 72 licensed stations in operation. Included were:-

5AC	V.R.P. Cook, 10 Grant Ave., Rose Park.
5AE	J.M. Honnor, Alpha Rd., Prospect.
5AM	P. Kennedy, 77 Edmund Ave., New Parkside, Unley.
5AQ	Sacred Heart College, Glenelg.
5AW	A.W. Kelly, c/o Lyndale Winery, Lyndoch, S.A.
5AX	A.H. Traeger, Brigalow Ave., Kensington Gardens.
5BF	F.G. Miller, Eleanor Ter., Murray Bridge.
5BG	H.A. Kauper, 6 Rothbury Ave., Tusmore.
5BJ	R.A. Bruce, 1 Henry St., Glenelg.
5BK	J. Grivell, Edithburgh Rd., Yorketown.
5BP	R.B. Caldwell, 53 Hughes St., Unley.
5BR	Blackwood Radio Club, Waite St., Blackwood.
5BW	J.G. Phillips, 31 Partridge St., Glenelg.
5BX	A.L. Saunders, Kent St., Glenelg.
5BY	D.R. Whitburn, Cor. Cudmore Ave. and Sprod Ave., Toorak Gardens.
5BZ	W.E. Launder-Cridge, "Pareora," Henley Beach Rd., Brooklyn Park.
5CF	C.F. Trott, P.O. Box 32, McLaren Vale.
5CM	R.M. Anthony, 3 High St., Unley Park.
5CX	C.E. Moule, 146 Young St., Parkside.
5DA	S.R. Buckerfield, Abbotsbury Place, Evandale.
5DC	E. Shepard, 12 Capper St., Kent Town.
5DO	D. O'Leary, 2 Hyde St., Tusmore Gardens.
5DP	H.E.E. Brock, 34 Barnard St., Nth. Adelaide.
5DR	P.W. Dear, 21 Maitland Terrace, Seacliff.
5DX	D.G. Taylor, 67 Victora St., Forestville.
5FT	J.S. Fitzmaurice, St. Andrew's St., N. Walkerville.
5GA	G.R. Anderson, Kingscote Ter., Kingscote, Kangaroo Island.
5GH	Mt. Gambier High School, Mt. Gambier.
5GR	G.B. Ragless, South Rd., St. Marys.
5HG	H.M. Cooper, 51 Hastings St., Glenelg.
5HY	A.A. Cotton, 15 Broadway, Colonel Light Gardens.
5IT	I. Thomas, 15 Eynesbury Ave., Kingswood Park, Mitcham.
5JA	P.J. Brewer, 21 Douglas St., Parkside.
5JC	F. Currie, 45 Carlisle St., Glanville.
5JH	V. Chennell, 53 Osmond Ter., Norwood.
5JM	Wayville Radio Club, 313 Young St., Wayville.
5JO	A.A. Reimann, 20 Grenfell St., Kent Town.
5JW	J.W. Wilkin, 67 Hill St., North Adelaide.
5KJ	E.C. McLoughlin, "Lynton", Port Lincoln.
5KM	F. Kempster, 9 Francis Ave., Fullarton.
5KW	K. Wadham, 5 First Ave., Helnsdale.
5LF	L.F. Sawford, Margaret St., Rosewater.
5LK	F.G. Annear, Carrow.
5MB	H.M. Brown, 24 Northcote St., Torrensville.
5MR	M.E. Richard, 5 Trevorten Ave., Glenunga.
5NC	Norwood Radio Club, 69 Osmond Ter., Norwood.
5OM	J.E. Vardon, 11 Belle Vue Place, Unley Park.
5PM	P.A. Messenger, Wills St., Largs.
5QP	K.M. Theel, 81 First Ave., St. Peters.
5RB	R. Bedford, Cottage Hospital, Kyancutta.
5RC	A.R. Cameron, 330 Kensington Rd., Leabrook.

5RE	H. Hobcroft, Box 160, Renmark.
5RG	R.C. Gurner, 220 Glen Osmond Rd., Fullarton Estate.
5RI	South Aust. Railways Institute, North Ter., Railway Station, Adelaide.
5RJ	D.M. Hancock, 14 Railway Ter., Kadina.
5RK	M. Clayton, 15 Lindfield Ave., Edwardstown.
5RM	R.M. Barker, 57 Newbon St., Prospect.
5RN	H.E. Edwards, 16 Princess St., Croydon.
5RW	Westbourne Radio Club, 14 Avenue Rd., Unley Park.
5RX	G.W. Luxon, 8 Brook St., West Mitcham.
5SF	S.F. Ackland, 74 Johns Rd., Prospect.
5SR	Signals (South Aust.) Radio Club, Keswick Barracks, Adelaide.
5WA	W.K. Adamson, 46 Woodfield Ave., Fullarton.
5WB	H.B. Wilson, 313 Young St., Wayville.
5WH	W.H. Barber, 50 Somerset Ave., Cumberland.
5WI	Wireless Inst. of Aust., Cor. Cudmore and Sprod Avenues, Toorak Gardens
5WO	Wallaroo Radio Club, Wildman St., Wallaroo.
5WP	W.S. Pitchford, 318 Wakefield St., Adelaide.
5WR	W.M. Richards, 32 Charlbury Rd., Medindie Gardens.
5WS	West Suburban Radio Club, 44 King St., Mile End.
5XK	A.J. Hewitt, 233 Henley Beach Rd., Torrensville.
5ZK	Adelaide Radio Club, 15 Lindfield Ave., Edwardstown.

In 1931 the location of 5WI was changed to the residence of Mr. I. Thomas, 15 Eynesbury Avenue, Mitcham but soon after was for the first time shifted to an address that was not the private address of one of the members of the Institute. The home of the station was in the Savings Bank Building, 176 Rundle St., Adelaide and it remained there until it was closed down during the war. The new club rooms were officially opened on 2nd September 1931, by the Deputy Director of the Post Office Mr. E.P. Ramsay, who said:-

"The South Australian Division of the Wireless Institute has for a long time felt the need of permanent headquarters, where Members could meet at any time of the day or evening to discuss amateur problems, which are many and varied; to house its ever-growing library; and to install the Institute's equipment; but lack of finance has in the past prevented the accomplishment of this ideal. Recently, however, the drive for new members and strict economy in expenditure resulted in a substantial surplus being accumulated, and early this year the Council felt that it was justified in recommending that permanent club rooms be leased, and this recommendation was enthusiastically adopted by Members, with the result that these rooms have been leased and are now the permanent headquarters of the South Australian Division of the Institute. The rooms, I understand, will be open to Members every afternoon and evening, and will be available for meetings of the various sections of the Institute. In the near future the Institute's experimental transmitter will also be installed here, and facilities for study will be provided.

Like many other organisations, the Wireless Institute has in the past experienced many struggles to keep going. Lack of interest of members has on many occasions disheartened the Executive, but due to the untiring efforts of the faithful few, the influence of the Executive in amateur wireless circles has been maintained, and the membership has steadily grown, until today it is at its maximum, and can boast of a large number of financial members, about 80 of whom hold their own experimental transmitting and receiving licence.

The Wireless Institute of Australia has recently been afforded official recognition by the Postmaster-General's Department, the officers of which now look to the Institute to maintain the good name the experimenter in Australia has enjoyed for so many years,

to police the experimental section of the Wireless Telegraphy Regulations, and to discipline the members of the Institute, so that all interested in amateur wireless will work in harmony and in accordance with the International Regulations.

The Institute has also offered — which offer has gladly been accepted by my Department — to investigate and endeavour to remedy all complaints of amateur interference with broadcast reception.

I am pleased to be able to state that my Radio Inspector reports to me that he has received the wholehearted cooperation of the Executive Officers of the Institute in these matters, and I very much appreciated the spirit of harmony which has existed between the Department and experimenters for so many years.

At the present time there are no less than 92 experimental licences in force in South Australia, out of a Commonwealth total of 805. Of these 92 experimental licences, 9 are held by Radio Clubs — 3 more of which are in process of formation. Most of these Clubs, I understand, are affiliated with the Wireless Institute, and are carrying out very excellent work — particularly in the training of their members in wireless principles and in bringing together those interested in this fascinating science. It is from the Radio Clubs, more so than from the Institute itself, that most of the new experimenters emerge. They later join the Institute, and invariably become interested in one or other of the Institute's activities.

Many outstanding achievements have been accomplished by members of this Division, notable among them being the low power distant contacts of your old friend Mr. Harry Kauper; Mr. Buckerfield — who, I think, still holds the South Australian record for long distance low power Morse contact, as a result of his communication with Finland a few years ago; Mr. Cooper — who has a habit of working schedules for months with all manner of experimental stations; and others too numerous to mention. We congratulate the members on their very fine achievements in the past, and hope they will continue to uphold the very good name Australian experimenters generally have enjoyed for many years in other parts of the world.

I cannot let this opportunity pass without mentioning the very good work done by your Councillors in the past in keeping the Institute active, principal among them being Mr. Caldwell — for many years your President, Mr. Whitburn — your President, who also as your Secretary was a very live wire; Mr. Thomas; Mr. Sawford, and your present Secretary, Mr. Elliott — to mention only a few. The Institute is to be congratulated on its initiative and enterprise in arranging and so successfully conducting the recent Radio Exhibition, which I understand enabled the Institute's funds to be considerably augmented. I was pleased, as the representative of the Postmaster-General in this State, to be able to afford you assistance in making the exhibition an attractive one. I arranged with my Superintending Engineer (Mr. Kennedy — who is a member of your Institute) to display the very latest mechanical appliances used by the Post Office. High-speed telegraph apparatus, a complete unit of an automatic telephone exchange, and the very latest measuring equipment used for the National Broadcasting Service formed an exhibit which attracted considerable interest, and enabled the public to see just how their communications were handled by this vast Department."

The station equipment at the premises comprised a three stage crystal controlled transmitter employing a 112A tube as oscillator and a pair of 210 tubes as amplifiers. The power input to the final amplifier was 30 watts at 600 volts. It operated initially in the 40 metre band on c.w. A standard AF2 frequency meter was used to check frequency. The receiver employed a Schnell type circuit developed by Mr. F.H. Schnell Traffic Manager of the American Radio Relay League. The set was simple to operate and very popular at the time. The antenna supported between two 13 metre wooden masts 26 metres apart, had a flat top 22 metres in length. Normal transmit antenna current was 0.8 amps.

Wireless Institute of Australia [S.A. Division] Council 1932-1933.
Back L. to R.: R. Bruce, G.B. Ragless, K. Wadham, D.G. Taylor, A.E. Williams, W.P. Pitchford.
Front L. to R.: O.Richardson, R.D. Elliott, L. Deane, Absent: H.A. Berry.

On 29th November 1934 the Institute sought permission to conduct telephony broadcasts from 5WI in the 80 metre band. It was proposed that the transmitter be operated by the Technical Development Section of the Institute. Permission was granted on 5th December provided the transmissions did not interfere with normal broadcast reception.

On 14th July 1936, the Chief Inspector (Wireless) sent a circular to all licensed experimenters on revised conditions concerning certain transmissions particularly in the short wave bands. The reasons for the changed conditions were brought about by:-

(1) the somewhat unnecessary use of telephony transmissions, particularly music, in cases where communication was only of an Interstate character and
(2) inefficient operating, particularly by some of the newer licensees.

The new conditions were to be effective from 1st September 1936 and were as follows:-

(1) The transmission of music in the 7 and 14 MHz bands was prohibited between the hours 5 p.m. and 8 a.m. local standard time and all other telephony transmissions were to be restricted to genuine experiments. Any one session was not to exceed 30 minutes duration.

(2) Transmission in the 7 and 14 MHz bands was permitted only where the oscillator was sufficiently controlled in the case of continuous wave or employed a crystal or master oscillator power amplifier system of control in the case of telephony. In addition, all power and modulation systems employed had to be of high efficiency.

(3) Telephony transmissions in the 7 and 14 MHz bands were in all cases to be restricted to a power of 25 watts input to the final amplifier stage.

(4) All new licensees were required to serve a probationary period of six months. During that period a maximum power of 25 watts (direct current input to the final stage) was permitted but the licensee was not allowed to use telephony on any frequency during that period. The licensee had to make application for permission to use telephony should he desire to do so on the expiration of the probationary period.

(5) A Vigilance Committee was to be appointed to observe all transmissions and log any experimental station whose transmissions were contrary to regulations.

During the 1930's there was great interest in the activities of the Institute and the number of licenced stations increased considerably. Over the seven year period 1930-1937 the number of stations increased from 72 to 182. Radio call sign handbooks listed the following stations in mid 1937:-

VK5AC — Cook, V.R.P., 86 Windsor Ave., Kilkenny
VK5AF — Ives, C.A., 12 Ramsgate St., Glenelg
VK5AG — Smith, W., 23 North St., Henley Beach
VK5AI — Reilly, E.D., 53 Stanley St., Woodville
VK5AK — Lawrie, K.A., 3 Gertrude St., Lockleys
VK5AM — Kennedy, P., 77 Edmund Ave., New Parkside
VK5AP — Morrissey, B.J.M., 40 Ballville St., Prospect
VK5AQ — Sacred Heart College, Glenelg
VK5AR — Richardson, A.K., 11 South Rd., Everard Park
VK5AT — Taylor, A.W., 22 Mary Elie St., Port Pirie
VK5AW — Kelly, A.W., Lyndale Winery, Lyndoch
VK5AX — Traeger, A.H., 61 Cuthero Terrace, Corryton
VK5AY — Haynes, T.A.J., 408 Cross Road, Black Forest Estate, Adelaide
VK5AZ — A.W.A Limited, 47 York St., Sydney (Station at Coastal Radio Station, Rosewater)
VK5BC — Lloyd, H.F., 5 Mary St., Hindmarsh
VK5BD — Briggs, D.R., Iona St., Broadview, Walkerville
VK5BF — Miller, F.G., Eleanor Terrace, Murray Bridge
VK5BH — Blunden, L.W., 58 Shelley St., Firle
VK5BJ — Bruce, R.A., 1 Henry St., Glenelg
VK5BK — Grivell, J., cr. Third and Fifth Sts., Gladstone
VK5BM — Willoughby, E.L., Knight St., Penrhyn
VK5BP — Caldwell, R.B., 53 Hughes St., North Unley
VK5BR — Blackwood Radio Club, c/o G. Ragless, South Rd., St. Marys
VK5BU — Bourne, F.F., 8 Edmund Ave., Unley
VK5BW — Phillips, J.G., Madge Terrace, Somerton
VK5BY — Whitburn, D.R., 77 Wattle St., Fullarton
VK5CB — Brimble, C.C., 27 Scarborough St., Somerton
VK5CH — Haines, C.L.H., Post Office, Box 34, Millicent
VK5CM — Anthony, R.M., 3 High St., Unley Park
VK5CR — Cheel, C.R., 40 Clifton St., Maylands
VK5CP — Laver, C.P., Cape Borda Lighthouse, Kangaroo Island
VK5CX — Moule, C.E., 146 Young St., Parkside
VK5CY — Henry, R.C., Cook
VK5DA — Buckerfield, S.R., 38 Queen St., Knoxville
VK5DB — Berry, L.D., 24 Moulden St., Norwood
VK5DC — Shepard, A.E., 33 Queen St., Norwood
VK5DI — 5AD-PI Radio Club, 313 Young St., Wayville
VK5DK — Robbins, T.F., 11 Moorhouse Ave., Fullarton Estate
VK5DL — Linklater, D.C., Railway Terrace, Pinnaroo
VK5DP — Brock, H.E.E., 2a Marlborough St., Malvern
VK5DR — Deer, P.W., 9 Arundel Rd., Brighton
VK5DX — Taylor, D.G., 67 Victoria St., Forestville
VK5EM — Mann, J.E., 149 Military Rd., Semaphore
VK5FA — Anderson, F.B., Elizabeth St., Tanunda
VK5FB — Brandon, E.F., Post Office, Box 80, Wilmington
VK5FC — Collins, C.H.J., 12 Hackett Terrace, Marryatville

VK5FG — Rogers, B.S., Blackwood
VK5FI — Giddings, A.H., 39 Second Ave., Nailsworth
VK5FL — Harris, R.C., 9 Giles Ave., Glenelg
VK5FM — Bowman, H.N., 24 Lambert Rd., Royston Park
VK5FW — Halliday, E.T., Wonga Ave., Hectorville
VK5GA — Anderson, G.R., Baulderstone Rd., Myrtle Bank
VK5GC — Burgess, G.T., 39 Airlie Ave., Prospect
VK5GF — Farmer, M.G., 134 LeStrange St., Knoxville
VK5GK — Carter, F.P., 55 Roebuck St., Mile End
VK5GL — Tilbrook, C.D.L., 24 Cecilia St., Brighton
VK5GM — Anderson, A.R., 16 Hauteville Terrace, Eastwood
VK5GP — Pitts, R.G., 65 Carlton Pde., Torrensville
VK5GR — Ragless, G.B., South Rd., St. Marys
VK5GU — Gregory, R.W., Hutchinson St., Mount Barker
VK5GW — Huppatz, W.C., McCoy St., Naracoorte
VK5GX — Phillips, A.W.A., 3 Anzac Highway, Golflands, Glenelg
VK5HB — Johnson, H.B., 429 Esplanade, Henley Beach
VK5HD — Lloyd, W.E., 5 Mary St., Hindmarsh
VK5HG — Cooper, H.M., 51 Hastings St., Glenelg
VK5HK — Backler, E.L., Kingston
VK5HL — Lunn, H.V., 10 Morphett Rd., Morphettville
VK5HM — Goldsmith, G.W., 15 Goldfinch Ave., Cowandilla
VK5HR — Heinrich, W.L., Post Office, Box 9, Bute
VK5HW — Wheeler, H.W., Wilpena St., Eden Hills
VK5IT — Thomas I., 15 Eynesbury Ave., Kingswood Park, Mitcham
VK5IV — Dennett, P.R., Coneybeer St., Berri
VK5JA — Brewer, P.J., 21 Douglas St., Parkside
VK5JB — Bergin, J.T., 11 Sefton St., Largs Bay
VK5JC — Cawthorn, E.J., 18 Flinders St., Kent Town
VK5JG — Georgeson, J., 67 Moseley St., Glenelg
VK5JH — Chennell, V., 37 Housnlow Ave., Cowandilla
VK5JK — Kidman, I.M., Robertson St., Naracoorte
VK5JN — Henderson, S.A., 19 North-East Rd., Walkerville
VK5JO — Reimann, A.A., 26 College Rd., Kent Town
VK5JR — Smith, J.A., 19 Flora St., St. Peters
VK5JS — Strafford, J., 71 Ann St., Stepney
VK5JT — Kilgariff, J., 70 Stanley St., Burnside
VK5JU — Berry, H.A., 38 William St., Norwood
VK5JW — Wilkin, J.W., "Willow-Bend Stud Poultry Farm", Nth Walkerville
VK5JX — Golley, J.C., 15 Pier St., Glenelg
VK5KB — Bowen, H.K., 44 Augusta St., Maylands
VK5KD — Davey, R.W., 199 Torrens Rd., North Croydon
VK5KG — Brooks, A.H., 13 Surrey St., Grange
VK5KH — Ring, K.M., 8 May Terrace, Kensington Park
VK5KL — Castle, C.H., 21 Harrington St., Prospect
VK5KO — De Cure, J.E., 25 Farrell St., Glenelg
VK5KR — Ireland, L.K., Chute St., Mount Gambier
VK5KW — Wadham, K., 96 Pirie St., Adelaide
VK5KX — Bulling, W.J., 617 Esplanade, Grange
VK5KY — Stapleton, J.W., 125 Commercial Road, Port Adelaide
VK5LA — Atkins, L.M., 16 Lockwood Rd., Erindale
VK5LB — Badenoch, J.H.L., 46 Hereford Ave., Trinity Gardens
VK5LC — Catford, L.E., Gladstone

VK5LD — Deane, L.A., 21 Davenport Terrace, Hazelwood Park
VK5LF — Sawford, L.F., 107 Wills St., Largs
VK5LG — Cotton, L., Post Office, Iron Knob.
VK5LJ — Davies, R.R., 8 Gurr St., Goodwood Park
VK5LL — Lucas, G.F., 19 Wilpena Terrace, Kilkenny
VK5LN — Drew, A.J., 19 Dimboola St., Kensington
VK5LO — Loeser, H.E., 2 Clifton St., Goodwood
VK5LP — Phillis, L.V., 5 Luhrs Rd., South Payneham
VK5LR — Lester, J., 15th St., Renmark
VK5LY — Hodder, C.W., 72 Porter St., Parkside
VK5MC — Coulter, J.M., 36 Brighton Rd., Glenelg
VK5MD — Barbier, E.A., Stockade Reserve
VK5MF — Smythe, A.C., 15 Northcote St., Torrensville
VK5MH — Baty, R., Addison Rd., Pennington
VK5MK — Bentley, F.E., 20 Neil St., Cowandilla
VK5ML — Coombe, G.S., 6 Manton St., Hindmarsh
VK5MV — Barber, S.G., 505 North Esplanade, Henley Beach
VK5MW — Atkins, K.J., 29 Park Avenue, Semaphore South
VK5MX — White, C.R., 69 Curran St., Kilkenny
VK5MY — Roberts, H.M., 58 Fourth Ave., Alberton East
VK5MZ — Lawrence, J.H., 17 Sheffield St., Malvern
VK5NR — Roberts, N.W., 11 Ninth Ave., St. Peters
VK5NW — Bailey, R.H., Mitchell St., Crystal Brook
VK5OJ — Green, H.R., 5 Dudley Ave., Prospect
VK5OP — Brown, L.A., 16 Park Terrace, Eastwood
VK5PB — Burford, W.P., Foster St., Naracoorte
VK5PN — Pearn, W.L., 20 Oxford Terrace, Sturt Park
VK5PR — Kilsby, K.W., Birdwood
VK5PS — Parsons, W.W., "Haigh Mansions", Esplanade, Henley Beach
VK5QP — Theel, K.M., Caulfield Ave., Clarence Park
VK5QR — Galle, R.V., 56 Olive St., Prospect
VK5RB — Bedford, R., Cottage Hospital, Kyancutta
VK5RC — Cameron, A.R., 330 Kensington Rd., Leabrook
VK5RD — Elliott, R.D., Farr Terrace, Da Costa Park
VK5RE — Hobcroft, H., Ral Ral Ave., Renmark
VK5RG — Gurner, R.C., 11 Strathspey Ave., Linden Park Gardens
VK5RH — Haskard, R.G., 9 Austral Terrace, Malvern
VK5RI — South Australian Railways Institute, North Terrace Railway Station, Adelaide
VK5RJ — Hancock, D.M., 86 Taylor St., Kadina
VK5RK — Deane, R.K., 121 Wattle St., Fullarton
VK5RL — Paech, R.L., 14 Fernleigh St., Underdale
VK5RO — Easter, E.R., Port Elliot
VK5RP — Parasiers, R., 138 Anzac Highway, Glandore
VK5RT — Manuel, R.T., 59 Gordon Rd., Prospect
VK5RX — Luxon, G.W., 8 Brook St., West Mitcham
VK5RY — Yates, R.C., c/o B.H.P. Co. Ltd., Whyalla
VK5RZ — Nestrom, O.L., 11 Ninth Ave., St. Peters
VK5SL — Fiedler, L.V., Blyth Terrace, Moonta
VK5SM — South Australian School of Mines and Industries, North Terrace, Adelaide
VK5SP — Finn, L.W., Simpson St., Seaton Park
VK5SU — Gray, F.M., 52 Ormond Grove, Toorak Gardens

VK5TR — Turner, R.R., 122 Seaview Rd., Henley Beach
VK5TT — Thebarton Junior Technical School Club, Ashley St., Thebarton
VK5TW — Welling, T., 106 Hill St., North Adelaide
VK5TX — Foster, J., 11 York St., North Kensington
VK5UK — Coakley, T.J., 10 Thomas St., Unley
VK5UX — Wallbridge, L.W., 20 Wattlebury Rd., Lower Mitcham
VK5WA — Adamson, W.K., 46 Woodfield Ave., Fullarton
VK5WB — Wilson, H.B., 313 Young St., Wayville
VK5WD — Wilkinson, D.A., 23 Main Avenue, Frewville
VK5WG — Govan, W.M., 39 Esmond Rd., Port Pirie
VK5WH — Barber, W.H., 46 Cottell St., Port Pirie
VK5WI — Wireless Institute of Aust. (South Aust. Division), 176 Rundle St., Adelaide
VK5WJ — Wiseman, W.J.C., Port Lincoln
VK5WK — Prince, A.E., 23 Warwick St., Walkerville
VK5WP — Pitchford, W.S., 10 Clarence St., Hyde Park
VK5WR — Richards, W.M., 32 Charbury Rd., Medindie Gardens
VK5WS — West Suburban Radio Club, 44 King St., Mile End
VK5WW — Walker, W.S., 20 King St., Alberton
VK5XA — Stacey, H.K., 55 Gwynne St., Firle
VK5XB— Sutherland, A.L., Gower St., Dunleath, Glenelg
VK5XJ — Pryzibilla, A., 19 Leicester St., Parkside
VK5XK — Hewitt, A.J., 233 Henley Beach Rd., Torrensville
VK5XR — Patterson, C., Peake St., Naracoorte
VK5YK — Eastern District Radio Club, 56 Statenborough St., Burnside
VK5YL — Geisel, Miss B.A., Charles St., Murray Bridge
VK5YQ — Charles, E.A., 193 Young St., North Unley
VK5ZC — Clayton, M.C., 15 Lindfield Ave., Edwardstown
VK5ZL — Weddell, J.A., 26 Kandahar Crescent, Reade Park
VK5ZU — Phillips, A.M., 68 Kintore Ave., Prospect
VK5ZX — Heath, A.H., 7 Clifford St., Prospect Park
VK5ZY — Mutton, A.K., 4 Burke St., Tusmore

At the outbreak of the Second World War all amateur station transmitting activities were forbidden. Shortly afterwards instructions were issued under National Security Regulations for all transmitting equipment to be dismantled and sealed up. Permits were granted to have possession or control of apparatus with the following restrictions:-

(1) The apparatus was not to be removed from the address shown on the Permit without permission of the Chief Inspector (Wireless).
(2) The apparatus was not to be used in any circumstances whatsoever and all transmitting tubes, transformers, tuning coils and microphones had to be placed in a solidly constructed receptacle which was to be sealed by an officer of the Postmaster-General's Department.
(3) The seal was not to be broken except by an officer of the Department.

In August 1942, the Government decided, in the interests of security that radio transmitting apparatus belonging to experimenters should be taken into official custody for the duration of the war. Permits granted under the Wireless Transmitting Apparatus (Possession) Order were revoked.

Apparatus specified in the permit had to be delivered to the nearest Postmaster in the sealed receptacle in which it was originally placed with the seal intact. The equipment was returned soon after the cessation of hostilities.

All Institute members and other experimenters did not however cease to become involved in radio. At the time when an invasion threat loomed and there were fears of interruption to the normal communications facilities in South Australia, the

Commissioner of Civil Defence and Navy authorities gave permission for the setting up of an amateur station network comprising a headquarters centre and several sub-control stations to maintain communications should cables be put out of service.

The headquarters control station operated on 1775 kHz and the sub control stations on 3605 kHz. The cost of establishing the stations were borne by the operators but Civil Defence assisted in the procurement of parts required for maintenance purposes.

Mr. H.W. Harrington the Post Office Superintendent of Wireless was appointed controller of radiocommunications with Mr. J. de Cure and Mr. A.E. Barbier as deputies. The network was kept in a state of readiness by regular weekly exercises as well as unscheduled ones. Radio telephony was used and duplex operation was maintained from headquarters to the sub-control stations.

Operators participating in the scheme included Mr. R. Bruce (VK5BJ), Mr. V.R.P. Cook (VK5AC), Mr. H.N. Bowman (VK5FM), Mr. H. Robinson (VK5HN) and Mr. R. Harris (VK5RR) at Woodville and Mr. C. Baseby (VK5BZ) at Unley Oval.

In 1945 many members desired to resume activities as soon as the authorities would permit and on 18.7.45 a meeting of 43 enthusiasts was convened in rooms in Gawler Place with Mr. J. Kilgariff in the Chair with the aim of reforming the Institute. Mr. E.A. Barbier was elected Secretary pro tem and Messrs Bowman, Ragless, McGrath, McAlister, Luxon and Thomas were elected to the Committee.

On 14th August 1945 a General Meeting was held at 17 Waymouth Street and the following were elected as Council Members:-

President	Mr. I. Thomas
Vice President	Mr. J. Kilgariff
Secretary	Mr. A.E. Barbier
Asst. Secretary	Mr. E.P. McGrath
Membership Organiser	Mr. J. McAlister
Publicity Officer	Mr. H.N. Bowman
Programme and QSL	Mr. G.W. Luxon
Treasurer	Mr. C.H. Baseby

At the first Council Meeting on 4th September 1945 the following were accepted as full members:-

A.J. Drew, J. Foster, G.W. Luxon, W.L. Pearn, C.A. Pryzibilla, A.F. Wreford, L.A. Deane, W.W. Parsons, H.A. Berry, E.M. Halliday, J.E. De Cure, D.A. Wilkinson, J. Kilgariff, E.A. Barbier, A.K. Richardson, G.B. Ragless, A. Heath, H. Robinson, R.L. Paech, K.A. Laurie, H.N. Bowman, A.C. Smythe, E.D. Reilly, H.E.E. Brock, S.R. Buckerfield, C.H. Baseby, A.H. Brooks, A.M. Phillips, I. Thomas, V.R.P. Cook, L.S. Cotton, E.P. McGrath, F. Williamson, F. Bourne, T. Laidler, A. Reimann, F. Miller, R.H. Grundy, F. Holsten, O. Nestrom, H.M. Roberts, G.F. Goldsmith, H. Wheeler and D. Whitburn.

The authorities decided that the reintroduction of licences was an opportune time at which to change some of the pre-war conditions. Two classes of licences were introduced — an A Class and a B Class. The B Class was equivalent to the pre-war licence and where possible old call signs were reallotted to those who had previously held a licence. Licences were not available to persons under 18 years of age.

The Amateur Operators Certificate of Proficiency existing at the time was to be known as the Second Class Amateur Operators Certificate of Proficiency with the exception that the speed of the Morse Code test was to be increased to 14 words per minute. A new certificate known as the First Class Amateur Operators Certificate of Proficiency was introduced. It called for a higher knowledge of radio and electrical theory and ability to send and receive in plain language, Morse Code at a speed of 18 words per minute.

On the technical side, the maximum power measured at the plate of the tube delivering power to the antenna circuit was not to exceed 50 watts in the case of a B Class licence and 100 watts in the case of an A class licence.

Other conditions imposed included (1) a B Class licensee must have completed 12 months satisfactory operation before being considered eligible for an A Class licence, (2) all new licensees were required to serve a probationary period of six months during which they would not use radiotelephony emissions (Persons who operated licensed experimental stations prior to 1st September 1939 were not subject to this restriction), and (3) transmissions of recorded music or any form of entertainment was not permitted.

Tentative frequency bands released by the Defence authorities for amateur use included 28-29, 50-54, 166-170, 1345-1425 MHz. In July 1946 bands 7150-7200 and 14100-14300 MHz were added and others soon followed.

On 9th February 1946 the Institute lodged a request for reservation of call sign VK5WI for an experimental station which it planned to establish. Acknowledgement that the request had been granted was received by Mr. Barbier on 17th February 1946.

On 26th November 1946 the Secretary sought permission on behalf of the Council of the Institute to broadcast Institute news for the benefit of country members. The proposal was to broadcast news bulletins in the 7 MHz band at 10 a.m. on Sunday mornings for half an hour. Approval was granted on 9th January 1947, with the proviso that the transmission time be limited to 15 minutes. The broadcasts were initially conducted by Mr. Reg Harris using his own equipment and call sign VK5RR. The first broadcast took place on 26th January on 7081 kHz.

About this time many prominent prewar members of the Institute had begun to settle down to civilian life after a period with the Services and they were not happy with the revised Regulations applicable to experimental stations. There was a strong feeling for reversion to prewar certificates and licence conditions and for the use of 100 watts of transmitter power to all who qualified for the Amateur Operators Certificate, to be followed by permission to use telephony and other privileges after the successful completion of a probationary period of six months.

In September 1947 amended conditions under which experimental stations could operate became effective. The Handbook for Guidance of Operators of Experimental Wireless Stations was re-written and the title changed to Handbook for Operators of Amateur Wireless Stations. The title was later changed to the present Handbook for Operators of Radio Stations in the Amateur Service. The new conditions provided for the stations to be known as Amateur Stations in lieu of Experimental Stations and for the issue of one class of licence with all licences being authorised to use a power up to 100 watts. The first and second class certificates were abolished and replaced by one certificate only, the examination being of the old second class amateur standard.

The Institute by this time had been firmly established in Headquarters at 17 Waymouth St. and with Mr. H. Austin as President and Mr. E.A. Barbier still as Secretary. There were some 300 members and decision was made to apply for approval to re-establish the Institute's official station VK5WI. Approval was granted on 13th May 1947 and operations were carried out using the equipment of Mr. R. Harris, a Council Member, situated at 110a Torrens Road, Kilkenny. In 1948 the station was transferred to Rose Park at the residence of Mr. A.W. Austin and remained there until 1954 when Mr. C.J. Othen of Hindmarsh conducted the station.

During the 1952 Royal Adelaide Exhibition the Institute entered VK5WI as a working exhibit and carried out demonstrations to an interested public. Transmitters were shown in operation working the 7, 14, and 50 MHz bands. A 50 MHz station was used to call relay stations at the start of each session to ascertain if they were ready to commence operations. A transmitter operating in the 7 and 14 MHz bands was a modified standard commercial broadcast transmitter which had been purchased for

experimental purposes. The exhibit was awarded a Silver Medal in the working hobbies section. The Governor, Sir Willoughby Norrie, showed keen interest in the station during his visit to the Exhibition. While he was there the operators worked two stations in America.

In August 1952 permission was granted for the Institute to use 3.5 MHz in addition to the 7 MHz band allocation for broadcast of its Sunday morning session because of propagation problems. In 1957, Morse Code practice sessions were commenced in the 288-296 MHz Amateur band. These were carried out by Mr. L.C. Sappiatzer (VK 5SS) on Monday, Wednesday and Friday evenings using modulated continuous wave.

Because of the increasing interest shown by young people in amateur radio work representations were made in 1954 to have conditions changed to enable licences to be issued to qualified persons who had reached the age of 16 years instead of 18 years. Approval was subsequently given and at the same time a restricted amateur licence became available. This was available to persons who had qualified since 1st January 1953 in all sections except Morse operating in the examination for the Amateur Operators Certificate of Proficiency. In order to facilitate the identification of the radiotelephone amateur stations operated by persons with Limited Certificates of Proficiency, call signs embodied three letter combinations which were not available for stations authorised to use radiotelegraphy. The call signs were taken from the series ZAA to ZZZ.

Permits for amateur station licensees to conduct experiments in television transmission and reception became available in 1956. The permits were issued to enable investigation, research and instruction in television transmitting and receiving techniques without pecuniary interest. The transmission of visual images was to be confined to material of an instructional value in the electronic field or to unimportant subjects of a personal nature. The conditions set down that transmission and reception of images could be undertaken in all the amateur frequency bands from 288 MHz upwards using equipment with a power not exceeding 100 watts input at the plate of the final transmitter stage. Television transmissions were to be identified by the suffix 'T' after the normal station call sign allotted to the licensee.

The South Australian Division of the W.I.A. played an important role in tracking the early satellites launched by Russia and the U.S.A. An early warning radio network of amateurs throughout N.S.W., Victoria, Western Australia and South Australia was set up to assist Moonwatch teams. The South Australian Division accepted the role of Co-ordinator as Professor Huxley was the co-ordinator for satellite observations.

By September 1957 the W.I.A. Headquarters had drawn up a plan and had it accepted by the Moonwatch Committee in the four States participating. The South Australian observers included VK 5WI and VK 5XU (Headquarters station and adviser), VK 5XV, VK 5XY and VK5CA. Most of the equipment was provided at the operator's own expense.

On 5th October amateurs were alerted to watch for Sputnik 1 put up by the Russians. At noon it was announced that the frequencies were 20.05 MHz and 40.03 MHz. Station VK5XV and VK5XY picked up the signals and found the satellite was overhead.

The Federal Executive Station in Victoria called in all operators who were able to track the satellite and in South Australia VK 5WI and VK 5XU and VK5XV operators stood by for 72 hours to receive tracking reports from all States. The reports were forwarded to Dr. Elford the acting co-ordinator in the absence of Professor Huxley. Eventually these reports were sent to Moscow and the Smithsonian Institute in Washington. Later the Weapons Research Establishment at Salisbury set up a Satellite Centre as a receiving centre for all data.

The Institute sought approval in 1958 to increase the power of VK5WI which at that stage was being operated by Mr. G.M. Bowen at Toorak Gardens. The authorities had had the matter of increased power under review for some time and the maximum power

for all stations was increased to 150 watts from 1st July 1958. Many enquiries had been made concerning the use of components capable of handling higher power and the ruling was that single components such as tubes, transformers etc, capable of handling greater power could be employed without restriction but where a combination of such components were in use, satisfactory methods had to be employed to ensure that the direct current power input to the plate of the final transmitter stage could not exceed that authorised. For example, the power supply transformer tappings had to be arranged in such a way as to obviate without a major alteration the possibility of an increase of voltage beyond that necessary to supply 150 watts.

The Sunday morning broadcasts were further expanded in September 1959 when an outlet in the 50 MHz band was put into service. In the following year 5WI was operated by Mr. K.M. Ring at Eden Hills and in subsequent years it was relocated at several other sites.

As a result of the adoption of recommendations of the Radio Frequency Allocation Review Committee which was set up to review frequency allocations of all classes of approved users in Australia, certain alterations to the bands of frequencies available for the use of amateur radio stations came into operation from 1st July 1962. Other changes were to be effective as from 1st July 1963 and the 1st January 1964. The authorised transmitting frequency bands were:-

Medium Frequency Band (MHz) 1.8 — 1.86
High Frequency Bands (MHz) 3.50 — 3.7,
7.00 — 7.10, 7.10 — 7.15, 14.00 — 14.35,
21.00 — 21.45, 26.96 — 27.23, 28.00 — 29.70.
Very High Frequency Bands (MHz) 52 — 45,
144 — 148, 288 — 296.
Ultra High Frequency Bands (MHz) 420 — 450,
576 — 585, 1215 — 1300, 2300 — 2450
Super High Frequency Bands (MHz) 3300 — 3500,
5650 — 5850, 10,000 — 10,500, 21,000 — 22,000

The 288 — 296 MHz band was not available for Amateur use until after 1st July 1963. The 420 — 450 MHz band was to be available from 1st January 1964.

By July 1966 the Sunday morning broadcasts of Institute activities were being transmitted between 0900 — 0939 on 3525 kHz, 7 MHz, 52 MHz and 144 MHz with slow Morse Code transmissions on Monday evening 1900 to 1930 on 3504 kHz. The Morse transmissions ceased in September of that year.

A revised edition of the Handbook for Operators of Radio Stations in the Amateur Service was published in 1967. The format of the new edition differed in many ways from the previous issue and included a number of changes. Some of the important changes were:-

(1) The holder of restricted (radiotelephony) licence could employ all types of emission other than radiotelegraph.
(2) Age qualification for examinations and grant of certificates were reduced to 14 years and for grant of licences to 15 years.
(3) Licensees of amateur stations could operate portable mobile stations without prior approval for a maximum period of five consecutive days.
(4) For the purpose of single sideband emission the radio frequency output peak envelope power under linear operation was limited to 400 watts.
(5) For the purpose of pulse type emission, the power input was to be determined by multiplying the peak envelope power input by the duty cycle, that is the ratio of pulse duration to pulse repetition period in the unmodulated condition and was not to exceed 150 watts.

An important activity sponsored by the Institute is the Youth Radio Club scheme which in 1974 had 12 clubs in South Australia. The clubs are open to boys and girls, generally of high school age. They aim to develop young peoples' interest in electronics and radio either as a career or hobby. Incentive certificates are awarded for examinations and special projects as recognition of achievement in club activities. They do not replace formal qualifications but provide a useful guide to a person's interests and capabilities when seeking a position in the radio or electronic field.

In 1974 the 5WI transmitter was installed in a building behind the Thebarton Corporation Work's Depot in West Thebarton Road. The building is of considerable historic significance having been designed as an incinerator by Walter Burley Griffin of Canberra fame. Plans for the building were submitted in September 1936 and the building officially opened in November 1937. It has a ground base of approx 12.5 metres square and stands some 17 metres above the ground. Also, there is approx 5 metres of basement area in which the furnace was located below ground level. It was last used for its designed purpose in 1955. The building has been classified as a Class No 1 building by the S.A. Civic Trust.

The executive at the time comprised President Mr. L.J. Diener, Secretary Mr. M.R. Dow, and Committeemen Messrs. E.B. Gliddon, C.J. Hurst, A.C. Wallace, R.A. Murphy and G.H. Herden.

Council members for 1977/78 included Colin Hurst President, Ian Hunt Vice President and Federal Councillor, Gerry Preston Vice President and WICEN Control, Clive Pearson Secretary, David Adlam Treasurer, Garry Herden Immediate Past President, Mike Hart Headquarters Supervisor, John Mitchell Education Co-ordinator, Allan Holker Programme Organiser, Rhondda Holker Membership Secretary. Other office bearers were Bevan Boden Broadcast Co-ordinator, John Eastaugh and Alan Raftery WICEN Co-ordinators, David Brown, Brian Roberts and Gerry Preston WICEN Records, Leith Cotton Intruder Watch, Garry Herden S.A. Repeaters, Bruce Buchanan Publications, Bob Murphy, Mike Hart and Craig Maitland Equipment Supplies Comm., Gerry Preston YRCS State Supervisor, Mrs. Maxine McEvoy YRCS State Secretary, Colin Hurst OSCAR Reporter, George Luxon QSL Officer and Tom O'Donald Scout Liaison Officer.

SECTION 3

THE WONDER OF WIRELESS

The Experimental Broadcasters

Interest in speech and musical broadcasts in South Australia was aroused soon after the First World War when the tremendous developments in radio technology that had taken place during the war years became known and a wide range of radio components began to filter into shops from various sources.

Experimental licences for receiving purposes were issued in 1919 but it was not until about July 1922 that the authorities made available for general issue, licences for transmitting purposes. Maximum power was fixed at 200 watts and wavelength allocated was the 200 metre band. The call sign prefixes during the most active period of experimental broadcasting was first A5. It was later changed to OA5 and subsequently to VK5.

The experimental broadcasters were of course dependent upon a continuous supply of suitable vacuum tubes for their work. The first tubes which became available shortly after the end of the war were brought to Adelaide by enterprising ships radio operators who found it a profitable pastime. Among the earliest tubes were the R type from Europe and the Audiotron and Moorhead types from the west coast of the United States. The R and Moorhead tubes were made in great quantities for military purposes during the war and large stocks immediately became available at the cessation of hostilities.

In 1919 the American Radiotron UV series were released and within a couple of years were soon in the hands of local experimenters. Beginning with the UV-200, a "soft" detector type the UV201, UV202 and UV203 soon followed. About 1925 when a great many enthusiasts were on air, the UX210 appeared on the scene and quickly became a favourite particularly as an oscillator. It was capable of 15 watts output. The low consumption UV201A with its thoriated filament was also introduced during this period and was a great favourite for many years. The earlier version of low consumption tube, the UV199 was not very successful as its life span was short. The first of the big tubes was the UV203 a 50 watt tube, and when short wave working became popular the RCA UX852 became available. The plate and grid leads of the UX852 were brought out separately resulting in reduced interelectrode capacity and base losses. This was the ultimate with experimenters and there are still a number kept as museum pieces by local collectors.

In addition to the R tube which frequently was pressed into service as an oscillator, tubes from the European markets included Mullard and Philips series. The Mullard ORA the name of which was derived from the first letters of the words oscillator, rectifier and amplifier was a popular receiving tube. The Mullard 0/20, 0/30 and 0/50 which had ratings of 20, 30 and 50 watts respectively were readily available for transmitting purposes. The Philips Z series of transmitting tubes were used in equally large numbers as they were on the market at about the same time. The greatest demand was for the ZI, ZII and ZIII which had ratings of 2.5, 10 and 50 watts respectively. Many of these also are still in existence proudly displayed on shelves in ham shacks.

It was in 1922 that the first practical experiments of any significance in the transmission of speech and music were carried out in South Australia. Mr. F.L. Williamson with his station 5AH in Dequetteville Terrace, Kent Town was the first to successfully broadcast speech and music. With the co-operation of two other notable experimenters, Mr. H.A. Kauper 5BG and Mr. L.C. Jones 5BQ, rapid progress was soon made. Mr. Williamson together with Mr. Kauper who lived at the time at Gurney Road, Dulwich were able to receive each other's broadcasts. While these tests continued, Mr. Jones was building up more powerful apparatus in order to bridge a greater gap in his home in Carlisle Road, Westbourne Park. One of the problems was the construction of a high voltage d.c. source derived from the a.c. mains, as high voltage batteries of high capacity for extended transmission tests were very costly. The experiments were quite successful and from this period great advancement was made in improving performance and efficiency.

Other experimenters quickly followed suit in telephony working and experimenters on the receiving side increased at a great rate. The Sunday morning and evening transmissions in particular were looked forward to by the many listeners with their crystal sets and battery operated tube sets. "Concerts" grew in number and attractiveness. The possessor of a receiving set proudly invited his friends to listen-in to the wireless concert and was not at all perturbed at any caustic comments on the quality of the music produced by the receiver.

Very few thought seriously of the quality of the speech or the music at the time. The novelty and wonder of hearing a voice or musical instrument in headphones or loudspeaker was sufficient appeal. The early transmitters and receivers were still in the experimental stages and there were few standards of comparison. Some broadcasters were enterprising in providing programme material. Mr. J.W. Hambly-Clark experimenting with 5AA cut his own Edison type cylinders as he played violin solos and broadcast these by placing a telephone carbon microphone down the throat of the long phonograph horn speaker. The up and down movements of the speaker were evident in the output. Nevertheless, the programmes were appreciated even though they were interspersed by plentiful "hullos" and comments on the quality of transmission, modulation, etc..

Typical of the keen interest shown in early broadcast experiments or tests was the broadcast of the election results in April 1924. On 5th April a 20 watt station was hastily installed in Salisbury Chambers, King William Street and with Mr. J.H. Chesterfield in charge of the equipment the election results were broadcast as they were received from the Returning Officer. In the Theatre Royal Building in Hindley Street a receiver and loudspeaker system was installed. A crowd estimated at 4,000-5,000 people assembled to witness the experiment and follow the results. The congestion in Hindley Street was of such proportion that a large squad of police was required to make way for traffic. In between election result announcements, music was played to the appreciative audience. The transmissions were also received in other parts of the State. Groups assembled at Bute, Kadina, Gawler, Roseworthy and at Mt. Barker and eagerly followed the broadcast until midnight.

It is doubtful whether any scientific invention introduced to the people of South Australia was received with such widespread enthusiasm as radio. The study of the new invention was taken up with keen interest all over the State and created a tremendous demand for radio components and equipment of all descriptions. It resulted in a mushroom growth of radio dealers and manufacturers which in turn brought about keen competition and along with it many weird and novel circuits which needed careful examination by constructors. Apart from the local weekly technical magazine dealing specifically with radio, the newspapers ran regular articles on radio doings with photographs, circuits and advertisements inserted by dealers explaining the advantages of their components, kit sets and fully assembled receivers.

Progress in experimental broadcasting was dramatic. The number of transmissions in the 200 metre band increased rapidly and it soon became necessary to organize rosters to minimise interference to reception. The period 1924-1928 was one of tremendous development. It saw the introduction of 5CL the first A Class station and 5DN the first B Class station as well as 5KA another B Class station. Magazines and newspapers, while publishing the programmes of the A Class and B Class stations also catered for programmes of some of the experimental stations.

Following decisions made at the International Radio Conference in Washington in 1927 the Australian Government gave consideration to the removal of experimental broadcasters from the 200 metre band. However, as a result of strong representations from listener groups and also the Wireless Institute of Australia the experimenters were allowed to continue broadcasting musical programmes on Sunday mornings before A Class and B Class stations came on air in the afternoon and after about 10 p.m. in the evening when the A Class and B Class stations closed down.

Although the number of experimental stations continuing in the 200 metre broadcasts declined compared with the number in operation in earlier years, those that provided regular programmes had a large following. The arrangement continued up until the outbreak of the war when all experimental stations were compulsorily closed down. The privilege was never restored.

Too much credit cannot be given to the early experimenters whose efforts were the beginning of broadcasting in South Australia. Very few of them foresaw the immense strides that would be made in only a few years. Many of these experimenters have passed on, some are retired and only a very few are still actively pursuing experimental activities. Experimental broadcasting of the early days is now only a memory. Unfortunately after so many years, records of many of the installations are no longer available. This Chapter therefore does not purport to relate in detail every contribution made by the early experimenters but it is hoped it will serve to revive the knowledge of the part many played during the fabulous twenties of experimental broadcasting.

5AC [Mr. V.R.P. Cook]

Mr. Cook is one of the very few active experimenters still operating in 1977 and who were involved in the pioneering experiments of the early 1920s. His station was operated from 37 Johns Road Prospect.

Roy Cook started his radio experimental work with XVN operated by Mr. E.R. Stanton before the First World War. After service with a local signals unit of the Army during the war when he was attached to the Army stations WAA and WAB in Adelaide he received experimental licence S099 in 1921 when the authorities began to issue licences for experimental purposes. The call sign was subsequently changed to A5AC then OA5AC and then to its present VK5AC.

In 1922 he gave one of the operators on the "Jervis Bay" £50 to spend in England for the purchase of the latest radio components. He subsequently received an assortment of components and 12 tubes of the R type. These were released in great quantities in Europe after the war and were readily obtainable. They were a general purpose tube and could be used with general satisfaction in any part of a receiving set and even as a low power oscillator. When used as a low frequency amplifier they required a plate supply of about 100 volts and a negative grid bias of 3 to 4 volts. Filament power was 4 volts at 0.7 amp. Mr. Cook distributed these to several of his experimenter friends including Hal Austin, Fred Williamson, Lance Jones, Bill Bland, Harry Kauper, Mr. C.R. Churchwood and Professor Kerr Grant. One of the tubes has been preserved in the local Telecommunications Museum. Unfortunately, the life of the R tubes was not very great, about 100 hours being the average.

By the end of 1922 he was well advanced with his station and in 1923 became a very active operator. The transmitter used UV201A type tubes with a Hartley oscillator

circuit. High tension was provided from a rectifier system using a chemical or 'slop' rectifier. In a later transmitter, mercury vapour tubes were used and 807 tubes introduced to give an output of 50 watts on 200 metres.

One of the first microphones used was a carbon solid back type originally used in a telephone instrument. This unit was popular among experimenters at the time. When the diaphragm vibrated with the sound waves it acted on the granules with pressures proportional to the pressure changes in the air. The microphone was not very sensitive compared with modern types. It had a normal resistance of about 50 ohms and as the resistance was very low compared with the input circuit of a tube a step up transformer was used.

In August 1923, during experiments on 250 metres, 5AC was received at good signal strength in Sydney by Master Jack Davis a 15 year old schoolboy operating 2DS on 6 watts. Davis normally transmitted on 380 metres but changed up to 250 metres a few weeks later to co-operate with Mr. Cook. Jack Davis at the time was considered to be one of the cleverest juvenile wireless amateurs in the country and the following year accompanied Mr. C.D. MacLurcan on the RMS Tahiti voyage to San Francisco on long distance, low power short wave transmission and reception experiments.

In 1923 one of the first "live" music transmissions in the State was carried out when a broadcast was made on the occasion of the Annual Smoko Social of the Adelaide Tramways. Five members of the Tramways Band assembled at Mr. Cook's residence and using a carbon microphone and his transmitter their musical items were broadcast from about 8.30 p.m. to 9 p.m. The broadcast was picked up at the hall in the city and played over a loudspeaker to an appreciative audience. The club was so pleased with the result that they sent Mr. Cook a letter of appreciation dated 21st November 1923.

A feature of transmissions from 5AC from 1924 was the Morse Code sessions for the benefit of those wishing to become proficient in receiving the code. In the August 1924 roster for amateur stations these were carried out every Saturday evening from 10 p.m. until midnight on 200 metres.

Various types of receivers were used in the early experiments. Several receivers employed UV202 and UV201A types and were generally of the 2-3 tube regenerative variety. About 1928 he acquired a screen grid tube and constructed a stable receiver for high frequency reception. Whereas high frequency amplification had previously been the prerogative of those who could handle a neutralised triode, the screen grid tube made it possible to all.

The antenna in use was a single wire Zeppelin type supported at one end by a water pipe guyed mast and a chimney at the other.

From about 1926 attention was diverted to the short wave bands with transmitters and receivers being rebuilt to cater for the shorter waves. A fine collection of QSL cards from all over the world is evidence of the high performance of the equipment and the regular periods on air. One of his transmitters built during 1924 has been preserved in the Telecommunications Museum.

5AD [Mr. A.R. Snoswell]

Mr. A.R. Snoswell on 5AD at Harris Street, Exeter was one of the first Adelaide experimental broadcasters to be heard in Perth with a music transmission. He was first licensed in July 1920 with a crystal receiving station but it was not long before he advanced to the transmitting stage.

In April 1924, Ray Snoswell was using a wavelength of about 250 metres for experimental purposes in the transmission of speech and music. He usually operated Monday, Wednesday, Friday and Sunday with evening transmissions being from 7.45 p.m. until about 10.00 p.m. and Sunday morning transmissions from 10.30 a.m. until 12.45 p.m.

The transmitter was a two coil type wired for grid or absorption modulation systems as desired. The high tension for the set was supplied from a step up transformer connected into a chemical rectifier and a smoothing filter network. Mica capacitors were used in the filter network as it was found that they gave better performance than the waxed paper types frequently used in filter circuits.

Mr. Snoswell used various receivers, some of which were several years old at the time. All the sets were home made and so were many of the components. Home made components included variable condensers, honeycomb coils, tube holders, rheostats and a loop antenna about 1 metre across the diagonal.

One of his receivers was a Clapp Eastman crystal receiver with tapped vario-coupler, the whole unit being contained in a small cabinet. This was a popular type of crystal set and several were in use in Adelaide at the time. Another receiver employed a one stage tuned plate amplifier and detector circuit using R type triode tubes. The receiver which he most frequently used was constructed about 1921. It employed the Armstrong three coil circuit with three stages of audio frequency amplification. The panel was about 30 cm by 20 cm and was cut from ebonite sheet on which was mounted the terminals, jacks and the tuner. By means of a switch the primary coil could be connected in series or parallel with the secondary winding. The tuning capacitor was a .005mfd unit fitted with a vernier. The detector tube was an 'Annaka' type fitted with twin filaments and with 24 volts being applied to the plate. British R type tubes were used in the transformer coupled amplifier stage with 100 volts on the plate. When listening, an Atlas loud speaker or head phones was used. The phones included one set of Kellogg 2200 ohm phones and one set of Brown 4000 ohm phones.

The filaments for the receiving tubes were energised from an A battery and the plates with an accumulator type B battery with a capacity of about 10 amp. hours. In addition to the 100 volt B battery there was a 50 volt unit and sometimes these two were connected in series for the transmitter plate supply.

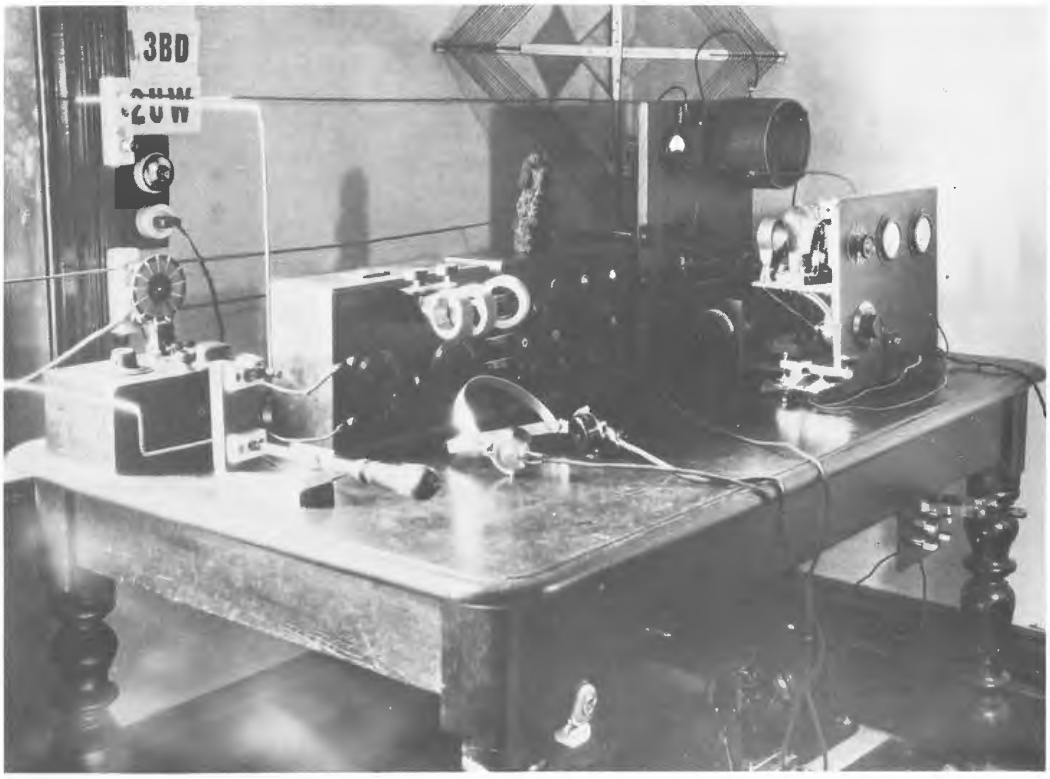
The antenna was a twin cage inverted L type some 25 metres long and supported by two water pipe masts 15 metres high. The cages were made from phosphor bronze wire in the form of 20 cm diameter cages. The feeders were also of the cage form but the diameter of these was reduced to 10 cm diameter. The two antenna cages were separated by wooden spreaders two metres wide. A counterpoise was used and it consisted of a three wire inverted L arrangement 5 metres above the ground and run beneath the antenna for its full length and insulated at the far end with egg type porcelain insulators.

5AH [Mr. F.L. Williamson]

Mr. Fred Williamson was a leading South Australian experimenter with his station 5AH at 25 Dequetteville Terrace, Kent Town. He was acknowledged as one of the pioneers in the State in the transmission of speech and music by radio and carried out the first practical demonstration of radio telephony. The tests were carried out in 1922 in co-operation with Mr. Harry Kauper 5BG at Dulwich about 2km away and then shortly after with Mr. Lance Jones 5BQ at Westbourne Park some 5km away.

In 1924 the transmitter employed two 5 watt Radiotron tubes in a Hartley oscillator circuit arrangement. Two similar tubes were used for modulation purposes using the Heising method. The main inductance was wound with copper strip on edge. For speech transmissions, the transmitter gave an output line current of 1.3 amps and when hooked up for continuous wave telegraphy working an output of about 2.5 amps into the same load was obtained. Transmissions were usually on 190 metres.

High tension for the plates was supplied by a motor-generator set. It was an ESCO unit powered directly from the a.c. mains. The machine operated at a speed of 2900 r.p.m. and had a rating 1.2kW. The d.c. output voltage was 600 volts. The filaments were fed with a.c. using a step down transformer.



Station 5AH in 1924 operated by Fred Williamson.

There were two receivers in use at the time. One used the popular three coil Armstrong regenerative circuit using honeycomb plug-in coils for primary, secondary and reaction. The primary was tuned by a 0.001 mfd variable condenser. A similar condenser with a vernier was used across the secondary coil. The detector section used a Phillips D.I. tube with 3.5 volts applied to the filament and 14 volts on the plate. Although the set was wired up for three stages of audio amplification only two were normally in use. Output was sufficient to drive a speaker but it had been found that three stages caused excessive distortion. This receiver was used mainly for listening to long wave stations transmitting in the bands 3000 — 2500 metres. The second receiver employed for the shorter wavelengths used tuned plate high frequency amplification.

The station antenna was a wire cage configuration made from stranded enamelled copper wire. The cage was formed with four wires and was in the shape of an inverted L. The overall length of the horizontal section of the cage was 22 metres while the vertical part was nearly 15 metres high. A counterpoise was installed beneath the antenna and consisted of three stranded copper wires. A loop antenna was also sometimes used with a receiver when working local stations.

Mr. Williamson had originally started off with the pre 1914 call sign XWA using spark set and crystal receiver and had improved his station in line with the state-of-the art to the stage where in 1924 the station was one of the best in operation. Hours of transmission varied in accordance with a roster and in August 1924 he operated to a schedule of 8 p.m. — 8.30 p.m. every Tuesday evening on 190 metres. Phone and Morse signals were heard in New Zealand in 1924 and an experimenter in San Francisco also reported having received clear signals. This reception in America took place during March 1924 and was one of the first transmissions from Australia to be clearly heard in that part of the world.

Mr. F. [Fred] L. Williamson who carried out the first practical demonstration of radio telephony in South Australia in 1922.

5AI [Mr. H.H. Lloyd]

One of the most popular stations for music broadcasts early in 1924 was 5AI operated by Mr. H.H. Lloyd, Trinity Street, College Park. The music was recognised by its high quality and clear modulation.

In 1925 the station equipment included a transmitter, a low loss short wave receiver, a four tube tuned plate receiver and a collection of experimental apparatus, components and test instruments. The transmitter constructed by Henry Lloyd employed two UV202 Radiotron tubes in a Hartley loosely coupled circuit arrangement. Power supplies were initially provided from motor generator sets. The high tension d.c. voltage for the plates was provided via radio frequency chokes at a potential of 500 volts by a Benwood set, the motor section of which was powered by the a.c. mains. A second motor generator set gave an output of 12 volts. This was used to power the Radiotron tube filaments through a rheostat and also for battery charging purposes when not being used for the transmitter. Both generators were mounted in metal frames under the bench together with the chokes and condensers. The switchboard which controlled the mains and generator output switching was fixed to the wall alongside the receiver.

The transmitter used grid type modulation and for phone and music tranmissions Mr. Lloyd had a selection of two good quality microphones. These were a Western Electric microphone and a Sterling hand multiple microphone. The Sterling was a very sensitive type for experimental purposes as its construction enabled it to deal with a large current. It was a four button type enclosed in a nickel plated container with an ebonite mouthpiece and fluted handpiece.

The low loss short wave receiver was normally operated with headphones but the four tube model operated a large horn type loudspeaker. Both receivers were powered by batteries.

Late in 1925 a short wave transmitter was constructed and he became very active in the short wave band. He acquired a 50 watt tube and built a power supply unit using a chemical rectifier to obtain a voltage higher than that given by the motor generator set.

5BC [Mr. A.R. Clarke]

Mr. A.R. Clarke was a prominent operator until 1925 when he put aside experimental activities of radio to enter the commercial side of equipment sales. The station using call sign 5BC was located at 47 Elizabeth Street, Norwood.

Alick Clarke first became interested in radio through the encouragement of Mr. J.W. Hambly-Clark who operated 5AA and was one of the pioneer experimenters in the State. Alick started off with a receiver using a nickel-iron coherer made for him by a friend who worked in the University laboratory. He made his own trembler bell decoherer as well as other components. The coherer was not a very satisfactory detector so he substituted a crystal. Several types were used, the most successful being galena, silicon and molybdenite.

Before he obtained his licence, Mr. Clarke imported a Marconi V24 tube from England. It arrived in Adelaide in 1921 and he received word from Customs that he could not take delivery of the tube until he had passed a test in Morse Code at 12 w.p.m. He went to the G.P.O. and after some discussions concerning the use of a buzzer instead of the normal Post Office sounder, he passed the test and took delivery of the tube.

He obtained Licence No. S602 in February 1922 and on 11th October 1922 the call sign became 5BC. His first transmitter was a simple device using a single tube in Hartley oscillator configuration with a test tube type battery for high tension and an accumulator for the filament. A chemical rectifier was used to charge the test tube battery. The transmitter was later rebuilt for phone working in the 200 metre band and

employed three tubes. Mr. Clarke made most of the components himself including the coils, the variable condenser and fixed condensers. The fixed condensers used tin foil and waxed paper sealed up with beeswax.

The first 200 metre receiver was a simple regenerative type using a single Marconi V24 tube with crystal detector and 400 ohm Sterling headphones. Subsequent receivers employed three coils and two tubes with sufficient output to drive a Sterling horn speaker. The Marconi V24 tube was of special construction with connections being brought out on the side nearest to the element in order to minimise capacitance between plate, grid and filament. This made the V24 superior to the R pattern for working at wavelengths above about 1000 metres. Plug-in honeycomb coils were also provided to allow reception of the long wave stations in Europe and America.

The antenna was a twin wire type with the wires spaced with wooden spreaders. One mast was 18 metres high and the other 15 metres. They were separated by about 37 metres and had a counterpoise system erected beneath. Both music and speech were transmitted on a regular basis. The music was obtained from gramophone records with a carbon telephone microphone placed in front of the horn. A year or so later Mr. Clarke was instrumental in importing for commercial use one of the first magnetic pickups in the State. It was a Marconi unit.

In 1925 Mr. Clarke when less than 21 years of age took charge of the Radio Department of Harris Scarfe Ltd. and remained there for some 14 years. He then became Radio Manager with A.G. Healing Ltd. in Hindmarsh Square and later Tape Recorder Manager with Ernest Smith and Co. Pty. Ltd. He retired in 1969 but continued part-time association with Ernest Smith and Co. for a further four-and-a-half years. In 1946 he was the first person in South Australia to demonstrate for commercial purposes the Pyrox wire recorder and in 1952 demonstrated tape recording for the first time with a Grundig tape recorder.

5BD [Mr. F.E. Earle]

5BD, the station operated by Mr. Frank Earle was situated at 6 Bakewell Road, St. Peters and in the 1926-27 period it also transmitted under the 5WI call sign as Mr. Earle during this time was Secretary of the Wireless Institute. It was one of the most consistent traffic stations on air and worked mainly on 80 metres and around 200 metres. The station was well known for its Sunday morning and late night music sessions. In 1924 Mr. Earle was on air with an hour programme from 10.30 p.m. — 11.30 p.m. every third night on 250 metres and had a large following.

His 200 metre phone set was one of the first on the air when transmissions started in this band. The transmitter used a 201A tube in the oscillator circuit and a similar type tube as modulator. Modulation was accomplished with the Heising arrangement. An earlier transmitter used up until about 1924 had employed a loose coupled Hartley circuit with a UV202 as oscillator and an absorption modulator. The high tension of 350 volts was supplied from a step up transformer and chemical or 'slop' rectifiers with a 'brute force' type of filter using the well tried choke — capacitor arrangement. The filaments were powered by a step down transformer. The power supply was also used for the 80 metre transmitter by using a simple changeover switching arrangement.

The 80 metre transmitter was mounted on an open frame with a panel carrying meters etc. in front. The open type of construction enabled quick changes to be made to the set. The transmitter employed a single UV201A as oscillator with an input of 12 watts. It employed a modified Hartley circuit loosely coupled to the antenna. During the first 12 months of operation many contacts were established particularly with New Zealand experimenters who reported good signal strength.

The receiver was a conventional Armstrong three coil type with a plug-in coil arrangement giving a band coverage 20 to 20000 meters. The set was built entirely by Mr. Earle and the coils were hand wound. The tubes were 201A types. There was

another two tube three coil Armstrong receiver constructed specifically for short wave reception but had not been used for long because the other unit was capable of covering the short waves as well as the long waves. One point of interest with the short wave set was that the three coil holder had long extension handles projecting from the panels. This arrangement minimised hand capacity effect during adjustment of the coils.

The high tension supply for the receivers was supplied by a home made test tube battery which had been in operation for some years. It required very little attention. Each cell consisted of two strips of lead inserted in a test tube with a sulphuric acid at the proper specific gravity. Charging was done by a half wave chemical rectifier using jam jars filled with ammonium phosphate.

The station antenna system comprised a 4 wire cage type antenna, 20 metres long and supported by two 17 metre masts. It was erected above a fan shaped counterpoise using four wires erected about 3 metres above the ground.

Mr. Earle obtained his transmitting licence in 1923 after having been interested in radio since about 1921.

5BF [Mr. F.G. Miller]

Mr. Miller was one of the foremost country experimenters. He operated station 5BF in Eleanor Street, Murray Bridge and could be clearly heard in many parts of the State including Adelaide. Transmissions were carried out on the exceptionally long wavelength of 440 metres and because of the lower attenuation compared with the more generally used wavelength at the time 200-250 metres, he was able to cover a wide area.

The transmitter which was designed and built by Francis Miller in 1924 comprised a two coil circuit employing a Radiotron five watt tube as an oscillator. Modulation was by the grid modulation system. The tube had an input of 4.4. watts and gave 0.75 amps into the antenna when lined up for 440 metres.

The receiver employed a spider web tuner with one stage of tuned radio frequency amplification, a detector and two stages of audio amplification. The detector circuit used a Dutch tube and the amplifiers used WD11 types. The WD11 was a high vacuum type and very suitable for amplifier use. Mr. Miller had used them in many of his experiments and found them to compare more than favourably with most other tubes on the market in 1924. Sufficient output from the receiver was available to drive a Western Electric loud speaker. A pair of Murdock headphones was also frequently used.

In 1926 Mr. Miller built a new type of receiver using three tubes. The tubes used were normally Radiotron UV201A's but the circuit was also suitable for Mullard PM3 or Philips B406 types. The receiver covered the bands 200 to 1200 metres in two switching stages. A special feature of the receiver was the use of an aperiodic tuned primary for the short waves and a semi-aperiodic primary for the longer waves. Unsightly plug-in coils were not used, the tuning being done with a coupler about 6 cm in diameter.

The main antenna used for receiving purposes was supported by two masts 15 metres high and 50 metres apart. A loop antenna was also used on occasions.

Mr. Miller was very active with his experimental station and had a large following of regular listeners. Although he carried out some telegraph working most of the experiments were carried out with phone.

In 1924 he broadcast a programme nearly every alternate day. Code transmission was usually conducted from 10 p.m. onwards while phone transmission was scheduled for 7.30 p.m. to 9.30 p.m.

When the Murray Bridge branch of the Railways Radio Club was formed Mr. Miller was appointed joint Secretary with Mr. Oats and played an important role in its activities.

5BG [Mr. H.A. Kauper]

Mr. H.A. Kauper was well known throughout Australia both on account of his amateur and his professional radio work. He operated experimental station 5BG and was Chief Engineer of broadcasting station 5CL operated by Central Broadcasters Ltd. Prior to his interest in radio, Harry (Henry) Kauper served in the R.A.F. and invented a device to enable a machine gun to be fired through the revolving propellor of an aeroplane. He and Captain Harry Butler formed an aviation company and it was during this period that he became interested in radio.

Mr. Kauper was issued with one of the first licences in the State after the war. His licence number was S643 and together with fellow experimenters participated in the first radio telephony tests. With his station at Gurney Road, Dulwich, he co-operated with Mr. Fred Williamson 5AH, in making the first practical radio telephone transmission. Mr. Williamson's station was located at Kent Town about 2 km away.

When he first set up his station in Dulwich in 1920 the transmitter was equipped with Telefunken tubes (war time souvenirs). By early 1925 he was using a loosely coupled Hartley circuit with two Radiotron UV203 tubes in parallel. The inductances were flat spiral pancake types fabricated from copper strip rolled out from round wire. The primary had eight turns and the secondary eleven turns. The closed circuit condenser was an Ormond model rebuilt and respaced with four spacers and fitted with low loss end plates and pigtails. The d.c. blocking condenser was a Telefunken high voltage type originally used in an aircraft spark transmitter. A relay in the grid circuit was used for keying purposes. A condenser was shunted across the relay to prevent transient surges. The grid condenser was locally made using mica and copper sheets.

The filaments were powered in parallel from a mains step down transformer with a variable resistance in the primary circuit. A Roller-Smith meter was bridged across the filaments. High tension d.c. was supplied by a synchronous rectifier running at 3000 r.p.m. A transformer stepped up the a.c. to 1750 volts for application to the rectifier. An r.f.c. was connected in each of the output leads. The machine was a two brush affair made up of a Fiat generator armature, fields obtained from a large fan motor and ball bearings housed in special end plates.

The antenna was an inverted L cage type consisting of six stranded copper wires spaced evenly round one metre diameter cane hoops. The lead-in was also a cage, tapering from 30 cm diameter to a single wire at the lead-in insulator. The top part of the antenna was 16 metres long and the lead-in portion about 13 metres long. The guyed masts were both 14 metres high and spaced 28 metres apart. The counterpoise was a four wire fan 28 metres long stretched between the masts and fixed three metres above the ground. Experiments with the counterpoise gave considerable improvement in antenna current. The current increased when the free ends of the fan were bridged and increased further when it was connected to a nearby galvanised iron shed through a condenser.

In November 1925, using only 7.5 watts with a 201A tube battery powered transmitter he worked two stations in New York. He reduced power further to 5.6 watts and contacted an experimenter on the western coast of the U.S.A. These achievements highlighted the great work which could be done using low powers.

Station 5BG shifted location on several occasions and in mid 1927 was operated from 6 Rothbury Avenue, Tusmore. The original station comprised a very simple arrangement with a Mullard ORA tube fed from a B battery operating on phone in the 200 metre band. After a while he directed his interests to long distance working with a 50 watt oscillator and a 50 watt modulator. High tension was supplied by mains voltage rectified by a 'slop' rectifier system. filaments were energised by a.c. from a step down transformer. Both music and speech were used for modulation employing various types

of microphones and a gramophone tone arm. The receiver was a two tube reflex arrangement using two 201A Radiotron tubes and a synthetic crystal. The antenna was a cage type suspended between two masts 16 metres high with a counterpoise erected just above the ground.

Harry Kauper was one of the early pioneers to see the tremendous advantages to be gained with a crystal controlled transmitter and began experiments in the cutting and grinding of crystals. His station subsequently became one of the earliest crystal controlled stations in Australia.

Probably the first crystal controlled operational transmitters in the world was built by the U.S. Navy in May 1924 and the first authoritative article to be written for the amateur appeared in an American amateur radio magazine a few months later. Harry Kauper had made considerable progress during 1925 in the art of cutting, grinding and circuit development and it was not long before he had a working oscillator.

One of his crystal controlled transmitters constructed in 1926 used a small receiving tube as the crystal oscillator followed by various graded power amplifier tubes which fed a T250 type tube. The T250 operated with a filament voltage of 12.5 volts at 5 amps and was normally capable of giving 250 watts dissipation for 2000 volts on the plate. The transmitter operated in the 30 metre band and fed into a single wire antenna suspended between two masts, one 10 metres and the other 20 metres in height. The plates of the low power tubes were fed from a 'B' battery source and filament from the mains via a step down transformer, except for the oscillator tube which was powered by an accumulator.

For medium power working the high tension supply for the intermediate stages of the transmitter was derived from a step up transformer and 'S' tubes. The final output stage was fed with 2500 volts d.c. derived from a 750 watt mains driven motor generator set.

5BK and 5RM [Mr. R.M. Barker]

Mr. Barker was one of a small exclusive group who operated two stations. Station 5BK was the registered call sign of the Electrical Supplies Depot, Rundle Street and used for phone working while 5RM was confined to Mr. Barker's personal experiments on c.w. They were located at 40 Newbon Street, Prospect.

Rupert Barker was a recognised expert and a very active experimenter. He was a former ships operator and had a good knowledge of the equipment installed at many of the world's major radio stations. His talks were popular at Radio Club meetings.

The design and building of 5BK had extended over some time before Mr. Barker was satisfied with its performance. Many of the recognised circuits had been tested but the loose coupled Hartley circuit proved to be most effective and he used this in 1925. The Hartley circuit was very popular with experimenters throughout the world. It was invented in 1949 by Ralph Hartley of the Western Electric Company in U.S.A. and was easy to set up.

The transmitter was modulated by a modified Heising system. Transmissions were usually carried out on 205 metres at about 7 p.m. each evening. Output from a 5 watt Radiotron gave 2 amps into the antenna and reports of good reception were received from all States. A standard telephone carbon microphone was used as a microphone. Although normal activities were associated with experiments using phone on 205 metres, facilities were available on the transmitter panel to enable transmission by c.w. or i.c.w. The transmitter was earthed to a long pipe driven deeply into the ground. In 1928 Mr. Barker completely rebuilt the transmitter in order to effect further improvements.

Power for the transmitter was supplied by a step up transformer connected to the mains. The secondary voltage 1300 volts was fed to the plates of Amrad 'S' tube rectifiers. The usual type of 'brute force' filter system was employed. Two chokes and a large bank of capacitors giving a total of 24 mfds ensured very low ripple content in the high tension d.c. voltage.

The antenna system was a cage type using six stranded copper wires. The overall length of the cage was just under 20 metres and height above ground was 7 metres. Before the erection of the cage antenna he used a single wire 20 metres long and 15 metres high. A counterpoise was used in conjunction with the antenna. It was fan shaped using four wires with the whole being suspended 2 metres above ground.

The 5RM transmitter was operated in the short wave band. It used a Hartley oscillator circuit with loop modulation. A single tube, a Marconi LS5 gave good signal strength with many good reports being received from Interstate and New Zealand experimenters. Transmissions were on 83 metres and 0.6 amp was fed to the antenna. Power supply was obtained from the same unit as that which fed the 5BK transmitter giving 500 volts on the plate. The panel of this transmitter on which the various instruments were mounted consisted of an ebonite sheet 30 cm by 30 cm and 6 mm thick. The inductances-antenna and closed circuit were wound on cardboard tubes 10 cm diameter with 6 turns of No. 12 bare copper spaced 4 mm apart. Radio frequency chokes were made with 250 turns of No. 30 gauge wire wound on a cardboard former of 6 cm diameter.

The receiver associated with 5BK was a seven tube tuned plate type based on a Scott Taggart circuit feeding into a Western Electric horn loudspeaker, while the receiver associated with 5RM was a Reinartz All Wave type modified to use a loosely coupled antenna coil. The Reinartz all wave tuner was a super selective receiver capable of working down to 30 metres and was designed by John L. Reinartz a well known American designer and experimenter. The set was quiet in operation being free from the noises usually found in regenerative sets at the time.

5BN [Mr. H.L. Austin]

Mr. Hal Austin's station 5BN was installed at No. 8 Parade, Norwood and was among the earliest to commence regular transmissions in South Australia.

Experimental and development work went on for a long period before the interesting 1926/28 era was reached and many transmitters and receivers were built only to be discarded for improved models. In 1924 he was broadcasting regular programmes on 220 metres and in the December roster period these covered Sunday mornings and also 7.30 p.m. — 9.30 p.m. for at least one night weekly.

In 1927 a crystal controlled transmitter with plug-in coils was operating on 176 metres. The plug-in coil facility enabled the transmitter to be also used for short wave bands. The crystal oscillator section employed an Apex 202 tube which had replaced a UX210 previously in use. The oscillator was coupled to a UV203. The available input power to the oscillator was about 15 watts and to the amplifier it was about 100 watts. However the full 100 watt power was seldom employed with the amplifier. Generally 30 watts was the operating condition. Grid control modulation was adopted as this was found to be highly suitable for the apparatus in use. Experiments had been made with several methods. This was typical of activity at this station. Mr. Austin's main aim was in improvement to the equipment rather than logging great numbers of DX's.

The set was entirely mains powered from the local supply. The high tension transformer supplied 3,500 volts with centre tap. This was applied to the plates of Amrad 'S' tubes at 1,750 volts per plate. Ripple was filtered out with a standard 'brute force' filter. Power for the crystal oscillator was supplied from an independent source

in order to ensure maximum stability and good regulation. A Raytheon rectifier was used with its own transformer and filter system. The output from this system was about 450 volts d.c. Filament power for all tubes was provided by a tapped step down transformer.

The transmitter components were mounted on a solid baseboard with wooden framework and all meters and controls were located on a bakelite panel. The tuning coils, chokes and tubes were mounted on a sub-panel above the base. The heavy components such as power transformers, chokes, modulation transformer etc. were fixed directly to the baseboard.

The receiver used a standard three coil Armstrong circuit but a great deal of experimental work was done to produce a very stable and easily handled receiver. All the coils were fixed, with a throttle condenser being used in the plate circuit for reaction. This procedure eliminated the floppy coil arrangement normally experienced with the standard three coil holder. The result was that the receiver went in and out of oscillation very smoothly.

The antenna was a single copper wire about 30 metres long supported by two masts each 16 metres high. With 30 watts input to the main amplifier, the antenna current was 1.3 amps. Unlike many installations of the period, a counterpoise was not used. A well laid earth system was used instead and found to give good results.

5BG [Mr. L.C. Jones]

Experimental station 5BQ was well known throughout Australia. It was operated by Mr. L.C. Jones at Carlisle Road, Westbourne Park. The 200 metre transmitter circuit was adapted from one used by many well known American experimenters at the time and gave high performance with good modulation qualities. Lance Jones was one of the first in Australia to experiment with speech transmissions. As early as 1914 he was working on the development of equipment but the work was interrupted owing to the restrictions imposed at the outbreak of the war. Soon after the cessation of hostilities he resumed tests in conjunction with two fellow local experimenters and quickly established communication by radio telephony.

Two five watt Radiotron tubes were used in the oscillator section with two similar tubes being used in the modulator. The Heising system of modulation was employed and owing to the high dissipation by the modulator tubes compared with those in the oscillator portion, the modulator tubes frequently ran very hot. This was characteristic of the Heising modulation method owing to the low modulation efficiency. The system invented by Raymond A. Heising of the Western Electric Company in the United States was very popular with experimenters throughout the world.

Power supply for the plates was provided by a 200 watt Benwood motor generator set installed on the floor beneath the bench on which the transmitter was located. The motor section was powered from the a.c. mains supply. A step down transformer catered for the filament requirements.

In early 1924 the receiving installation was very simple but major improvements were made in subsequent years. The set comprised one high frequency tube plus crystal detector using a reflex circuit of the tuned plate type which enabled him to read continuous wave. He simply detached the cats whisker from the crystal and tuned the two circuits closely until the tube oscillated. The partial rectification in the high frequency tube enabled continuous wave signals to be read.

In 1925 he built a three tube reflex set which later became very popular with other experimenters. It was based on a John Scott-Taggart design but used an additional stage of high frequency amplification which greatly increased the sensitivity. Tubes used were RCA UV1714 types with an RCA transformer in the second stage. Plate voltage was about 100 volts and good loudspeaker volume was obtainable on many Interstate stations.

The antenna was a cage type using five wires of stranded copper. It was supported at the distant end by a mast about 17 metres high. At the lead-in point it was 13 metres above the ground. A counterpoise system of stranded copper wire was erected beneath the antenna. Two copper wires were spread two metres apart and supported on posts to fix them three metres above the ground. With a plate current of 50 milliamps to the oscillator tubes the antenna current was 1.5 amps. The average current when working phone was about 1.37 amps.

Mr. Jones obtained extremely good results with his station on 220 metres as shown by reports from Interstate listeners. The Secretary of the Wireless Institute in Tasmania reported 5BQ as being very much louder than Sydney broadcasters when he was using a four tube reflex receiver with crystal detector. A listener in Goulburn in New South Wales reported that various gramophone selections were heard, also a flute solo which was very distinct when he was operating a two tube non-regenerative receiver. A report from Clifton on the Darling Downs in Queensland also praised the transmissions indicating that music broadcast during one of the Sunday night transmissions was played to perfection by a four tube set and Atlas loudspeaker. During 1924 the normal music broadcast schedules from 5BQ were between 8.30 — 9.30 p.m. on Sundays. After 9.30 p.m. experiments were on phone mainly for Interstate contacts.

Mr. Jones also held the licence for experimental station 5DN, call sign of the Adelaide Radio Company Ltd., which he formed in association with Messrs. G.A. Miller Randle and Harry Kauper. He filled the post of Manager of the Company. Call sign 5DN subsequently became associated with the first commercial broadcasting station in the State.

5BR [Blackwood Radio Club]

This station was operated by the Blackwood Radio Club which was founded in 1923. Within a couple of years of its foundation, it was participating in regular programmes of broadcasting. In 1926 the transmitter was under the control of Mr. L. Griffiths.

The first transmitter was a relatively simple unit built mainly for experimental purposes, but by 1928, the Club had an impressive installation including 200 metre band and short wave transmitters. Early in 1928, the transmitter on 210 metres had been maintaining a schedule on practically every night and nearly all day on Sunday. At that time, it was under the control of Mr. J. Ferry. Even though the input power at the time was only 3 watts good reports were received from country places particularly in the Moonta and Kadina area. The circuit was a split series fed Hartley oscillator with the Telefunken system of modulation being employed. A Bosch pick up was used when transmitting musical items from records.

Soon after, a new transmitter was installed in the Club's own shack at Blackwood. Previously the programmes had originated from Clapham. The transmitter was a master oscillator type employing a Colpitts circuit with a UX201A tube, a Philips A630 as the modulator and a UX210 as an amplifier. The maximum input was 8 watts to the three tubes. The Heising system of modulation was employed with the choke being made of nearly 2000 turns by the Club's transformer expert Mr. R. Ragless. In January 1927, Mr. Ragless had also constructed a 1200 volt high tension transformer for the transmitter.

Power for the plates was supplied by a Raytheon full wave rectifier and choke-condenser filter circuit to remove ripple. The mains power variations in the district was subject to considerable variation and this sometimes affected the voltage fed to the tubes. Normally the antenna current averaged 0.4 amp.

In May-June 1928 the Sunday transmission schedule was 12.30 p.m. — 2 p.m., 2.30 p.m. — 3 p.m., 4 p.m. — 5.30 p.m. and for a period after 10 p.m. On the broadcast of Sunday 26th May, the Blackwood Radio Club Studio Orchestra made its debut and their performance was greatly appreciated by those listeners who tuned in.

A new transmitter for short wave working was constructed in May 1928 using a split series Hartley oscillator circuit. Input was about 12 watts to a UX210 tube and fed into a Zeppelin antenna supported from the top of a 17 metre high mast. Transmissions were on 32 metres on continuous waves every Friday evening commencing at 7 p.m. and ceasing about 11 p.m. In addition to working experimenters in most other States, contacts were made with many overseas countries, one of the first of which was Canada. The Club's short wave receiver was constructed to the popular Schnell circuit with two stages of audio.

5BS [Bedford Park Sanatorium]

The 5BS station was a magnificent installation professionally designed and built for soldiers at the Bedford Park Sanatorium, Sturt. The installation was made possible by public contribution and by the energy of Mr. Hugh Corpe who initiated the movement which raised £2000.

The transmitter which was probably one of the best in Adelaide at the time was built and installed by Messrs. Newton, McLaren Ltd. of Leigh Street. It was unique in that three systems of modulation were provided for telephony and two for telegraphy operation. It was probably the first in Australia with such a wide range of modulating facilities. The three systems for music and speech were the Heising, grid and absorption methods. In the Heising method a Class C modulated amplifier and a Class A modulator were fed through a common iron core choke of sufficient inductance to offer a high impedance at the lowest modulation frequency so that it was able to pass the d.c. current but impeded the flow of audio frequency current. Voltage variations at the plate of the modulator due to audio frequency excitation on the grid were applied directly to the plate of the modulated amplifier which acted as a plate load to the modulator. In the grid method of modulation the modulator was connected in the grid circuit of the modulated amplifier in such a manner that the output was controlled by the music or speech signal. In the absorption method, modulation was effected by shunting the antenna circuit with a speech controlled absorption tube. Morse was transmitted by either continuous wave or interrupted continuous wave techniques.

All controls and meters were mounted on a large panel well lit by a reading type table lamp. Only two switching operations were necessary in order to put the transmitter on air. A Morse key was mounted on a shelf at the bottom of the panel. A Radiotron five watt UV202 tube was employed in the oscillator circuit.

The transmitter was powered by a 250 watt motor generator set with the motor being powered from the a.c. mains. The generator gave 500 volts d.c. for the plate circuits and 10 volts d.c. for filaments.

The antenna system was a large cage type supported by two tall masts. It was supplied and erected by the Adelaide Radio Company and employed a counterpoise beneath the antenna with insulators at one end in accordance with the normal procedure. A pipe earth system was also provided for the equipment. The antenna current at the input to the feeder was 1.5 amp.

The receiver associated with the station was a magnificent long range seven tube type donated by the South Australian Radio Company.

The station officially went on air on 21st June 1924 and was under the control of Mr. W.J. Davey. Reports soon came in from Queensland, New South Wales and Victoria indicating that the music and speech transmissions were being received loud and clear in the 200 metre band. The opening and presentation of the equipment to the Repatriation Department was carried out by the Governor, Sir Tom Bridges. His address was broadcast by the station and heard at many distant centres by listeners who tuned-in to hear the unique ceremony.

5BW [Mr. J.G. Phillips]

Station 5BW operated by Mr. J.G. Phillips was officially licensed for transmissions on 15th June 1926. It was installed at 31 Partridge Street, Glenelg and achieved much success in the short wave bands as evidenced by the large number of verification cards mounted on the walls of the shack at the time. The phone broadcasts in the 150-200 metre band were popular with local listeners.

Mr. Phillips had two separate transmitters, both of which he designed and constructed himself. Workmanship was of a high order and the whole installation was neat in appearance. The Hartley oscillator circuit was used for both the 200 metre and short wave transmitters. Tube types UX210 were employed as oscillators. Loop or absorption method of modulation was used for the 200 metre transmitter. The short wave unit was keyed by a 'side swiper' arrangement which incorporated a fast acting relay and gave clear, easy-to-read signals.

High tension for the plates was furnished by a rectifying system made up of four 201A tubes used as bridge diodes and a filter system. A step up transformer provided the high tension a.c. for the rectifier and a step down transformer provided power for the tube filaments.

Various types of single wire dipole antenna systems had been tried but by January 1927 a small cage system was found to be the most efficient and was adopted for subsequent normal transmissions. It was supported between masts to give an average height above ground of just over 17 metres. For short wave working the antenna was worked on the third harmonic. A short fan counterpoise was erected directly beneath the antenna and the result was an efficient system.

The receiver was a modified two tube Reinartz type designed for optimum working up to 100 metres. Because it was not efficient when receiving in the 200 metre band another receiver was constructed early in 1927 to overcome this deficiency in the station facilities.

The operator had been a keen short wave listener for several years before obtaining a transmitter licence and it was natural that his interest should be biased towards the short wave field. A great many countries were worked, including France, Indo China, Egypt, Hawaii, Italy, Borneo, China, South Africa, Japan, England, Canada and U.S.A.

5BX [Mr. A.L. Saunders]

The installation of 5BX was a good example of what could be achieved by experimenters with only limited space available. The station belonged to Mr. A.L. Saunders at 17 Esplanade, Glenelg and was located in a small room of a second story flat. The provision of a suitable antenna and counterpoise was particularly difficult but surprisingly good results were achieved in working overseas countries with both phone and Morse Code.

Most of Mr. Saunders' early experiments were confined to the 30 metre band where he achieved considerable success using a loosely coupled Hartley oscillator circuit with a UX210 tube. Several other forms of oscillator circuits then in popular use had been tried but the Hartley circuit gave the best results. Various alterations were made to the transmitter and power supply subsequent to the commencement of operations early in 1926 but by 1927 the high tension supply had been made permanent with a step up transformer connected to the mains and feeding a single 201A tube connected up as a diode to give half wave rectified output. A large bank of condensers helped smooth out the ripple to give a reasonably steady potential on the plate. Reports for both phone and code showed clear audible signals. The UX210 filament was fed from the mains with a step down transformer.

The receiver was a modified Reinartz type employing two tubes and three coils. Like the transmitter it was constructed by Mr. Saunders and worked well with long distance contacts.

The antenna posed a difficult problem. A single 7 metre water pipe was attached to the building and a stranded copper wire antenna fixed to the top with egg type insulators. The other end was taken directly into the second floor flat and in the process it was just clear of the roof. In parts it was shielded by the tin roof and as a result was not very efficient. The counterpoise was erected inside the room in the shape of a fan so there was not much space for movement particularly when the transmitter was in operation.

Within twelve months Mr. Saunders had accumulated hundreds of verification cards. Included were cards from U.S.A., Canada, New Zealand, Africa, England and Philippine Islands.

5DA [Mr. S.R. Buckerfield]

When Mr. S.R. Buckerfield established two-way communication with an operator in the United States it was a great thrill for South Australian experimenters. It was the first authenticated report by a South Australian and one of the first in Australia. He contacted the American U6AKW in California in the early hours of the morning of 2nd February 1925 on c.w. from his station 5DA located at 4 Regent Street, Parkside. Input power at the time was 20 watts and wavelength was 90 metres. The receiver was a two tube model of the regenerative type. His transmitter employed a loosely coupled shunt fed Hartley circuit with two Phillips ZII tubes in parallel. High tension was 900 to 1000 volts d.c. supplied by a step up transformer and Amrad 'S' tubes. The filaments were fed with a.c. via a step down transformer. The antenna was an L type with an overall length of 20 metres and about 10 metres above ground. The normal antenna current was 1 to 1.2 amps. The transmitter which used grid type modulation was capable of operation from 40 to 95 metres. It was later remodelled to work with two Phillips ZII A's as oscillators and two as modulators. One of these tubes is now in the Telecommunications Museum.

Although Roy Buckerfield was a very active short wave worker he was also interested in the longer wavelengths. In August 1924 he was one of the experimenters providing regular phone transmissions. His wavelength was initially 120-170 metres which was somewhat shorter than the 200-250 metres band that many others operated on but he achieved very good results. His programmes were usually broadcast for about an hour from 7.30 p.m. or 8.00 p.m. on Tuesday and Thursday evenings with a Sunday morning session from 11.00 a.m. until noon followed by a Sunday evening concert programme. Later he operated in the 200-250 metre region. The transmitter was a loosely coupled Hartley type using two Radiotron UV202 tubes. Heising type modulation was employed. The plate voltage was 500 to 550 d.c. supplied by Amrad 'S' type rectifiers. Nominal antenna current was 1.4 to 1.6 amps. The antenna was an inverted L type, 13 metres above the ground and some 40 metres in length.

Like many operators of the period, he started off experimenting on the reception side using crystal sets in 1921 and graduated to transmission early in 1924. He quickly established a reputation for good signal level and high quality modulation. The majority of music was broadcast using gramophone records with a microphone placed in front of the horn but a feature of the Sunday broadcasts was the live Sunday Night Concert programme. Wests Theatre Orchestra musicians provided much of the music. Reception reports came from all States and as far away as New Zealand. Early in 1925 he was engaged with a Melbourne experimenter on transmissions on 250 and 90 metres in order to determine the best wavelength for phone transmission between Adelaide and

Melbourne. After these tests he endeavoured to link up with England on 90 and 40 metres, but transmission was not successful because of low signal levels and local interference. At that stage he was using a 50 watt Radiotron tube in his transmitter.

In 1925, he was engaged on the construction of radio sets and apparatus for Paroso Ltd. in Gawler Place and the following year with Transatlantic Wireless Manufacturing Company, Kintore Avenue, Prospect. At Transatlantic, he was in charge of the laboratory and experimental work associated with the manufacture of newtroformers, condensers, transformer stampings, power transformers and complete receivers including one of the outstanding receivers of the period, the Newkradyne. This "one control" receiver was developed by Mr. Buckerfield in conjunction with Mr. C.R. Brown, Manager of the Company. It was claimed to be the most sensitive, foolproof and efficient five tube receiver procurable. Some of these receivers are still in existence in Adelaide as collectors' treasures.

Another item of radio equipment he developed in conjunction with Mr. Brown was a direction-finding receiver which, with the aid of a rotatable loop antenna, was able to locate a noise source. The receiver contained two high frequency stages, a detector and two stages of audio.

The Transatlantic Wireless Manufacturing Company were associated with the construction of the 5KA transmitter for Sport Radio Co. in 1927 and Mr. Buckerfield assisted with the establishment of the station.

5GA [Mr. G.R. Anderson]

George Andersen became interested in wireless in 1913 when he assisted his brother to operate a spark transmitter and an iron filing coherer. The spark coil was about 30 cm in length and fed an antenna comprising a single strand wire about 10 metres long and 6 metres above the ground. A clothes line about 12 metres in length served as an antenna for the receiver. Experiments ceased with the outbreak of the war.

George resumed activities after the war as soon as the authorities permitted experimental work and in 1920 while living at Walkerville Terrace, Gilberton constructed his first tube receiver. It was a single tube regenerative type using one of the "C" type triode tubes made in the United States by Elmer P. Cunningham. It was obtained from Newton, McLaren Ltd. and a licence had to be obtained for its purchase. The filament was powered by a car battery and the high tension supply comprised a bank of test tube cells. Tuning of the receiver was done from the front panel using a selection of pancake and honeycomb coils for different bands in the antenna, grid and feedback circuits. A four wire cage type antenna system was used and gave good results. It was 25 metres in length supported by two masts about 13 metres high. The Cunningham tube was later replaced by a twin filament A.W.A. Expanse B type tube. Following the success of this receiver George then embarked on the construction of more sophisticated receivers.

His first transmitter was a tuned plate tuned grid arrangement. High tension was provided by a circuit using a W.E. Type 205D triode tube adapted as a half wave rectifier. It was in service for a long time and has been preserved as a museum item. The microphone was a home made model fabricated from a solid block of marble 10 cm by 5 cm by 8 cm with a stepped cavity insert containing two gold plated electrodes. A hole at the top enabled the correct quantity of carbon granules to be poured in to give optimum performance. The microphone was used for many years and is now in the Telecommunications Museum in Adelaide.

When trouble was being experienced with the cable between Kangaroo Island and the mainland in 1928, George employed his station as the Kingscote end of a radio link. The transmitter used Meissner circuit configuration and employed a 210 type tube. The filament was powered from a car battery while high tension could be provided by either a Ford coil arrangement or a bank of some 400 dry cells of the type used in magneto

telephones at the time. The set was modified for phone operation using absorption type modulation with surprisingly good results. An ordinary carbon telephone insert was used for speech and when broadcasting music, the microphone was placed near the gramophone speaker unit. The original antenna was a single wire but George replaced this with a cage type of four wires spread by hoops 33 cm in diameter suspended by two 12 metre high masts spaced 40 metres apart. The feeder was a cage lead-in 6 cm in diameter. A counterpoise about 3 metres above the ground was suspended beneath the antenna. The receiver in use was a three tube tuned radio frequency model. George remained on Kangaroo Island for a period of 2-1/2 years and his broadcasts on 200 metres were popular with many listeners in Adelaide.

5HG [Mr. H.M. Cooper]

The 5HG experimental station was located at Hastings Street, Glenelg and was placed in operation in 1926.

Mr. Harold Cooper constructed the set himself without previous experience in the radio field and without having seen a working installation. Transmissions were first carried out on 80 metres using 201A tubes and with B batteries of the Columbia type supplying the high tension. The drain was 5 milliamps from an 80 volt source.

The high tension supply was later provided from the mains after construction of a rectifier employing two 'S' tubes and a filter. A second hand transformer purchased for the rectifier system was faulty and had to be re-wound before the rectifier could be put into service.

After successful working on 80 metres, Mr. Cooper made some modifications to enable transmissions to take place on 30 metres. He used an antenna cut to the appropriate length with a counterpoise to take account of the two wavelengths being used. He was one of the earliest experimenters in South Australia to make use of the Zeppelin antenna. In 1928 he was working into a full wave Zeppelin after having previously used a half wave version. Antenna current was 0.65 amps.

The transmitter being employed in 1928 used a Hartley oscillator circuit with two tubes of the UX210 type connected in parallel. Input power was 30 watts. Filament power was derived from the a.c. mains with a step down transformer. This transmitter and one of his receivers are now in the Telecommunications Museum.

The receiver was constructed to a Reinartz circuit giving a range coverage of 20 to 20,000 metres. The shack also included other types of receivers which had been assembled over a period of time.

Mr. Cooper made contact with a great number of experimenters in other countries as evidenced by a large box full of DX cards. Countries included Africa, Finland, Borneo, Japan, China, Alaska, England, France and Chile.

5HY [Mr. A.A. Cotton]

Mr. Cotton was manager of the radio department of Harringtons Ltd. and operated 5HY from Harvey Street, Kilkenny. At the time, Mr. Cotton was one of the long term experimenters having first started with a spark transmitter on 14th April 1913 using call sign XVS.

The station comprised two transmitters fed from a common power supply. One transmitter was designed for operation in the 150-200 metre band and the other for the 30 metre band. The two transmitters were located on top of a bench with the power supply mounted underneath the shelf. 'S' type tubes were used in the rectifier system in conjunction with a large step-up transformer and 'brute force' filter. A switching arrangement allowed the supply to be switched from one transmitter to the other in a matter of seconds. Filament supply was provided by a tapped transformer fed from the mains.

The 200 metre transmitter employed 201A tubes early in 1927 but later more powerful tubes were used. The 201A tube was a hard detector-amplifier type rated at five volts at 0.25 amp for filament. The tube was made by the General Electric Company with the first release being made in 1919. The circuit was the popular loose coupled Hartley arrangement with modulation being effected by the Heising system.

The 30 metre transmitter was also wired as a loosely coupled Hartley circuit but in a slightly modified arrangement. It used a UX210 type tube and was very neatly constructed.

The key was located on the bench adjacent to the short wave transmitter and was so wired that it could be easily switched from one transmitter to the other.

The antenna system comprised a single wire some 27 metres long suspended from a single 10 metre high mast. A three wire fan type counterpoise was erected beneath the antenna.

The receiver was mounted on the bench with the transmitters and consisted of a three coil tuner with a resistance coupled amplifier added giving a four tube performance capability. It had a tuning range to cover both the short wave and broadcast frequencies and possessed high selectivity. Monitoring was by either Baldwin phones or a loudspeaker. The loudspeaker was used during 200 metre working when signal strength was adequate.

Mr. Cotton obtained outstanding success with his station. Within four months of setting it up he received good reports with 200 metre phone working from many country centres in South Australia as well as long distance reports from New South Wales and Victorian listeners. On the short wave band early contacts included operators in Japan, Philippine Islands, United States and New Zealand.

5JA [Mr. P.J. Brewer]

Mr. Brewer's station 5JA was located at 21 Douglas Street, Parkside. He first went on the air in July 1926. He was a keen continuous wave operator using only moderate power. Mr. Brewer was an expert at Morse code having been a telegraphist employed by the Eastern Extension Company.

For the first six months that the station was on the air the transmitter high tension voltage was supplied by a large accumulator 'B' battery. With this arrangement he was able to work no fewer than nine countries.

In 1927 Mr. Brewer replaced the B battery with an a.c. rectifier system employing two 'S' tubes. The supply including the bulky power transformer and filter system was mounted on a shelf beneath the operating table. The filament transformer was also located there.

The popular split series Hartley oscillator circuit was used and early in 1927 a UX210 tube was being employed. In the circuit both the plate and grid were coil tuned as was the normal practice. Workmanship of the station was of a high order. For telephony working the grid modulation system was used.

The receiver employed a three coil circuit with one audio stage of the loose coupled Reinartz type. Best reception was obtained with a floating earth. The shack was also equipped with a five tube neutrodyne broadcast receiver which fed a horn type loudspeaker.

The antenna was a standard half wave Zeppelin type with feeders being very closely spaced and separated by small sections of insulating material. A low resistance earth system was preferred to the counterpoise system used by many other experimenters at the time. The antenna tuning condenser and a changeover switch were fixed to the wall alongside the transmitter.

Mr. Brewer had worked many overseas countries with particularly good reports being received from Great Britain, U.S.A., South Africa, China and Java.

5LF [Mr. L.F. Sawford]

Mr. L.F. Sawford was well known on both short and long waves with his station 5LF located at Mead Street, Peterhead. He went on air in mid 1925 after being interested in radio for some four years previously. In 1927 he was maintaining a programme of regular transmissions and at the same time was a member of the Wireless Institute Council and the Port Adelaide Radio Club.

Len Sawford was on the radio staff of C.M. Lowe, a well known Port Adelaide electrical firm. Most of the gear in his station was home made as he preferred to make components to his own specifications rather than buy commercially made items.

Four Radiotron tubes type 201A were employed in the 200 metre phone transmitter. Two of the tubes were used in the oscillator section of the circuit and two in the modulator and amplifier stage. The circuit was a loosely coupled Hartley type with the Heising or Choke system of modulation. A Kellogg type carbon granule microphone was used for speech and music broadcasts. When music was being first broadcast the microphone was placed in front of the gramophone horn.

The shortwave transmitter employed a Radiotron UX210 tube in a coupled Hartley circuit with 600 volts on the plate. A temporary grid modulation system was frequently brought into service for phone working. The U.S.A. was worked on many occasions on phone with the arrangement.

A common power supply energised both the long wave and short wave transmitters. A 600 volt d.c. supply was obtained from a step up transformer which Mr. Sawford wound himself, an electrolytic or 'slop' rectifier and a filter network to smooth out the ripples. All filaments were supplied with a.c. from a step down transformer. Mr. Sawford also made this transformer. The transmitter units were mounted on the top of a table and the power supply units were assembled on a bench beneath. A switching system enabled the supply to be connected quickly to either transmitter.

The electrolytic rectifier of the type at 5LF was widely used by Adelaide experimenters for supplying high voltage direct current to transmitter tube plates. A number of cells in narrow glass containers contained electrodes of aluminium and lead in a solution, usually a mixture of ammonium phosphate and rain water. Normally about 50 to 60 volts was allowed per cell but many units worked at much higher levels. The cells were connected in series combinations and as a bridge network to rectify the applied high voltage. Glass jars of the lolly or preserving bottle type about 6 cm in diameter and 10 cm high were popular. As the solution became acid in operation, ammonia was added at intervals. An insulating film of oil was placed on top of the solution to minimise the creepage of salts up the aluminium electrodes. Sometimes a rubber tube over the electrode above the liquid level served the same purpose.

The receiver in use was a standard three coil unit using low loss coils and was remarkably sensitive as evidenced by the large number of overseas contacts registered in the log book. More than 30 countries had been worked on 30 metres by 1928.

The antenna system was an end fed Zeppelin type suspended between two masts each 17 metres high. The antenna was also used when he desired to use it as a third harmonic radiator. A standard earthing system was used without any counterpoise wires. A switch box allowed the antenna to be switched to either of the two transmitters or the receiver as required.

Late in 1927 Mr. Sawford was using a De Forest 'H' tube, one of the very few in Adelaide at the time. It gave high performance from the very short wave lengths down to 200 metres and was not subject to flashover as all leads were brought out at widely separated places. Internal construction was rigid and both grid and plate were made of molybdenum. The tube worked with a plate voltage of 1000 to 3000 volts and a grid bias 50 to 500 volts. The radio frequency output was capable of up to 150 watts depending on the circuit.

5MA [Mr. M.B. Anderson]

By 1927 Mr. M.B. Anderson of Torrens Road Cheltenham was a very active experimenter with call sign 5MA. In the same year he became well known when he installed his station on the six masted sailing ship 'E.R. Sterling' and carried out experimental and research work on short wave phenomena in conjunction with Australian, English and American experimenters. During the voyage he used call sign EX5MA.

The set he installed had previously been successful in working another experimenter in Dallas U.S.A. with only 25 volts on the plate. The transmitter was a modified Hartley circuit using a UX210 tube as oscillator. The Heising or choke method of modulation was employed. High tension was 350-500 volts d.c. to the plates of the transmitting tubes. It was supplied by a motor generator set driven from a 12 volt battery source.

The receiver which Mr. Anderson made entirely from local parts except imported tubes was mounted on the same panel as the transmitter. It employed three coils including a reaction coil.

The antenna comprised a single vertical copper wire 26 metres long fixed up the side of one of the wooden masts. A counterpoise was installed by tacking insulated wire to the deck.

The ship's normal radio equipment was a 1kW quenched spark transmitter working on 300 to 600 metres and a Federal receiver covering the band 15-20,000 metres. The antenna was an enormous size being some 50 metres high and overall length nearly 100 metres and the use of these facilities gave a valuable means of comparison for long distance signalling with results obtained from the 5MA short wave set.

Mr. Anderson was a keen receiver experimenter and constructed many types for various purposes. One of the best known which was copied by many young enthusiasts around 1925 was a single tube regenerative receiver using a modified form of a Flewelling super-regenerative circuit. It gave good performance on either loop or external antenna. Mr. Anderson reported that he received broadcasting stations in Sydney, Melbourne and Perth as well as coastal radio stations at Port Moresby and Geraldton on loudspeaker strength. The set employed a Philips 201A and later a UV201A tube with 50 volts on the plate, a variable grid leak to improve setting up of the reaction control, two coils of the spider web or honeycomb types with a variable condenser bridged across the reaction coil and a 0.0005 mfd. variable main tuning condenser. The headphones were placed in series with the high tension battery and the plate.

5MB [Mr. H.M. Brown]

This station which commenced transmissions in July 1927 was operated by Mr. H.M. Brown at 24 Northcote Street, Torrensville. Merv Brown had however been a keen listener for some three years before going on air with his transmitter.

Most of the activities were confined to short wave working and several bands had been tried with varying degrees of success. The transmitter mostly used was set up for the 30 metre band and employed a loose coupled Hartley circuit with a Radiotron UX210 tube. The applied potential was 650 volts which was slightly higher than that normally employed for this type of tube. The transmitter was very well constructed with the main coil being nickel plated. All interconnecting wiring was done with flat copper strip which gave a neat appearance to the whole installation. The transmitter was used for 20 metre working on occasions after carrying out minor adjustments to the assembly. Experiments were also carried out on five metres but a separate transmitter was used for this purpose.

The high tension for the plate was originally provided with a 24 jar 'mud pot' arrangement which gave very little trouble. A 10 mfd condenser was used in the filter circuit to smooth out the ripples. In 1928 a new rectifier system was built using a 1,000 volt transformer with output rectified by two 'S' type tubes paralleled up in a half wave arrangement and feeding into a choke-capacitor filter network. Output from the system was 800 volts and was applied direct to the UX210 tube plate.

The receiver was a straight forward two tube type using three coils with throttle control. The shack also contained a four tube tuned plate type constructed by Mr. Brown for reception of broadcasting stations in the medium frequency band.

A half-wave Zeppelin type antenna was used. A current of one ampere was normally fed at the feeder input when working 32 metres. Several types of dipoles had been tried from time to time but the standard Zeppelin gave the best results. The antenna current with transmitter tuned for 20 metres was 0.65 amp and when tuned for 30 metre working it was 0.9 amp. The Zeppelin type of antenna used by many experimenters throughout the world was originally a half wave dipole end fed through a quarter wave transmission line developed as a trailing antenna for Zeppelin airships. It subsequently became known as the Zeppelin or Zepp and the term applied to practically any resonant antenna fed at the end by a two wire transmission line.

By the end of 1927 Mr. Brown had worked at least 30 countries and the wall of the shack was plastered with more than 260 cards from operators he had contacted. In addition to radio experimental work he conducted classes in Morse Code and was instrumental in teaching many of those who later became active and well known operators. Mr. Brown subsequently worked at broadcasting station 5PI from 1934-1936 and as a Radio Inspector in the Post Office.

5RJ [Mr. D.A.M. Hancock]

Experimental station 5RJ was one of the few country stations in active operation in the 1927-28 period. It was operated by Mr. Darcy Hancock at 14 Railway Terrace, Kadina. The station was first licensed on 17th August 1927 and went on the air shortly after.

The transmitter used a Hartley oscillator circuit with a single 201A type tube. This was a very popular circuit with local experimenters but Mr. Hancock completely rebuilt the transmitter using a split Colpitts circuit arrangement with a UX210 tube. This type of circuit was developed by E.H. Colpitts for the Western Electric Company in the United States. In the circuit the filament was connected not to a point on the inductance as with the Hartley arrangement but between two condensers in series which shunted the single inductance used. Modulation was by the Heising method using a single tube. The station was often heard on phone around 33 metres and many excellent reports were received by Mr. Hancock on his transmissions. He was also an expert code operator.

Kadina at the tme did not have an a.c. town supply. There was a power supply but distribution was at 200 volts d.c. and this was difficult to employ directly for transmission purposes. He required 400 volts for the plate of the tube and overcame the problem by building an accumulator battery of 100 cells which gave 200 volts across the terminals. By connecting this with correct polarity across the town supply he was able to make up the full 400 volts. Input to the transmitter was about 22 watts. Filament supply was provided by 'A' batteries.

High tension supply for the transmitter tube plates was a major problem for experimenters working in country areas where there was no suitable mains supply available. Dry batteries were not only expensive in initial cost but they could not be reused. Several high tension accumulators were available commercially and could be purchased in groups of 12 to 30 cells per container giving a voltage range of 24 to 60

volts. For higher voltages, banks were placed in series. Popular types in demand had capacity ranges of 2.0 to 3.5 ampere hours. The units were composed of tubular or rectangular type cells fitted in strongly constructed polished mahogany or teak crates.

The antenna was a long wire type so cut to resonate at the third harmonic of 33 metres. With the Colpitts oscillator he was able to feed 0.5 amp. into the antenna. Soon after the Colpitts transmitter was put on air a full wave Zeppelin antenna was built and replaced the long wire.

Within a year of commencing transmissions Mr. Hancock built up a large list of foreign operators which he had worked as evidenced by the many cards which were pinned to the wall. Countries worked included, Java, India, China, South Africa, England, Canada, England and U.S.A.

5SL [Mr. L. Fiedler]

Mr. Les Fiedler was one of the well known 200 metre phone workers after he went on air in June 1927. His transmissions were received at loud-speaker strength as far away as Tasmania, Queensland, New South Wales and Victoria. The station was located at Claire Street, Woodville West. In addition to 200 metre working, transmissions were carried out on 32 metres. Music broadcasts were carried out using a H.M.V. gramophone and carbon microphone.

The 200 metre transmitter was in three sections — oscillator, modulator and power supply — with controls being mounted on a polished plywood panel. The circuit was a loose coupled Hartley type and various types of modulation were tried before settling on the Heising or choke system. The oscillator and modulator each employed a single UX210 tube. The filaments were fed by a.c. with a step down transformer and the 700 volts d.c. was supplied from what was known as 'mud pots'. A 24 jar chemical rectifier had been used when the station went on air and it was still giving good service 6 months later. The filter unit comprised a 50 Henry choke and a bank of mixed condensers which added up to 200 mfds total.

The 30 metre transmitter had an ebonite panel on which was mounted two meters, antenna feeder terminals and various switches. It used a UX210 tube and the 200 metre transmitter power supply was used when that transmitter was not being worked. Both grid and Heising methods of modulation had been used at various times.

For 200 metre working Mr. Fiedler used a Weagant type receiver. It used three plug-in type coils and three 201A tubes. Two variable condensers were used — one for tuning the main closed circuit and the other for controlling reaction. This latter was often described as the "throttle control" by experimenters. It was very sensitive and was frequently used on short wave working as an alternative to movable coils.

A Reinartz circuit was first used for a short wave receiver but was not altogether satisfactory. A modified form of the Weagant circuit was later built up for short wave purposes. The Weagant circuits were developed by Roy A. Weagant and were particularly suitable for the reception of damped waves. Across the plate circuit of a tube which was being used in the ordinary way as a detector, was connected an oscillating circuit of series inductance and capacitance which could be tuned. This circuit was called the 'X' or tertiary circuit and acted in a retro-active way similar to that of the tuned plate circuit developed by E.H. Armstrong in 1913.

Both receivers were powered by a 110 volt P and B accumulator 'B' battery for high tension and an 'A' battery for filaments. Charging was carried out on the premises using a home made chemical charger which gave many years of service.

The antenna for 200 metre transmissions comprised a copper wire cage 25 metres in length supported between masts 16 metres high. A large counterpoise erected just above the ground took up most of the back-yard.

5WA [Mr. W.K. Adamson]

Station 5WA was operated by Mr. W.K. Adamson at 25 Olive Street, Parkside and had been operating since about 1924. Most of his activities were confined to short wave in the 1927-28 period although some working had been done on 200 metres for a while. Ken Adamson built his first receiver in 1920 at Pt. Augusta and learnt Morse Code by listening to VIA. The receiver was a crystal set using a sliding type coil 5 cm diameter and 15 cm long. He used an iron pyrities crystal given to him by a ships operator. He obtained his experimental licence in 1922.

The transmitter was a loose coupled Hartley circuit with the inductances being constructed of No. 6 gauge copper wire and mounted on a glass base. All the main tuning condensers were enclosed in celluloid covers to prevent dust from settling between the plates. The transmitter employed a single UX210 tube.

The high tension was provided by a chemical rectifier and transformer which gave 600 volts d.c. output. The filter comprised a choke coil and four mfds of capacitance. Ken Adamson made the transformer himself and enclosed all the high voltage components of the system inside an enclosure covered with wire mesh for safety purposes.

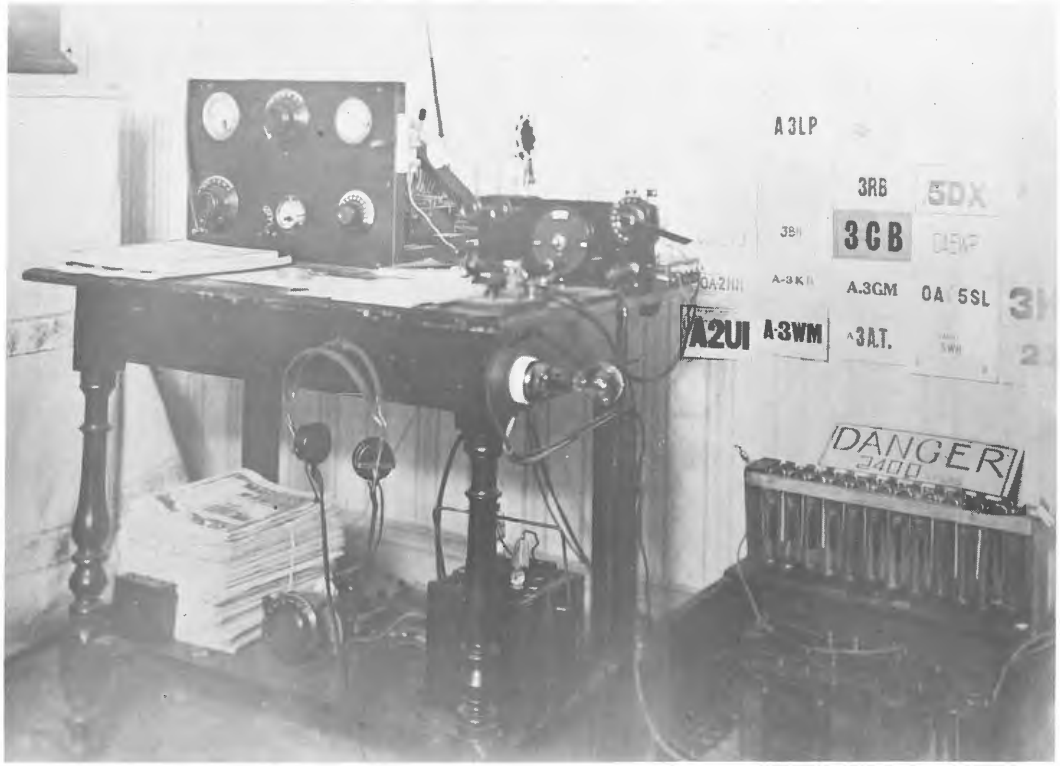
The antenna in use was an end fed Zeppelin type, very popular at the time. For an input of approximately 30 watts to the transmitter the antenna current was one amp. The antenna was supported by two poles spaced 20 metres apart. One pole was supported on the roof of the house and the other on top of a palm tree. The height above ground was about 13 metres.

The receiver was a two tube set employing three coils with throttle control. The detector tube was a UX120 a common power type tube and the audio amplifier was a PM4. The audio transformer was an All American type with a step up ratio of 10 to 1. The receiver had wide band coverage and worked down to 20 metres. The tubes were fed from a six volt 'A' battery which was charged from a home made 'slop' rectifier made from a half gallon oil tin.

These home made rectifiers were widely used by Adelaide experimenters. Tubes placed a heavy drain on the accumulator and unless charging facilities were available in the home it meant frequent trips with the accumulator to the garage. The usual arrangement was to suspend a piece of aluminium partly immersed in a saturated solution of bicarbonate of soda. The container was any clean tin that happened to be available. Kerosene and oil tins were popular. The aluminium which was held clear of the tin acted as one electrode while the tin acted as the other. The aluminium terminal was connected to the positive terminal of the accumulator and the tin to one side of the secondary winding of a step down transformer. The voltage drop was generally about 20 volts, so to charge a 6 volt accumulator a transformer with secondary voltage of 30 to 50 volts was used. A rheostat was placed in series with the battery to adjust the charging current.

For his entry into the 200 metre phone field, Mr. Adamson built a transmitter with three huge pancake coil inductances measuring about 30 cm across with the formers being cut out of three ply. It used a UV202 tube but the transmitter did not receive a great deal of use for some time.

In 1928 Mr. Adamson still had in his shack parts of the early crystal set which he had made in 1922. It was a huge device being mounted on a panel about 50 cm high by 100 cm wide. Two condensers were used with large plates and they required considerable effort to operate them. They were home made and consisted of zinc plates about 7.5 cm by 10 cm sandwiched between glass quarter plates recovered from old photographic equipment. There were 10 fixed plates and 9 movable plates which were attached to baseplate and arm so that the zinc plates moved in a horizontal direction between the glass plates. One of these condensers has been preserved in the Telecommunications Museum in Adelaide.



Amateur transmitting station OA5WA operated by Ken Adamson 1926.

A great deal of experimentation took place with his equipment to obtain optimum performance and many of the modifications resulted in considerable improvement. Countries worked included India, England, Hawaii, France, Belgium, U.S.A., New Zealand, Philippines, Kenya and Uruguay. On 23rd August 1928 he was made a member of the WAC Club in recognition of having held two-way communication with amateur stations in all six continents.

Ken Adamson entered the commercial side of radio in 1923. For two years he was Manager of the Radio Department of Duncan and Fraser Ltd. followed by four years with the Service Department of A.G. Healing Ltd. In 1932 he set up his own business, Radio Services Ltd., 74A Pirie Street initially to provide maintenance and repair of radio receivers.

5WH [Mr. W.H. Barber]

Mr. Barber was a well known experimenter on low power short wave phone work although he did do a considerable amount of work in other fields. His station 5WH was located at 48 Somerset Avenue, Cumberland and operated normally with an input power of 10 watts.

In 1926 Bill Barber won the Jewell Electrical Instrument Co's. gold watch offered in competition for low power work. The competition was for maximum 'miles per watt' and with the very small total input power to filament and plate of 0.39 watt he successfully established communication with a station in New Zealand on 4th June 1926. The distant station X1FD was operated by Mr. F.R. Booth of Hamilton and the working took place over some 3840 km (2400 miles). Because of the low output, stability was a major factor in the success and he achieved this by using a top grade tube, a

constant power source and low loss components. His signal was reported as R5-6 initially and on the first reduction of power the level dropped to strength 3, gradually dropping to strength 2. The signals were steady throughout the test and readable.

The transmitter he used was locally constructed and employed a UV199 tube, a Philco 83X battery and Dubilier fixed condensers. The UV199 was somewhat similar to the UV201A used by a great many experimenters except that when the UV201A was used as an amplifier the plate voltage could be taken up to 120 volts without danger of overload. The type 199 was originally made by the General Electric Company when a need arose in 1923 for tubes which would operate from dry batteries. The tube was rated at three volts, 0.06 amp.

Some eight months before the low power competition Mr. Barber used a Radiotron UX210 in his transmitter with an input of 30 watts and successfully established communication with most countries of the world where experimenters were active. The list included Iceland, U.S.A., Canada, Japan, China, England, Porto Rico, Belgium, Alaska, Borneo, Brazil, Java, South Africa and French Indo China.

The Philco battery which was used for the competition transmission was a type very popular with experimenters who relied on battery for high tension. A typical arrangement was an assembly of 12 cell units giving 24 volts per battery. Actual capacity was relatively small compared with the filament accumulator being of the order of 5 ampere hours for a unit about 12 cm by 20 cm overall dimensions. Charge rate was about 0.25 amp. Batteries used with small receivers had capacities of about 1.2 ampere hours. The Philco battery incorporated a 'dry charge' during the manufacturing process and apart from the initial filling with acid required no attention until discharged.

The station antenna comprised seven strands of enamelled copper conductor 27 metres in length suspended between two masts. One mast was 14 metres high and the other 20 metres high. A counterpoise held 2 metres above the ground and insulated at one end was installed directly beneath the antenna.

5WI [Wireless Institute]

The South Australian Division of the Wireless Institute of Australia has operated an experimental station since 6th September 1921 when it was granted a licence for the purpose of conducting experiments in radio telegraphy for receiving and transmitting purposes. The license number was S519 and the equipment used was the private property of the Secretary Mr. C.E. Ames who lived at 59 Carlton Parade, Torrensville. In accordance with Post Office policy at the time the licence for the station was issued to a trustee (Mr. Ames) who had to notify his acceptance of responsibility for the observance of Regulations, by the members of the Institute.

The transmitter comprised a rotary spark unit, a spark coil capable of producing a spark across the secondary ball gaps of 3.75 cm in length with a primary input voltage of 10 volts a.c. It was loosely coupled to the antenna with an 0.006 mfd condenser in the oscillator circuit. Two receivers were in use. One was a crystal set and the other a single tube regenerative type. The antenna was a four wire flat top type fed at one end with a single wire. The flat top was in angular configuration of overall length 37 metres and 18 metres above the ground at the highest point.

Mr. Ames changed his address to 20 Grange Road, Hindmarsh and the Institute made application at the same time to carry out experiments using phone. The equipment proposed was a Hartley oscillator using a single R type tube. It was to be loosely coupled to the antenna with modulation by the grid modulation arrangement with a telephone carbon microphone, battery fed in a primary circuit. Facility was also to be available to enable Morse transmissions by keying directly in the grid lead. The filament supply was to be 6 volt accumulator with a step down transformer as an alternative. High tension for the plate was to be supplied by a rectifier bridged across a

step up transformer. Total input to the tube was estimated to be 56 watts. The licence was amended on 30th May 1922 approving the proposal but stipulating that the maximum wavelength was to be 200 metres. The Institute had sought a wavelength in the region 1,000-2,000 metres. The transmitter as built, was much lower in power than originally planned. Early in 1924 it was operating on only 5 watts input and used absorption or loop method of modulation. Notwithstanding the low power, it provided good coverage. Report from one listener 80 km from Adelaide indicated that a five tube receiver gave loud and clear signals using a loudspeaker with one power amplifier stage.

In November 1924 the call sign of the station was changed to 5AV and on 28th June 1925 approval was granted to change it to 5WI following representations by the Institute to have uniform call signs for Institute transmitters throughout the country.

The station soon became active on 170 metres and carried out regular transmissions in accordance with a pre-arranged roster. During December 1924, 5WI was one of five experimental stations on the roster. It broadcast half hour programmes on alternate days from either 7.30 p.m. to 8.00 p.m. or 10.00 p.m. to 10.30 p.m. Many reception reports indicated wide coverage of the transmissions. In 1926 experimental transmissions were expanded to cover the short wave bands. In the same year Mr. Ames ceased to be responsible for the station and it was transferred to the new Secretary.

5WP [Mr. W.S.F. Pitchford]

Mr. W.S.F. Pitchford was licensed in June 1926 and up until January 1927 was very active on phone transmissions in the 200 metre band. After that he included short wave working in the 33 metre band in his operations. The station was located at 318 Wakefield Street, Adelaide. He was for sometime also the official operator at 5WS the West Suburban Radio Club.

The 200 metre transmitter was built around a 201A tube employing a Hartley oscillator circuit but he later improved it by using a UX210 tube. Reception reports indicated a clean and easy to read signal.

The 33 metre transmitter also used a Hartley circuit. It employed a 201A tube with 200 volts d.c. on the plate. The high tension was provided by a system of 'slop' rectifiers bridged across the mains with a step up transformer and filter network. Input to the transformer was 200 volts a.c. direct from the house mains. The filament was energised from the mains using a step down transformer. The power supply was a common arrangement for the two transmitters, with a switching arrangement to feed either transmitter as required. The switchboard was neatly wired and well protected so that changeover operations could be carried out quickly and safely.

The station receiver was an adaptation of the Schnell receiver with an untuned primary connected directly between antenna and earth. The coils were wound in the Lorenz fashion with triple covering of cotton. The oscillation was controlled by a smooth running condenser which was preferred to the tickler coil arrangement on many other receivers. It was particularly efficient for phone transmissions. Reception with the set was very good and experimental tranmissions from a great many countries were logged.

Because of the limited space available and high level of electrical interference in the city area a lot of experimentation was carried out in order to find a satisfactory antenna system. Dipoles were not suitable but an end fed Zeppelin gave by far the best results amid the trees, tram cables and power lines.

After the erection of the Zeppelin antenna Mr. Pitchford was able to pick up some of the more elusive distant stations particularly in the U.S.A. He improved the 33 metre transmitter with a UX210 tube and was able to considerably improve on previous performance.

5WS [West Suburban Radio Club]

The West Suburban Radio Club which was founded in 1924 operated 5WS from 44 King Street, Mile End and worked under the management of Mr. V.K. Coombe. It was one of the most active stations in operations and the voice of Vic Coombe who was an invalid, was known to a great many people throughout the State. Transmissions were carried out on 200 metres and 30 metres using separate transmitters.

The 200 metre transmitter used a shunt fed Hartley oscillator circuit with a UX210 tube. The modulator employed a UX210 in a Heising circuit. One of the problems with the Heising method of modulation or plate choke method as it was also called, was that the modulator efficiency was low. This meant either larger tubes had to be used to develop sufficient power to modulate fully or if similar tubes were used for the modulator and oscillator then the modulator tube had to be driven significantly harder. The station had several microphones including standard carbon telephone types and a special cigar box type which Mr. Coombe used frequently.

The 30 metre transmitter was a tuned plate tuned grid type using UX210 tubes throughout. High tension was supplied by a single 'S' tube followed by a bank of six one microfarad condensers in parallel. The 'S' tube rectifier was a popular rectifier with experimenters where the tube was first developed. The plate was a flat carbon electrode with a cup shaped cathode with a small tube like opening. The tube contained helium. When the plate was made positive, free electrons were drawn from all parts of the cup through the opening to the plate. In doing so they collided with the atoms of helium and ionized them. This allowed the tube to conduct. When polarity was reversed the current conduction was only a fraction of a percent of the normal current.

The short wave transmitter was keyed at the centre tap and antenna current was 0.75 amp when feeding into a full wave Zeppelin antenna.

The 5WS station provided a unique type of broadcasting service at the time on 200 metres and was still operating into the 1930's with a large following. Broadcasts were carried out for several years every Sunday morning and after the regular broadcasting

Vic. Coombe 5WS — 1930.

stations had closed down on Sunday nights. Hundreds of letters were received each month from all parts of Australia and New Zealand together with a great number of telephone calls requesting the broadcasting of certain items. Mr. Coombe was in possession of a library of some 1500 records and had access to many thousands more privately owned. The equipment at the station was well constructed and produced high quality signals. In the early 1930 period the accessories available such as amplifiers, pick-up equipment, microphones etc. compared most favourably with equipment being used by other licensed stations.

Broadcast Reception on Trains

As a step in boosting experimental wireless the Wireless Institute set up nine receivers in a special nine carriage train on 16th October 1924 for a night journey to Hallett's Cove. It was the first large scale public demonstration of broadcast reception on a moving train. The sets ranged in size from three tubes to seven tubes. Most receivers employed loop antennas but a few used lengths of wire suspended from lamp shades. Well known experimenters who operated receivers included Harry Kauper, Fred Williamson, Hal Austin, Clem Ames, Roy Buckerfield and J.P. Hale. Special programmes were broadcast by 5DN and 5AB for the occasion.

In August 1925 during a railway maintenance inspection trip from Cockburn to Mount Dutton just south of Oodnadatta a carriage was fitted out by Mr. H.H. Armstrong for broadcast reception using a two tube receiver and an external multi wire antenna supported by poles which projected a couple of metres above the carriage roof. Good reception was reported of transmissions from 5CL, 2BL and 3LO. The trip lasted six weeks and at most times signals were at loud speaker strength.

The Southern Suburban Radio Club on 10th October 1926 carried out experiments on the effects of bridges, cuttings and tunnels during a train trip to Belair with 300 guests. It was found that steep sided cuttings and tunnels had considerable influence on signal strength. Some 15 receivers were in operation. Those who operated sets included Messrs. S.R. Buckerfield, R.G. Gurner, F. Jervois-Draysey, R. Holland and T. Fotheringham.

Although isolated fixed installations were made in State and Commonwealth VIP railway carriages in the 1930's, it was not until 1952 that a co-ordinated programme of tests was carried out to assess the reliability of reception on long distance journeys. Jack Strachan of the Commonwealth Railways fitted out a carriage with a 'Disposals' National HRO receiver and an antenna wire just above the roof. Tests between Port Augusta and Kalgoorlie were encouraging and in December of the same year more extensive tests were made by Ted McGrath and Arthur Capel of the Post Office radio group. They used RAC type AR88D and Hammarlund Super PRO receivers. Tests were conducted during several return trips and it was found that reception from 5CK Crystal Brook was reasonably reliable between Port Pirie and Kingoonya and from 6GF Kalgoorlie between Rawlinna and Kalgoorlie. The intermediate section was well served by short wave transmissions from Wanneroo in Western Australia and Lyndhurst and Shepparton in Victoria.

Two German built lounge cars AFA92 and AFA93 were the first to be fitted out for public entertainment. The receiver comprised a seven tube triple ganged type powered by a d.c./a.c. converter feeding a 5V4G rectifier unit. The set was tunable across the whole of the medium frequency band and four crystal locked frequencies were provided for short wave reception. The output was fed to two 120 watt audio amplifiers which fed a five inch Rola speaker in each compartment. The receiver was built in the Port Augusta workshops by staff under Jack Strachan. In 1974 sets were still in operation on the Maree-Alice Springs route but more modern types had replaced the original sets on other lines. One of these receivers is now in the Telecommunications Museum in Adelaide.

SECTION 4

FIFTY GOLDEN YEARS

— The Commercial and National Broadcasting Stations

BROADCASTING

About 1922 men of vision began to see the possibilities of broadcasting as a form of entertainment. It was not envisaged as being of any other use than that of an entertainment business. The varied quality of services now being given by broadcasting stations was not foreseen. Interested people represented the matter to the Government. Some were of the opinion that commercial interests should provide the broadcasting services while others thought it was a matter for the Government as they already had a monopoly in other wireless fields. The Government showed no interest in running a service but foresaw possibilities and decided to bring together interested parties to see how best a public service could be inaugurated.

In May 1923 Postmaster-General Gibson convened a conference in the Postal Institute Hall, Melbourne and about 70 people from Wireless Institutes, Radio Associations and other interested bodies attended. Mr. Gibson told the conference that the Government was anxious to see broadcasting inaugurated in Australia and he desired to ascertain the wishes of the people who would be responsible for running the service. The conference sat for two or three days and drafted recommendations. The delegates by majority recommended a scheme called the Sealed Set Scheme whereby the Government would licence various broadcasting companies to transmit on wavelengths to be allocated. People who wished to listen to programmes would be required to pay a Government licence fee plus subscription charge to one or more broadcasting companies of their own choice. The sets were to be sealed by the Post Office to receive only the programme or programmes to which the owner had subscribed.

Mr. L.C. Jones well known Adelaide business man and operator of experimental station 5BQ was appointed to represent the interests of the Radio Association of South Australia. Mr. Jones in reporting on the results of the conference said that as a result of the conference deliberations the following proposed regulations were agreed to and forwarded to the Postmaster-General:

(a) A number of wavelengths to be allotted for broadcasting purposes. Such wavelengths to be selected in respect of their suitability for stations of various powers, and their suitability for standardisation of receiving apparatus and subject to their not being required for public wireless telegraph or wireless telephone services.
(b) Licences or concessions for broadcasting stations to be granted for all available wavelengths within a given area.
(c) Each broadcasting station to be licensed for transmission on one wavelength only, but transfers may be approved by statutory authority.
(d) Licences to be issued under the Wireless Telegraphy Act to the public for receivers of design approved by statutory authority and capable of receiving signals of one wavelength only and incapable of variation without intentional tampering.
(e) Licences on nominal fee to sell or hire receiving apparatus to be issued to bona-fide manufacturers and electrical or other traders.

(f) All licences to be renewed annually excepting in the case of broadcasting stations and trading concerns which were to be for five years.
(g) Concessionaires and licensed dealers to be authorised to issue licences to all their customers who had paid their subscription to the concessionaire.
(h) Receiving licences and renewal thereof to be withheld from all persons who do not pay the annual subscription to the broadcasting stations.
(i) The Government to take effective measures to protect the industry.
(j) Dealers and traders only to supply receiving equipment or parts thereof to holders of receiving licences.
(k) Dealers and traders must collect the first year broadcasting subscription on all receivers sold.
(l) Since there will be ample room for competitive broadcasting services it is unnecessary to place any limitations on the nature of the services provided. Each concessionaire may decide for himself the class of service that will bring him the greatest number of subscribers.
(m) Retailers to keep a record of all equipment sold, together with the name, address and licence number of purchaser and to notify the concessionaries of any particular wavelength accordingly.
(n) Any person, company or manufacturer dealing in or using wireless equipment without a licence from the Government shall be subject to an adequate penalty.
(o) The administration of regulations governing broadcasting to be in the hands of a board having thereon representations of the Government, broadcasting stations, manufacturers, traders and the press.

Mr. Jones also said that the conference affirmed the principle of preference to Australian, British and foreign manufactured apparatus in that order on such terms as would encourage the use of Australian and British manufactured apparatus and made a recommendation accordingly. Another resolution recognised the right of the fully qualified persons indulging in bona-fide experimental work to be without hindrance, except as prescribed in Statutory Declaration No. 169 of 1922, such right to be kept in mind in the allotment of wavelengths, subject to the experimenter giving an undertaking not to poach on broadcasting services.

Regulations giving effect to the recommendations were gazetted on 1st August 1923. The main licensing conditions were:

(1) Licences were issued by broadcasting stations or their agents with fees being paid to the Postmaster-General's Department at monthly intervals.
(2) All receivers had to be of a type approved by the P.M.G. Department with the sets being sealed for reception on one or more fixed wavelengths.
(3) Radio dealers were licensed and charged an annual fee of £1 before being permitted to trade in receivers.

The listeners were required to pay a fee of 10/- per annum to the Government in the case of single station reception or £1 per annum for a set capable of multiwave reception. The subscription fees fixed by the broadcasting companies varied from 10/- to £4/4/- per annum.

The Government gave approval for the establishment of two stations in Sydney, one in Melbourne and one in Perth. The first station to commence transmission was 2SB (later 2BL) in Sydney which started officially at 8.00 p.m. on 23rd November 1923 from a studio in Smith's Weekly Building in Philip Street. The next station on the air was 2FC Sydney on 5th December 1923 followed by 3AR Melbourne on 26th January 1924 and 6WF Perth on 4th June 1924.

It soon became evident that there were technical problems in designing suitable receivers which conformed fully with the stipulated requirements. Of more than 150 separate receiver models submitted for approval, about 90 were rejected on the grounds that they did not reasonably conform with the requirements.

Although there was no broadcasting company operating under the the Sealed Set Scheme in South Australia, the Government had the matter under consideration and the local people were keeping a close watch on activities in the other States. In addition to technical problems with receivers there was another matter about which the South Australian wireless community was concerned. Apparently certain of the Regulations in draft form prepared at the 1923 conference appeared somewhat different when in their correct legal sense in the Act. Opinion of many people was that the Act was unworkable.

The other States were becoming alarmed with the deteriorating situation, particularly in view of the small response to licences and they wrote to the Radio Association of S.A. seeking South Australian support in requesting the Postmaster-General to convene a second conference so that the whole question could be reviewed. The Postmaster-General was reluctant to have the matter re-opened. He being of the opinion that at the conference the whole position was studied from all aspects and that the wireless bodies themselves had prepared the draft from which the Regulations were drawn up. In March 1924 he saw no reason why the question should be reopened.

However, by the end of June only 1,400 licences had been taken out throughout Australia and it was evident that broadcasting stations could not operate economically under the arrangement. On 11th July, Prime Minister Bruce tabled new Regulations creating two categories of stations, A Class and B Class stations. The new Regulations were approved six days later. The A Class stations were to be financed by listeners licence fees and the B Class from advertising revenue. The licence fees were related to three separate zones. Within 250 miles of Adelaide (Zone 1) they were 35/- per annum; 250 to 400 miles from Adelaide (zone 2) 30/- per annum and over 400 miles (Zone 3) 25/- per annum.

In addition special licences were scheduled for hotels and places of entertainment where profit was to result, the rates being £10, £9 and £7.10.0 for the three zones respectively. Dealers licences were fixed at £5, £3 and £2 according to zone. Experimenters were provided for by a small reduction in the licence fee. In the first zone they were called upon to contribute 20/- in the second 17/6 and in the third 15/-. It was expressly stipulated that experimental licences would only be issued if the Department was satisfied that the applicant possessed sufficient knowledge to undertake scientific research and investigation.

As part of the plan, it was intended to license two A Class stations in New South Wales, two in Victoria and one each in Brisbane, Perth, Hobart and Adelaide. These stations were to operate at not less than 5000 watts and were required to broadcast regular and complete programmes of news and entertainment. They were empowered to accept a limited number of advertisements but the greater part of their revenue was to be derived from the licence fees of which the Post Office retained 5/- out of each licence to cover administrative expenses.

One of the first organisations to be set up for the purpose of obtaining the A Class licence allocated for South Australia was the Millswood Auto and Radio Company Ltd. They had in fact set up in 1923 and made application for a high power broadcasting station on the basis that it was only a matter of a short time before broadcasting would get under way in South Australia. In addition to the operation of a broadcasting station the company proposed to manufacture radio equipment and to import motor cars. As early as March 1924, a 250 watt station had been installed pending the erection of their high power station but owing to alterations in the Regulations which were not to the liking of the Company they abandoned the proposal.

In 1924 a permit was granted to Central Broadcasters Ltd. to establish a broadcasting service. The station 5AB commenced transmission at 8 p.m. on 20th November 1924 from the Grosvenor Hotel, North Terrace with a 175 watt transmitter.

Two days later the call sign was changed to 5CL. The service was carried on under permit until 14th January 1925 when the A Class licence was granted. At the time some 1200 broadcast listeners licences had been issued with the first being taken out as early as 8th July 1924.

By 1st August 1924, one application for a B Class licence had been lodged and three other interested parties had made enquiries. Station 5DN had commenced transmissions under a permit in about June 1924 and was granted a licence on 1st December 1924. Others had made attempts to commence a service but plans were not proceeded with. One of those interested was Messrs James Marshall & Co. Ltd., Rundle Street, drapers and warehousemen.

From 1st August 1925, a new scale of listening licence fees came into operation. The amended rates were Zone 1, 27/6, Zone 2, 22/6, and Zone 3, 17/6. This was a decrease on the earlier charges and at the same time several other reforms were introduced. It had been customary to collect the full amount of the fee for the year but the new scheme allowed half yearly payments. The idea was to help young wireless enthusiasts who might find it difficult to raise 27/6 in one sum. Another change was to do away with the Regulation requiring personal application for a licence. Previously, the listener had to apply in person at the local Post Office.

A point of concern with South Australian listeners was that licences were issued for the privilege of listening to an A Class station transmitting on a power of 5000 watts whereas 5CL was only operating with an input power of 175 watts. The technical press mounted a vigorous campaign urging that licences should be post dated to the date of approved broadcasting. The Radio Inspector, Mr. Harrington, stated that the amended Regulations covered the particular situation and that he proposed to write to all those who had taken out licences prior to 1st August 1925 regarding the date of renewal of their licences.

In January 1926, the technical press raised another issue. Concern was expressed at the comparatively slow development of broadcasting as a public utility and the crushing effect of licence fees. Interstate groups apparently felt the same way because in Sydney a committee appointed by the Electrical Employees Association asked that either a select committee or a Royal Commission should be appointed by the Government to investigate the position of broadcasting with respect to:

(1) The efficiency of broadcast stations.
(2) The equity of the present distribution of revenue.
(3) The real ownership of A Class stations.
(4) Whether ownership by large vested interests in the entertainment business would lead to a restraint or hampering of radio as a competitive institution.
(5) The adequacy or otherwise of the licence fees.

The committee also deemed it advisable for a Royal Commission to look into claims for royalties made by copyright owners and patentees who between them claimed about 40 per cent of the revenue.

Some South Australians were particularly concerned with the apportionment of the licence money in the case where there were two A Class stations such as in Sydney. One station received 70 per cent and the other 30 per cent. It was argued that 50-50 was a fairer basis as the 70-30 basis almost certainly ruled out the chance of the formation of a second A Class station in South Australia.

In December 1926 the Acting Prime Minister, Dr. Earle Page announced that the Government had decided to appoint a Royal Commission to enquire into wireless in Australia. The Government felt that an enquiry similar to that which had earlier proved advantageous in Great Britain would clarify the position. In selecting the members of the Commission the Government did not include any person directly involved with

broadcasting. The Chairman was Mr. J.H. Hammond K.C. of Sydney, with Sir James Elder, Mr. A.J.B. McMaster and Mr. C.E. Crocker (President of the Institute of Engineers, Australia) being other members.

The terms of reference of the Commission were:

(1) To enquire into and report on wireless broadcasting within the Commonwealth in all its aspects, making recommendations as to any alterations deemed desirable in the policy and practices at present in force.

(2) To enquire into and report on the development and utilization of wireless services for public requirements within the Commonwealth.

The Commissioners assembled in Melbourne on 5th February 1927 for the purpose of considering the necessary arrangements for the conduct of the enquiry. The public enquiry opened in Melbourne on the 8th March and during 50 public sittings which were held, some 165 witnesses were examined. The work of the Commission attracted a great deal of public interest and attention and considerable publicity was given to the evidence presented by the various parties.

Witnesses were examined from all parts of Australia and the views of country listeners were ascertained. In addition, the A Class Broadcasting Companies, certain of the B Class Stations, Amalgamated Wireless (Australasia) Ltd, Radio Dealers Association, Association for Development of Wireless, Performing Rights Association and the Listeners League were represented and assisted in the investigation.

The Commission commenced taking evidence in Adelaide during June and a number of witnesses were examined. Those representing South Australian interests included Messrs. A.L. Brown, General Manager, Central Broadcasters Ltd (5CL); C.R. Brown, Manager, Sport Radio Broadcasting Co. Ltd (5KA); A.A. Cotton, Secretary, Wireless Institute of Australia (South Australian Division); J.E. Davison, Managing Director and Editor in Chief, News Ltd; H.W. Harrington, Radio Inspector, Postmaster-General's Department; E.J. Hume, Proprietor B Class Station 5DN; H.A. Kauper, Chief Engineer, Central Broadcasters Ltd; F.A. Pennington, Chairman, South Australian Radio Dealers Association; E. Senior, Programme Director, Station 5DN; R.H. Wallman, Chairman of Directors, Central Broadcasters Ltd and A.G. Waterhouse, President, Australian Listeners League (South Australian Division).

Mr. A.L. Brown gave a detailed account of the history of Central Broadcasters Ltd and its negotiations with Amalgamated Wireless (Aust) Ltd for transmitting equipment. He expressed concern about the high royalty charges and urged the Commission to recommend relief from AWA's royalty charges which amounted to 20 per cent of the gross receipts of the company.

The Manager of Sport Radio Broadcasting Company, Mr. C.R. Brown told the Commission that broadcast transmitters should be located 10 miles (16 km) from the city. He also said that interference from howling receivers was a problem and regenerative type sets should be banned.

The representative of the Wireless Institute, Mr. A.A. Cotton, asked that Amateurs be allocated specified wave bands which would not interfere with other stations. He also requested that Amateurs be permitted to use 500 watts and to broadcast on the same wavelength as broadcast stations when the latter were not operating.

Mr. F.A. Pennington speaking on behalf of the Radio Dealers Association suggested that all A Class stations should be widely separated in wavelength and that the operation of receivers be kept simple so that any listener could tune in a station easily. He was critical of the licensing system, pointing out that dealers were required to take out a £5 licence to operate a set at their usual business address and a £5 licence for each traveller who might be sent to the country. He considered the one licence should cover all direct employees of the business. Another matter he raised was the restrictions placed on the demonstration of receivers for sale. The Association considered that leaving a set in the home of a prospective buyer which was the most effective way of

securing a sale, should not be an act of grace but a right enjoyed by the trader under the law. A further handicap to wireless was that a listening-in licence applied to a particular place and should the licensee wish to take the set with him on a holiday trip or to a friends home he had to obtain a permit. He felt that there should be no more difficulty in moving a wireless set than in moving any other personal possession.

The Managing Director of The News told the Commission that his company was concerned with the way stations obtained their news items. He said some broadcast stations stole the news collected at great cost by the newspapers.

On the matter of broadcasting and relay stations, the Commissioner after hearing all the evidence came to the conclusion that very little change to the system in existence was desirable. The stations had to pioneer the development of radio as applied to entertainment and the transmission of popular programmes of music and other items, and in nearly every case the stations had carried on their operations at a loss. It appeared to the Commission that Central Broadcasters Ltd (5CL) operations would eventually result in a profit but not sufficient to reimburse the accumulated losses during the term of the licence held. The station was employing a staff of 13 and the cost of operation was about £70 per week.

The evidence disclosed that a large proportion of listeners-in were enjoying the advantage of wireless by means of crystal sets. Another large section utilized cheap type tube sets. The range of reception in those cases was necessarily limited and the larger broadcasting stations, recognising that many persons in the country would be induced to take out listening licences if the cheaper type of receiving set would enable them to enjoy the advantage of broadcasting, were considering the estabishment of relay or regional stations in the vicinity of some of the more densely populated country centres. Much evidence was submitted dealing with the relative merits of high power metropolitan stations as against relay or regional stations but the evidence established that the former would not enable many country listeners to utilize crystal receivers.

At the time the Commission heard evidence there were 40 licensed radio dealers in the State out of a total of 2797 throughout Australia. Evidence put before the Commission suggested that a number of dealers had no knowledge of the technical side of radio and the legitimate dealer complained of competition with the backyard dealer. Suggestions had been made that dealers should pass an examination to qualify for a licence and that they should only be permitted to sell sets which had been stamped with the approval of some central authority. However, the Commission was of the opinion that the more healthy competition and the greater freedom permitted in competition, the better it would be for the public.

From the commencement of inquiries, the Commission found that the demands by Amalgamated Wireless (Aust). Ltd for Patent Royalties both on broadcasting stations and radio traders were a constant subject of discussion. The evidence disclosed that the operations of the company extended over every field of radio and created considerable friction and dissatisfaction. The company had become legally entitled to a large number of patents and it had been claimed that no tube receiving set could be manufactured without utilizing one or more of the company's patents and likewise no broadcast transmitting station could be lawfully operated without a licence from the company. The Commission further observed that even in cases where AWA had sold and erected transmitting stations to broadcasting companies, the contract insisted upon by AWA included an obligation on the part of the broadcasting company to pay royalties on patents employed in the equipment sold and erected by AWA. The royalty demanded by AWA from A Class broadcasting stations was 5/- for every listeners licence amounting to 20 per cent of the stations gross revenue from licence fess. The Commission considered the royalty demanded was entirely out of proportion to the

capital cost of the equipment in respect of which it was demanded. In the case of 5CL the price of the plant supplied by AWA was £7240 and the royalties demanded or paid during 1926 amounted to a staggering £4025.

The Commission presented its report to the Government on 14th July 1927 and one result was a new arrangement with AWA under which the broadcasting companies and the traders were not required to pay anything to AWA — at all events for a period of five years — but the company was to receive 3/- per annum from each listener's licence fee.

On 26th July 1928 the Government took the first steps towards the inauguration of the National Broadcasting Service when it gave notice of its intention to acquire the A Class stations. The general question of broadcasting services had received close consideration by the Government following the Report of the Commission and it was decided to make a change whereby the Government itself would own and operate the stations and arrange under contract for the supply of the programmes. At the same time an Advisory Committee on Broadcasting was appointed for the purpose of advising the Postmaster-General on matters relating to broadcasting.

After several meetings of the Committee which comprised Mr. H.P. Brown (Chairman), Professor J.P.V. Madsen, the Honourable R.B. Orchard and Messrs J.H. Hammond and W.H. Swanton, the Government approved of a detailed broadcasting policy which included:

(a) The control of all broadcasting activities by the Postmaster-General's Department.
(b) The Postmaster-General Department being responsible for the installation, operation and maintenance of the complete technical services comprised in the national broadcasting system.
(c) The invitation of tenders for the supply of broadcast programmes by a contracting company.
(d) The licensing of a number of B Class stations to be owned and operated by private enterprise.

It was also decided that the national service should be inaugurated in each State on the expiry of the licences held by the private companies which previously supplied the main service known as A Class services.

A contract for the supply of the programme services was let to the Australian Broadcasting Company Ltd. The company commenced operations on 16th July 1929.

The introduction of the national service in the various States commenced on the day following the date of expiration of the licences. The first station taken over was 2FC Sydney on 17th July 1929. The Adelaide station 5CL was taken over on 14th January 1930.

In 1932 a further major change was effected in the broadcasting arrangements when the Australian Broadcasting Commission was brought into being to replace the Australian Broadcasting Company. The arrangements regarding the B Class stations were continued. When the A.B.C. took over on 1st July there were 12 National and 43 B Class stations in operation throughout Australia giving service to 370,000 licensed listeners.

By that stage there were three B Class or Commercial Stations as they are now known, in operation in South Australia. In addition to 5DN there was 5KA which commenced in 1927 and 5AD which was commissioned in 1930. The first broadcasting station to be established in the country area was 5PI. Service commenced on 7th January 1932 with a low power transmitter in Ellen Street, Port Pirie. Two years later it was relocated at Crystal Brook with increased power. The next country station was 5CK Crystal Brook on 15th March 1932, the first Regional station of the National Broadcasting Service. A transmitter rated at 7500 watts was used. It was the most powerful transmitter in South Australia at the time. Programme was fed over land line

from Adelaide. An alternative National station for the Metropolitan area, 5AN, was established on 15th October 1937.

Four country commercial stations then followed. The Murray Bridge station 5MU was opened on 16th September 1934 followed by 5RM near Berri on 30th September 1936, 5SE Mt. Gambier on 3rd July 1937 and 5AU Port Augusta on 25th May 1938. No further country commercial stations have been commissioned since in this State.

Expansion of the National Regional broadcasting network commenced in 1950 with the commissioning of 5LN Port Lincoln. This was followed by 5WM Woomera, 5MG Mt. Gambier, 5PA Penola, 5MV Berri, 5LC Leigh Creek and the latest, 5SY Streaky Bay on 31st May 1972.

The general plan of broadcasting has not been disturbed since the formation of the National Service except that in 1964 the ABC took over the technical facilities associated with studios. After 50 years of broadcasting the Australian public was being served by 84 National and 118 Commercial stations. The number of exclusive broadcast listeners licences at June 1973 was 321,040 and the number of combined broadcast listeners and television viewers licences was 2,493,429. The licensing system was abandoned in 1974.

In its comparatively short history of half a century, broadcasting has progressed from the position of a novel source of entertainment to the status of an essential public service. Its influence on the lives of the people is now so far reaching that its control has become a problem of major national importance.

The National Metropolitan Services

The beginning of the present day metropolitan service of the National Broadcasting Service can be traced back to the South Australian Radio Company which early in 1924 was operating an experimental transmitting station with call sign 5AB. Prolonged equipment tests were generally carried out every night and at least three nights a week a programme was broadcast. The wavelength was 340 metres and the power varied with the particular test being carried out.

The first major broadcast by the Company was on 5th April 1924 when the State election results were broadcast. An experimental transmitter of 20 watts input which had previously been located in Pulteney Street was hurriedly removed to Salisbury Chambers, King William Street where an antenna and counterpoise were temporarily erected.

The Manager, Mr. W.C. Smallacombe, announced the election results as they came to hand. One of the receivers in the metropolitan area was located in the office of the "Country News" in the Theatre Royal Building, Hindley Street where a crowd estimated at between 4000 and 5000 listened to the broadcast. Musical items were broadcast in between the announcements. Mr. A.S. Harris, a member of the Company, also listened in at his home in Bute. Reception was reported from many other country areas including Mount Gambier.

The business of the South Australian Radio Company was at the time being conducted in Salisbury Chambers but the firm had taken a seven years lease of a building in King William Street next to Kither's Building with plans to transfer the radio sales activities to the new building and to use the Salisbury Chambers premises as a studio for transmission of entertainment and news.

In June the company announced that it intended to make an immediate start in erecting a large broadcasting station. Although Regulations concerning the establishment of broadcasting stations were under review at the time by the Government the company considered that any changes would be unlikely to seriously modify its plans. They planned a 5 kilowatt station with programmes on the approved

continental and American lines covering bedtime stories, news bulletins and vocal and instrumental concerts. They also proposed to encourage local artists and as proof, had already started this when on 15th June they broadcast excerpts from locally produced plays and musicals.

An announcement by Mr. Smallacombe in June indicated that the Company expected to have a 500 watt station operating in Adelaide within six weeks and the complete high power station in full working order before Christmas 1924.

The press announced in August that the Company had been granted a licence to operate an A Class broadcasting station in South Australia and was losing no time erecting the necessary equipment. There was however no official confirmation that an A Class licence had been granted. A transmitter was being installed in the Grosvenor Hotel, North Terrace and workmen were busy during the month hauling up timber for temporary masts to be erected on the flat roof of the hotel. Erection of the wooden masts which were some 20 metres high commenced on 13th August. The antenna consisted of two sets of six copper wires in cage form using cane hoops. A counterpoise was also erected. A temporary 100 watt transmitter was installed with the intention of getting on the air as soon as possible pending delivery of the 500 watt transmitter.

Mr. H.M. Anders was head of the company's technical staff and Mr. Ern Gunner was in charge of the station. Prior to transferring to the company Mr. Gunner worked with Newton, McLaren Ltd. where he was engaged in the design of the Bedford Park transmitter. Before coming to Australia he worked with the British Broadcasting Company.

In September the Company registered as the South Australian Broadcasting and Radio Company limited, King William Street, with a nominal capital of £100,000. The provisional Directors were Messrs. J.G. Arnold, A.S. Harris and M.E.A. Scott. Mr. A.R. Campbell was Secretary (pro tem). In a prospectus dated 21st August 1924 it was set out that the company was being formed to purchase as going concerns the business and assets and the liabilities of the South Australian Radio Company and the South Australian Broadcasting Company together with the leasehold premises at King William Street and the depot near Pulteney Street and for that purpose to adopt a certain memorandum of agreement made and executed on the 18th of August 1924 between the South Australian Radio Company and South Australian Broadcasting Company (as vendors) and the Trustee of the proposed Company.

It was also stated that arrangements had been made for the installation by the South Australian Radio Co. of a 5000 watt broadcasting transmitter and pending the completion of the large transmitter, a 500 watt transmitter had been obtained and was being installed on the garden roof of the Grosvenor Hotel.

The inaugural transmissions on 100 watts input gave reasonable signal strength but trouble was experienced with the modulating arrangements. The level of modulation was low and there was a high degree of distortion. The daily programme advertised on 1st October showed broadcast times as 12.15 p.m. to 1.45 p.m., orchestral music; 2.30 p.m. to 4.30 p.m., instrumental, pianoforte and vocal items; 7 p.m., fairy tales for the little folk; 7.40 p.m. to 7.55 p.m., Dalgety's market reports and 8 p.m. to 10 p.m., concert. There were only a few listeners and as the operating costs were high and no revenue was forthcoming, the station was closed down in October.

Late in October the registration of a new company, the South Australian Broadcasting Company Ltd was announced with a capital of £30,000 to carry on a broadcast service only. The original subscribers were Messrs. A.E.J. Smythe, A. Hyde, A.S. Harris, J.T. Timms and W.C. Smallacombe.

Plans included the erection by Amalgamated Wireless (Aust) Ltd. of a 5000 watt station within 8 weeks with AWA manning the station with its own technical staff and the S.A. Broadcasting Co. Ltd. providing the programmes.

Any hope that the South Australian Broadcasting Company had of establishing a broadcasting station was soon shattered by the announcement that liquidation was proposed and that the affairs of the company were to be wound up.

From the ashes rose Central Broadcasters Ltd. which was registered on 4th November 1924 and another move was set in motion to establish a high power broadcasting station in South Australia. The board of the new company included Messrs. Harris, Timms, Smythe, Campbell and Smallacombe.

The company decided to build its own studio and transmitter and erect them on the Grosvenor Hotel, the site of the earlier 5AB installation. The services of Mr. A. Hopton an experienced radio engineer from Melbourne were engaged and with the assistance of Messrs Ern Gunner, Don Gooding and Ted Ashwin the transmitter was assembled in the company's workshop in Pulteney Street in a very short time. Assembly took two days and installation another day. Tests were successful and at 8.00 p.m. on 20th November 1924 the first programme was broadcast. Mr. Gooding who possessed a First Class Operator's Certificate was in charge of technical operations.

The transmitter input power was about 175 watts and it operated under permit pending the issue of a licence if the low power service proved to be satisfactory. The transmitting wavelength was 420 metres and it operated under call sign 5AB, although the company was reluctant to use this call sign. They requested the use of 5CB as being more identifiable with Central Broadcasters but this call sign was already in use by Newton, McLaren Ltd for test purposes. On 22nd November call sign 5CL was allocated and this satisfied the company as it was at least a combination identifiable with the full title of Central Broadcasters Ltd.

The director of the first programme which was a concert was Mr. L. Hopf assisted by Mr. L.L. Griffiths and Mr. Smallacombe as announcer. Songs rendered by Mr. J.L. Davey were "The Blind Ploughman" and "The Three Fishers" and by Mr. G. Meyers, "Less than the Dust" and "Harlequin". Violin duets were played by Miss M. Lynch and Mr. C. Tonkin with Miss A. Lynch at the piano. Mr. Harvey contributed piano solos.

For the first week programmes were broadcast from 3 to 4 p.m. and 7.30 p.m. to 10 p.m. week days, giving a total of 22-1/2 hours for the week. The following week, transmissions for Saturday were introduced and on 27th December a Sunday programme was broadcast. From the New Year the programme hours were 11 a.m. — 12 Noon, 3 p.m. — 4 p.m., 7.30 p.m. — 10 p.m. Sundays and week days, and 3 p.m. — 4 p.m. and 7.30 p.m. — 10 p.m. on Saturdays.

The transmitter employed two 250 watt Marconi tubes, the plate supply of which was provided by a 400 watt generator. The filaments were powered from two 12 volt batteries. The generator output voltage was 1800 volts under normal operating conditions with facilities being available to vary the voltage between 400 to 2000 volts if necessary. The equipment was mounted on a bakelite panel fixed to an iron frame. The two Marconi tubes were mounted on the front of the panel together with antenna meter, oscillator plate meter, filament voltmeter and modulator plate meter. Filament switches and thermostats were also fixed to the panel. The antenna helix and grid exciter coils were mounted on stand-off insulators on the top of the panel. The transmitter employed the choke control system of modulation.

The speech input equipment was also fixed to a bakelite panel but on an adjacent rack. It was a four tube amplifier unit using tubes in push pull. The tubes employed were a Radiotron 201A, two AP double element tubes and a five watt Radiotron. A loudspeaker usually mounted on the floor was connected to the amplifier via a switch for testing and tuning purposes.

The antenna was a three wire flat top type suspended between two masts, one 23 metres high and the other 20 metres high. The strain insulators were 75 cms long fitted

with anticorona rings to handle high voltages at the ends of the wires. The spreaders were over 4 metres long. The system included a counterpoise of eight wires spread out on a wooden framework. Antenna current was 4 amps.

The studio was draped with heavy baize and was located about 15 metres away from the control room. The microphone was mounted on a tripod and was provided with an auxiliary circuit in the switch lead to light a red lamp outside the door when the microphone was in use. In addition to the technical equipment, the studio contained a Salonola gramophone, a Stentaphone complete with motor and compressor and a Hobart M. Cable reproducing piano.

The slow progress in establishing a high power A Class station in Adelaide was causing much concern among the dealers who estimated they had £50,000 of equipment on their shelves. A deputation waited on the Deputy Postmaster-General to see if something could be done. The deputation comprised Messrs Miller (Edison-Swan), J.P. Hale (Newton, McLaren Ltd), L.A. Harper (Wireless Supplies Depot) and W.R. West (Adelaide Radio Co) and represented the South Australian Radio Dealers Association. The Deputy Postmaster-General forwarded their views to headquarters for consideration.

Meanwhile, 5CL was experimenting and introducing new programmes to build up the number of listeners. On New Year's Eve an outside broadcast was broadcast from King William Street in front of the Town Hall to bring to listeners all the noises which go to make up New Year's Eve in Adelaide. A great deal of experimentation went into the determination of the best positions for the microphones to broadcast the Lord Mayor's speech, the chimes of the Post Office clock and the band. A line was provided by the Post Office between the Town Hall and the Grosvenor Hotel and a two tube amplifier installed at the Town Hall. This was the first time such a feat had been attempted by 5CL and quickly led to regular outside broadcasts from racecourses and churches.

The company was granted an A Class licence on 14th January 1925 and it lost no time in making arrangements to speed up the installation of a 5000 watt transmitter. It also published a prospectus for the issue of 20000 ordinary shares of £1 each and appointed Messrs J. Jensen of South Melbourne, R.F. Gardiner of Sydney, A.L. Brown of Victoria, R.H. Wallman of Adelaide and A.R. Campbell of Adelaide to the directorate. Mr. Jensen was Chairman of Directors and Mr. Brown was Managing Director. The registered office was in Willcox Building, Waymouth Street. The company stated that negotiations for the equipment for the 5000 watt broadcasting station led to an agreement between the company and Associated Radio Company for the supply of (a) 5000 watt broadcast transmitter including electric machines, receiver and accessory apparatus, (b) antenna and earth material, including insulators, spreaders, halyards etc (c) one complete set of sound collecting equipment comprising amplifier, microphone and batteries and (d) one small set of sound collecting equipment to be used in conjunction with the larger set. The total price was £7,940. In addition, it had been arranged for Associated Radio to supply masts etc. and to do the work of erecting the station and installing the apparatus in working order under the superintendence of skilled Engineers. The total cost of this aspect of the work was estimated to be £4,000 so that the total cost of providing the technical plant was to cost the company nearly £12,000.

According to figures supplied by the prospectus, the estimated revenue from 1st July 1925 to 30th June 1926 from licences and other sources was expected to be £16,150 while expenditure was estimated to be about £12,000. Expenditure on the technical facilities was estimated to be £2,930 for Royalty to AWA (Ltd), £780 for plant maintenance, £1,446 for engineering and studio staff and £100 for rental of landlines.

The Postmaster-General stipulated that the 5000 watt transmitter had to be on the air by 20th May 1925. The company foresaw no problems in meeting the date as the supplier had guaranteed to have the transmitter ready in good time. The main task was

to secure a suitable site for the transmitter and to erect the antenna and buildings. One of the early areas examined was in the Morphetville district where moist soil would ensure a good earth system and a paved road passed the site. The site finally chosen was 3 hectares in Lipsitt Street, Brooklyn Park, near the present Adelaide Airport.

The wavelength of the station was changed to 375 meters as from 19th January 1925 but while the Brooklyn Park activities were progressing the company was having some problems with the transmitter at the Grosvenor. Early in February the armature of the generator burnt out and put the station off air for two days. Many listeners were very annoyed. It occurred during the first day's play of the fourth cricket test. One of the great advantages of the broadcasting service was the direct descriptions of test cricket and this had resulted in the build up of a large audience. The breakdown also caused the postponement of the Governor's address in connection with the inauguration of the weekly Boy Scouts talk. The generator was dismantled and taken to the workshops of Newton, McLaren Ltd. for repair.

By the end of February there was not much evidence of substantial progress at Brooklyn Park and many shareholders and listeners began to ask questions. They wanted to know what steps were being taken to expedite the erection of the building to house the transmitter and the erection of the antenna mast. It was less than 12 weeks before the deadline set by the Postmaster-General for commissioning of the station. Apparently the expected financial support from South Australians was very slow in forthcoming. However, at the end of March the company announced that it had placed the first 5000 shares and it was confident of the success of the flotation. Further applications were being received and over 10,000 taken up. This meant that the company was in a position to take positive steps with regard to the installation of the high power transmitter.

Although there may have been a fair amount of criticism concerning slow progress on the installation of the 5000 watt transmitter the low power station operators at the Grosvenor were being congratulated on the greatly improved programmes and long distance transmissions. A new double button Kellogg microphone resulted in a great improvement in quality. Listeners commented that the "tinniness" noticeable in previous transmissions had been overcome by the new microphone and a mellowness obtained equal to the best Interstate stations. Reports from listeners as far away as Innisfail in North Queensland, Christchurch in New Zealand, Launceston in Tasmania were high in their praise. A letter from the Secretary of the Launceston Branch of the Wireless Institute was typical. He said "It is just marvellous how clearly you come through and I am a good few hundred miles away from you in Launceston. I listen to all the stations in Australia and New Zealand and you come in the best. You are quite as loud as 3LO and much clearer. The cornetist who occasionally gives us items (Mr. Herbert G. Boyce) is the best we have heard on the air. You can hear him on the loud speaker 100 yards away. I am using a four tube set".

A typical programme published during the period indicated the following items:

Monday to Thursday

10.30 Pianoforte Selections.
11.00 News Service
12.00 Pianoforte.
12.15 Cables and General Information.
12.30 Studio Orchestra.
1.00 Stock Exchange, Market and Weather Reports, Orchestra until 1.30.

Afternoon

3.00 Pianoforte and Gramophone.
3.30 Stock Exchange and Market Reports,
Official Weather Observations and Forecast,
Pianoforte until 4.00.
4.30 News Bulletin.

Evening

7.00 Bedtime Stories for Children.
7.50 Stock Exchange Reports, Market and
Weather, General Information and announcements
re Programme.
8.05 Concert Items.
9.05 Official Weather Observations and Forecast.
10.00 News Service.
Close down.

Fridays

The Orchestra commences playing at 12.00 until 1.00.
Community singing from the Town Hall between 1 and 1.50 p.m.

Saturdays

The Morning News is given at 10.45. The Orchestra plays between 11.00 and 12.00 noon. Cable Service follows.

Sundays

4.00 Weekly — Bible Study talk for young folks,
and Solos — Conducted by Rev. W. Keith Steward.
6.45 Divine Service.
8.45 Studio Concert.

The technical staff in charge of operations at the time were still Messrs Gunner, Gooding and Ashwin. Their job of maintaining these high quality transmissions was not an easy one however, because the high tension generator continued to give trouble. It failed for the second time early in April and repair work took seven days. A small generator was obtained on loan from the Bedford Park Sanatorium experimental station and service was maintained on reduced power.

Meanwhile tenders had been called for the supply of the lattice steel mast. Many offers were received including four from local South Australian groups. A contract was placed with Johns and Waygood Ltd. of Victoria for the work. By the middle of May fabrication of steelwork in the Contractors factory had been almost completed.

The foundations for the building were put down in mid May and the building was ready for occupancy by the end of June. It was constructed of wood and fibrous cement sheets battened, cavity filled with sawdust and put on concrete foundations about 60 cm high. The floor was of concrete and roof of Marseilles tiles. Extensions were added over the years and by 1929 it comprised an apparatus room, a workshop and store and a caretakers room and a tiled awning was added all round.

The mast anchor blocks were put down during June and the mast sections arrived at Port Adelaide during the first week of July. The transmitter was undergoing factory tests in Sydney during July and was expected to be shipped by the end of the month. Meanwhile the wavelength of the Grosvenor transmitter was changed to 395 metres — the wavelength allocated for the new transmitter. This was effected in June.

The 62 metre high mast was lifted into position late in the afternoon of 5th August. A pole fixed to the top to carry the 5CL pennant gave it an overall height above ground of about 70 metres. The triangular structure with 120 cm sides was raised by using the falling jury method employing a 20 metre wooden jury pole fabricated from massive wooden planks bolted together. The top of the jury pole was guyed by strong steel cables to four points along the mast. By means of a tackle hitched to the top of the jury mast and hand operated winch, the jury pole was slowly pulled to ground level causing the main mast to assume an upright position. A large bolt through the bottom allowed the structure to pivot. Six men were on the handles of the winch. The dead weight of the mast was about 9 tonnes. The operations were directed by Mr. Donald MacDonald of the Associated Radio Co. of Australia who came from Melbourne to supervise the work. Mr. Jack Davies was the works Foreman. Spectators on site included Messrs H.W. Harrington (Radio Inspector) H.R. Syme, A.R. Campbell (Secretary of Central Broadcasters Ltd) Mr. D.C. Cameron, Mr. R.H. Wallman (Director) and Mr. W.C. Smallacombe (Announcer).

The mast created an impressive sight and was a landmark which could be seen from a great distance. It attracted thousands of visitors from all over Adelaide. On the Sunday following the erection the roads were blocked with motor cars and sight-seers. Workmen who climbed to the top reported that traffic could be easily seen moving along King William Street with the Victoria Park racecourse also being visible.

The antenna system included a ground mat of No. 14 hard drawn copper wires buried about 20 cm below the surface and covering almost the whole of the property. More than 2000 soldered joints were made at crossover points and at joints. The total length of wire was several kilometres. The antenna proper was a cage about 25 metres long using 150 cm diameter spreaders of copper tubing. It was supported at one end from the top of the steel mast and at the other by 13 metre steel strain poles. Large strain insulators with corona rings were fitted at the ends to handle the high voltages. From one end a four wire sausage type lead-in of phosphore bronze wires some 50 metres long connected to the transmitter via a porcelain lead-in insulator. The mast was erected on leased land but the building was on company owned land.

The greater part of the transmitter was despatched from Sydney on 18th August and Mr. Joe Reed, Engineer, from AWA's works arrived in Adelaide on the same day to supervise its installation and testing. Installations work progressed rapidly and the first long speech test was conducted on 8th September. The test transmissions were carried out using call sign 5MI on 415 metres. Interstate reports soon came in reporting high volume and good modulation. Reports come in from Queensland, North West of Western Australia and a press cable from New Zealand saying the programmes had been picked up there much louder than any other Australian station.

Each test showed a progressive improvement and the company closed down the installation at the Grosvenor on 15th September and switched to the 5000 watt Brooklyn Park transmitter. During the testing period, transmissions from the Grosvenor filled in during the time when the Brooklyn Park transmitter was closed down for adjustment or was off air due to fault condition.

The total power consumed by the transmitter including modulators, master oscillators, speech amplifier and machines was of the order of 15 kilowatts. It had a power rating of 5 kilowatts calculated in accordance with the Regulations at the time. The transmitter consisted of six units viz

(a) Three phase rectifier for high tension supply.
(b) Power amplifier and modulator.
(c) Submodulator and line amplifier.
(d) Master oscillator.
(e) Closed circuit inductance and condenser.
(f) Antenna circuit inductance.

Power for operation of the transmitter was obtained direct from the three phase public supply. The filaments were energised by means of step down transformers connected to 240 volts. To even up the load the power for the filaments of various units was drawn from separate phases. Variable control of the secondary output was obtained by means of auto transformers fitted with coarse and fine adjustments to allow for accurate setting of the terminal voltage for the filaments.

The high tension supply was obtained from a rectifier employing six MR7 tubes so connected as to "double wave rectify" the three phase supply which was stepped up in voltage to 12000 volts with 415 volt primary and two 12000 volt secondary windings. The output from the tubes was passed through a filter system consisting of eight mica condensers and a large choke. After being smoothed separate supplies were taken to the main oscillator, master oscillator and sub-modulator. The former supply was passed through a large choke which enabled the modulator tubes to control the supply to the oscillators in accordance with the speech and music frequencies.

The programme from the studio was fed to an amplifier with two DE5 tubes. The output of the unit was designed to normally feed into a submodulator but this circuit was not wired in initially at Brooklyn Park.

The master oscillator which except for its plate supply was a self-contained radio frequency generator. It consisted of two MT7A tubes in parallel, with associated filament transformers, meters, condensers, and tuning inductances. Its function was to generate the exciting energy for the main oscillators. It was connected by means of a coupling coil to the grids of three MT7A oscillator tubes in parallel. On the panel were mounted four Weston meters indicating the filament voltage, radio frequency current, plate current and oscillator grid current.

The main oscillator and modulator panel contained three MT7A tubes and five MT7B tubes as oscillators and modulators respectively. In addition, there were transformers and controls for regulating the voltages to the rectifier filament and plate transformers. Meters indicating the conditions in various parts of the circuit were located in the front of the panel. The tubes and associated apparatus such as feed condensers and grid resistances were mounted at the back.

The closed circuit radio frequency inductances and power condenser were mounted on a square table. The items comprised tuning inductances viz main inductance, variometer and antenna coupling inductance and in a space below the inductance was the closed circuit power condenser with its radio frequency meter on the front panel. The antenna inductance was mounted on a similar table with its ammeter matching the one on the closed circuit panel.

In October the company finalised furnishing of a new studio for 5CL at 59 Franklin Street. The site, a two storey building was close to the Post Office with the studio being on the second floor. At the time, the transmitter was still under the control of AWA but preparations were being made to hand it over to Central Broadcasters Ltd technical staff.

Unfortunately the station did not come up to expectations as far as the Adelaide listeners were concerned. The extraordinary claims reported in the press just before the station commenced transmission on high power came to almost nothing. A few months before the new transmitter came on air the Engineer in charge of the work was reported as saying that 5CL would be "easily heard in London and America". A few days before the great day a second spokesman was reported as sayin that if the full 5 kilowatts was modulated, "Berlin would be ringing up to know where the earthquake was down South". Another agreed that, "if all the available power was modulated the inhabitants, if any, of the North Pole could listen in comfortably every night".

Although mail bags of letters were coming in from all States and New Zealand complimenting 5CL on its transmissions, only very few were received from within the State. In fact, most of those from local listeners were complaints about the service

rather than praise. People within about 40 km claimed the transmission to be erratic. One listener said "for several nights it is perfect, then apparently for no reason we are treated to a night of mush. It is painful to allow the loud speaker to remain connected let alone keep the phones over the ears". It was suggested that the operators were chasing range instead of studying the interests of local crystal and one tube set owners who could not get distance and were compelled to listen to 5CL.

It was some months before the technical staff overcame a lot of the teething problems associated with the new transmitter. In fact, the power was not raised permanently to 5 kilowatts until the 18th January 1926. From then the reliability improved considerably. For emergency purposes the old transmitter used at the Grosvenor was overhauled by Ted Ashwin and installed at Brooklyn Park. The final work associated with the winding-up of the Grosvenor installation was the removal of the wooden masts and antenna. They were dismantled during the first week of May by members of the South Australian Railways Radio Club and taken to Murray Bridge.

The Management of the company was determined to improve the technical standards of the station to the highest possible level and on 7th June 1926 appointed Mr. Harry Kauper to the position of Chief Engineer.

At the beginning of the winter of 1926 some problems were experienced with rain water entering the Brooklyn Park building and affecting the operation of the transmitter. It resulted in two fire outbreaks — one on 24th April and the other on 30th April. The terminal strips and components were often wet. The water entry was worst on the southern and western sides with the water coming in through the sawdust packing between the asbestos inner and outer walls. The inside asbestos sheeting was also wet in many places after a heavy down pour and a lot of temporary repair work was necessary to correct the situation.

The report and statement of accounts presented to shareholders by the company in July showed that a profit of £580 was made during the half year from November 1925 to April 1926 after making provision for royalty payments and allowance for depreciation. The report stated that the policy of the board was to make 5CL the best and most popular station in Australia, in pursuance of which better programmes had been broadcast and as a result not only had the number of receiving licences increased but renewals were being freely taken out. There were then 13,000 licences in South Australia. The company was reaping the benefit of extra expenditure on programmes and the board was determined that a high standard of service should be maintained. The staff had been augmented to cope with the increased demands of service. Messrs. J. Jensen and R.F. Gardner resigned from the board following the transfer of the interests of Associated Radio Company of Melbourne from the company. The casual vacancies were filled by Messrs Lavington Bonython and R.J. Rudall. The statement of accounts showed that the licence fees and advertising revenue less provision for royalties totalled £6,867. The chief items of expenditure included £2,347 for salaries, wages and payments to artists, £2,350 for plant maintenance and depreciation, £2,350 for electricity charges and £123 for telephone and land line costs.

It became necessary to provide an improved electrical switchboard and in August 1926 Newton, McLaren Ltd manufactured and installed a new board. It was a multi circuit three phase board made of a thick slate panel supported on an iron framework. It was fitted with recording meters (AES.Co), fuses, switches, circuit breakers and other miscellaneous components.

In November some of the original members of the company left to take up positions elsewhere, Mr. A.R. Campbell transferred to the National Musical Federation, Mr. W.C. Smallacombe linked up with Fada and Mr. Ern Gunner of the technical staff also joined Fada. The technical operations at that stage were still under the control of Harry Kauper, Chief Engineer and his assistant Ted Ashwin. On 30th August Mr. W. (Bill) E. Launder-Cridge a former ships radio operator joined the technical staff. The books of

the company showed that the wages being paid at the time to the technical staff were £10 per week to the Chief Engineer, £6.10.0 per week to the Outside Engineer and the 1st Station Engineer, £6 per week to the 2nd Station Engineer, £3 per week to the Senior Control Operator and £1.10.0 per week to the Junior Control Operator. In comparison, Announcers were paid £12 a week.

Major modifications were carried out on the transmitter during 1927. By August the high power stage had been completely remodelled by the installation of W.E. 4220B water cooled tubes, the submodulator was remodelled and a superior neutralization system installed to improve stability. The wavelength was also changed during the year because of heterodyne problems with the Queensland station 4QG. The water cooling system for the tubes consisted of three 1600 litre round corrugated iron tanks on insulated wooden stands, three ply rubber hoses, a 500 watt three phase motor coupled to a centrifugal pump of 54 litres per minute capacity, two water jackets with insulators, a thermostat and a thermometer. Other mechanical and electrical equipment introduced during the remodelling stage included a 1000 volt a.c. 200 watt generator driven by a 200 volt single phase motor. A 24 volt 130 amp. d.c. generator driven by a three phase motor was added later.

Some of the other important technical activities during the year included the relay during Good Friday morning of the programme of the Dutch station PCJJ in Eindhoven, Holland. The reception was carried out in the suburbs by means of a specially arranged superheterodyne receiver attached to a short antenna. The speech was clear and the musical items had very little distortion considering the long path over which the signals travelled and the facilities available. Shortly after, a second relay of importance was carried out. It was on the occasion of the arrival of the Duke and Duchess of York in Melbourne. The arrival was broadcast by 3LO but because the signal strength in Adelaide was very poor during daylight hours when the broadcast was made, signals were picked up at Mt. Gambier on a five tube Atwater Kent receiver and then sent over land line to Adelaide. On 9th May the Post Office relayed to all A Class stations in the Eastern States and South Australia the opening of Federal Parliament in Canberra by the Duke of York. The ceremony occupied one and a half hours and the broadcast was highly praised for its clarity and freedom from interruption. This was the second time 5CL had participated in a large Interstate hook up. The first was in 1925 when the Post Office engineered the first network hook up of six radio stations in four States for a Commonwealth Loan talk by the Secretary to the Treasury.

During the winter the company began broadcasting football but ran into a lot of opposition from the Football League. A similar problem had been encountered when outside broadcasts of racing events were broadcast but these were soon satisfactorily resolved. The announcer, Mr. Smallacombe who had rejoined 5CL, and the technician had to operate under extreme difficulty, often in a hazardous situation in order to view the players. Many broadcasts were conducted from the roofs of houses overlooking the ovals and the League was so incensed that it considered erecting screens. The attitude of the League subsequently changed and they allowed the game to be broadcast from within the grounds.

About this time alterations and improvements were made to the studios and the facilities. One major improvement was the introduction of the latest type of Western Electric condenser microphone. The Manager Mr. A.L. Brown while on a visit to Melbourne heard a demonstration of one of the microphones and was so impressed with its clarity and sensitivity he immediately placed an order for one for 5CL. It was received on 29th May 1928 and its performance was so good that the company ordered two more W.E. Co. types which arrived on 1st July. With the introduction of three Bosch magnetic pickups in June 1927 the studio was able to produce high quality music programmes from both gramophones and local studio concerts.

The studio technical staff was augmented when Mr. J. Ryan was appointed to take charge of land line work. Mr. Ryan had been manager of the engineering department of 3AR Melbourne before his appointment. The additional staff and facilities enabled the programme period to be extended and as from 5th September the station was on air daily until 11.30 p.m. The better studio accommodation also allowed a greater audience to attend the broadcasts of the 5CL Twinkler Boys Club under the control of Mr. Mills. This was a very popular club and had a large membership.

In May 1928, the studio and office building was damaged by fire and plans were prepared for the erection of new studios in Hindmarsh Square. Pending completion of the work, operations were carried out from Brooklyn Park. A feature of the new studios was the special jarrah dancing floor in the main studio designed to enable regular dance nights to be held by 5CL similar to those held by 3LO in Melbourne. After five months the technical staff were well advanced with the control and switching equipment. The company moved into the premises as from 28th October 1928.

The year 1928 also saw considerable publicity being given to the poor service being provided by the broadcasting service to the farmer and other country dwellers in South Australia. The three stations in operation at the time 5CL, 5DN and 5KA were all located in Adelaide. At the beginning of 1928 some 17,000 licences had been issued in the State but only 3,300 were for country listeners. According to population statistics the proportion should have been roughly equal because on a population basis there were about 310,000 people living in the Metropolitan area and about 250,000 living in the country. Many considered that radio was more valuable to the countryman than the city dweller and that relay stations were a must. From an examination of the financial position of 5CL, it is evident that the company could not have been expected to extend its operations to country areas, although it is to their credit that in May 1928 they applied for a licence to operate a shortwave service on 70-80 metres to feed country areas from Brooklyn Park but approval was not given. They had proposed broadcasting 5CL's normal service with a new 5 kilowatt short wave transmitter.

It was about this time that the Government gave notive of its intention to acquire A Class stations in order to set up a National Broadcasting Service which would include the establishment of relay stations in country areas. Central Broadcasters Ltd. ceased broadcasting as from 13th January 1930 with a Dance Session programme. The technical staff included Mr. Harry Kauper, Chief Engineer; Mr. Jack Ryan Outside Broadcast Operator; Mr. Ken Bertram, Apprentice; Mr. Bill Maddocks, Control Operator; Mr. H.W. (Darby) Tostevin, Control Operator; Mr. Don Gooding Station Operator; Mr. Len Porter, Station Operator; Mr. Bill Launder-Cridge, Station Operator and Mr. Tom Welling Station Operator. When the Post Office took control Messrs. Launder-Cridge, Welling, Gooding, Tostevin and Porter transferred over but did not remain for very long. Most left to enter commercial station organisations.

The Post Office took over the responsibility for operation and maintenance of the technical plant on the 14th January while the programmes were provided by Stuart Doyle & Co. for the Australian Broadcasting Company. Staff of the Radio Inspector's office controlled operations until September when responsibility for this work was transferred to the Transmission Section of the Engineering Division with Mr. F.P. (Frank) O'Grady being Divisional Engineer in charge, assisted by Mr. Laurie Billan, Engineer. Mr. O'Grady subsequently became Director-General of the Post Office. Technical staff involved in the early work of the National Broadcasting Service included Messrs. Nelson Stone, Tom Collins, Ted McGrath, Chris Comas, Cec Pike, Brian Blundell, Len Cooper, Bill Whisson, Jim Harris, Bill Miles, Charlie Ancell, Pat Callinan, Bob Hamilton, Jock (Frank) Anders, Claude Mann, Bert Retallack, George May, George Ramsay, Bert Lampe, Alf Johns, Ron Nicholle, Ron Haines, Ted Holton and Al Smythe.

No. 1 studio 5CL Hindmarsh Square, 1931.

The Hindmarsh Square studio complex comprised one large production studio and one common control booth/switchroom. All amplifying equipment was battery operated and the programme level was controlled by a standard potentiometer in the input circuit of the programme amplifier. The level was deemed satisfactory if an occasional flick of the pointer of the meter in the plate circuit of the final audio amplifier could be observed. Faders and volume indicators so common-place today had not then been developed. As from 1st July 1932, the Australian Broadcasting Commission took over responsibility for providing the programmes.

In 1936 Post Office staff installed a replacement transmitter at Brooklyn Park. It was rated at 5 kilowatts antenna power and was operated off the 3 phase 415 volt electric supply mains. Two master oscillators were provided. The main utilising a temperature controlled crystal oven which kept the station frequency accurate to within a few Hertz at a frequency of 730 kHz. A spare master oscillator was provided and by the use of a changeover switch, the output of either oscillator unit could be connected to the grid circuit of the first separator stage of the transmitter.

This stage consisted of push-pull 4242A tubes operating in a class 'A' condition. These drove push-pull 4270 tubes operated as a class 'B' grid modulated amplifier with a plate supply of 3,000 volts. The modulator was a single 4242A tube operated class 'A' and choke capacity coupled to the grid circuit of the modulated amplifier. The output from the modulated amplifier was coupled to the grid circuit of a class 'B' linear power amplifier using 4220C type water cooled triodes. With a plate potential of 11,000 volts these tubes gave a radio frequency output of approximately 5 kW modulated 100%.

The filament supply for all rectifier tubes and the separator stage was by means of transformers stepped down from the 240 volt a.c. mains. The filament supply to the modulated amplifier was employed by means of Scott connected transformers connected to the 415 volt three phase supply. Motor generators supplied the filament current at 21 volts for the water cooled power amplifier tubes. High tension supplies of 1,500, 4,000, and 12,000 volts were all obtained by means of three phase hot cathode mercury vapour rectifiers.

To safeguard the transmitter, it was necessary that circuits be switched on in a definite sequence, and in order to prevent any conditions which would cause damage to any tubes or other equipment a system of time delay, interlocking and overload relays was in use. Before any high tension supplies could be switched on, it was necessary that the water cooling pump be in operation, as water flow contacts and pressure contacts had to be operated before the motor generator set could be excited. After the filament generator was run up to 21 volts and all gate switches closed, bias and high tension supplies could be switched on. Failure of the bias supply would result in contactors falling out and disconnecting all high tension power supplies, thus preventing damage to tubes due to excessive plate currents. To safeguard personnel, gate switches were provided in series with the bias contactor which prevented the application of any high tension voltages, should any gate giving access to the rear of the transmitter be opened. An earthing relay earthed the e.h.t. supply through a resistance when power was switched off so as to discharge all filter condensers.

About 1944 a further major change to the 5CL facilities took place when the mast was raised from its base and mounted on a spider frame supported by three porcelain insulators. It was fed via a 200 ohm open wire six wire transmission line and an inverted L coupling network.

During 1935 the Hindmarsh Square studios were converted to a.c. operation. The prototype equipment included only two vacuum types, the type 77 and the type 89 tubes, both especially designed for low a.c. hum level. The final installation used 6C6 types. Copper oxide rectifier units were also introduced. The equipment was commissioned on 10th July and at the same time facilities were increased to include three studios and a separate switchroom. This was the first studio group in Australia to be operated directly from the a.c. power mains.

During June 1939 on the occasion of the Simpson Desert Expedition broadcasts were made direct from the desert. Colonel Thomas then Manager of the ABC in South Australia made arrangements with the party before they left Adelaide to attempt three broadcasts.

The party carried a Traeger pedal wireless set similar to those provided for operation with the Royal Flying Doctor Service. They arranged for regular schedules to be kept with Harry Ding of VHU9 Yunta who received and transmitted all traffic for the expedition, including reception of the three broadcast programmes and relaying over Post Office lines to the ABC studios in Adelaide. Although Yunta which is on the Broken Hill route was nearly 100 km away the party never failed to make contact.

The pedal wireless was a 7 tube set with types 30, B240 and 33 in the transmitter section and types KL4, KF4, KF3 and KK2 in the receiver. The set was capable of operation off batteries as well as the pedal generator. Batteries were carried on the expedition and lasted through the trip so the pedal generator did not get a great deal of use.

Harry Ding's equipment comprised a crystal controlled three stage transmitter using PC03/3 tube as oscillator, PE 05/15 as buffer and PC 1.5/100 as power amplifier. The suppressor of the power amplifier tube was modulated by an EL5 tube which was preceded by two 6C6 audio stages and a model 707A Shure crystal microphone. The power supply employed a 1450 volt transformer with a single 866 half wave rectifier for the final stage, a pair of 866 rectifiers and 400 volt a side transformer for the crystal

oscillator, buffer and modulator and an 83 rectifier for bias supply. Power input to the final stage was 1100 volts at 99 watts giving a carrier output of about 30 watts. The transmitter was designed and built by Graham Phillips in conjunction with Bland Radio Co. in 1937/38. Two receivers were in use. One was a Bland 7 tube three band battery operated type with band coverage 1000 kHz to 20 MHz and the other was a modified Block and Gerber 11 tube five band a.c. operated type with band coverage 540 kHz to 25 MHz.

The first radio transmission was made from Charlotte Waters near the ruins of the telegraph station. The telescopic antenna support poles were erected in the afternoon and the equipment set up for a tryout when night came. Contact was made with VLU9 without any trouble. The first messages were sent to the ABC and also the Advertiser, to say that the expedition was now at the starting point for the trek across the desert.

Soon after the party set out along the track three tubes burnt out. The set was put in working order again but it required the use of all the spare tubes and an urgent request was sent out for more spares to be flown to Oodnadatta and then railed to Abminga. It delayed the trip three days.

The first broadcast took place under conditions of heavy rain for which the party was not fully prepared. They were 90 km east of Hale and the transmitter was operated in a small shelter with the commentator Mr. Madigan, leader of the expedition, crouched under the tarpaulin with no table, very poor light and notes scribbed with a pencil on a sheet of crumpled paper. Unfortuantely the broadcast was not a success. Signals were too weak and it had to be repeated a few days later.

The second broadcast was scheduled for 21st June and it had been announced in the earlier broadcast that a full blooded aborigine in the party named Andy would be on air. It was not only unique for a full blooded aborigine to broadcast to the people of South Australia but he spoke from the heart of the desert. Andy spoke a few words and sang a corroboree song.

The last broadcast was made from Hay River on 23rd June only 37 km from the Queensland border. Each member of the expedition spoke for a few minutes.

During the war years a standby service of BBC news was provided using AR7 type receivers and rhombic antennas at Brooklyn Park and Mt. Lofty. The service was frequently used and was available at the Hindmarsh Square studios and the Brooklyn Park 5CL emergency studio. Also, during this period additional emergency studios were set up at Prospect and Bowman St. Crystal Brook. Once each week the normal programme was routed through these points as well as the Brooklyn Park emergency studio to test the facilities. Because of the shortage of male staff six female telephonists were employed at the main studios as booth operators.

The Hindmarsh Square studio complex was developed further in subsequent years and on 4th October 1964 the responsibility for the studio technical services was taken over by the Australian Broadcasting Commission. At that stage there were six network studios and four production studios each with individual control booths with facilities involving the use of some 20 amplifiers, in each, a switchroom containing 105 amplifiers and 8000 transistors and diodes used for programme switching, tape recording facilities comprising 12 high quality console recorders and 115 portable recorders and replay machines, together with facilities for handling complex outside broadcast and public address requirements of Royal Tours and Festivals.

The studios were at the time providing continuous programme for over 18 hours per day employing a large technical staff which at June 1964 included: J. Grivell, Officer-in-Charge, Supervising Technicians L.C. Pridham, W.S. Walker, E.F. Furneaux, J.J. Penney, J. Foster, Senior Technicians E.W. Pointon, M.J. Weir, G.D. Mayman, M.J. Daddow, A.A. Grigonis, L.E. Catford, A.J. Love, R.W. Tate, Technicians, C.B. Anderson, H. Bambacas, J.B. Branford, D.K. Briggs, D.R. Briggs, J.E. Davey, K.E.

Fitzgerald, R.H. Gaddes, D.V. Hurley, R.E. Padman, A.W. Parker, G.F. Pointon, K.F. Scott, F. Turnham, M.D. Wilson, R.P. MCullough, R.T. McKinnon, B.A. Richardson, K.W. Roberts, R.J. Chamberlain, A.M. Hartley, S.G. Littlefield, G.W. Luxon, R.F. Robertson, K.W. Sommer, J.M. Yeates, R.G. Askill, J. Newgrain, G.A. Blackstock, I.D. Broadfoot, M.J. Cant, P.B. Harris, R.S. Kelton, L.A. Pearson, V.F. Pirkmaier, G.J. Roberts, J.M. Rounsevell, M.L. Shuttleworth, V. Vanagas and Technicians-in-Training J. King, J. Hodge, A. Dent and G.R. Halprin. Divisional Engineer in charge of the Studios was Brian Perkins, assisted by Frank Mullins, Tom Harrison and Noel Murphy.

Many of the new facilities incorporated in the studios over the years to improve programme presentation and to reduce fault incidence were designed, developed and installed by Post Office engineers and technicians. Some of these developments included the elimination of metallic contact from main programme circuits by the employment of switching transistors, a preset and air control unit for the main network switching system incorporating crossbar switches and silicon controlled rectifiers and a remotely controlled fader using light dependent resistors which could also act as an electronic on-off switch.

The Australian Broadcasting Commission in turn continued to improve facilities but on 13th October 1975 transferred all studio operations to new premises at Collinswood using equipment of the most modern design. Engineers in 1977 responsible for the facilities included John Starr Director Technical Services, Frank Brogan, Staunton McNamara, Peter Gonda, Don Woolford, Ron Ehrke and Grantley Rogers. Senior technical staff in charge of installation and operation activities included John Ward, Charles Muscat, Bill Legg, Dudley Wilkinson, Frank Gill, Bill Walker, Bob Fuller and Trevor Bauer.

Many changes also took place with the transmitting facilities subsequent to the installation of the 5 kilowatt water cooled transmitter for 5CL at Brooklyn Park. On 15th October 1937 a second metropolitan national station was brought into operation with the commissioning of 5AN using a 500 watt transmitter on 890 kHz and self supporting tower on a building in Post Office Place near the G.P.O. The transmitter was of S.T.C. manufacture and was located in an annexe at the Central Telephone Exchange building. It employed 4242A tubes in the modulator, buffer and modulated amplifier stages and two 4279A tubes in the final amplifier. Type 6C6 tubes were employed in the crystal oscillator and two submodulator stages. Rectifier tubes comprised nine 872A and three 83V types. The self supporting insulated tower which was also the radiator was 62 metres high and was located on top of a building which in turn was 24 metres above ground level. A counterpoise system consisted of some 25 radials varying in length from 10 metres to 90 metres extending to adjacent buildings was erected about two metres above the roof of the building. Current at the base was 6.7 amp. The feeder was an 80 ohm concentric type using an outer tube of 25 mm diameter and an inner tube of 6 mm diameter.

The field strength contours of 5AN were greatly modified by the Mt. Lofty Ranges to the south east and east, the Barossa Range to the north east and the long sea paths to the north west and west. The 5mV/m contour roughly followed these ranges from the south round to north east gradually opening out to approximately 40 km on the plains to the north. The 0.5 mV/m contour line had a somewhat similar shape extending to 64 km south and gradually drawing in to approximately 40 km to the east. It then extended gradually out to 70 km north east, 150 km north north east and 200 km north and north west over the flat terrain of those areas.

The installation was transferred to Brooklyn Park on 4th May 1944 and located in a new building erected alongside the 5CL building. At the same time the power of the transmitter was increased to 2000 watts by providing four 4279Z tubes in push-pull

parallel in the power amplifier stage. The tower was re-erected on the eastern side of the building but subsequently shifted to the southern side to make way for an access road to the airport.

In 1948 both 5CL and 5AN antennas were reduced in height from their original 62 metres to 45 metres. To improve the efficiency of the 5CL mast following the decrease in height, a 3 metre diameter armature was fitted to the top together with an eight wire umbrella loading system. An inverted L antenna supported between the top of the mast and a 16 metre pole served as an emergency antenna. In 1949 5CL was provided with a 2000 watt standby transmitter.

From 11th May 1952, the main 5CL transmitter was modified to operate with high level plate modulation. The alterations involved the use of 4220C water cooled tubes as Class C radio frequency stage and Class B modulators in association with a modulation transformer and an inductor. An intermediate radio frequency stage using 4270A tubes and associated 3000 volt high tension unit were eliminated. The transmitter was considerably simplified and the overall power consumption reduced. The frequency response was flat within 1dB from 50 Hz to 10 kHz and the distortion at 96 per cent modulation was of the order of 1.1 per cent, a vast improvement on the previous figures. Most of the equipment had been recovered from 5CK where the water cooled transmitter had been replaced.

The new airport, the rapid growth of housing nearby and the need to replace plant which had reached the end of its economic life led to the decision to establish the station at another site with new equipment. A site of about 24 hectares was purchased at Pimpala to enable the establishment of a metropolitan transmitting centre to accommodate 5CL and 5AN.

Building work commenced on 18th October 1959 and installation of equipment started on 11th August 1960. The equipment comprised one 55 kilowatt main transmitter and one 10 kilowatt unit for standby purposes for 5CL together with one 10 kilowatt main transmitter for 5AN and one 2 kilowatt standby. The 5AN facilities were subsequently upgraded and now both 5CL and 5AN operate with identical facilities. The transmitters operate into a 172 metre high sectionalised dual frequency radiator with a capacity top. The mast was supplied and erected by Electric Power Transmission of Sydney with the erection being completed on 9th May 1961.

The transmitting centre is the largest in South Australia. The design, installation and supervisory staff included Messrs Chris Comas, Frank Mullins, Bill Gold, Don Beames, Aub. Johns, Charlie Thain, Bert Steer and Frank Henschke. The station was officially opened during a broadcast by the Postmaster-General Hon. C.W. Davidson at 6.20 p.m. on 20th September 1961.

The Officer-in-Charge of operations and maintenance on commissioning was Ken Bytheway. He was assisted by Messrs Arthur Bate, Don Taylor, Ian Rankine and Bruce Combe. Subsequent Officers-in-Charge were Messrs Alf Cole, John Schroeder and Dave Carthew. Principal Technical Officer Arthur Capel oversighted operations and standards.

Other technical staff who have worked at the National Metropolitan transmitters at Brooklyn Park or Pimpala include Joe Brady, Charlie Ancell, Les Pridham, Mick Weir, Reg Davies, Andy Comas, Bernie Carr, Ray Chamberlain, Eric Manoel, Laurie Billin, Ted Reilly, Jim Ryan, Alan Channon, Peter Ginnane, Barry Hutton, Bill Edwards, Bill Fisher, Bill Walker, Geoff Williams, Don Holmesby, John Warner, Kevin Newport, Norm Scott, Phil Binns, Alwyn Muggeridge, John Saegenschnitter, Brian Dodgson, Reinhold Ritter, Jim Sinclair, Richard Snow and Martin Morris.

Engineers who have been associated with the operation of the Pimpala transmitting station include Messrs Ted McGrath, Bill Shapley, Brian Hammond, Bruce McGowan, George Wiencke, Janis Ozolins, Ron Falkenberg, Max Chadwick and Mike Mazzei.

The National Regional Services

Station 5CK Crystal Brook was the first Regional station of the National Broadcasting Service and was commissioned on 15th March 1932. It was officially opened at 8 p.m. by the Hon. J.E. Fenton M.H.R., Postmaster-General in a speech from Canberra. Other speakers during the ceremony included the Hon. L. Hill Premier of South Australia, Stuart Doyle of the Australian Broadcasting Company and the Mayors of Crystal Brook, Port Pirie, Laura, Jamestown and Clare. The construction team under the control of Mr. Frank O'Grady included Messrs. Laurie Billin, Bill Whisson, Ted McGrath, Chris Comas, Len Cooper and Jock (Frank) Anders.

The transmitter was manufactured by Standard Telephones and Cables and installed under the supervision of the company Engineers, Messrs McQuillan and Thaw. It was rated by the manufacturer at 7500 watts. The measured input power to the antenna at 635 kHz was approximately 6750 watts. At the time, it was more powerful than the metropolitan station 5CL. The power amplifier employed two water cooled tubes of the WE4220B type supplied with high tension at about 12,000 volts. Filament voltage was 24 volts at 41 amps. The master oscillator — intermediate stage employed four tubes, one 4012A, one 4211E and two 4015A types. The crystal unit was accommodated in a W.E. standard oven with thermostat control set to give an operating temperature of 50°C. The line amplifier and submodulator stages used one 4012A tube and two 4212D tubes in a resistance and transformer coupled circuit. The modulated amplifier employed the Heising method of modulation with two 4212D tubes operating with 14 volts on filaments and 1500 volts high tension.

High tension supply for crystal oscillator, master amplifier, master amplifier buffer was supplied by a 750 volt d.c. generator, the high tension for the modulator, modulated amplifier and sub-modulator by a 1500 volt d.c. generator and the high tension for the first linear amplifier by a 4000 volt generator. The extra high tension was provided by three 4222A half wave rectifier water cooled tubes with transformer secondary voltage in excess of 12000 volts and 22.5 volts at 41 amps on the filaments. Two generators provided filament power. One provided 18 volts at 155 amps while the other gave 26 volts at 100 amps.

Power for operation of the equipment was supplied by the Adelaide Electric Supply Co. at three phase 415 volts 50Hz but a standby engine generator set was installed for emergency situations during line breakdown. The set was a 120 H.P. Gardiner Petrol Engine direct coupled to an 80 kilowatt 415 volt three phase alternator. Cooling water was contained in twelve 2700 litre galvanised iron tanks.

The antenna was a multiple tuned six wire flat top Alexanderson type supported by two self-supporting lattice steel towers each 56 metres high and spaced 80 metres apart. The tower material was supplied by Johns and Waygood of Melbourne, and the erection carried out by Messrs. Gibb and Miller of Port Adelaide. The erection was completed on 30th July 1931. A feed from each end of the antenna was dropped down vertically to tuning huts by sausage feeders while the transmitter was fed to the centre of the antenna by another vertical feeder. The resistive component of the antenna was 67.5 ohms and the normal antenna current was 10 amps. The earth mat comprised a rectangular grid of copper wires covering an area of 131 metres by 94 metres crossjointed at about one metre square sections.

Many improvements were made over the years to the transmitter by the elimination of motor generating plant and the provision of more efficient tubes and circuitry. By 1948 all tubes were operating with a.c. on filaments and all high tension supplies provided by mercury vapour rectifier tubes. Bias supply for the final amplifier was catered for by a three phase selenium rectifier. At that stage the final amplifier tubes were 4220C water cooled types, the modulator tubes were PP849A types and the modulated amplifier tubes were TA4/1500 types.

About 1949 consideration was given to the replacement of the transmitter with a 10 kilowatt main unit, and a 2 kilowatt standby unit. A new transmitter of AWA manufacture was subsequently ordered and tested during February 1952. It was officially placed in service on 29th March.

A Regional studio associated with 5CK was opened at Port Pirie on 24th June 1954. A function was held in the Port Pirie Town Hall at 8.45 p.m. when the speakers were Mr. E.R Dawes, Vice Chairman Australian Broadcasting Commission, Mr. E.H.D. Russell M.P. Federal Member in the House of Representatives for the Division of Gray, and Mr. C.R. Davis, Mayor of Port Pirie. The speakers were introduced by Mr. C.C. Wicks South Australian Manager of the Australian Broadcasting Commission. The speeches were followed by a musical programme until 10.00 p.m.

The studio and facilities were established in a five room house suitably converted to serve the purpose and conveniently situated in Gertrude Street, two blocks from the Post Office and the main business area of the town.

In 1959 a contract was let for the erection of a 190 metre high sectionalised antifading radiator to improve the service area of the station. The structure was erected on a nearby property and connected by a six wire transmission line. It was put into service on 4th February 1962. The Alexanderson antenna then became a standby.

Further changes to the transmitting equipment were made on 17th June 1966 when the AWA 10 kW/2kW transmitter was replaced by two STC 5kW units operating in a parallel mode.

Soon after the station opened in 1932 the Officer-in-Charge occupied a residence on the site and this arrangement continued until 19th October 1970 when the station was modified for unattended operation and brought under the control of staff at the National Television Station ABNS-1 at The Bluff. Staff members who at various times had been Officer-in-charge of 5CK and who occupied the residence included Messrs. Bill Whisson, Morris Wallace, Jack Grivell, Pat Callinan, Brian Blundell, Alf Cole, Roy Buckerfield, Ken Bytheway, Bill Roy, Brian Roberts and Dave Carthew. The house was subsequently sold and removed from the station. In 1977 Mr. Brian Beyer at ABNS-1 was in control of 5CK operations.

It was some 18 years before the next National Regional station was put into service in the State. Station 5LN Port Lincoln commenced transmission on 14th November 1950 using identical main and standby AWA 200 watt transmitters operating on 1530 kHz. The official opening ceremony was held in the Supper Room of the Civic Memorial Hall at 7.30 p.m. The Manager of the Australian Broadcasting Commission then entertained guests at the Pier Hotel. The main antenna was a lattice steel mast 40 metres high fed by a 200 ohm open wire transmission line. The earth mat consisted of 60 radials of copper wire spaced six degrees apart. To cater for failure of mains power, an Armstrong Siddley 5kVA single phase motor generator set was installed. During 1964 both transmitters were overhauled and rewired. In 1974 they were replaced by two 100 watt STC solid state transmitters in parallel operation. At the same time, the programme input equipment was upgraded. The mast was also replaced in 1974 by one of similar height following corrosion problems with the members. A 50 ohm coaxial feeder replaced the open wire line. The first Operator-in-Charge was Mr. Jack Martin.

Three years later 5WM was commissioned at Woomera with two 200 Watt Philips transmitters on 1580 kHz. It commenced operation on 18th September 1953 using a T type antenna 22 metres above ground level supported by two lattice steel towers set apart some 40 metres giving a horizontal antenna length of 30 metres. The earth system comprised a three metre square copper mesh tied to 60 radials at six degree spacing fanned out to a length of 30 metres. A PT29M coaxial feeder linked the transmitter to the coupling box and the L type matching network. The station was the first to be

established in the State under a major plan prepared by the Australian Broadcasting Control Board for the development of National Broadcasting Service regional stations. The first Officer-in-Charge of operations and maintenance was Mr. Eric Cawthron.

A station at Mt. Gambier similar to that at Woomera and operating on the same frequency followed. It was commissioned with call sign 5MG on 26th September 1955 using 200 watt main and standby Philips transmitters. The station was originally provided with a 4.5 kVA Turner diesel engine generating set for emergency power purpose but this was removed on 19th September 1958. The opening ceremony was performed from the Civic Hall Mt. Gambier where taped speeches by the Postmaster-General, the Hon. H.L. Anthony and Senator K.A. Laught were played. These were followed by speeches by Mr. E.R. Dawes Vice Chairman of the Australian Broadcasting Commission and His Worship the Mayor of Mt. Gambier Mr. S.C. Davis. The first officer in charge of the station was Mr. Bill Legg. Mr. Murray Higgins was Divisional Engineer in charge of the installation of the 5LN, 5WM and 5MG transmitters.

A regional studio for the Australian Broadcasting Commission was opened in Mt. Gambier on 17th March 1959 for the purpose of providing local programme material for 5MG and 5PA. The building constructed of local stone was located in Penola Road a short distance from the main street. The studio was built on modern lines and although small by metropolitan standards was particularly well equipped electronically and acoustically. After the official opening by the Postmaster-General the Hon. C.W. Davidson with a recorded speech, a reception was held in the C.W.A. Clubrooms.

On 25th June 1974 the original 5MG transmitters were replaced by a pair of STC solid state 100 watt units operating in parallel.

The first medium power station was officially opened on 14th December 1956 at Penola with the commissioning of a 2000 watt transmitter to cover the south east area of the State. The transmitter was of Philips manufacture and comprised indentical main and standby units. Call sign was 5PA and the transmitter operated on a frequency of 1160 kHz.

Speakers at the opening included the Postmaster-General, The Hon. C.W. Davidson, Mr. E.R. Daves of the A.B.C. and Dr. A.J. Forbes Federal Member for Barker. Later in the evening a special documentary was broadcast on Penola under the title "Penola, Past and Present".

The antenna was a sectionalised antifading radiator 94 metres high with a 10 metre diameter armature. The armature took the form of six radial arms of steel frame construction, and twelve radial copper cables, two of which were positioned between each adjacent arm and terminated on a galvanised steel cable joining the free ends of cantilevered arms. At a height of 70 metres, the mast was broken electrically by means of a sectionalising insulator and the two sections of the mast connected together through an adjustable inductor physically located below the sectionalising insulator on a special platform. Antifading properties of the mast radiator were achieved by selecting the current distribution on the mast to give a minimum of high angle or sky wave radiation and a maximum of low angle or ground wave radiation. A radial earth system terminated on a copper sheet at the base of the mast. A standby antenna consisted of a vertical wire supported by a 30 metre pole.

The first Officer-in-Charge of the station was Mr. Lew Grubb who lived on site in a house provided.

The population in the south east had almost doubled by 1965 and it became apparent that the station was not providing an adequate grade of service to the developing population. In order to improve the situation plans were prepared to increase the power to 10 kilowatts, to install a directional antenna system to limit interference with a transmitter in another State sharing the same frequency and to relocate the station at a site about 10 km east of Naracoorte. Transmissions from Penola ceased on 28th June

1960 and commenced from the new site at Naracoorte using the same call sign and frequency on the following day. The new transmitter comprised a pair of STC 5 kilowatt transmitters normally operating in a parallel mode. The antenna system was a pair of 130 metre high Skillfast lattice steel guyed masts suitably fed to give an approximate figure of eight field strength pattern. A flat top T type antenna was installed as a standby. Emergency power plant in the form of a 60 kVA engine generating auto start set was provided to cater for mains power fail situations.

On 31st July 1957, station 5MV Berri was commissioned to provide a service in the Upper Murray River area on 1590 kHz. Main and standby 2 kilowatt Philips transmitters were installed on a site about 3 km north east of the Berri town centre. The antenna consisted of a lattice steel radiator 40 metres high erected over an earth mat with 120 radials each 100 metres in length. The antenna was linked to the transmitter by an open wire 200 ohm transmission line. A T type antenna supported by two 25 metre windmill type towers was constructed as a standby. Power for equipment operation was provided by the 11kV mains but a 15 kVA diesel engine generating set was installed in case of mains failure.

A regional studio associated with 5MV was commissioned in Renmark at the same time as the transmitter. The studio was located in the Municipal Building in Ral Ral Avenue and facilities catered for announcing and programme production as well as for disc, tape replay and recording equipment.

The official opening of transmitter and studio was performed by the Postmaster-General, the Hon. C.W. Davidson before a packed hall in the Renmark Institute during the evening of 31st July 1957. The ceremony which preceded a performance by the South Australian Symphony Orchestra was attended by a number of distinguished visitors. The opening ceremony and portions of the concert were broadcast over 5MV.

The transmitter was originally operated on a staffed basis with the officer in charge living in a house erected on the site. The first Officer-in-Charge was Mr. Bob Fuller and he was succeeded by Mr. George Connon who retired on 13th October 1972. On Mr. Connon's retirement the station was modified for remote control operation and placed under the control of staff at television station ABRS-3 Loxton with Harold Stanford being in charge in 1976 and Roger Hedley in 1977. Mr. Jack Truss was Divisional Engineer responsible for the installation of the 5PA and 5MV stations.

A low power station was established at Leigh Creek on 30th June 1971 to provide for the local community. With call sign 5LC on 1570 kHz the transmitter was installed in the Post Office Exchange building with the antenna being located some 400 metres away. Main and standby STC 100 watt transmitters were provided and they were connected by UR67 coaxial cable to the antenna. After the loss in the long transmission line the input power to the antenna was 50 watts, the authorised power. The antenna was a 21 metre triangular lattice steel mast structure with 25 cm sides. Emergency power supply arrangements were catered for by the use of a feed from the exchange battery using an inverter. The Officer-in-Charge on commissioning was Alan Hudson.

The last of the National regional stations installed up to 1977 was 5SY at Streaky Bay located about 8 km north of the town. Operating on a frequency of 690 kHz it was commissioned on 31st May 1972. The transmitters were identical main and standby 2kW AWA types feeding into a directional antenna system comprising two lattice steel guyed masts 140 metres high suitably phased to give a directional pattern with main lobes approximately along the coast line. The feed to the antennas was via a 50 ohm coaxial cable type UR74. A 30 kVA engine generating set was provided for use in the event of a mains power failure. Mr. Max Muirison was in charge of the station when it went on air. Mr. Bruce McGowan controlled the installation of the 5LC and 5SY facilities.

The Commercial Metropolitan Services

By the 1st August 1924 only one firm application for the establishment of a B Class station in Adelaide had been submitted although several groups acting on behalf of business firms had made enquiries and were conducting feasibility studies.

An examination of schemes being studied at the time shows that the types of services could be classified under three headings, viz:

(a) Non revenue earning service — educational.
(b) Non revenue earning service — self advertising.
(c) Revenue earning and self advertising services.

Proposals regarding class and duration of programmes varied from musical items, without advertising for two hours duration nightly on three nights per week, to a similar programme interspersed with advertising every night. The powers proposed varied from 100 to 500 watts input.

The question of the number of B Class licences which should be granted within a radius of say 40 km of Adelaide had been under consideration by the authorities and technical experts for some time and the general opinion was that B Class licences should be limited to one educational non-revenue earning station with a maximum input power of 500 watts and two revenue earning stations each with a maximum input power of 1000 watts. There appeared to be little support for self advertising non-revenue stations.

There was some concern that B Class stations would cause interference with the A Class service proposed for Adelaide and it was suggested by some experts that the wavelengths allocated to B Class stations should be at least 100 metres on either side of that allocated for the A Class service.

The two most active groups for a B Class licence during September 1924 were Messrs. James Marshall and Co. Ltd., the well-known Rundle Street drapers and merchants and Mr. E.J. Hume of Parkside. Others who had earlier shown interest did not proceed. Mr. Hume by this time already had a station 5DN in operation for test purposes.

Towards the end of the year Mr. J.C. Marshall made a visit to the Eastern States to pick up technical and programme points for the firm's new station. They proposed the erection of two steel masts 40 metres high on top of Marshall's Building with a 500 watt transmitter. Mr. J.H. Chesterfield of the S.A. Radio Company was given the task of designing and installing the station technical facilities.

At the beginning of 1925 the technical press announced that licences to operate B Class stations had been received by 5DN (E.J. Hume) and James Marshall and Co. The James Marshall station was to operate on 275 metres with call sign 5MC. However, shortly after, the company lost interest and dropped plans for establishment of the station.

By 1926, 5DN had been well established and there were four organisations interested in setting up a second B Class station in Adelaide. They were Sport Radio Broadcasting Co. Ltd., Messrs. Oliver J. Nilsen and Co., Adelaide Radio Co. and the S.A. Railways Institute. Even in those days it was not easy to find exclusive wavelengths throughout Australia and it was suggested that two share a common wavelength. On this basis Sport Radio and Oliver J. Nilsen were to share one wavelength and the S.A. Railways Institute and Adelaide Radio Co. share another. This meant that those sharing a common wavelength would broadcast on different times, for example, Sport Radio was to operate on Tuesday, Thursday and Friday from 8 p.m. to 11 p.m. and on Saturday from noon until 8 p.m. while Oliver J. Nilsen was to broadcast on Monday and Wednesday from 8 p.m. to 11 p.m. on Saturday from 8 p.m. to 11 p.m. and on Sunday from 2 p.m. to 5 p.m. In December 1926 it was reported that Oliver J. Nilsen had already arranged for a studio and transmitting house in Frederick Street, Findon with

one of the masts being in position. The power was expected to be 100 watts and the transmitter was already under construction at the company's works in Melbourne. Mr. Edwards who had had wide experience with the Marconi Company in England was to be in charge of the technical plant.

The Railways Institute was also well advanced with plans and by August had the transmitter constructed and under test. It was assembled by Mr. A.R. Snoswell under the direction of Mr. L.C. Jones. The circuit was the well known Hartley oscillator type. The transmitter had a high quality input amplifier for transmission of musical items. The power of the transmitter was about 40 watts. The Institute had expected to be given permission to broadcast with a B Class licence by Christmas 1926 and had prepared tentative programme schedules. In addition to official Railways information concerning times of train arrivals and departures they proposed to make use of the South Australian Railways Band, the Railways Orchestra and Glee Club and numerous well known vocalists on the staff of the Railways.

Of these four organisations which were keen in 1926 to establish B Class broadcasting stations, only Sport Radio was successful when it started transmissions in 1927 using call sign 5KA.

In 1929, the South Australian Worker announced its intention of setting up a B Class station at Parkside using a 500 watt transmitter and horizontal cage type antenna with counterpoise. They proposed to broadcast lectures which were delivered to various classes of the W.E.A. and the University of Adelaide and in particular W.E.A. lectures delivered in the Adelaide Trades Hall. This was to be supplemented with a programme of first class vocal and instrumental items. However, plans were subsequently shelved.

In 1930, 5AD was established as the third B Class station in the State and until 1976 when 5AA opened the situation in Adelaide remained static except for the closure for a period of 5KA during the war.

Although various groups have since from time to time announced plans to establish stations, nothing has come of the plans. One of the most persistent attempts was made by Mr. V.K. Coombe of Mile End who for some seven years provided a programme over experimental station 5WS. In May 1930 in response to numerous requests from listeners for extended week day and Sunday transmissions, permission was sought to establish a B Class station. Mr. Coombe had been guaranteed finance up to £2000 by a well known Adelaide business man for the installation of an up to date transmitter, furnishing and equipping of the studio and the maintenance of the plant. The transmitter proposed was a 100 watt crystal controlled type with low level modulation feeding into an L type antenna. A licence was not granted because of the shortage of frequences. Applications were lodged again at various times up until the late 1930's but without success.

5DN

The call sign 5DN was originally allocated to the Adelaide Radio Company of 146 Rundle Street founded by Messrs G.A. Miller Randle, Harry Kauper and Lance Jones. Mr. Jones who was manager of the Company was the registered operator. There is no known record of 5DN having regularly transmitted from the Rundle Street premises. Mr. Jones was a very active and well known experimenter with his private station 5BQ at Westbourne Park.

Late in 1923 Mr. E.J. Hume of "Peltonga" Park Terrace, Parkside entered into negotiation with Commonwealth authorities with a view to establishing a broadcasting service in Adelaide. Mr. Hume believed radio had great possibilities, particularly in the education and cultural fields. Early in 1924 approval was granted with an interim permit to carry out broadcasting on an experimental basis.

He began negotiations with the Adelaide Radio Company for the supply of a 500 watt (final input) transmitter. The Company offered to supply immediately a low power transmitter as an interim measure pending construction of the 500 watt unit, with operation being covered by making the Company 5DN licence available for transfer to Parkside.

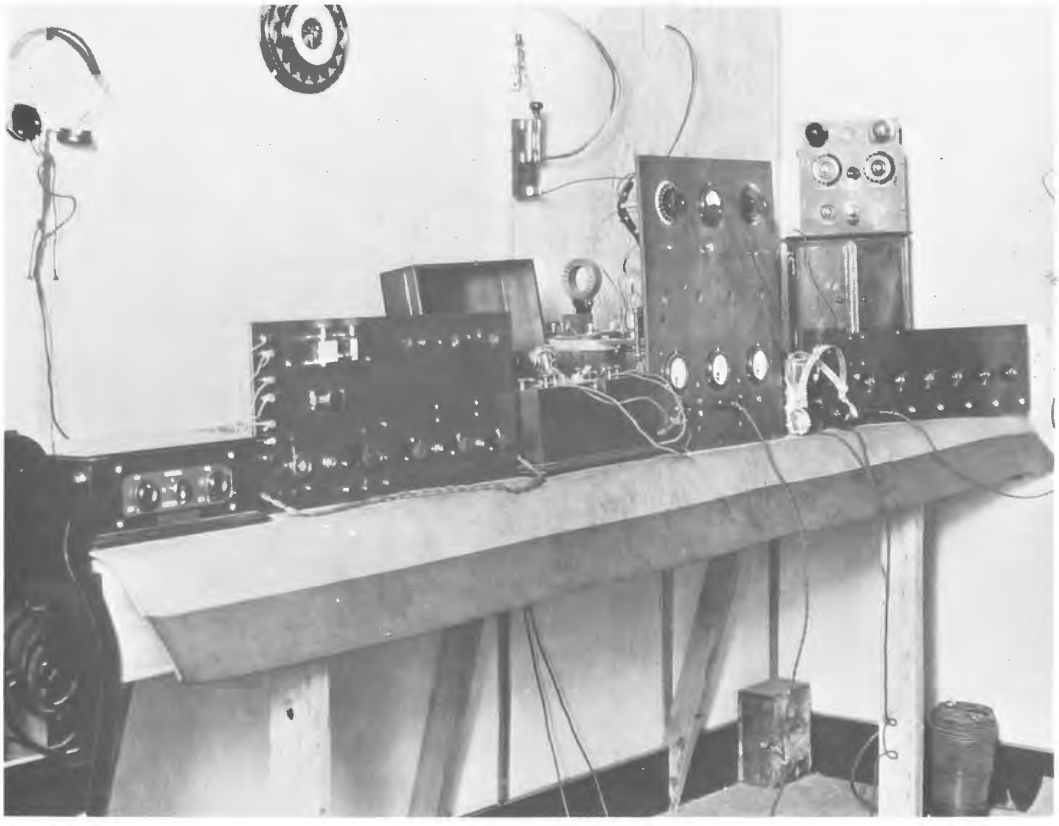
Mr. L.C. Jones who built and operated the original 5DN transmitter.

Following receipt of approval for the licence transfer arrangement, Mr. Jones removed his private 5BQ transmitter equipment from Westbourne Park in June 1924 and installed it in a building which Mr. Hume had caused to be erected for the purpose at Montpelier Street, Parkside, on land extending through to Porter Street. The transmitter was connected to the Music Room of Mr. Hume's residence where live programmes originated, by Post Office landline. The speech input equipment including amplifiers and microphones were purchased separately by Mr. Hume direct from the Western Electric Company, U.S.A. Test transmissions commenced on 12th June 1924.

Transmissions at first consisted of phonograph records from the transmitter room at Montpelier Street, the microphone being placed inside of the phonograph horn. They were carried out under the personal supervision of Mr. Jones who was assisted at various times by Harry Kauper, Fred Williamson and Ray Snoswell. All equipment and services including the services of operators were supplied by the Adelaide Radio Company under ordinary commercial contracts and paid for by Mr. Hume.

Although the input to the modulated oscillator stage was only about 35 watts many reports of reception were received from Interstate listeners and also New Zealand. Programmes from Mr. Hume's Music Room studio consisted of live artist performances and only very few recorded items.

The first land line outside broadcast took place on the occasion of a concert by the Conservatorium Band under the baton of Mr. Ord Hume who was visiting Adelaide. The transmission was successfully carried out by Mr. Jones assisted by Mr. Williamson. It was soon followed by many concerts from the Elder Conservatorium by the courtesy of the Director of the Elder Conservatorium of Music, Professor H. Davies.



Original 5DN transmitter, Parkside, 1924.

Many halls and churches were connected by land lines and by June 1926 these included the Conservatorium, Adelaide Town Hall, St. Peters Town Hall, Parkside Methodist Church, Maughan Church, North Adelaide Congregational Church, Stow Church, Hindmarsh Congregational Church, Flinders Street Lutheran Church and Piccadilly Cafe.

Shortly after transmissions had commenced, Mrs. E.J. Hume who was well known in the fields of art, music and literature, took charge of the live artist programmes and under her supervision, many fine programmes were enjoyed by listeners from the Music Room of their home in Park Terrace.

The first studio microphone was a Western Electric double button carbon type. Later a Reis type was added to the facilities.

When 5DN first began to assume the proportions of a broadcasting station Mrs. Hume usually announced "Five Don N Adelaide Transmitting". During that period the old Army telegraphic method of naming letters of a call sign was frequently used for experimental radio transmissions. The usage was discontinued in September 1925 but the form was used for some time after by the Press. Mrs. Hume was the only lady announcer in Australia actively engaged in broadcasting.

From the studios at Parkside many a prominent radio artist saw the beginning of a career. Musicians and singers learnt new presentation techniques with Mrs. Hume guiding them to the right positions before the microphone, selecting the music that would broadcast well and herself contributing to the programmes from time to time.

The first radio play broadcast in South Australia came from Mrs. Hume's Music Room studio. It was arranged by Mrs. Hume who was a prominent member of the Adelaide Repertory Theatre. In 1924 the theatre produced "The Lilies of the Field" and shortly after its opening as a stage play the actors gathered in the studio and broadcast the complete play.

First 5DN studio, Parkside, 1924.

Continual improvements were being made to the station equipment to improve efficiency and quality of modulation. By September the transmitter operating on a wavelength measured at 313 metres consisted of four 5 watt Radiotron tubes with two being used in the oscillator stage and two in the modulator stage. The oscillator circuit was a modification of the Hartley type with modulation being effected by the Heising system. Late in 1924 the Adelaide Radio Company installed the transmitter which had been ordered earlier. The transmitter operated at 120 watts for some time due to the late delivery of a 2000 volt generator and then at 240 watts, the limit allowed under the licence conditions. It had a self excited modulated oscillator which was modified in July 1925 to a master oscillator, separator and Class C modulated amplifier. Early in 1926 the self excited master oscillator was replaced by a crystal controlled unit. The high tension voltage was provided by an Electric Speciality Co. motor generator set driven from the mains. Its output was 2000 volts d.c. and commutator ripple was smoothed out by a bank of filter condensers. At first, filaments were powered by a high capacity storage battery but when the new transmitter was installed its filaments were powered from the output of a motor generator set. Meters located on the panel gave current readings of the plates of the oscillator and modulator tubes as well as other parameters. The earth for the transmitter was provided by a series of copper sheets buried in the ground just outside the equipment room.

The antenna was supported by two wooden masts each 20 metres high and spaced about 30 metres apart. The masts were similar to ship's masts, with a crossarm and with cleats at the crossarm to allow the top section and antenna to be lowered vertically if necessary. They were designed by Mr. Hume and fabricated on site by a carpenter to Mr. Hume's specification. Each mast was secured at the base to a stout piece of timber set in the ground in concrete while the top was guyed with three heavy wire cables broken up with egg type porcelain insulators. The antenna an inverted "L" type, was about 20 metres in length at the top with the lead-in being also 20 metres. The horizontal section was made in the form of a five wire cage separated by 65 cm diameter cane hoops. The wires were seven strands of 20 gauge copper. The lead-in was also in cage form but tapered down to a lead-through insulator.

Immediately beneath the antenna was a five wire counterpoise, which started from a two metre spreader at the station end, two metres above the ground and extended to a three metre spreader on the far mast. It was an active counterpoise. One end of the antenna tuning circuit was connected to the antenna while the other end was tied directly to the counterpoise. The inductor neutral point was tied to earth.

The facilities in 1924 also included a receiver using plug-in coils and Magnavox moving coil loudspeaker with the eight ohm coil of the speaker being fixed to a corrugated metal diaphragm in a chamber at the base of the horn. A matching transformer 10,000 ohms to 8 ohms was used to couple the speaker to the receiver. A storage battery provided six volts at two amps for the electromagnet. The speaker was driven by a push/pull Class A Marconi amplifier with two five watt tubes. The amplifier and speaker were also used for monitoring the local transmission of 5DN in conjunction with a diode tube. The receiver had two stages of resistance — capacitance coupled triodes, an anode bend detector and a resistance — capacitance coupled audio frequency stage for c.w. code reception. The Sterling headphones used with this receiver are now in the possession of Mr. Jack Hume an announcer for many years with 5DN and they were exhibited in the Adelaide G.P.O. in 1973 during the display to commemorate 50 years of Broadcasting in Australia.

The building which housed the transmitter also had a large room for a studio and was specially erected for the purpose. It was of reinforced concrete construction of dimensions 12 metres by 6 metres adjacent to which were two small buildings, one for

the generating equipment and the other for storage battery equipment. The floor was covered with rubber and carpets and the walls lined with asbestos sheets. A private line linked transmitter and studio.

December 1924 saw the first broadcast of Christmas carols over 5DN. On the Tuesday evening before Christmas Day the Salvation Army Band under Bandmaster Turner gathered in the courtyard which was provided with temporary lighting for the performance. There were 20 bandsmen and great care was taken by Mr. Jones in fixing the stations of the bandsmen to ensure a balanced broadcast. The kettle drum was given a back seat but the cornets gave some trouble with overloading during loud passages. The broadcast was very successful and much appreciated by the listeners.

Mr. Hume had originally applied for an 'A' Class licence but when this was not approved, he submitted an application for a 'B' Class licence in July 1924. 'B' Class licence No. 14 was issued on 1st December 1924 and from that date the experimental licence of the Adelaide Radio Company was withdrawn. The Parkside station retained the 5DN call sign it had been using for experimental purposes since June 1924.

In June 1925 Mr. Jones retired from active work in connection with the station operations. Mr. Ernest J. Hume junior took over the technical responsibilities and held the position of Chief Engineer until September 1941. At the time of installation of the first transmitter at Parkside, he was attending practical work classes at the School of Mines as well as attending a series of lectures on Radio-Physics by Professor Kerr Grant. After leaving 5DN Mr. Hume joined the staff of Hume Steel Limited which later became the Steel Division of Humes Ltd. He remained with that company until he retired in August 1971.

Mrs. Hume relinquished her direction of programmes from the end of November 1925 and her place was taken by Mr. Evan Senior who acted as announcer as well as programme director. He also produced a children's programme and was well known as "Uncle Don". During the year the station's first musical trio was formed with Miss Winnie Hambridge (violin), Miss F. Beaumont (piano) and Mr. Challacombe (cornet).

With the granting of the B Class licence regular transmission schedules were introduced. Prior to that, the only regular publicised feature was a live artist programme each Thursday evening. A session of recorded music was usually broadcast on other weekdays. From February 1926 a policy was introduced to ensure the broadcast of a live artist concert every night. On 26th April a further advance was made with the introduction of the all-day programme. From that date musical programmes, very largely live artist performances were broadcast from 10 a.m. until midday and in the afternoon from 2 p.m. until 4 p.m. The evening session from 6.30 until 7.30 was occupied with bedtime stories, News Services, Stock Exchange reports and market reports. Concerts to please a wide range of tastes were broadcast from 8 o'clock. Minimal use of phonograph records was the objective.

The B Class licence provided for revenue to be made through broadcast advertisements. The charge fixed by 5DN was £1 per minute. It was station policy not to advertise on Sunday, to investigate the truth of advertisements, and to be discriminating in placement of advertising matter in relation to its suitability to other parts of the items being broadcast. Sessions for music lovers, for example, were kept free of advertising matter except for brief initial and following announcement of sponsorship, where appropriate.

About that time it was announced that the station would be shifting to new premises in the city. It had been realised that having the studio at Parkside was an inconvenience to artists and also expansion of facilities was necessary to cater for the increased transmission period. However, it was about 12 months before anything further on the move was heard. It was then announced that a suite of rooms had been secured in Paringa Buildings, Hindley Street.

During the middle of the year 5DN Proprietary Limited was registered as a company. The capital was set down at £50,000 and the specified objects were:- "to take over, purchase, lease or otherwise acquire from any person as company or broadcasting station, licence or licences (either A or B Class) and to deal with, hold, and operate the same and to give such consideration thereafter as may be arranged and to carry on the business of broadcasting, re-broadcasting, relaying and transmitting by wireless concerts and other entertainments, announcements, messages, advertisements, reports and news of all kinds, and to carry on all or any of the business of manufacturers merchants, importers, indentors, exporters, agents, brokers and dealers in broadcasting transmitting, receiving, radio and other wireless sets, transmitters, receivers, equipment, machinery, appliances and apparatus of all kinds."

The comprehensive list of possible activities, likely and unlikely, was a common practice with companies at the time. Although the objects covered a very wide field, the main purpose of the company was to expand in the broadcasting field.

The first shareholders of 5DN Pty. Ltd. were Mr. L.C. Jones, Mrs. V.L.H. Hume, Mr. E.C.S. Lindsay, Mr. H. Thomson and Mr. E.J. Hume. The company however did not take over the licence nor did it seek to obtain one.

The station remained on a proprietory basis without aid of external capital until Messrs Savery Pianos Ltd purchased 1000 shares at £1 each. All funds to that time apart from advertising revenue were provided by Mr. Hume, the founder, up to the time of his death in 1928 and thereafter by his son, Mr. E. (Ern) J. Hume junior. The original licence issued to cover a period of five years expired late in 1929 and it was a condition of renewal that the licence be in the name of a public company. Early in 1930 Hume Broadcasters Limited was formed.

During the first week in August 1926 the new rooms in Paringa Building, Hindley Street were completed and occupied. The suite of rooms which comprised studio, control room and waiting room were on the top floor of the building. The studio which was the largest of the rooms was tastefully draped with heavy blue material. The material enhanced the acoustic properties of the room so improving the quality of the programme by preventing excessive reverberations. Included in facilities were gramophone turntables and magnetic pick-ups, an organ, and a grand piano. The magnetic pick-ups were designed and built by Ern Hume and resulted in greatly improved quality of the recorded programme. They were used for sometime until commercially made Bosch type reproducers became available.

The studio microphone was a Western Electric double button type usually mounted on a pedestal in the centre of the studio. A receiver and loudspeaker were provided in the waiting room to enable artists and visitors to hear programmes while waiting. The amplifier equipment in the control room was built by the station's engineering staff and was arranged in a metal framework for ready access to components for maintenance purposes. A window was provided between control room and studio to allow the control operator to watch proceedings in the studio.

During October, work commenced on upgrading the technical facilities including an increase in power of the transmitter. A high voltage generator had been delivered some time earlier but had experienced insulation troubles on two occasions, necessitating rewinding of the armature. When put into service the higher voltage enabled the transmitter input power to be increased to 240 watts. The standby transmitter was the original 35 watt unit.

Further improvements to the technical facilities were completed during March 1927 when a new submodulator was installed. This resulted in improved quality of transmissions. Steps had also been taken to utilise a number of new microphones of the electrostatic or condenser type in place of the carbon types which caused a slight "hiss" in the programme background.

From November, the evening transmissions were extended until 11.30 p.m. and each week night except Monday when the usual late dance show normally went until midnight. The extension of hours was in part the result of a great many requests from local and Interstate listeners.

After some time in Paringa Building the studios were shifted back to Parkside because of the economic situation. They remained there until 1932 when Messrs Savery's Pianos Ltd acquired an interest in the company. Both transmitter and studio facilities were then shifted to 29 Rundle Street following receipt of approval on 17th May 1932. At that stage, the studio and transmitter shared the same building at Parkside with leads from microphone and pick-up equipment being taken through the wall of the building to the transmitter. The transmitter employed a low level modulated amplifier driving a 220 watt linear amplifier with equipment being mounted on two self contained panels. The original antenna and counterpoise systems were still in use. Approval was given for the transmitter power to be increased to 300 watts unmodulated carrier concurrently with the shift to Rundle Street.

New facilities in Rundle Street were brought into operation about mid 1933. The transmitter comprised a 960 kHz crystal oscillator followed by a screen grid isolator amplifier which provided the r.f. drive to a 50 watt Class C modulated amplifier. A 250 watt tube operating as a Class A amplifier was used to modulate this stage by the Heising method. The modulated amplifier provided an input to a Class B linear amplifier using a water cooled Western Electric 4228A tube. The output was fed via a transmission line to the antenna. The unmodulated input to the linear amplifier was 900 watts giving a power to the antenna of 300 watts. Power for operation of the equipment was obtained from the Adelaide Electric Supply Co. 50 Hz mains at 220 volts single phase and 440 volts three phase. A motor generator set provided 22 volts d.c. for the output tube filament. High tension was derived from a full wave mercury vapour tube system. The new transmitter and associated speech input equipment were designed and built by Ern Hume. Western Electric condenser microphones were acquired for the studio and for outside relay purposes. The same wooden masts as used at Parkside were transferred to the top of the Rundle Street building in 1932. Temporary masts were put up at Parkside to enable the transfer to take place. The same original Parkside five wire cage antenna and counterpoise were also employed at Rundle Street. The antenna was subsequently improved to increase its efficiency by erecting a single wooden mast on an adjacent building on the eastern side of Savery's Building, using a wire transmission line for feed purposes.

In 1936 plans were prepared to shift facilities to the 12th floor of the new CML Building on the corner of Hindley and King William Streets. A transmitter originally used at 2GB Sydney about 1928 was purchased and transferred to the new premises. The output of the station was raised from 300 watts to 500 watts concurrently with the installation of the transmitter. The transmitter employed a 210 tube type oscillator, a 210 buffer, a 210 modulated amplifier, a 250 modulator, a Marconi MT7B first linear amplifier with an STC 4220C water cooled tube as a final amplifier. Single choke Heising method of modulation was employed. The filament supply for the 4220C was provided by a d.c. generator giving 21 volts at 40 amps and powered by a 2kW three phase motor. High tension supplies were 500 volts minor high tension and 8500 volts e.h.t. to the two linear stages. Rectifiers were Philips DCG5/2500 grid controlled types connected in a single phase bridge (four tube) arrangement. Arc backs were frequent.

The transmitter was in operation until February 1948 when a locally built 500 watt transmitter was installed. The new unit comprised a basic arrangement of 6C6-6C6-6F6-809 tubes followed by an 813 radio frequency amplifier, and an AWA 833A tube modulated by two Amperex H.F. 300 tubes. All tubes were forced air cooled and high tension supply was 2500 volts d.c. The cabinets were built by Ramsay Bros.

Eliza Street Adelaide and all transformers with the exception of the Trimax modulation transformer were made by 5DN staff. The original water cooled transmitter was tranferred to 2BH Broken Hill.

The programme input equipment for the CML studios was built from apparatus previously used in 5CL Hindmarsh Square studios. It was not entirely suitable for the purpose and many of the amplifiers had to be rebuilt. The 12 volt filaments were powered by batteries on float. The 200 volt d.c. for high tension was also supplied by batteries.

The antenna was a six wire cage type centre fed and supported by two wooden masts erected on top of the building. Each mast was 31 metres high with a 24 cm square base section tapering to a circular top section. They were guyed by strong stranded steel cables broken up with egg type porcelain insulators. The antenna had an input resistance of about 50 ohms and was insulated by large porcelain insulators tested to withstand 9 tonnes. Some 700 metres of steel and copper wire went into the construction of the system. The top of the masts were 71 metres above the street and were the highest construction point in the city. A counterpoise with about the same spread as the antenna was installed using 7/.029 copper wire.

During 1937 station staff participated in two unusual outside broadcasts. In July, a successful broadcast was made from an aeroplane in flight. On the first round trip by Guinea Airways new Lockheed Electra listeners heard the familiar voice of Ken Crossman as he described en route a 300 km/h trip from Sydney to Adelaide. At the end of the year, on the occasion of the Grand Prix motor races at Lobethal one of the commentators, Gordon Marsh, seated himself in a gum tree about 22 metres above the ground in order to obtain a good view of the circuit. The operator Frank Hill perched alongside with all his technical equipment to ensure a trouble free broadcast.

After the war modifications were made to the speech input equipment to convert it to mains operation and to improve the frequency response and distortion characteristics. Improved pick-ups and turntables were also installed. Up until the time that L.P. records appeared on the scene RCA AZ4211 needle type pick-ups were in use.

In April 1952, station 5RM in the Upper Murray which had been relaying 5DN programmes ceased to be part of the network and in order to extend coverage by the 5DN transmitter, plans were prepared for an increase in power and a shift to a new site. On 1st May 1954, the transmitting equipment was transferred to Dry Creek and the use of a 2000 watt transmitter and improved soil conductivity increased coverage compared with the C.M.L. site. A 63 metre lattice steel mast with a half wave copper wire radial earth system was erected on the site. This was the maximum height allowable by DCA because of aircraft requirements at nearby Parafield airport. When West Beach airport was opened and many activities transferred away from Parafield approval was given for the erection of a 145 metre sectionalised radiator. The 63 metre mast was relocated to another part of the site to allow the 145 metre structure to use the earth mat. During the relocation the wooden masts which had been in service on the CML building were used to provide a temporary antenna. The sectionalised radiator was placed in service during November 1958. The 63 metre mast which was located on the edge of the main earth mat was used for standby purposes and was frequently brought into service by remote control from the studios in times of heavy static or storm activity.

The studios in CML Building were shifted to Tynte Street, North Adelaide on 17th December 1956. They were equipped with the most up to date equipment and facilities with the whole installation being controlled by the Chief Engineer, George Barber. There are presently four studios in operation.

In June 1974 on the occasion of the stations 50th Anniversary of broadcasting a series of special promotions and contests for listeners were conducted. Included in the promotions were a contest to find early model radio receivers and in particular to find a

working 1924 model and a Radio Essay contest for high school students on the subject of "Radio in the Next 50 years". The same year saw the installation of a new 2000 watt transmitter at Dry Creek to replace the one which had been installed there 20 years earlier. In May 1976 the transmitters were transferred to a new site at Wingfield.

Chief Engineers who have been in charge of 5DN installation and operation facilities include Ern Hume, Don Taylor, Sid White, George Barber and Lawrie Sjoberg.

George Barber was Chief Engineer for 30 years before handing over to Lawrie Sjoberg in 1972 to become Technical Director. He retired on 27th August 1976. After leaving Black Forest school George trained as an electrician and joined 5DN in April 1939 as a technician having obtained a B.C.O.P. He served a period of two years at 5RM from August 1940 as Engineer in charge and after returning to 5DN was appointed Chief Engineer in 1942. George was an active pre war Amateur operator on VK5MV after obtaining his ticket in 1934.

Other technical staff who have been associated with the station include Andy Fisher, Dud. Wilkinson, Colin Howie, Tom Gardner, George Baczoka, Adrian Wallace, Brian Palk, Jack Lester, Hughie Lloyd, Les Ruge, George Digance, Wykham Bailey, Barrie Quick, Bob Paech, Frank Hill, F. Wells and Warwick Parsons.

5KA

Early in 1926 the Transatlantic Wireless Company of Prospect announced plans to seek a licence for a B Class station and if granted to establish a high power station for broadcasting of racing and other sporting results in South Australia as well as results of major Interstate events. It proposed to cover a wide range of sport including racing, boxing, cricket, football, swimming and yachting. In addition, it proposed to rebroadcast news bulletins transmitted by the English high power station at Rugby and to supplement programmes with vocal, instrumental, band and educational items. A great interest was shown at the time by the public in sport and the management were hoping for subscriptions particularly from hotel proprietors to cover costs.

The licensing authorities were not happy about the name of the Company and indicated that they were prepared to grant a licence subject to the name being changed to something more appropriate. A power of 2000 watts on 250 metres was suggested by the Company with broadcasts on Monday, Wednesday, Friday and Saturday with a church broadcast on Sunday. They expected to have plant available to begin transmissions in September 1926.

Progress was not as rapid as the promoters had expected but when a licence was issued on 26th August plans were immediately developed to float a company and establish service. The new company was to be known as the Sport Radio Broadcasting Company Ltd. with a nominal capital of £25000 made up of £1 shares of which 25000 were to be issued to the vendor. The objects as set out in the prospectus were to take over as a going concern the business of broadcasting, radio and general wireless dealers carried on by Mr. C.R. Brown, trading as The Transatlantic Wireless Manufacturing Company; to establish a station in Adelaide for broadcasting results of all sporting events, supplemented by trade advertising; and to put forward a co-operative scheme with hotel keepers and sports agencies for sending out full sporting programmes and sporting results as soon as possible. The first directors were Mr. C.R. Brown, Mr. G.M. Cordon, Mr. S. Goldsworthy and Mr. G.T. Foch.

In December the new Company announced that it expected a 4000 watt generator which it had ordered from Messrs Howell and Company of London to arrive within a few weeks. The engineer in charge of setting up the station Mr. S.R. Buckerfield was anxiously awaiting the arrival so that he could proceed with the erection and completion of the technical facilities.

The station was officially opened on the 25th March 1927 on a private home site at 51 Kintore Avenue, Prospect. The company considered this as only a temporary home as they had plans for an increase in power and enlargement of studio facilities. Transmissions commenced on 300 watts carrier power with a wavelength of 250 metres and reports soon came in from listeners at far away places congratulating the station on its high quality signals and lack of fading. Early reports of loudspeaker strength signals came from Townsville and the north west of Australia.

The programmes consisted of musical items and talks, mostly sporting on four evenings each week from 8 to 10 p.m. and descriptions of sporting events on Saturday afternoons from noon to 5.30 p.m.

Within a month of going on air the Company began negotiations to arrange for the broadcasting of race meetings. They planned to eventually broadcast all metropolitan and country meetings but initially started with the country meetings. The first broadcast was set down for the Port Augusta races on July 5th and July 7th.

A programme to continually improve the technical facilities was implemented shortly after the station went on air and by July modifications had already been made to the transmitter and studio equipment. A new speech choke in the transmitter resulted in more efficient modulation. Several new microphones had been procured and outside broadcast amplifiers were under construction.

One of the policies of the management was to feature the rebroadcast of international stations and the first successful attempt was a rebroadcast of a programme of the American station WGY. Using receivers which the Company manufactured itself, the reception was very clear. Piano items were received with exceptional clarity and the announcements made by the WGY announcer were logged as "perfect". The programme was rebroadcast during the afternoon but had to be discontinued during the evening when local electrical interference marred the programme.

Broadcasting of football began in August when the station received the go-ahead from the Football League. The first broadcasts took place from the Adelaide Oval and the Prospect Oval with portion of each match being described by Matt Kinnear.

In September 1927, 5KA was merged with the National Musical Federation of Kithers Building, King William Street. The object of the merger was to provide a better service to the public. The NMF had been formed for the express purpose of operating broadcasting stations in Australia.

In May 1928 the hours of transmission were expanded with the introduction of the following timetable:

Monday to Friday	—	9.00 am to 10.30 am
		11.30 am to 1.00 pm
		2.00 pm to 3.00 pm
		5.00 pm to 6.00 pm
		8.15 pm to 10.15 pm
Saturday		9.00 am to 10.30 am
		11.30 am to 12.45 pm
		8.15 pm to 10.15 pm

It was about this time that the station moved from Prospect to corner Flinders Street and Divett Place in the city where two wooden masts supported the antenna. In August 1931, the location was changed to Richards Building, 99 Currie Street, where it remained until closed down on 8th January 1941 by order of the Naval Department when National Security Regulations were invoked.

One of the important events for the station during 1937 was the opening of the Bondezvous in Richards Building. It was located on the first floor and beautifully equipped with a first class ballroom floor with an area of some 650 square metres. Broadcast of the dance band sessions was a popular part of the station's programme.

The offices and two studios 7.6 m x 7.3 m and 7 m x 5 m were located on the third floor of the building. At this time the station had a total staff of forty compared with only seven in 1932.

While at Currie Street, the power was increased in 1938 to 500 watts by the installation of a transmitter constructed by the station staff. Many of the components such as transformers, chokes, rheostats and condensers were fabricated in the workshops. The only section made commercially was the exciter which consisted of two identical AWA units with switch changeover facilities. The transmitter was forced air cooled and employed four 805 type tubes in parallel push pull combination in the final stage. The modulator which was a high level type used a pair of 805 tubes in Class B configuration. The antenna comprised a flat top type with horizontal spreaders supported by two wooden masts. It was fed at one end by a feeder which led directly from the transmitter located on the top floor of the building.

After 5KA had been closed down, there was a lengthy period before it recommenced transmissions. It was reopened at a time when the country was engaged in war and considerable difficulty was experienced in its re-establishment. Important accessories were extremely difficult to procure but with co-operation from many quarters including those stations in operation, transmissions from 5KA recommenced on 6th December 1943. The station was established in the Central Methodist Mission building Franklin Street using the 500 watt transmitter previously located in Richards Building. A wire strung from the church steeple served as an antenna.

A year after commencement of transmissions the station brought into operation a 62 metre high lattice steel self supporting tower insulated at the base and used as a radiator. It was mounted on the ground supported by porcelain insulators tested to withstand 90 tonnes. The base dimension was 5 metres square and the structure tapered to just under one metre square at the top. The total weight of material was about 20 tonnes. An aircraft warning light was placed on the top. The new radiator gave a greatly improved signal strength compared with the temporary wire antenna previously in use.

The studios were laid out on the straight line system where the control and presentation rooms were centred between two studios, permitting simultaneous visual control of programmes being produced for 5KA and 5AU. Large windows dividing the rooms were triple glassed with each pane at a different angle in order to reduce reflection as far as possible. The walls of each room were treated with rock wool tiling for acoustic purposes.

The same treatment was used in the auditorium which had seating capacity for more than 350 persons — claimed to be the largest auditorium of any commercial station in the State at the time. Another feature of the facilities was a film machine for reproducing the sound track from films.

On 1st May 1954 transmitting facilities were upgraded with the installation of a 2000 watt transmitter at Cavan on a site sharing building and antenna with 5AD. The antenna height was 86 metres. When 5AU Port Augusta was provided with a new transmitter at Nectar Brook, the original AWA 200 watt unit was transferred to 5KA and installed in the city as a standby transmitter. On the implementation of 24 hour transmissions, the city transmitter was put into operation on a regular basis at those times when the Cavan transmitter was shut down for scheduled maintenance purposes.

Chief Engineers who have been associated with the station include Roy Buckerfield, Ern Gunner, Charlie Tareha, Colin Howie, Bob Paech, George Matthews, Col Crowe and Bruce Martin who was in charge in 1977. Other technical staff include Bob Parasiers, Max Wills, Sid McLean, Oliver Nestrom, Rex Fenwick, Bob Barringer and Wallace Ryrie.

5AD

Station 5AD was the fourth metropolitan station to go on air when it commenced operations on 2nd August 1930 following the issue of a licence on 2nd June 1930. It was officially opened at 8.00 pm by the Attorney-General the Hon. W.J. Denny representing the Premier. Other speakers included Lord Mayor Lavington Bonython, the Postmaster-General the Hon. J.A. Lyons on land line from Melbourne, the leader of the Liberal Party the Hon. H.L. Butler and the Leader of the Country Party in the Legislative Council Mr. A.P. Blessing. After the opening ceremony a musical programme was broadcast until 10 pm followed by a dance session which ended at Midnight.

The Architects for the studio were Messrs Woods, Bagot, Jory and Laybourne-Smith. They specified walls and ceilings to be lined with Celotex which had high sound absorbing properties. The studio occupied a very large area some 21 metres long by 6 metres wide.

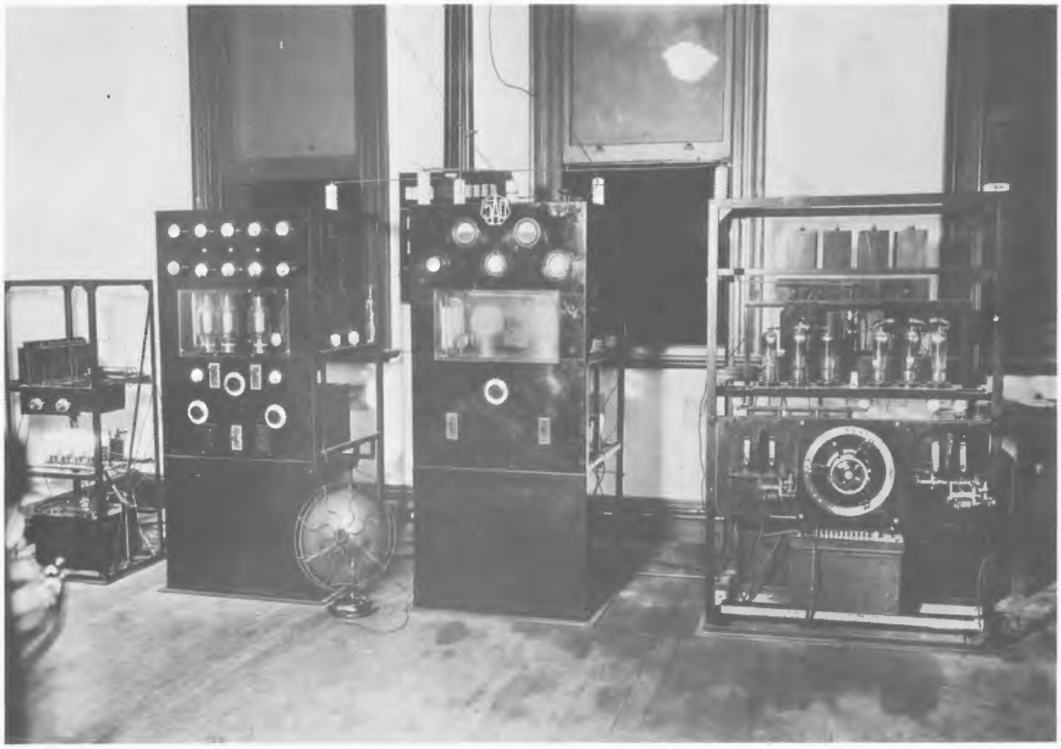
When the transmitter went on air listeners experienced some difficulty in isolating the four metropolitan stations. The problem was particularly bad between 5AD and 5KA which were only 110 kHz apart. Although such a wide separation causes no problems today many receivers in use in 1930 were not very selective and wavetraps had to be fitted to some sets. There were a great number of single tube and crystal sets in use and estimates showed that of 19000 receivers in operation in the metropolitan area at the time about 30 per cent were crystal sets or single tube types with poor selectivity.

The transmitter was designed by Harry Kauper one of the States leading radio engineers. Messrs. Ted Ashwin and Bill Maddocks assisted with the installation. The input to the final stage when commissioned was 560 watts. The licenced power into the antenna was 300 watts unmodulated carrier and the frequency 1310 kHz. The transmitter had a linear final stage using two air cooled tubes in parallel. Soon after a water cooled STC 4228 tube was fitted. Distilled water for the tube was purchased in 200 litre drums from Fauldings. The rectifiers employed in the e.h.t. supply were arranged as a single phase bridge scheme for the 2000 volt supply and as a three phase full wave scheme for the 5000 volt supply. The rectifiers were mercury vapour 866 types. The high voltage equipment for the rectifiers was supplied by Newton, McLaren Ltd. The oil filled 5000 volt transformers were manufactured in their local workshops.

The final stage of the transmitter was modified about 1939 when the linear stage was replaced with a high level plate modulated stage. Further modifications took place in 1947 when the modulators and final tube types were changed from Amperex 849A to RCA 833A.

The first commercially manufactured transmitter was purchased from STC Sydney for installation at Cavan. This was a 2.5 kW type using in the high level stages, tubes type 4279Z. This was installed in 1954. In 1968 an STC type 4-SU-55D replaced the earlier STC transmitter.

The antenna on commissioning of the station was a T type suspended between two wooden masts, one being on the building in No. 11 Waymouth Street (now the Editorial Building of the Advertiser) and the other on the building where the transmitter was installed. The antenna was about 50 metres above ground level. Later a 50 metre high self supporting insulated tower was erected and is still a city landmark. It is now used to support v.h.f. antennas and can be put into use in an emergency with a 500 watt transmitter. When the station power was increased to 2000 watts in 1954 a new 86 metre high lattice steel mast was provided at Cavan. The mast material was supplied by Metters Limited and the erection carried out by Mr. J. Ratcliffe. The radiator is used in a dual frequency mode, being also used by the 5KA transmitter.



Original 5AD transmitter 1930.

The early studio equipment consisted of a number of Philips carbon microphones and two B.T.H. magnetic pick-ups. There were two turntables of the spin-start synchronous speed types. In the control room a four channel input audio mixer was installed together with turntables for playing discs from the control room. These were a popular type known as the "Green flyer".

In 1937 an R.C.A. heavy duty two speed turntable was installed for the playing of 40 cm (16 inch) diameter discs for both lateral and vertical cut grooves. New turntables replaced the spin-start type during 1939 — these being two speed Presto types manufactured in the U.S.A. by a well known supplier of disc recording apparatus. Turntables in use in 1977 were three or four speed models manufactured by the Rola Co. of Australia.

Disc recording equipment was installed in 1937-8 for the production on a commercial scale of recorded features. A new recording studio 8 metres by 7 metres was set up conforming to specified acoustic requirements. It was lined with the latest sound absorbing material known as "Sorb-soun".

The studio was constructed on what was known as the semi floating principle i.e. it was practically isolated from the rest of the building which housed it. The arrangement ensured that noises were not transmitted to the recording equipment via the building members.

The recording plant had a frequency response almost flat from 35 to 8000 Hz and was fully duplicated to provide for continuous recording. Two recording turntables were supplied by A.W.A. The recording head was a Presto 1B while the audio equipment was built by the 5AD staff.

The transcriptions had a mirror smooth surface of cellulose acetate and were cut with a sapphire stylus which provided polished grooves thus minimising needle noise. Playbacks could be cut for direct replay or for processing on blank discs ranging from

25 cm to 43 cm in diameter and providing up to 30 mins playing time on each side. As a result, a one hour show could be recorded on one 43 cm diameter disc. Two master discs were cut for each feature and these enabled additional copies to be made when required. One well known production was "Yes What", originally the "Fourth Form of St. Percys". Another station feature was to disc record broadcasts from ships berthing at Outer Harbour and to replay them to air after editing.

Part of this recorder and some of the blanks are now in the possession of Mr. A. Matthews and were shown at the 50 years of Broadcasting Display in the G.P.O. in 1973. Alan Matthews played a major role in developing wire and tape recorders used at 5AD. He assembled the first wire recorder about 1940 but it was only a partial success mainly because of high distortion and reliability problems.

Following difficulties experienced in operating a disc recorder as a mobile unit for recording General Montgomery's progress through the streets of Adelaide, the wire recorder was rebuilt. Piano wire was used but it was far from ideal as the wire would not easily retain the magnetic impressions. It was erased by a permanent magnet and biased for linearity firstly by accurately locating a permanent magnet and later by current from a torch cell. The amount of current through the head was very critical and because the transformer iron used in construction of the head was not suitable the recording was subject to erasure on replay. A coil near the head subsequently corrected the problem.

The wire was thick and the reels had to be large to hold 5 to 10 minutes of programme. Replays were first dubbed on disc. When first used in 1946 it was one of the first of its kind in Australia. Commercially produced units soon became available and in 1948 5AD purchased one of the early Pyrox models.

In 1952-53 Alan developed a clockwork tape recorder which was used to make a recording in an aircraft to cover the Redex Trials on 13th August 1954. It was the first time 5AD made a recording in an aircraft for re-broadcast.

A great variety of microphones have been employed for studio work since 1930. As new and better quality types became available these were installed. The type most consistently used until 1960 was the RCA type 44B (a velocity type). This was first used at 5AD about 1937.

The design of studio desks remained basically unchanged until about 1966 when announcers were given control of all on-air programme levels. The equipment has in more recent years been installed in 'U' or horseshoe shaped desk to include disc playing cartridge tape players, microphone channels and outside broadcast switching.

The station participated in one of the first Interstate relays when on 2nd February 1932 a tennis talk programme was relayed from 6ML Perth. Other stations which were linked in the hookup were 3DB Melbourne and 2UW Sydney.

During the war years a short wave listening station was established at Northcote (near West Lakes) for the reception of BBC news services for use by radio stations and the newspapers. The radio news services were relayed from the Advertiser offices for 5AD and 5DN (5KA having been closed down until December 1943). An emergency transmitter was built and installed in the basement of Mr. H.N. Bowman's residence, Battams Road, Payneham. It was jointly financed by 5AD and 5DN. There was never any cause to put it into operation.

A large number of technical staff have been employed at 5AD over the years, not only in connection with its own local activities but also in connection with rebuilds and new facilities at network stations in the country. Staff employed up until the outbreak of the war include Messrs. H. Kauper, E.K. Ashwin, W. Maddocks, D.M. Gooding, L.G. Porter, T.W. Welling, H.W. Tostevin, H.B. Wilson, B. Forgan, R.R. Withall, E.F. Halliday, R. Parasiers, W. Gill, J.L. Schaumloffel, H.N. Bowman and F.L. Williamson. During the war years Mr. A.R Matthews became a member of the staff. Those

employed since the end of the war include Messrs. D. Gooding (Jnr.), N. Martin, N. Taman, J. Harvey, M. Boxer, K. May, R. Windschied, G. Wright, J. Barker, R.S. Langhans, W. Brooks, M. Dean, J. Kotyla, B. Nash and M. Rogers.

The first Chief Engineer was Harry Kauper who came over from 5CL to establish 5AD when the former was taken over by the Post Office. He only stayed a short while and in 1931 Don Gooding took over as Chief Engineer.

Don Gooding was educated at the Port Pirie High School and joined the RAN in 1915 as a radio telegraphist. From 1921-24 he served as a ship's operator in the merchant marine and from 1924-30 worked with Central Broadcasters Ltd on 5CL. Shortly after the Post Office took over 5CL, Don transferred to 5AD where he remained as Chief Engineer until 1958 when he left to become Chief Engineer at ADS-7 until 1961 when he died. He served a period on the Council of the Royal Flying Doctor Service.

The present Chief-Engineer Lew Schaumloffel was educated at the Unley High School and the School of Mines before joining 5AD as a Junior Technician in 1937. He worked there until 1942 when he took up the position of Chief Engineer at 2BH where he remained for five years. After a period with the PMG Radio Laboratories in Adelaide, Lew returned to 5AD and in 1958 became Chief Engineer. He has been active in Amateur radio since 1939 when he operated VK5LS. While in NSW he operated with call sign VK2JM.

5AA

Applications for a fourth commercial station in Adelaide were called in the Australian Government Gazette of 16th July 1974. The closing date was 29th November 1974 and applications were lodged by:-

(1) Festival City Broadcasters Pty. Ltd.
(2) Adelaide Community Radio Pty. Ltd.
(3) Radio Adelaide Pty. Ltd.

The Australian Broadcasting Control Board convened an inquiry on 3rd March 1975 in Adelaide. It was concluded on 11th March and on 25th June 1975, the Minister offered to grant a licence to Festival City Broadcasters Ltd. for establishment of the station.

The granting of the licence was subject to the following technical conditions:-

(1) The station was to operate on the frequency 1390kHz which was to be shared with 2LT Lithgow and 4LM Mt. Isa.
(2) Power to be a maximum of 2000 watts with an increase to 5000 watts when existing commercial broadcasting stations in Adelaide increased power to 5000 watts.
(3) The provision of a directional antenna system designed to limit radiation on 064^{o}T to not more than 50 mv/m at 1 mile unattenuated.
(4) The transmitter site to be generally North of Adelaide.

The inquiry was of special significance as it was the first inquiry held by the ABCB into applications for a licence for a commercial station in a capital city of any State. The last licence granted for an Adelaide station was that of 5AD in 1930. At the time Adelaide was the only mainland capital city with less than four commercial stations. Perth had four, Brisbane had five and Sydney and Melbourne each had six stations.

The company was granted a licence for a period of five years from 13th March 1976 and went on air at 7.00 a.m. on 14th March 1976 using call sign 5AA.

The technical studio and transmission facilities including two 2 750 watt transmitters operating into a combining unit and computer controlled studio equipment were designed, supplied and installed by Amalgamated Wireless (Aust) Ltd. of Sydney. Standby power plant units for both transmitters and studios were supplied by Evan Jones of Adelaide.

The transmitters located at Bolivar were the first commercial station units in South Australia to feed a power of 5000 watts into the antenna system.

The directional antenna with twin 54 metre high masts was the first in the metropolitan area.

The studios are located at Fullarton Road, Kent Town and comprise the most modern facilities capable of either manual announcer control or fully automatic control. Programmes are broadcast 24 hours daily.

John Ferguson who formerly worked in Western Australia was in charge of the technical facilities assisted by Wayne Cherry.

5UV

In 1972 the Adult Education Department of the University of Adelaide was granted a licence for the operation of a station for tertiary educational purposes. The station was to be used for transmitting lecture material — other than music — to students.

The service was licensed by the Australian Post Office under the Wireless Telegraphy Act as there was no provision in the Broadcasting and Television Act for authorisation of such a service. The call sign was VL5UV and transmissions commenced on 28th June 1972 on a frequency of 1630kHz using an output power of 300 watts from a transmitter installed on a site in the Dry Creek area North of Adelaide. The studio was located on the University grounds North Terrace.

During 1974 considerable public discussion took place throughout Australia on the subject of public broadcasting — an all embracing term incorporating educational, community, ethnic, music and other special interest type non-profit broadcasting services. The discussions included a conference and seminar in Sydney in July followed by a similar study sponsored in Adelaide by the University of Adelaide during November of the same year.

Ministerial approval was subsequently granted for the transfer to the AM broadcasting band of the University of Adelaide station. As from 24th February 1975 it operated under call sign 5UV on a frequency of 530kHz and transmitter power of 500 watts. From that date, programmes have included music, "public access" programmes as well as adult education courses and topical talks.

Commercial Country Services

The extension of 'B' Class commercial stations into country areas soon came under consideration by both the Government and commercial groups following the successful commissioning of 5DN in Adelaide. The manufacturers and distributors of radio receivers were also anxious to see stations put into operation in country areas — either national or commercial — in order to boost sales.

One of the first surveys to assess likely receiver sales was conducted by Mr. W.J. Bland of Harland Radio Co. who carried out a tour of Yorke Peninsula in July 1925. He took a Harland Special Four receiver to explore reception conditions and to demonstrate to local residents the use and development of radio. Demonstrations and tests were carried out in the Institute Buildings of all the principal towns on the Peninsula and in most cases attracted large crowds. The Adelaide stations 5CL and 5DN were heard at good volume and so were Interstate stations 3LO Melbourne and 2BL Sydney. The Interstate stations however were subject to a great deal of fading. Although Mr. Bland saw only a few sets throughout his travels, everywhere people were "talking wireless" and they saw big things ahead for it.

A major problem with setting up a commercial station in country areas was the low revenue expected even from large towns such as Mt. Gambier and Port Pirie. This was later borne out by experience at Port Pirie and Murray Bridge where the managements found it extremely difficult to raise more than £7 a week in revenue. Also, in the late twenties the economic situation throughout the nation made it difficult to find financial backers for radio station ventures.

In October 1930 the Government decided to examine the position in South Australia to see where B Class stations might be established in the future in order to assist in the orderly allocation of frequencies. After a detailed study by experts, opinion was that such stations might be profitably established at Mt. Gambier in the South East, Renmark, Loxton and Morgan in the Murray River district, Port Lincoln on Eyre Peninsula and at Port Augusta. As those areas were poorly served by Adelaide broadcasting stations at the time it was considered that they would be subjected to very little competition. A National regional station had already been planned for installation at Crystal Brook and it was considered inadvisable to licence any further stations in the Port Pirie and Yorke Peninsula area.

In October 1931 a Victorian business man indicated that he would be prepared to support establishment of a station in Mt. Gambier if a licence could be obtained. The population in Mt. Gambier was about 12000 within a radius of 40 km and 16000 within a radius of 80 km. These figures only included those people living in South Australia and as a station located at Mt. Gambier could also be expected to cover a significant part of Victoria the total population served by a station at Mt. Gambier would have been much greater. In May 1932 approval was given for establishment of a station on a site about 3 km east of the Post Office to operate on a frequency of 1490 kHz, with a power of 50 watts unmodulated carrier and call sign 5MG.

The Company was registered as the Mt. Gambier Broadcasting Co. Pty. Ltd. and a schedule of advertising rates showed that broadcasting was to be conducted between the hours 10 a.m. to 5 p.m. for an advertising rate of £5 per hour or 15/- for 120 words and between 7.30 p.m. and 10.30 p.m. for a rate of £10 per hour or £1 for 120 words. The rates covered only broadcasting time and station facilities. Additional charges were to be made for artists, orchestras, landlines etc. but no charge for gramophone music. The coverage area was stated to be South East of South Australia, Murray River Irrigation areas and Western Victoria. The company expected to commence transmissions on 1st November 1932. However, it was not able to secure the necessary capital to enable purchase of equipment for the work to proceed. The licence was subsequently cancelled on 28th March 1933.

On 7th January 1932 the first broadcasting station to be established in the country area of South Australia commenced transmissions. It was 5PI Port Pirie operated by the Midlands Broadcasting Service. In the same month another Port Pirie firm, Musical Recreations announced its intention of establishing a commercial station in a country centre. In order of preference the company suggested Port Pirie, Victor Harbor, Clare, Mt. Gambier, Port Augusta and Renmark. They proposed to form a limited company with a capital of £3000 using a 250 watt transmitter to broadcast continuously from 6 a.m. until midnight every day. No frequencies were immediately available from the authorities and the plans were shelved.

Attempts have been made since 1931 to establish a commercial station at Port Lincoln but without success. A local resident complained in October 1931 about the inadequate service being provided by a local experimenter and made enquiries about conditions for setting up a full time broadcasting station. However, he did not proceed with the matter. Early in 1932 the Radio Advertising Company based in Adelaide announced plans to establish a station in Port Lincoln. They proposed a transmitter of 750 watts unmodulated carrier power situated about 4 km out of town. A licence was issued on 15th March 1932 allocating call sign 5EP. The Company had also arranged to install a station in Bunbury, Western Australia, and because of extended delays with the Bunbury project and the inability to obtain sufficient capital for the Port Lincoln station the scheme was abandoned in 1933. In 1935 Mr. Colin L. Bottrall, a Radio and Electrical Contractor of Port Pirie sought permission to establish a low power station in Port Lincoln but in April 1936 decided not to proceed as the delay in obtaining a licence

had resulted in backers withdrawing financial support for the venture. Mr. Bottrall had been associated with the successful establishment of 5PI in Port Pirie some three years previously. The last attempt to get a commercial station on the air in Port Lincoln was abandoned in May 1971.

Savery's Pianos Ltd. of Adelaide in January 1932 investigated the feasibility of setting up a station in Gawler with a 500 watt transmitter. The plan was to produce the programmes in studios in Adelaide and use a programme line to connect with the transmitter. The intention was to provide a third commercial station for Adelaide listeners as well as to cover the Barossa Valley towns. The company received advice that no frequency was available and so plans were dropped. They then sought approval to set up a 100 watt transmitter in Broken Hill for operation initially on three hours daily during the evening with the programmes being produced in Adelaide. This also had to be abandoned because of the lack of a frequency.

In 1934 Mr. W.H. Barber, Principal of Radio and Mechanical Devices a firm of radio, mechanical and electrical engineers endeavoured to set up a station in Port Pirie. Mr. Barber was the licensed operator of experimental station VK5WH. He had been associated with the establishment of 5PI in the town in 1932, and operated it before it was sold and shifted to Crystal Book. He proposed a transmitter of at least 50 watts located on a vacant site opposite 164 Ellen Street with programmes consisting of recorded music, relays, advertising and items of general interest in and around Port Pirie. Hours of transmission were to be 12 noon to 3 p.m. and 6 to 10.30 p.m. A company with a capital of £5000 was to be set up to install and operate the service. However, it was considered by the authorities that the district was well covered by 5CK and 5PI and no licence was granted.

In the same year at least three groups made efforts to establish broadcasting stations in towns along the Murray River. One group based in New South Wales proposed a station at Renmark while H.E. Hall and Co. of Berri proposed a 50 watt station at Berri. Both schemes collapsed for want of a frequency allocation. The only proposal which was supported during this period led to the establishment of 5MU at Murray Bridge on 16th September 1934. Twelve months later 5RM at Berri also on the Murray went on air.

Two interesting proposals were put forward in 1935 to provide low power services to several country towns. One of the schemes developed by an Adelaide business man who operated an Amateur station was to use 50 watt transmitters geographically situated so that the service area would not overlap the areas of the other stations. It was proposed that they all share a common frequency and that the stations be located at Port Augusta, Port Lincoln, Port Pirie, Peterborough, Kadina, Gawler, Victor Harbor and Mt. Gambier. The plan was to obtain local interest through musical societies, bands, clubs etc. and to earn revenue by advertising. Transmission hours were to be 7 p.m. to 11 p.m. The second proposal put forward by Mobile Broadcasters of S.A. Ltd. involved one self contained transmitter mounted in a van and shifted from town to town. Power supply was to be provided by an engine/generator set and the antenna was to be fixed to collapsible masts erected in close proximity to the building selected in the various country towns as a temporary broadcasting studio. The programmes were to consist of recorded music, sponsored sessions and local community concerts etc. Advertising was to be obtained from manufacturers and wholesalers interested in the sale of purely rural products and from local business people. Country towns in which the company proposed to operate included Mt. Gambier, Millicent, Wallaroo, Kadina, Moonta, Kapunda, Victor Harbor, Clare and Tanunda. These schemes received no support for licences and were subsequently abandoned.

The next three years saw the commissioning of two more commercial stations in country areas. In 1937, 5SE was put into operation in Mt. Gambier and in 1938 5AU was commissioned in Port Augusta. No further country commercial stations have been

commissioned since in the State, although proposals have been put forward from time to time for new stations. Some of these proposals up to the end of the war included the establishment of stations at Clare in 1939 and again in 1945, Whyalla in 1940, Wallaroo in 1941 and Nuriootpa in 1945.

5PI Crystal Brook

The first country broadcasting station established in the State was 5PI operated by the Midlands Broadcasting Services Limited, Radio and Electrical Engineers, Radio House, 192-4 Ellen Street, Port Pirie. It commenced transmissions on the 7th January 1932 some two months before the first National Regional station 5CK located not far away in Crystal Brook. A licence to establish the service was issued on 24th November 1931. Those behind the establishment of the station included Messrs. Bill Forgan, Merv. Middleton, Colin Bottrall, Bill Barber and Harold Elliot. Mr. Bottrall was still active in Port Pirie in 1976 as a radio and electrical contractor.

The first transmitter was the experimental transmitter belonging to Mr. W.H. Barber who operated with call sign VK5WH. It had a rated input of about 20 watts using a single Philips TB 04/10 tube. The transmitter was located in a room devoted to general repair work of the business run by Mr. Barber. Later a new transmitter built in Adelaide to a circuit by Don Gooding was installed. It had a rated input of 50 watts to the final stage and was crystal controlled. The oscillator tube was a Philips TB 04/10 tube with 300 volts on the plate. The modulator was a 50 watt Philips unit driven by a two stage amplifier. High level modulation was employed on a modulated amplifier Philips tube with 500 volts on the plate. The high tension was provided from a full wave rectifier supply using 866 type rectifiers. Bias was supplied by 'C' batteries. To prevent radio frequency entering the town main supply, wave wound r.f. filters were fitted to the supply leads.

At first a temporary antenna was provided consisting of a single wire 20 metre in length running from a short pole to the roof of an adjoining building. This was later replaced by an antenna using two wooden mast supports each 24 metres high supplied and erected by Mr. Caldicott of Bowden. They were constructed from double plank oregon timber bolted together at the bottom section with a single 10 cm square upper section and guyed with 16 wire ropes. The antenna was a Zeppelin type with a fan shaped counterpoise suspended 5 metres above the ground.

When the station ceased to operate from Port Pirie the masts were purchased by Mr. Bottrall and one erected at his place of business at 136, The Terrace, Port Pirie. In 1941, it crashed to the ground during a violent storm but the upper section was recovered and in 1974 was being used to support one end of a 30 metre dipole for his station VK5ZNB. Portion of the original butt has been preserved in the Telecommunications Museum.

The microphone was a heavy Philips type. Later a condenser type made in Adelaide was used. A pick-up of B.T.H. make was used for playing gramophone records. One of the few pieces of test equipment was a wavemeter which operated with a pea lamp to indicate the transmitter frequency. Normal operating frequency was 1040 kHz.

Programmes were broadcast from 7 p.m. to 10.30 p.m. Monday to Saturday and 7 p.m. to 10 p.m. Sunday. The published schedule programme for February 1932 was:

7.00 p.m. Bedtime Stories by Auntie Trixie, Uncle Harold, Auntie Betty and Uncle Bill.
7.30 p.m. Musical items.
7.45 p.m. Talks of local interest.
Monday — The Solomontown Swimming Club.
Tuesday — The Automobile Assn. of S.A.
Wednesday — The B.H.A.S. Athletic Association.
Thursday — The Port Pirie Motor Cycle Assn.
Friday — The 5PI Radio Club.
8.00 p.m. Close — Musical Programme.

The first full-time announcer was Miss Bonnie (later Mrs. Daphne Norton) who started when 19 years of age with the Childrens Session. The transmitter technician doubled as an announcer for the Sunday session.

The venture was not a financial success because of the small revenue received from advertisements. It was acquired by the Advertiser in 1932 and subsequently replaced by a new station on a site near Crystal Brook. Approval to relocate and upgrade the station was given on 5th February 1934.

The new station was declared open at 7 p.m. on 1st June 1934 by the Prime Minister, Mr. J.A. Lyons on relay from Melbourne. The station had been put on air at 6.45 p.m. and broadcast a peal of bells for 15 minutes to enable country listeners to tune in. At the conclusion of the speech a programme from 5AD studios in Adelaide was relayed through the station. The programme included music and cricket scores in the match between Australia and Surrey. At 9.45 p.m. Mr. Vic. Richardson gave comments on the play. Darby Tostevin and Merv. Brown were in charge of the station.

Initially programmes were broadcast from 9 a.m. to 9.30 a.m., 10 a.m. to 1 p.m. and 5 p.m. to 11 p.m. Mondays to Friday, 1 p.m. to 11 p.m. Saturday and 5.30 p.m. — 10 p.m. Sunday.

Reports of reception during the test period from 11th May and soon after it began regular transmission were received from all Australian States and from New Zealand. Listeners in Invercargill and Wellington reported signal strengths to R6. An Adelaide listener with a two tube receiver said signal strength was strong enough to drive a loudspeaker while another listener at Bordertown reported good signal with very little fading.

The new station was equipped with a 2000 watt transmitter designed by Don Gooding, Chief Engineer of 5AD and constructed by the 5AD technical staff. The station was the first 2000 watt station established in South Australia. The crystal oven was a wooden box about 25 cm cube with a hinged lid to give access to the crystal holder which had provision to vary the air gap between the holder and crystal for frequency adjustment. In 1945 an AWA type was installed with frequency adjustment being effected by a variable capacitor across the crystal.

The final stage was a linear amplifier using STC water cooled tubes type 4228A. There were two d.c. filament generators giving 24 volts at 100 amps and two water pumps which circulated rain water through the tube cooling system. In 1939 the final radio frequency stage was modified and high level modulation equipment installed.

During 1945 the final water cooled tubes were replaced with two air cooled type 833A tubes connected in parallel. In 1952 these 833A's were replaced with a Philips forced air cooled type TBL 6/6000. About the same time a standby 1000 watt transmitter was built by 5AD/5PI technical staff. A new STC 2000 watt transmitter 4-SU-55D was installed in 1967 and is still in operation.

The original antenna was a six wire cage type with 30 cm diameter rings supported by two 41 metre high oregon pine masts. The supports were 203 mm square at the base. Each mast was guyed at six levels and they were spaced 16 metres apart. The antenna was an Alexanderson type with each end being tuned to ground by variometers. Some years later after the antenna had been dismantled some of the sections were taken to Port Augusta where they were cut up and used as masts for small boats.

New halyards were fitted to the antenna on 27th June 1940 and again in April 1942, March 1946 and a new antenna erected on 13th November 1949. A 153 metre high lattice steel antenna guyed at four levels was erected on 27th May 1953 and provided with a buried copper earth mat which covered practically the whole of the triangularly shaped property. A lattice steel standby radiator 39 metres high was put up on 20th May 1961.

The station was also provided with studio facilities including a programme input panel, a condenser microphone, two turntables fitted with magnetic pickups of the BTH type, a wall mounted speaker, a panel set in flush with the desk comprising faders, and keys and also Morse Code keys for communication with 5AD staff in Adelaide over the land line. The tubes used in the equipment were types 57, 58 and 2A3 (2.5 volt indirectly heated types).

The original building and residence were still in use in 1977 but have undergone some alterations since erection because of damage. A few days before Christmas 1938 a gale tore the roof off the house and demolished two chimneys. In 1940 the station building suffered some severe cracking due to foundation movements and had to be underpinned. In January 1942 the windows were blackened and wire mesh fitted to meet war time requirements. In April 1943 one of the water tanks was blown away during very high winds and in September of the same year the verandah area of the building was cemented. In October 1947 the walls of the house and station were rough cast cement rendered and the two buildings repainted.

The station has now been in operation on its present site for over 43 years and many operators have worked there. Some have spent only short periods on relief duties while others have had extended periods of duty. Most left to serve duty at other stations in the network, some went to National Broadcasting Service stations, and some left for war time service. Included in the list are Messrs. L.G. Porter, T. Welling, M. Brown, H.W. Tostevin, E.F. Halliday, R.R. Withall, G.W. Connon, L.E. Catford, B. Forgan, A.R. Matthews, P.R. Walker, J.N. Combe, N.W. Growden, D.P. Gooding, G. Albucht, W.S. Dickie, W. Govan, G. Nicolai, A.S. Hart and H.N. Bowman. Those responsible for operations and maintenance in 1977 were Messrs. R.H. Bailey, H.A. Behenna and R.H. Grundy.

Bob Grundy Officer-in-Charge in 1977 did his first tour of duty at the station in 1939. He became Chief Engineer on 12th March 1952. Bob is an active Amateur with call sign VK5BG and in 1938 was a member of the "Leichhardt Expedition" to the Simpson Desert where he operated a pair of Traeger pedal transceivers for communication. Dry batteries were taken on the trip and consequently the pedal system did not get a great deal of use.

Another Chief Engineer who was at the station for a long period was Len Porter. He started at 5PI on 20th April 1934 before the Crystal Brook transmitter went on air and became Chief Engineer in 1936, remaining there until 1952. Len joined the Royal Australian Navy during the 1914-18 war as a trainee wireless operator on spark transmitters. He was a keen Amateur operating with VK5MP and experimented with various antenna systems. It is believed that he was the first Australian to contact all forty eight States of the U.S.A. on 28MHz. During the 1939-45 war he studied the Japanese code and was offered a position in 1943 in Intelligence. His service with the Advertiser Broadcasting Network exceeded 35 years.

5MU Murray Bridge

The Postmaster-General considered the question of establishing a station in the Murray Bridge area for a long time before giving his approval for a licence to the Murray Bridge Broadcasting Company. Those behind the Company were Mr. H.W. Smith, Managing Director and Mr. F. (Frank) G. Miller a well known local experimenter who designed and built the transmitter and studio equipment.

The transmitter/studio building was erected on a site at the corner of Eleanor and Thomas Streets, Murray Bridge. The station with call sign 5MU went on air on 16th September 1934 with a 50 watt transmitter on frequency 1450 kHz.

The programme schedule allowed for broadcasting on Monday, Tuesday, Wednesday, Thursday and Friday evenings from 7 p.m. to 9.30 p.m., Saturday from

7 p.m. to 10 p.m. and Sunday from 10 a.m. to 11 a.m., 2 p.m. to 3 p.m. and 8.30 p.m. to 9 p.m. The programmes included relays from one of the city stations and regular broadcasts of the latest gramophone releases.

The station was not a financial success because of the poor support by local business for advertising time. It was purchased by the Advertiser Newspapers Ltd. in 1935, only a relatively short time after the station had been commissioned.

The 50 watt transmitter was modified by 5MU staff with a linear amplifier output stage to a design by Don Gooding of 5AD to give an output of 200 watts. Alternating current was provided by an alternator driven by a d.c. motor powered from the town supply. From 1st May 1954 the station output was further increased to 500 watts. The station later operated with a daytime power of 2000 watts and night time power of 1000 watts using an STC transmitter type 4-SU-55 installed on 1st December 1965. The frequency was 1460 kHz, having been changed on 15th August 1939.

The original antenna was a Marconi quarter wave flat top type with six metre spreaders. It was strung between two wooden masts 30 metres in height. The masts were in three sections, spliced at each joint with galvanised hoop iron. Carpentry was by Mr. Ted Faehrmann a local carpenter and the erection was supervised by Mr. Miller. On 14th October 1949 the antenna was replaced by a tubular guyed radiator 50 metres high installed over a radial earth mat.

The ownership of 5MU was transferred to the Murray Bridge Broadcasting Co. Ltd. on 1st January 1974. A studio was constructed in the premises of Bridge Printing Office, Seventh Street and broadcasting from the studio commenced on 1st May 1975.

In October 1977 the early standby transmitter was replaced by an STC model. The transmitter was donated to the Telecommunications Museum in Adelaide.

Technical staff who have worked at the station on its operation and maintenance include Messrs. F.G. Miller, R.H. Grundy, R.E. Dube, L.P. Porter, R. Parasiers, C. Davidson and K. May.

Frank Miller who remained in charge until February 1953 was well known in the field of early experimental broadcasting with his station 5BF. Born in Maitland, South Australia in 1896, he was a signaller during the 1914-18 war and assisted in the development of the teletype machine. He worked on this while in the trenches and was credited with its invention by the Royal Signal Corps. Acknowledgement of this achievement was sent to his parents by cable from London. He was attached to the 32nd Battalion Signal Corps serving in Egypt and France. Frank was also associated with one of the first two way radios for EFS work. He made the equipment for the Mobilong District Council to operate on 2980 kHz. A base station installed at the Murray Bridge Council Chambers powered from the 230 volt d.c. mains was controlled by Bod Grundy while Frank took charge of the portable unit which was powered by batteries and a vibrator. The antenna system was at one time supported by four broom handles at the four corners of a caravan. However, a fair deal of trouble was experienced with the antenna as it was often damaged by overhanging tree branches.

Mr. Dube also served at the station for a long period. He commenced as a technician in March 1949 and took over as Officer-in-Charge in 1966 from Bob Parasiers. He joined the R.A.A.F. in 1939 as a radio technician in training. Late in 1940 he served with the Dutch Fleet Air Arm in the Netherland East Indies. He also spent a period in the Research Laboratories of the Post Office in Melbourne. Mr. Dube passed away on 24th October 1974.

5RM Renmark

The principal groups behind the company which established 5RM were the Australian Dried Fruits Association, the Murray Citrus Growers Association and certain Adelaide interests including Savery Pianos Ltd. The station was commissioned on 30th September 1935. It was originally allocated a wavelength of 319 metres with the

proviso that it be changed to 353 metres from the 1st September. However, as the station did not go on air until the end of September it started up on 353 metres (850 kHz). It was the longest wavelength of any commercial station in Australia at the time. The present operating frequency is 800 kHz.

Programmes were initially broadcast from 7 p.m. to 10 p.m. but after some weeks the period was extended so that the station broadcast Monday to Saturday at 7 a.m. — 8.30 a.m., 12 noon — 2 p.m., 6 p.m. — 10 p.m., and Sunday 6 a.m. — 10 a.m. Programmes were provided from the local studio and on relay from 5DN after a programmes line to Adelaide had been provided. This arrangement continued until 1952 when programmes from 5KA on relay were broadcast. Studios erected in Berri in 1965 now provide most of the programme material. The facilities include three studios and a control room.

The company was registered as River Murray Broadcasters Ltd. with Mr. W. Queale as Chairman. Mr. H.R. Pinkerton was Managing Director and the River interests on the board were represented by Messrs. C.S. Ruston (Renmark) and A.P. Wishart (Berri). Mr. R.W. Pfeil was appointed advertising Manager and Announcer and Mr. Jas. P. Jack who had worked at 5KA was appointed Chief Engineer. Subsequent technical staff include George Barber, Frank Hill, Pat Giddings, Dud. Wilkinson, Andy Fisher, Jack Lester and Hughie Lloyd. Hughie Lloyd Officer-in-Charge in 1977 first worked at 5RM in 1940. He returned in 1942 and has been there ever since.

The site for the station was chosen by Ern Hume of 5DN after a two weeks detailed examination of the country between Waikerie and Renmark using a portable transmitter for field strength assessment purposes. The station was constructed on Murray Heights about one kilometre upstream from Spring Cart Gully and 50 metres above the river level. The architects for the building were Messrs. Ashton and Fisher of Adelaide and the building contractors were Messrs. Kennett and Daniel. The building which contained seven rooms included a machine room 8 metres by 5 metres, transmitter and studio and living accommodation for the Chief Engineer. Power for operation was supplied by the Renmark Irrigation Trust at 450 volts, three phase, 50 Hz.

The transmitter was a low level modulated type built by Ern Hume. His brother Jack Hume assisted in the construction with welding and transformer winding activities.

A crystal controlled oscillator, temperature controlled at 50°C was provided with a buffer amplifier and the unit enclosed in a metal box for shielding purposes. The buffer provided drive for a 30 watt screened grid radio frequency amplifier, also shielded. This amplifier in turn provided drive for a 250 watt plate modulated Class C amplifier. The modulated output of that amplifier was taken to a linear amplifier — Class B — which employed two water cooled triodes of 4220 C type with one in service and the other as spare. A spare water jacket was fitted at the same time to allow for future power output increase.

Output from the linear amplifier was connected to a two wire balanced transmission line of 500 ohms impedance. The line was about 200 metres in length and terminated at a coupling box near the antenna feeder. Drive and coupling of the linear amplifier was adjusted to deliver 1000 watts carrier power to the transmission line.

The transmitter contained a feedback amplifier to drive the modulator with audio input level of 6 milliwatts for 100 per cent modulation. The modulator consisted of two 250 watt triodes in Class A push pull arrangement. Filters were provided to provide an audio pass band of 30 Hz to 5 kHz.

Direct current power for plates, filaments and bias was supplied by motor generator sets located in the machine shop.

The original antenna was a flat top Marconi type with spreaders and fed at the centre. The top section was wrecked during a storm and the antenna was then modified as a single wire T type suspended between two wooden mast sections 41 metres high

and spaced 80 metres apart. Each mast was guyed at five levels and the antenna was still in service in 1976. The site was a good choice as the field strength measured at the mile point was found to be close to the theoretical limit. An earth mat installed under the antenna was taken down to the water level in the nearby Murray River by heavy copper straps. The mat comprised about 12 radials varying in length from 20 to 50 metres.

During the first three years of operation some alterations were made to the transmitter layout and location. The transmitter was removed to another room. The layout was changed from a completely enclosed cubicle arrangment to a lengthwise format with components mounted on a framework along the wall.

In May 1939 the transmitter was modified by Ern Hume by rebuilding the linear amplifier section. The output was increased to 2000 watts. The transmitter then consisted of a Pierce oscillator, a 6C6 buffer, a 6F6 untuned buffer, an 860 screened grid first radio frequency amplifier, a 4212E modulated amplifier and a 4220C linear amplifier with 1000 volts d.c. on the plate. The modulators were a pair of 4212D tubes. Filament power for the 4220C was provided by a motor generator set giving d.c. output. Other filaments were fed with a.c.

On 1st April 1952 a lease arrangement with 5DN expired and in November 1952 a new 2000 watt Philips transmitter was put into service. A 200 watt AWA unit was provided for standby purposes. The transmitters were transferred to a new building in 1955 and during the transfer the residential portion of the building caught fire and was destroyed.

In July 1976 the transmitting facilities were relocated on a site just over a kilometre north of the original site. The new building houses the 2kW Philips transmitter and an STC 2.5kW unit. New solid state programme input equipment was provided together with an auto start diesel generating set to maintain transmissions during periods of mains power failure. The antenna is a 120 degree top loaded lattice steel mast with a standard radial earth mast system. The site plan was been designed to take into account a future additional structure for a directional antenna.

The studios are situated at 35 Vaughan Terrace, Berri with programmes being provided 0530 to 2300 daily except Saturdays when transmissions continue until 2400 hours.

5SE Mount Gambier

Station 5SE was the fourth station of the Advertiser Broadcasting Network to be put into operation. It was officially opened by the Postmaster-General Senator A.J. McLachlan at 8 p.m. on 3rd July 1937 by relay from Melbourne. The transmitter was located at Arthur Street, Mt. Gambier.

Transmissions on the first day commenced at 7.30 p.m. to enable listeners to tune in before the ceremony. A special feature programme followed and included "The Fourth Form of St. Percys", "Mr. and Mrs. Everybody", "Lor" and "Lumnee" and "Magazine of the Air".

To mark the opening, the Directors of the Advertiser Newspapers Ltd. entertained prominent business people in Jens' Hotel. The Chairman of Directors, Mr. J.F. Downer said that 5SE was not a relay station like 5PI and 5MU but the South East's own station broadcasting programmes from Mt. Gambier.

The transmitter had an output power of 100 watts and operated on a frequency of 1340 kHz. It was built by 5AD staff under the supervision of Mr. H.B. Wilson who oversighted the installation. The programme input equipment was also built by the 5AD technical staff. R.C.A. inductor type microphones were employed in the studios. The power supply from the mains was 460 volts d.c. and a motor and alternator set was provided to give 220 volts 50 Hz for the equipment.

The transmitter frequency was changed to 1370 kHz as from 5th January 1938 and this led to many complaints from listeners concerning interference from 2LT Lithgow which operated on the same frequency. After sunset, particularly during winter months the sky wave signal from 2LT was at a high level and caused interference in areas just outside of Mt. Gambier. An increase in power of the 5SE transmitter to 200 watts on 27th September 1940 improved the situation.

A 500 watt transmitter built by the 5SE technical staff was commissioned on 15th January 1952. The 200 watt unit was kept as a standby until a second 500 watt transmitter was completed on 7th June 1954. The antenna current using the 500 watt transmitter ws 2.9 amps with input power to the final stage being 756 watts with 2100 volts high tension. The increase in power considerably improved the signal strength in the nearby towns of Penola, Glencoe, Millicent and Port MacDonnell.

A 2000 watt STC type 4-SU-112A transmitter replaced the 500 watt installation on 3rd November 1972. A 1000 watt unit constructed by 5AD staff was installed as a standby. These transmitters were located at a new site at Compton about seven kilometres north west of Mt. Gambier.

The original antenna was an inverted L type supported by two wooden masts 38 metres high and spaced 80 metres apart. It was a three eighth wavelength with a series capacitor. The antenna was replaced on 4th December 1958 by a self supporting lattice steel tower 58 metres high. Concurrently with the shift of the transmitters to Compton on 3rd November 1972 a directional antenna system using two 62 metre guyed masts was provided. The station operating frequency was also changed with the shift.

A new Control Room console was built by the 5SE technical staff in 1964. A new Control Room audio mixer built by 5AD staff was installed in 1972. The following year a new studio desk was installed. On 1st October 1976 new studios were opened in Commercial Street and the station began operating on a 24 hour basis.

In 1950 the studio recording equipment consisted of a Pyrox wire recorder and a disc recording machine. The wire recorder was replaced by a Magnecorder tape machine which in turn was superseded by Rola 77 MK III recorders. Cartridge machines were in use in 1974 and were the Plessey CT80 types.

Mr. H.B. Wilson who installed the station remained for three weeks after commissioning to operate and maintain the facilities. He was succeeded by Mr. Tom Welling as Officer-in-Charge. Other technical staff who have worked at the station at various times include Messrs. B. Forgan, C.A. Ferguson, R. Withall, D. Pitt, A.D. Wood, J.B. Lewis, G.R. Nicolai, S.M. Millowick, J.H. Scheggetman and M.F. Dean.

Tom Welling served at 5SE from 24th July 1937 until his death on 31st October 1960. Tom was born in England and joined the Royal Flying Corps in 1916 as Radio Instructor. In 1920 he joined the Marconi Company and served as a ships radio operator for seven years. He resigned ship in Adelaide in 1926 and joined 5CL in 1929. He left 5CL after it was taken over by the Post Office and joined 5AD staff in 1932 following a brief visit to England. In 1937 he transferred to 5SE. Tom was an active Amateur on VK5TW.

Mr. C.A. Ferguson officer in charge in 1977 served 6-1/2 years with R.A.A.F. Signals from June 1940. He was Shift Technician at 5SE from April 1948 until November 1960 when he was appointed Manager/Engineer-in-Charge. In July 1971 he became Assistant Manager/Chief Engineer. Col. has been a licensed Amateur VK5CJ since 1937.

5AU Port Augusta

In September 1937 the Port Augusta Broadcasting Co. Ltd. announced that plans were being prepared to establish a broadcasting station in Port Augusta. It was the intention to link the station by land-line to 5KA in Adelaide for some of the programmes. A licence to establish the station was issued on 5th October 1937.

Directors of the Company were Messrs. H.L. Tucker, A.A. Bottomley, O.W.K. Rischmueller, G.E. Haddy and A.R.R. Higginson. Mr. Haddy was the Secretary. It was a private Company and the directors decided that no public call for capital would be made.

The station was officially opened by the Mayor Mr. L.G. Riches M.P. shortly after 7 p.m. on 25th May 1938. A musical programme including items by local and 5KA artists was broadcast during the evening. Although associated with 5KA, the station broadcast its own programme except on isolated occasions. The initial broadcast times were Monday to Friday 7 a.m. — 9 a.m. and 6 p.m. — 10.30 p.m., Saturday 7 a.m. — 9 a.m. and 6 p.m. — 11 p.m. Sunday 8 a.m. — 10 a.m. and 6 p.m. — 10 p.m. Mr. Harvey Heath was engineer-announcer in charge of the station.

The station was housed in a large building situated on a hill near the hospital. The building which contained many rooms was formerly the home of Mr. H. Boully a well known pastoralist. The interior was redecorated and the studio rooms equipped with sound absorbing material.

The transmitter had a power output of 200 watts and was made by A.W.A. Sydney. The installation was carried out by Messrs. Charlie Tareha, R. Kitto and Nutley. The completion of the work was delayed for some time when vital parts of equipment were over-carried to Geraldton in Western Australia. The power supply in Port Augusta was 200 volts d.c. two wire and 440 volts d.c. three wire. A motor alternator set was provided to power the transmitter. The motor was powered by the 440 volt d.c. supply and the alternator produced 230 volts a.c. single phase. The station transmitter power was later increased to 500 watts.

The transmitter was intalled in an alcove off the main studio with an open wire transmission line being taken through the wall via lead-through insulators to a coupling box near the base of the mast.

The announcer's table and control console was built in one piece with three Garrard turntables supplied by South Australian Radio Pty. Ltd. of Adelaide. R.M.F. wide range high fidelity pick-ups and a Universal Standard microphone were supplied by M.L. and R.C. Fitton Ltd. of Adelaide.

The 58 metre high antenna was a bore casing type mast supplied by Colton, Palmer and Preston Ltd. It was 15 cm diameter at the base tapering to 10 cm at the top. Five sets of guys broken up with 96 egg type insulators were used. The structure stood on a porcelain insulator and a base about 60 cm above ground. It was erected in sections by Messrs. Tareha, Oakley and Kitto. Almost 8 km of copper wire went into the radial earth mat. The mast was painted in black and white bands and was a landmark in the district.

On 8th January 1941, the station along with 5KA was closed down when National Security Regulations were invoked. It was reopened on 6th December 1943 by the Postmaster-General Mr. Ashley. Messrs. Harry Cooper and Staunton McNamara put the station into operation.

In 1961 a new transmitting station was established at Nectar Brook with a 2000 watt STC transmitter and directional antenna system using two 50 metre high lattice steel masts. The increased power and directional antenna increased the coverage area particularly in the Whyalla area. The field strength in the direction of the main lobes towards Port Augusta and Whyalla was about 450 mv/m at a measured mile. The antenna system was the first directional system established in the State. In addition to modern studios at Port Augusta which were opened on 6th December 1968, the station has an equally modern complex at Whyalla. The Whyalla studios were rebuilt and commissioned in July 1972. A second studio equipped with fully solid state facilities was subsequently brought into operation.

In 1976 the transmitter was relocated on a site at Mambray Creek in order to improve coverage, particularly into the Whyalla area. The new facilities were commissioned on 3rd December 1976 with a change in frequency from 1450 kHz to 1240 kHz. This frequency is shared with stations in Northern Territory, Queensland and Victoria and a new directional pattern was established for the antenna. The antenna uses two lattice steel masts 92 metres high fed in the appropriate phase relationship. The transmitters at the new site comprise the 2.5kW STC Nectar Brook unit and a new 2.5kW unit. They operate in a main/standby mode.

Technical staff who have worked at 5AU include Harry Cooper, Staunton McNamara, Bill Legg, Oliver Nestrom, Ron Hipwell, George Matthews, Bruce Hannaford, Bruce Martin, Graham Pitts, Ron Hodgson, Ted Marsden, Chris Gilbert, Charlie Tareha, Derek Coombes and Alan Hewitt who was in charge in 1977.

TELEVISION

Several South Australian experimenters were active in the late 1920's in the television field. Many novel devices were produced but nearly all made use of a spinning disc with a spiral array of holes near the outer edge in order to disassemble the image into a series of dots. A similar disc at the receiving end was used to reassemble the picture. Generally the systems gave poor results. Aside from the crude pictures, synchronization was a major problem.

At least one magazine published in the United States and distributed in South Australia reported on new developments, published articles on construction and carried a wide range of advertisements for television kits, parts, discs, neon lamps etc. However, local interest in experimental work waned when the magazine reduced its coverage of the subject and it was not until about the mid 1930's with the development overseas of the cathode ray television system that local interest was renewed. With the outbreak of the war in 1939, all experimental work ceased.

The first major tests in the development of a public television system were conducted over a period from late 1955 to early 1956. A 10 watt transmitter on Channel 8 was located at the Hendon factory of Philips Electrical Industries and receivers were installed in the homes of selected observers. The observers recorded the quality of the reception using specially prepared charts. The results were later analysed for the information of set designers. Particular attention was paid to the effects of interference caused by motor vehicle ignition systems and domestic appliances.

Television was inaugurated in the State in 1959 when two commercial stations began transmissions. Southern Television Corporation Ltd with call sign NWS9 and Pye transmitters at Mt Lofty began service on 5th September 1959. Studios were located in Tynte Street, North Adelaide. Chief Engineer was John Batchelor who was still in charge in 1977. On 24th October 1959, Television Broadcasters Ltd commissioned Philips transmitters at Mt Lofty and studios at Strangways Terrace, North Adelaide with call sign ADS7. Siemens transmitters subsequently replaced the Philips units. Don Gooding was Chief Engineer on commissioning of the station and in 1977 Norm Sawyer was in charge. The third commercial station in Adelaide SAS10 operated by South Australian Telecasters Ltd. began operation some seven years later on 26th July 1965 with AWA transmitters also at Mt Lofty. Chief Engineer on commissioning was Peter Smith now Director of Engineering for the TVW Ltd group of stations. In 1977 Don Caddy occupied the position of Chief Engineer. All the stations began with an effective radiated power of 100kW for vision and 20kW for sound.

Expansion of commercial stations to country areas began on 25th March 1966 when SES8 operated by South East Telecasters Ltd went on air with Pye/Astor parallel transmitters at Mt Burr. A Rohde and Schwarz phased array of screen backed

horizontally polarized dipoles was mounted on the 152 metre high mast which also carried the local National station antennas. Programmes were fed from the studios at Mount Gambier by a microwave link. Chief Engineer at the time of commissioning was Michael Hennessy and in 1977 Gary Smythe was in charge of the technical operations.

Spencer Gulf Telecasters Ltd commissioned studios at Port Pirie and an AWA transmitter at The Bluff on 1st March 1968 using call sign GTS4. The RCA/Coel vertically polarized antenna shared the 168 metre tower of the National Service ABGS-1. The feeder was a 50 ohm 80 mm cable without pvc sheathing. Engineer in charge on commissioning was Evan Downing and in 1977 Noel Norton was in charge of technical operations. During 1970 the company extended its coverage by the provision of two low power translator stations on Eyre Peninsula. A Channel 8 station on Mt Olinthus using a 1 watt translator and 5 watt amplifier went on air on 16th March 1970. Programme was received off air from The Bluff GTS4 transmitter. On 22nd May 1970, a Channel 5 station was commissioned at Borthwick Hill with programme being received off air from Mt. Olinthus. Both stations shared building and antenna facilities on site with National stations.

The latest commercial station to be put into service as at 1977 was RTS-5A Loxton which commenced operations on 26th November 1976 on a site adjacent to the National station. It operated on Channel 5A with a transmitting antenna having a directional pattern such that the effective radiated powers were 40kW in the direction of Waikerie, 20kW in the direction of Berri and 19kW in the direction of Renmark. The station was operated by Riverland Television Pty Ltd with Kevin Saban as Chief Technical Officer. In 1977 Mike Alsop assumed responsibilities for the technical facilities.

By 1977 four high power stations each of 100kW effective radiated power were in operation for the National Television Service with programmes supplied from the Collinswood studios of the Australian Broadcasting Commission. John Starr was Director of the Commission's Technical Services.

ABS2 Mt Lofty was the first of the National transmitters to be put on air when it was commissioned on 11th March 1960. Vision transmitters comprised a pair of Marconi 10kW units operated in a parallel mode and the sound units comprised two Marconi 2kW transmitters in parallel. The phased array antenna consisting of screen backed horizontal dipoles was mounted on a 136 metre high tower and fed by a 50 ohm 80 mm aluminium sheathed Styroflex cable. Programme was fed by a single hop link from the Collinswood studios. The link was subsequently replaced on the introduction of colour television. Installation of the facilities was controlled by Jack Truss assisted by Brian Hammond. Cliff Moule was the first Officer-in-charge of the station. He retired in 1977 and was succeeded by Harold Stanford.

Just over five years later, on 10th April 1965, ABNS-1 The Bluff was commissioned with parallel 10kW vision and 2kW sound Marconi transmitters. A phased array of screen backed vertical dipoles was mounted on a 168 metre high tower and fed by a 50 ohm 80 mm semi flexible coaxial cable. Brian Hammond assisted by Max Chadwick controlled the installation and commissioning. The first Officer-in-charge of operations and maintenance was Brian Roberts. He was later succeeded by Wes. Graham, Dave Carthew and Brian Beyer who was in charge in 1977.

A third high power station ABGS-1 Mt Burr went on air on 3rd December 1965 with 10kW vision and 1kW sound AWA transmitters. The phased array antenna consisting of screen backed horizontal dipoles was mounted on a 152 metre high mast and fed by a 50 ohm 80 mm semi-flexible coaxial cable. The programme was fed over a broadband radio link via Bordertown. Brian Hammond and Max Chadwick controlled the installation of facilities and Ron Mitchell became Officer-in-charge when the station went on air. He was still in charge in 1977.

ABRS-3 Loxton the latest of the 100kW e.r.p. National stations, was placed in service on 20th January 1971 using a pair of AWA 10kW vision and 1kW sound transmitters. Vertical polarization was employed using a dual channel split level phased array consisting of screen backed dipoles on a 168 metre high mast and fed by a 50 ohm 76 mm semi-flexible heliax cable. Bruce McGowan assisted by Janis Ozolins controlled the installation works and Wes. Graham took charge of operations on commissioning. Following short term relief by others, Harold Stanford took charge until 1977 when Roger Hedley assumed control. Arthur Capel, Principal Technical Officer, was responsible for oversighting the standards and technical performance of this station as well as the Mt Lofty, The Bluff and Mt Burr stations.

The first of the low power National transmitters was installed at Keith on 9th July 1969 using Channel 4 frequency. It was located in the microwave radio repeater building and derived programme from the link to Mt Burr. A Rohde and Schwarz transmitter fed a 50 watt ELIT power amplifier which matched into a three stack array of folded dipoles. The antenna was located 76 metres above ground and was fed by a 50 ohm semi-flexible cable. On 29th March 1970, a Channel 2 transmitter was put on air at nearby Bordertown using a 500 watt Toshiba transmitter operated in a low power mode. The transmitter was later replaced by an NEC 100 watt unit. Antenna was a two stack array of folded dipoles.

During 1970 two low power translators were established on Eyre Peninsula. Mt Olinthus on Channel 6 was installed on 23rd March 1970 and Borthwick Hill on Channel 3 was commissioned on 28th May 1970. Both stations employed 1 watt translators followed by 50 watt amplifiers. Antennas were RCA/COEL dual channel split level phased array types consisting of screen backed dipoles. Mt Olinthus received its programme off air from The Bluff ABNS-1 transmitter while Borthwick Hill received its programme off air from the Mt Olinthus translator.

In 1973, stations were put into service in Thevenard, Kongwirra and Woomera. Channel 9 Kongwirra and ABVS-7 Thevenard were both commissioned on 16th July 1973. Kongwirra used an NEC 10 watt transmitter feeding an RCA/COEL antenna comprising a single panel of screen backed dipoles on the 48 metre tower at the local radiocommunications station. Thevenard which was a translator installation received programmes off air from the Kongwirra transmitter. It employed an ELIT translator and 10 watt amplifier feeding a single panel of screen backed dipoles as antenna on a 30 metre high Skilfast mast. The Woomera low power transmitter ABWS-7 with an NEC 10 watt unit was commissioned on 30th November 1973. The antenna was a Hill's type of phased dipoles fed by a 22 mm diameter coaxial cable. Programmes were taken off air from The Bluff ABNS-1 at a site at Moonlight north of Port Augusta and fed by microwave bearer to Woomera.

The most recent National television station to be commissioned in the State was ABLCS-9 Leigh Creek. It went on air on 28th April 1977 employing an NEC 10 watt transmitter feeding a Hill's antenna system comprising two screen backed dipoles on a 25 metre high mast. The station had local video tape replay facilities for tapes supplied from the ABC Adelaide studios. It was the twentieth television station to be commissioned in the State and the twelfth for the National Service. In 1977 Bruce McGowan, Ron Falkenberg and Yanis Ozolins were responsible for the design, installation and maintenance of National transmitters.

Colour television transmissions were available from 1st March 1975 from commercial and most National stations. Although the conversion of the whole National Network throughout Australia was originally scheduled to be completed by 1978, enough work had been completed throughout the network by March 1975 to provide subjectively acceptable colour from all stations. Full standard colour services were provided in South Australia from all transmitters and translators by 1977.

FREQUENCY MODULATION BROADCASTING

As early as 1942, the question of whether frequency modulation broadcasting should be introduced in Australia had been considered by Parliamentary Committees. Because of the prevailing wartime conditions, investigations were deferred. In November 1944, the Postmaster General requested the Parliamentary Standing Committee on Broadcasting to investigate and report as to the manner in which frequency modulation broadcasting should be incorporated in the domestic broadcasting system.

Following consideration of the report the Government decided to carry out trials in the VHF band in order to obtain experience on design and performance of transmitting and receiving equipment and to study the propagation effects of frequency modulation broadcasting in typical areas. Accordingly, the Post Office set up experimental transmitters in Sydney and Melbourne in 1947 and in Adelaide in 1948. The programmes had not been especially designed for the stations but consisted of programmes also available on one or the other of the two National Metropolitan medium frequency transmitters.

Although the transmitters and their connecting links to the ABC studios were capable of transmitting high fidelity programmes with a bandwidth of about 15kHz the actual programmes transmitted used this wide bandwidth only when the station was broadcasting a local programme. Interstate programmes were limited by the characteristics of the available interstate programme channels to about 5kHz.

The Adelaide station comprised a 250 watt AWA transmitter installed in July 1948 at Mt Bonython and operating on 97.3 MHz. It fed a halo type antenna of four elements. Ted McGrath was in charge of installation and was assited by Roy Buckerfield, Bert Lampe and Arthur Capel. Operating staff included Jim McLennan, Jack Lester, Arthur Capel, Alby Smith, Ian Gillett, Cliff Linke and Len Radford. Late in 1951 the halo antenna was replaced by a 17 metre high pylon type comprising slotted line sections. On 2nd November 1953 a 3000 watt AWA transmitter replaced the 250 watt unit. Eric Craig, Bruce McGowan, Dudley Field and Bill Gold were associated with this work. The equipment was subsequently relocated at Mt Lofty and commenced operations from the new site on 11th August 1960.

The station remained in service until 30th June 1961 when following the recommendations of the Huxley Committee on radio frequency allocations, the VHF Channels used for frequency modulation broadcasting were allocated for use in connection with the extension of television services to country areas.

In June 1968, following continued interest and representatives from frequency modulation enthusiasts and questions asked in Parliament the Postmaster General made a comprehensive statement on the subject of frequency modulation broadcasting in Australia. In 1970 he instructed the Australian Broadcasting Control Board to inquire into the possibility of introducing frequency modulation broadcasting in Australia. The result was a comprehensive report which the Government accepted as a blueprint for the introduction of frequency modulation broadcasting. Briefly, the Board recommended that the service be introduced in the ultra high frequency band. Planning was expected to take up to three years.

However, following widespread debate on the use of VHF versus UHF, the Government set up an Independent Inquiry comprising Sir Francis McLean, Chairman of the Telecommunications Industry Standards Committee of the British Standards Institution and a former Director of Engineering of the BBC and Professor Cyril Renwick. Hearings at various centres opened on 14th January 1974 and concluded on 22nd February 1974. Hearings in Adelaide commenced on 7th February on 9th floor AMP Building, King William Street. Submissions were presented by (i) Catholic Radio and Television (ii) Mr. C.E. Moule and (iii) The University of Adelaide.

The Inquiry recommended among other things that frequency modulation broadcasting should be started in Australia as soon as possible using the Pilot Tone Stereo system in the VHF band (88-108 MHz). The recommendation was accepted and steps taken to introduce a service initially with transmitters in Adelaide, Melbourne, Sydney and Canberra with programmes originating from a new stereo studio installed in the ABC Collinswood building, to all transmitters via circuits of 15 kHz bandwidth.

On 24th January 1976, a 24 hour service commenced with the commissioning of a 10kW NEC transmitter 5ABC FM at Mt Lofty, the site of the earlier mono experimental service. Frequency was 92.1 MHz and the transmitter fed four corner reflector type antennas located on the television tower at the 100 metre level phased to give an approximate ommdirectional radiation pattern.

SECTION 5

CALLING ALL SHIPS

— The Coastal Radio Stations

Coastal radio stations are in two categories — official and unofficial. There is now only one official station in South Australia — VIA Adelaide. It is part of the Coastal Radio Service operated by the Overseas Telecommunications Commission (Aust.) in accordance with powers flowing to it from the Overseas Telecommunications Act and is operated largely by conditions laid down in international regulations. The Station is one of 18 forming the Coastal Radio Network throughout Australia and Papua New Guinea.

While the safety of life at sea can be regarded as the major function of the Coastal Radio Service, other services which it provides include radio medical advice to ships which do not carry a doctor, warnings associated with navigation hazards, cyclones and storms, telegraphic traffic to and from ships on matters concerning arrivals and departures and business or personal messages to and from passengers and the ships crew, and also weather observation data from ships at sea to assist in weather forecasting operations.

The unofficial stations are known as Limited Coast Stations and are operated mainly by various organisations associated with the fishing industry. These stations provide ship-shore-ship communication on the fishing industry channels. The rules for these services are designed basically to foster the development of coordinated private networks operated by groups engaged in common activities rather than a greater number of independent networks and also to ensure that the official service is not circumvented. While there are Limited Coast Stations associated with yachting clubs and similar type marine activities located at various points along the coast, in the mid 1970's the main stations associated with the fishing industry were established at Streaky Bay, Port Lincoln, Kingscote, Kingston, Robe, Beachport, Cape Banks and Port MacDonnell.

Ship stations also fall into two categories, namely those which are compulsorily fitted with radio by Commonwealth or State Marine Laws and those which are voluntarily fitted. To a large extent the conditions of operation and technical requirements in relation to the equipment are similar. However, whereas the licensing rules for compulsorily fitted vessels have been drawn up in accord with International Radio Regulations and Australian Marine Laws and provide for such ship stations to communicate with official coast stations, provision has been made for voluntarily fitted vessels to participate also in unofficial or private services where the official service does not meet a particular requirement. In 1976 there were about 900 small craft in South Australian waters fitted with radio.

Coastal Radio Station — VIA Adelaide

By 1899, Marconi had developed his equipment to the stage where interest was being shown in the use of it for marine purposes. The British Admiralty considered it desirable to obtain sets for trial purposes and an agreement was entered into with Marconi's company, the Wireless Telegraph and Signal Co., for the installation of equipment for naval use.

One of the first sets was installed aboard the cruiser Juno, and not long after, the St. George was fitted out with wireless. These two warships came to Australia as escort with the Duke and Duchess of York in 1901 when the St. George participated in the first marine wireless communication in Australia. It communicated with hastily erected shore stations near Queenscliffe lighthouse in Victoria in May 1901 and at Longbeach lightstation, Sandy Bay in Tasmania in July 1901. Although the Duke and Duchess called at Port Adelaide on 9th July, there is no known record of any wireless communication having been conducted with local experimenters.

The increasing use of wireless telegraphy for maritime purposes raised many questions of international interest and at the invitation of the German Government, a conference took place in Berlin in August 1903. In the same year, the Australian authorities drafted legislation for submission to Parliament. An Act, called the Wireless Telegraphy Act, was passed on 18th October 1905. In submitting the measure, Senator Keating indicated that the purpose of the legislation was to make Wireless Telegraphy in the Commonwealth a government monopoly. The Act is still in force with only relatively minor amendments being made in the intervening years.

The Act gave the Postmaster General's Department the exclusive privilege of establishing, erecting, maintaining and using stations and appliances for the purpose of:-

(a) transmitting messages by wireless telegraphy within Australia and receiving messages so transmitted, and
(b) transmitting message by wireless telegraphy from Australia to any place or ship outside Australia, and
(c) receiving in Australia, messages transmitted by wireless telegraphy from any place or ship outside Australia.

In a subsequent Overseas Telecommunications Act 1946-71 provision was made for the Overseas Telecommunications Commission which now operates the Coastal Radio Service, to establish, maintain and operate radio telecommunication services licensed under the Wireless Telegraphy Act.

The Chief Electrical Engineer of the Post Office was appointed as the first officer responsible for carrying out the work of administering the Wireless Telegraphy Act. The duties became effective from 18th October 1905.

The first fixed land station was licensed on 7th June 1906. It was constructed at East Devonport in Tasmania and enabled communication to be established with a similar station erected at Port Lonsdale in Victoria. The stations were constructed and owned by the Marconi Company who set them up for demonstration purposes. Although they handled messages satisfactorily, the Government of the day declined to purchase the stations.

The Australian Naval authorities were keen to establish coastal wireless stations at strategic locations and in 1907, a conference consisting of Admiral Henderson together with representatives of the Postmaster General's Department and the Defence Department recommended that coastal stations be constructed at Cape York, Torres Straits, Port Moresby, and Sydney together with stations later at Geraldton, Cape Leeuwin, Wilson's Promontory, Fremantle and Northern Tasmania.

The Government acted on the recommendations, and in March of the following year, called tenders for the construction of coastal wireless stations at Cape York, Thursday Island, Goode Island, Port Moresby and Fremantle. Although five tenders were received none of them was accepted.

The matter was not dropped however, because shortly after, Parliament approved the following resolution:-

"This House is of the opinion that Wireless Telegraphic Stations should be immediately established as found desirable around the coasts of Australia and that our Merchant Marine should be equipped with wireless installations as an up-to-date means

(1) of gaining intelligence of the appearance in Australian waters of a hostile force.

(2) of saving life and property imperilled by accidents upon the sea".

In October 1909 tenders were again invited, but this time, for the construction of high power stations at Sydney and Perth each with a range of 2000 km. There was a considerable difference in prices tendered by the organisations which were eager to gain the contract. The lowest tender price was £4150 per station, submitted by Australasian Wireless Ltd., of Sydney, a company which offered the Telefunken 25 kW quenched spark system produced by the Telefunken Company in Germany. Other tenderers included Lepel Wireless Sydnicate of London for £7000 per station, the British Radio Company of London for £9317 per station and the Marconi Company of London for £19,020 per station.

A contract for the work was placed with Australasian Wireless Ltd., but when the stations were being constructed, the Marconi Company brought action against Australasian Wireless Ltd., and the Australian Government for patent infringements. The final outcome was a merger of the local interests of the two overseas concerns in a new company, Amalgamated Wireless (Australasia) Ltd. The Marconi Company held half the shares with Telefunken and Australian shareholders having the remainder. Telefunken lost its share with the outbreak of the war.

The Navy was far from happy with progress and the means available for communication with shipping. In a report dated 1st March 1911 on naval communications aspects, Admiral Henderson recommended that a system of high power wireless stations be installed to transmit messages from the Navy office to naval vessels and that a system of medium power stations be set up for normal ship-to-shore communication and for commercial purposes. He also recommended that the Goverment take direct control of wireless for public and private purposes with control being vested in a special Branch of the Post Office.

While the installation of the coastal stations was in progress the Government decided to appoint a wireless expert to the Postmaster General's Department. His duties included the design and superintending of the establishment of the various stations. The High Commissioner in London was asked to invite applications in England from persons competent to perform the work and willing to undertake the duties for a period of three years at a salary of £600 per annum.

As the Prime Minister was in London attending a conference the Postmaster General asked him to consider the matter with the High Commissioner and to arrange to despatch an expert as soon as possible. There were 43 applications and the Prime Minister requested Mr. C.E. Bright, The Government's Electrical Adviser, to select six names for consideration. Mr. John Graeme Balsillie a Queenslander by birth was selected for the position.

On 4th August 1911, Mr. Balsillie who had had considerable overseas experience in wireless telegraph engineering installations in Europe and Asia departed for Australia to take charge of the Commonwealth wireless activities, except those associated with the Defence Services. He arrived on 6th September and immediately set to work from offices in Treasury Gardens. Melbourne. His designation was "Engineer for Radiotelegraphy" a position he occupied until 1916 when he resigned. His charter was to establish what is now known as the Coastal Radio Service and to administer the provisions of the Wireless Telegraphy Act and Regulations. At that time there had been 30 radio licences issued, all for experimental purposes.

Except for the Perth and Sydney stations, coastal radio stations around the continent and in Papua and New Guinea were designed and constructed by the Australian Government staff employing circuitry developed by Balsillie. It was known as the

Commonwealth or Balsillie system and was adopted as the standard system in Australia. The spark transmitters were manufactured in Sydney by the Maritime Wireless Company controlled by the Reverand Father Archibald Shaw and another partner. Father Shaw was a Catholic priest and former telegraphist in the Post Office.

In order to provide staff to operate the stations as they were commissioned a notification of vacancies appeared in the Commonwealth Gazette of 30th December 1911. It called for positions of assistant operators 5th class in the Clerical Division. Requirements were that applicants must be:

(a) capable of working at 25 words per minute, send and receive.
(b) possessed of a general knowledge of precedents in working radiotelegraphy as contained in the Handbook for Wireless Telegraphists issued by the British Postal authorities.
(c) possessed of an elementary knowledge of the working of internal combustion engines.

Later, positions were advertised for staff in The Professional Division for Engineer-Operators. A position of Engineer-Operator Class F for Adelaide was created and advertised in the Gazette of 3rd July 1911.

The Adelaide Coastal Radio Station using call sign POA (Post Office Adelaide) was commissioned on 1st October 1912. Its call sign was later changed to VIA and was the fifth station to be put into operation and the last of the capital city stations. The station was located on the Grand Junction Road, Rosewater about 2 km from Port Adelaide. Power for operation of the plant was provided from the 400 volt town supply stepped down to 200 volts at 50Hz. No standby power plant was provided.

A staff of three operated the facilities between 8 a.m. — midnight. Traffic to and from the State telegraph system as well as time signals was handled via tie lines linking the station with the Adelaide General Post Office and the Observatory. Mr. F.J. Burgoyne was in charge of the installation of the station and Mr. A.F. Newman took over the operational functions.

The transmitter was a uni-directional impulse system and one of the most efficient spark systems in use at the time. The transmitter was essentially a shock excitation transmitter with quenched gap and condenser coupling between the circuits. The quenched gap was one of the important features of the system and in this regard was somewhat similar to the Telefunken system even though the quenching arrangements were different. Air under high pressure ensured near perfect insulation of the gap between discharges so that it was in proper condition for successive trains of oscillations constituting the signal. In so doing it prevented heating and other effects which tended towards ionization in the vicinity of the electrodes with the production of arcing. The air blast employed in the system quenched the discharge at the gap immediately the condenser had changed its charge into useful high frequency power.

In the original Balsillie system the spark electrode was a conductor made of an amalgam of copper, silver and tin and screwed to conductors of copper tubing. The electrode had an 0.4 mm diameter hole through the centre. The other end of the copper tubing was threaded to take a rubber tubing connector which was linked by a hose to a compressor unit driven by a 1.5kW motor delivering air to the gap at the pressure of 700 kPa. The whole was mounted in a wooden box mounted on porcelain insulators. Changes were subsequently made to this part of the system.

The condenser consisted of a bank of Leyden jars each with a capacity of about 0.002 microfarads. The jars had copper deposits placed on the glass by a special process. The circuit used 30 jars with about half the bank being common to the oscillating and radiating circuits. The method of coupling to the antenna was therefore electrostatic coupling and not electromagnetic as employed in many other systems.

The oscillator coil was a spiral inductance of 19 turns of silvered copper of rectangular section about 15 mm wide and 1.5 mm thick. It was fixed to a grooved polished oak frame with insulating spacers. Tap connections were provided for inductance change purposes. In the original design a magnetic helix was provided but this was subsequently superseded by a spiral inductance when it became unnecessary through the introduction of a loosely coupled resonance transformer.

The transformer used to supply energy to the spark gap was designed to supply 20,000 volts at single phase. It was an open magnetic air cooled type with a normal rating of 5-7 kVA. The normal primary voltage was 110 volts at 400 Hz. The primary winding consisted of 60 turns of double wire wound in six layers of 10 turns. Empire cloth was used to insulate layers. The secondary consisted of six coils arranged three on each side of the primary, each being separated from its neighbour by Empire cloth. The coils each consisted of 2200 turns of wire wound in 40 layers of 55 turns each and were impregnated with self drying varnish by the vacuum process. The transformer was energised by a rotary convertor having an output of 5 kilowatts at about 500Hz.

The operating key was a double current sending type used in conjunction with a magnetic relay. The relay was used to make and break the primary and high tension circuits acting as an automatic switch.

The helix consisted of 24 turns of copper tubing about 12 mm diamater provided with adjustable taps and a flexible lead to enable inductance changes to be speedily carried out. Power input to the antenna through the helix was measured by a hot wire ammeter inserted in the earth lead.

In the tuning arrangements the antenna circuit was tuned by means of the antenna helix to the desired wavelength, the value of the coupling circuit tap having been predetermined. The closed circuit was tuned approximately to the antenna circuit frequency. The oscillatory circuit which included the secondary of the power supply high voltage transformer, spark gap, condenser, inductance and high frequency choke was then tuned as close as possible to resonance with the frequency of the current supplied by the converter.

The VIA transmitter had a good range and was usually the first station heard by ships coming south from Japan and Hong Kong. In 1923 when the "Changsha" hit a reef near the Philippines, VIA was the first station to pick up and answer the SOS call. Mr. Hugh Taylor one of the radio operators on the "Changsha" later worked at VIA.

The VIA antenna comprised a twin T squirrel cage type. Each cage was fabricated from four phosphor bronze cables each being made up with seven strands. The cables were separated by pine spreaders and copper rings made from 9 mm diameter tubing. The antenna cages were separated by wooden spreaders and supported by two masts constructed of creosoted laminated oregon pine in 11 metre lengths. The pine planks were fixed together with coach screws giving an overall dimension of each mast of 52 cm square. The masts were spaced 78 metres apart and were guyed in four directions at three levels. Massive concrete foundations supported the base and guy anchorage. Each mast was erected by attaching a jury pole at the base. It was maintained at right angles by steel ropes attached to various points along the mast. A cable was attached to the top of the jury pole and by operation of a winch the jury pole top was pivoted down towards the ground and in doing so raised the mast. Temporary guy ropes maintained control over the operations until the mast was raised to the vertical position and the permanent guys fixed to the foundation blocks. Each mast which was 44 metres in height was fitted with a stout copper conductor from top to ground for lightning protection purposes.

The station earth system employed a large buried copper plate near the building and a grid or chessboard system buried below the surface of the ground. Balsillie had done some experiments at the Hobart station on the effect of an earth system and came to the conclusion that the normal antenna height of 56 metres could be reduced to 44

metres and would maintain the same efficiency if a ground wire system was used. He was working on a theory to use "mastless" transmissions for working between land based stations and raised antennas for communication with ships. He intended to make experiments in South Australia to see if the masts could be done away with altogether as he considered that the difference between day and night range was not so great when ground wires were employed. The results of any experiments, if carried out, are not known.

About 1918 the earth system at VIA was considerably modified by the installation of additional grid wires. Trenches three metres one way and seven metres the other were dug and new wires laid and joined up with the old. All crossover points were soldered.

The receiver originally installed was known as a Type 3 set employing three crystal detectors wired to a three position switch to allow any one crystal to be selected. It was used in conjunction with an interference rejector or Type 4 set. Many forms of crystals were used at VIA before the introduction of the vacuum tube. Bornite and zincite combination, silicon, galena and specially prepared iron pyrites were all used with satisfactory results. Each operator used what he fancied. Local samples of iron pyrites were particularly sensitive. Galena was widely used with the best samples coming from Western Australia. The galena mined in the Adelaide Hills and at Broken Hill was not as sensitive as many other available. The main objection to galena was that the catswhisker contact was easily disturbed. Even after the introduction of the tube type receiver, crystals were still held at VIA for many years for standby purposes.

In 1912 a new Navigation Act was passed by Parliament and it contained a clause making it compulsory for ships trading in Australian waters to be equipped with apparatus for wireless telegraphy. Section 236 set down, that "every foreign going ship, Australian made ship or ship engaged in coastal trade carrying 50 or more persons, including passengers and crew, must before going to sea from any port in Australia be equipped with an efficient apparatus for wireless communication in good working order in charge of one or more persons holding prescribed certificates of skill in the use of such apparatus." Efficient apparatus, meant that it was capable of transmitting and receiving messages over a distance of at least 160 km day and night.

In 1914 Adelaide was one of a network of 19 coastal stations reaching right around the continent and including stations at Broome, Darwin, Thursday Island, Cooktown and Flinders Island. Ships working the Adelaide station were equipped with a variety of apparatus. Not a great many ships were equipped with radio during the early phases of operation of the station but most of the equipped vessels were fitted with Marconi or Telefunken sets.

The most frequently encountered Marconi equipment on ships which visited South Australia had outputs of 2,1.5 and 0.5 kilowatts. Many of the 1.5 kW sets were made by Amalgamated Wireless Australasia Ltd. in Sydney but many of the 2kW sets were of American Marconi Co. origin.

The 2kW marine set had a daylight range of 700-1000 km whereas the 0.5kW unit range was about 400-600 km. The 2kW unit installed on some cargo ships comprised:-

(a) A panel mounted transmitter consisting of the necessary power measuring instruments oscillation transformer, condenser, variable and plug-in type antenna inductance, quenched spark gap, motor and generator field rheostats, wavelength changing switch, several resistance units and a compensating reactance regulator.

(b) A 2kW 500 Hertz motor generator with synchronous rotary spark gap mounted on the generator shaft, protective condensers, starting resistance, automatic motor starter and necessary controlling appliances.

(c) A receiving unit with crystal rectifier and headphones.

(d) Antenna changeover switch with necessary appliances for protecting the receiving apparatus from the transmitter signals.

(e) Transmitting key.
(f) High potential closed core transformer.

The high voltage transformer of these sets was immersed in semi-liquid grease. The secondary potential was about 12,500 volts and this voltage was applied directly to the terminals of the high potential condenser of the closed oscillation circuit. The transmitting condenser comprised six copper plated glass jars of 0.002 microfarads capacity each, three of which were connected in parallel for working VIA on 300 metres and six in parallel for the 450 and 600 metre bands. The oscillation transformer was of the inductively coupled type, the primary and secondary windings consisting of strip-copper, spiral wound edgewise on a rectangular insulating support. The secondary turns for the various wave bands were selected by means of three flexible plug connections.

The most common forms of crystal detectors fitted at the time were combinations of zincite/bornite, steel/carborundum and steel/galena. A few isolated ships which called at Adelaide had magnetic and electrolytic detectors but in the 1920's these were generally held as standby units where tube sets were in use. The carborundum detector was by far the most popular with many of the early operators and it was not unusual for an operator on changing ship to take his carborundum detector with him.

Mr. V.R.P. Cook an Analysist with the Department of Customs and Excise at Port Adelaide and who now operates VK5AC obtained one of the carborundum detectors from a ship's operator in 1916. He later converted it to a chalcopyrite type using a platinum spring in lieu of the steel spring fitted to the original detector. The detector was used in his original experimental station. The chalcopyrite was obtained from a collection of minerals owned by an early prospector. The exact source is unknown but it was from a site in the Northern part of the State. Many good samples were later obtained from Mutooroo Station Mine near Broken Hill.

Nearly all Telefunken equipment fitted to ships which called in at Adelaide employed the quenched spark method of transmission. The quenched spark was a particular feature of Telefunken installations. It used a number of copper discs accurately turned and separated by rings of thin mica. The spark gap was made up of a number of these discs held together by a cradle. A short circuiting metal spring was provided to allow the operator to adjust the energy to the range he desired to obtain. In the small ship sets, cooling ribs provided sufficient cooling but for the larger units a blower directed a flow of air over the unit.

The condenser in the small Telefunken set was generally a paraffined paper type but for sets over 2 kW, Leyden jars were used. Independent inductances, or variometers as they were known, were used to tune the circuits. These variometers consisted of two flat coils of copper strip in separate frames, one of which was stationary and the other being made capable of rotating on its axis. Two variometers were employed, one in the closed and one in the open circuit and in addition another series of coils in a similar frame were inserted in the antenna circuit.

Many of the early Telefunken receivers used an electrolytic detector of the Schlomilch type. This was adopted as the company standard in 1903 and employed a platinum wire 0.03 mm in diameter of which only the tip projected from a glass tube. The detector was arranged in an ebonite container in such a way that it could be placed in circuit using a clip arrangement on the tuner. Molybdenite detectors were also fitted up the same way but both types were later replaced by other crystals types and then tube types.

One of the ships fitted with Telefunken equipment and which was a regular visitor to South Australian waters was the lighthouse servicing ship "Lady Loch". The set was a 1.5kW unit using call sign VHS. The receiving equipment at various periods comprised a magnetic detector, a carborundum crystal detector and a one tube set employing a Japanese Annaka tube. The first operator was Mr. Edwin Clements who was later succeeded by Mr. Les Glew.

Included among the early Australian owned merchant ships fitted with radio were the steamships, Riverina, Ulimaroa and the Zealandia of the Huddard Parker Line in 1910. By 1913 there were some 50 radio equipped ships using Australian call signs. These included 20 Government vessels. Ships operated by the Adelaide Steamship Company were Grantala VHJ, Wandilla, VHI, Warilda VHH and Willochra VHG. The equipment fitted to the Adelaide based ships had a stated day range of 300 km and a night range of 1300 km. The normal operating wavelength was 600 metres but facilities were also available to operate on 300 metres.

One ship of particular interest on the South Australian scene was H.M.A.S. Protector. As H.M.C.S. Protector the ship was built in England and arrived at Port Adelaide on 30th September 1884. She was in service in South Australia until 1900 when her services were offered to the British Admiralty for the Boxer Rebellion in China. She arrived back at Port Adelaide on 7th January 1901 and by 1902 had become a Commonwealth owned ship. Wireless telegraph equipment was first fitted to the Protector in 1914. The apparatus was an old pattern Marconi Mark 1 Wireless Telegraphy Set which had originally been appropriated to H.M.A.S. Pioneer.

Receiving equipment fitted to ships working VIA during the period of about 1925 generally consisted of separately packaged units comprising receivers audio amplifiers, radio frequency amplifiers, wavemetres and detectors ranging from various types of magnetic, electrolytic, crystal and vacuum tube types. Many installations were equipped with acceptor-rejector circuits as a means of increasing selectivity. Receivers of this period usually consisted of an antenna or primary circuit used for tuning the antenna to resonance with the frequency of the signal to be received and a secondary circuit tuned to resonance with the primary thus transferring the maximum amount of current to the detector circuit. The normal practice in using vacuum tube detectors and amplifiers was to connect these units to the receiver by external straps and binding posts. One form noticed on several American ships consisted of a detector, variometer, variocoupler and audio amplifier panels. It enabled a range of radio circuits to be made up. Two variometer, variocoupler, detector and audio amplifier panels made up a three circuit regenerative receiver with a two stage audio amplifier. The detector unit contained filament rheostat, plate control potentiometer, grid leak, grid condenser and tube socket. Audio amplifier panels mounted filament rheostat, tube socket and audio transformer. Binding posts provided battery and interpanel connections. Before the vacuum tube, the loose coupler circuit was very popular with ships installations. It generally consisted of a primary coil tuned with a slider and secondary coil tuned with a multipoint tap switch. Sometimes the primary was tapped and the slider fitted on the secondary side. Coupling with the primary was accomplished by sliding the secondary coil in and out of the primary on two brass rods. A more elaborate model had the primary coil enclosed in a hard rubber box with a coaxial double multi point switch for tuning. Antenna and ground were connected to the primary while galena, chalcopyrite or other crystal and headphones were bridged across the secondary coil. Variable condensers in the antenna circuit and across the primary were used for fine tuning adjustment.

The radio equipment fitted to ships constructed in modern times in South Australia is very elaborate compared with that fitted to ships constructed 50-60 years ago. For instance the Iron Duke constructed at Whyalla in 1974 is fitted with a wide range of communications and radio navigational aids undreamed of by early ship's captains and navigators. The main transmitter is a Marconi Commander covering the l.f. and h.f. bands and powered from a 115 volt 50 Hz source derived from the 415 volt ships mains. The transmitter produces a current of 7 amps into the antenna which is 41 metres long and 30 metres high. The main transmitter is backed up by a modified Marconi Salvor III unit powered from a 24 volt battery for emergency purposes. The main receiver is a Marconi Apollo covering the range 15-28,000 kHz powered from 115 volts a.c. while the

emergency unit is a Marconi Monitor normally driven from the mains but with-capability of 24 volt operation for 500 kHz reception. The automatic keying device is a Marconi Autokey powered from a 24 volt battery. The auto alarm unit is a Marconi Lifeguard tied to the 115 volt supply but with a 24 volt battery supply for operation of the bells.

Other equipment fitted to the Iron Duke includes a Marconi Lodestar direction finder, a Kelvin Hughes radar unit operating on 9410 MHz, a Koden Fax receiver, a v.h.f. transceiver for operation on channels 6,8,12,13, 14 and 16, five AWA u.h.f. transceivers and five handphones for operation in the 27240 kHz band. Lifeboat equipment comprises Clifford Snell 610 equipment with a hand generator for the power source and covering the frequencies 500,2182 and 8364 kHz with the 8364 kH being for transmit mode only.

On 6th September 1915 the Wireless Telegraphy Act was amended to enable administration of the Act to be transferred to the Navy Department. Control became effective from 1st October and included control of the radio stations and the administration of the Wireless Telegraphy Act together with the respective staff. Radio Commander Frank Gillespie Cresswell of the Royal Australian Naval Radio Services was placed in charge.

Commander Creswell served in the Royal Australian Navy from the time of its inauguration and in 1912 received the appointment of Fleet Wireless Telegraph Officer, rising to the rank of Radio Commander and Acting Director of the Radio Service in July 1916. On his return from Naval Operations in the Pacific during the early stages of the war, he was selected to take over the control, under the Naval Board, of the Wireless Telegraphy Department. His first work in taking over was to organise the Commonwealth Radio Service on Naval lines and under naval discipline.

The local VIA staff were taken on Naval strength. The Officer-in-Charge was given the rank of Commissioned Telegraphist, the next in charge classified as Warrant Telegraphist and the others became Petty Officers. The positions which the staff occupied in the Radio Telegraph Branch of the Post Office were abolished under the Commonwealth Public Service Act. The Officer-in-Charge was also Radio Inspector in South Australia for the Navy and was frequently called upon to investigate unauthorised stations or suspicious signalling. On 11th November 1918 Warrant Telegraphist E.H. Smellie who had taken up duty as Acting Officer-in-Charge of VIA on 1st December 1917 led a procession of 100 naval personnel on a victory celebration march in Adelaide. Ellis Smellie remained at VIA until 25th May 1920 when he was transferred to Perth. Other staff at the station during Mr. Smellie's period included Harry Selfe, Mick Anthony, Ossie Jarman and Dan Lennon. On Leaving VIA Mr. Smellie handed over to Julian Leslie but returned for a further period of service as Officer-in-Charge during 1957-1958.

The Royal Australian Naval Radio Service was disbanded on 28th October 1920 and on the following day staff were transferred back to the Post Office.

From 27th October 1920 the Postmaster General's Department resumed control and a Wireless Section was set up in the Chief Engineers Branch in Melbourne to carry out the duties. The Post Office took immediate steps to plan for upgrading of the facilities. Tube type transmitters had by then become readily available and decision was made to replace the inefficient spark systems. Specifications had been drawn up for new facilities to be provided and funds set aside. However, in 1921 a proposal that Amalgamated Wireless (A/Asia) Ltd. take over the Coastal Radio Service in the Commonwealth was under consideration and decision was made to defer the upgrading work until the question of Government policy had been settled.

The Coastal Radio Service had been far from profitable. In 1920/21 revenue for Adelaide Radio was only £988 while the cost of operating and maintaining the station

amounted to £1943. Throughout Australia the network was operating at a loss of some £60,000 per annum.

In 1921 the Wireless Telegraphy Regulations were amended to include provision emerging from the Navigation Act relating to the requirement for ships over 1600 tons on the Australian Register to carry wireless telegraph equipment.

Concurrently, positions of Radio Inspector in the Post Office to administer the Act and Regulations were provided for Sydney, Melbourne and Perth. The Adelaide position was established in January 1924 when Mr. H.W. Harrington came from Sydney to take up the position of Superintendent of the Wireless Branch. Mr. P.B. Traynor was appointed as Assistant Radio Inspector at the same time. The first office of the Wireless Branch was situated on the corner of Grenfell and Twin Streets. After a short stay it was transferred to Pirie Street, just behind the Stock Exchange building. It was later moved to the G.P.O. main building where it remained for a number of years before being transferred to Post Office Place. After a stay of about 15 years it was again moved, this time to Electra House in King William Street. Subsequent shifts saw it located in CIC Building in Franklin Street, B.P. House in Flinders Street and Q.B.E. House in King William Street. Superintendents who succeeded Mr. Harrington were Mr. H.K. Burbury from Tasmania, Mr. P.B. Traynor, Mr. C.A. Comas who retired in June 1974 and Mr. D.E. Caudle.

In 1922 a Parliamentary Committee on Wireless investigated proposals which led to an agreement between the Commonwealth Government and Amalgamated Wireless (Aust.) Ltd. The agreement provided for the transfer to AWA of the operations of the Coastal Radio Service and for the company to develop services to overseas countries in accordance with Government policy. The technical adviser to the Committee was Mr. James Malone, Chief Engineer of Telegraphs and Wireless in the Postmaster General's Department. Mr. Malone later became Controller of Wireless.

The arrangement was that the company was to take over all radio stations operating at the time excepting those wholly controlled by the Department of Defence and to operate and reorganise the service in order to furnish a service at least equivalent to that being provided at the time of takeover. Sites, buildings, masts and other assets were to be taken over at a valuation made by a committee including two representatives of the company and two of the Government with an independent chairman or by arbitration. During the period of reorganisation or for three years the Government was to pay the cost of operating the local station and to refund the revenue received therefrom. The existing personnel of the Government radio service were to be taken over by the company, pension rights and retiring allowances being preserved.

Control by AWA of VIA Adelaide was effective from 8th May 1922 and at the time the staff comprised Mr. M.G. Pope, Radio Station Master, F.W. Hepher (relieving) and telegraphists J.M. Johnson, H.R. Deneen, J.A. Chesterfield and A.H. Longstaff. Mr. Johnson had been associated with radio since 1910 when he joined Australian Wireless Ltd. and worked on the erection of Australia's first two stations — Pennant Hills and Applecross. In later years he transferred to other fields and in 1934 set up the Beam Picturegram service. For many years he was Chief of AWA's aviation department. Mr. Longstaff subsequently went to England for training in Beam Wireless techniques and remained there for a quarter of a century as AWA's London Representative.

Three years after AWA took over the station only Mr. Deneen was still on the staff. At the end of 1925 the Officer in Charge was Mr. J.B. Stoyle and in addition to Mr. Deneen, there were Messrs. C.J. Lennon, A. Kempling and A.S. Hart. Mr. Hart subsequently retired as O.I.C. of the Station in March 1955, having taken his ticket in 1913. He later became an Instructor in the Marconi School in Melbourne.

When AWA took over the station, VIA was operating a continuous commercial ship service with time signals at midday and midnight S.A. standard time, and weather forecasts. The Balsillie spark transmitter was still in service and the receiver comprised a Commonwealth standard type with a wave range of 200 to 20,000 metres for tube or crystal detector.

During the period that the Navy had control of VIA until 1920 some changes were made to the station plant. A station Inspection Sheet prepared in 1924 shows that receiving apparatus in use then consisted of a locally built pancake tuner, a Royal Australian Navy long wave inductance and a single tube receiver of De Forest manufacture employing an AWA Expanse B tube. This type of tube was first made by AWA in 1920 and was a soft type employing a double filament. Switching arrangements were provided to enable cutting in either the pancake inductance or the R.A.N. long wave unit. The receiver tube was powered by Edison type LT accumulators and Commonwealth type dry cells were used in a large series bank for high tension. About 18 months life was obtained from the high tension battery. An acceptor-rejector circuit was also in use. The unit enabled undesired signals to be rejected when using a broadly tuned receiver. It comprised a series antenna inductance linked to a rejector circuit (inductance and capacitance in parallel) which was bridged across an acceptor circuit (inductance and capacitance in series). The inductance in series with the antenna was adjusted in such a manner that the resultant inductance and capacitance of this position of the circuit was in resonance with the incoming signal. When the acceptor circuit which was the primary of the receiver was adjusted to the desired frequency, incoming signals of that frequency set up oscillations in that circuit. Undesired signals flowed through the untuned rejector to ground.

The Inspection Sheet also shows that the transmitting equipment consisted of a mixture of the original Balsillie equipment and Royal Australian Navy spark transmitting apparatus (maximum power approx 7 kilowatts) with independent drive rotary spark. The discharger which was an asynchronous type was driven by a 110 volt direct current motor. Power for the motor was supplied by a generator coupled to a variable speed Century repulsion motor fed from the 200 volt station 50 Hz supply. The spark frequency was about 300 discharges per second and energy for the spark was provided by a transformer which produced 22000 volts. The primary of the transformer was connected to the 200 volt station supply. Apparatus on the station also included two motor generator sets which were not in use at the time having been withdrawn from service.

On 4th October 1925 an ICW transmitter was installed. It was a 0.5 kW panel originally designed and intended for use in broadcasting stations. It was provided as a temporary measure pending the manufacture of a permanent installation which was in the course of construction at the A.W.A. works in Sydney. The ICW transmitter was a two tube (T250) coupled Hartley oscillator with an a.c. plate supply at about 8000 volts at 400 Hertz. This 8000 volt unrectified supply was provided by a 600 watt Amalgamated type F alternator driven from a 120 volt a.c. source.

The installation of the transmitter was necessary not only to improve the efficiency of transmissions but because of the increasing number of complaints being lodged by broadcast station listeners regarding interference from the spark transmissions. Stations 5CL and 5DN were both in operation at that stage. The spark transmissions ceased from 22nd October 1925.

The original antenna system was still in use in 1925 but some time later a fire damaged one of the oregon members and the whole installation was replaced with steel tubular type supports.

About the time that the new transmitter was delivered improved receiving apparatus was provided. Regenerative type receivers made by AWA were put into operation and together with the transmitters the new facilities resulted in a great improvement.

The adoption of Beam Wireless necessitated even more equipment at coastal stations and test sheet records show that a 5kW short wave Beam feeder transmitter for VIA was under test at the AWA works in Sydney on 17th-18th March 1927 and was given an operational test by working the Melbourne Coastal Radio Station VIM on 30 metres. The transmitter was installed at Rosewater during November and operated on wavelengths of 17.36, 19.88 and 50 metres.

In October 1926 the Postmaster General announced that the question of radio installations on vessels trading between Australian ports had been receiving attention and that discussions had taken place with the State Governments. Experimental radio telephones had been installed on some trawlers working out of Sydney. The sets had a range of about 150 km and rental costs were about £220 per annum.

With a view to investigating the matter thoroughly, the Postmaster General had arranged for a committee comprising the Chief Manager of Telegraphs, the Wireless Engineer for Lighthouses and the Deputy Director of Navigation in Victoria to report on the practicability of installing radio telephones on small vessels and at lighthouses and other places ashore.

On 28th January 1927 the Government appointed a Royal Commission on Wireless to inquire into various aspects of wireless in Australia. Included in the recommendations submitted in the Report of the 14th July 1927, were the following:-

(1) That all land and coastal stations should be re-acquired by the Federal Government and placed under the control of the Postmaster General.

(2) That the consideration, if any, to be paid to Amalgamated Wireless (Australasia) Ltd., for such stations shall be determined in the event of disagreement in the same manner as on the occasion when the said stations were acquired by Amalgamated Wireless (Aust.) Ltd., special regard being paid to the fact that stations are being operated at a loss.

(3) That in cases where State legislation on the subject of ships installations does not exist, representations should be made to the State Goverments concerned to bring vessels not trading beyond the limits of their respective States within provision similar to those of Section 231 of the Commonwealth Navigation Act 1912-20.

The Government drew up a new agreement with AWA amending previous agreements. Under the new agreement which was dated 15th November 1927 the company retained the stations and the Government paid the company an annual subsidy towards the upkeep of the stations and received 30 per cent of the revenue therefrom.

A radio telephone service from VIA with small ships belonging to the Adelaide Steamship Co. was inaugurated during August 1929. The first ship fitted with wireless equipment was the "Mulcra" and service started with her on the 17th August. Service was conducted initially on wavelengths of 800 to 200 metres.

By 1934 four transmitters were in operation. These included the main Coastal Radio Service transmitter operating on 600, 720 and 800 metres, a 25 watt "Pup" transmitter installed during September 1932 and with operational capability on 32.55, 600 and 720 metres, the TC3 telephony transmitter installed for the small ship service, then working on 197.4 and 600 metres, together with the CRS Short Wave 5 kW Beam feeder transmitter.

During May/June 1937 arrangements were made for Parafield airport to use the facilities at VIA for direct two way communication with aircraft. Equipment to allow this form of communiation was installed at VIA and connected by landline to Parafield.

In 1945 a Commonwealth Telecommunications Conference was held in London and decision was made that each of the Commonwealth countries should assume public ownership of radio and cable installations and services in its own country. In June the following year the Australian Government gave expression to this agreement and

created a new corporate body, the Overseas Telecommunications Commission (Aust) to be responsible for the maintenance and operation of telecommunications services between Australia and other countries, with ships at sea and between Australia's external territories.

The coastal radio stations and services were purchased from AWA by the Government on 1st October 1946. Under a Caretaker and Management Agreement, the company continued to operate the services on behalf of OTC for some four months whilst the new Commission completed its organisational arrangements. OTC assumed full control of the radio services on 1st February 1947. Most of the company's staff at the coastal stations transferred to similar positions in the new organisation so that the stations continued to be manned largely by the same people.

During 1947 facilities were introduced at all coastal radio stations to provide radio telephone communication with small ships in Australian coastal waters. This small ships service still operates making possible the exchange of telegrams in addition to providing a vital SOLAS (Safety of Life at Sea) Service. Initially only one frequency was used for this service. Now three frequencies in the 2, 4 and 6 mHz bands are employed by all stations, in addition to the international distress frequency 2182 kHz. VIA maintains a continuous loudspeaker listening watch on three frequencies including the distress frequency. Weather reports and navigational warnings are broadcast on two of these frequencies.

In 1952 some of the Rosewater receiving facilities were transferred to Brighton because of local noise and interference problems. The receivers and antennas were located in the yard of the Minda Home, Brighton with the receivers being remotely controlled from Rosewater. Signals were fed over telephone pairs to the operating position. A small concrete building housed the receivers and a buried copper plate was put down for an earth system.

In 1963 a new coast station centre was established at McLaren Vale some 40km south of Adelaide on a site of about 26 hectares. The rapid industrialisation of the Rosewater area had increased electrical interference to the point where a move to a new site became imperative. The time was opportune too, to increase the power of the main transmission and to provide added and more modern facilities. The McLaren Vale site was chosen because it was within reasonable distance of Adelaide; it was protected by land barriers unlikely to be developed industrially and therefore relatively immune from electrical interference and the site was adequate for all transmission and reception facilities as well as for future expansion. The station was the first of a new style in Coastal Radio Service facilities. Five new houses of attractive design were built in the McLaren Vale district to accommodate the staff. The station was officially opened by Sir Giles Chippandall C.B.E. on 29th March 1963 before a small gathering of distinguished guests.

At 12.45 p.m. Mr. T.A. Housley C.B.E. General Manager of the Overseas Telecommunications Commission addressed the guests and introduced Sir Giles, the Chairman of the Commission who unveiled a commemorative plaque which has the following inscription:-

"The Overseas Telecommunications Commission (Aust)
McLaren Vale Coastal Radio Station
Officially opened by Sir Giles Chippandall C.B.E. on
Friday 29th March 1963.
Commissioners:
Sir Giles Chippandall C.B.E. — Chairman
E.W. Easton — Vice Chairman
P.A. Dorrian
G.H. Lush Q.C.
A.E. Chadwick

General Manager:
T.A. Housley C.B.E.
The original Coastal Radio Station at Rosewater opened on 1st October 1912 and closed on 29th March 1963."

The General Manager then announced that the Rosewater Station would make its final call.

At precisely 1.00 p.m. Mr. H.S. Taylor transmitting on 6410kHz announced:-

"Rosewater VIA calling all ships.
The new Coastal Radio Station at McLaren Vale has just been officially opened by Sir Giles Chippandall, Chairman of the Overseas Telecommunications Commission.
Rosewater Station from which I am speaking is now closing down after 51 years and all future operations will be conducted from McLaren Vale.
Please stand by".

Mr. Taylor then followed with:-

"Rosewater VIA calling McLaren Vale.
Will you please take over control McLaren Vale. This is Rosewater Station closing down. G.B."

At two minutes past 1 o'clock McLaren Vale replied:

"Your closure signal received Rosewater and we now take over control, thanks, Roger".

The first contact McLaren Vale made was with the "Maltara". This was then followed by contacts with the "Troubridge", Neptune Island lighthouse and the "Orion". The Orion was on her final voyage before being retired after 28 years service. At the time of contact the Orion was some 960 km west of McLaren Vale.

Mr. Hugh Taylor who sent the last message from Rosewater started in radio in 1916 when he was trained at the Sydney Naval Station. He spent some 18 years at sea having worked on many ships including the "Captain Cook", the "Arafura", H.M.A.S. Gayundah, H.M.A.S. Gunundeahl and H.M.A.T. Bakara. He joined the Island Radio Service in New Guinea in December 1936 and the VIA staff in 1942.

The Rosewater staff at shut down comprised Mr. E.J. O'Donnell, Officer-in-Charge, Mr. H.S. Taylor, Mr. J. Fuge, Mr. D. Bartlett and Mr. J. Tweedle. The same staff also became the first staff at McLaren Vale.

Mr. O'Donnell had been Officer-in-Charge of Adelaide Radio since October 1958 and was previously stationed there in 1923-1925. With a lifetime spent in the Coastal Radio Service he retired two months after the new station opened. Mr. Taylor then took over as Officer-in-Charge. He in turn was subsequently succeeded by Mr. Banks, and then Mr. M. Lang who was still in charge in 1977. The other staff included Mr. D. Maher, Mr. J. McGregor, Mr. G. Denson, Mr. F.E. Jacvides, Mr. R. Imrie, Mr. R.M. Inwood, Mr. T.J. Mackey and Mr. B.M. Bradley.

The facilities provided at McLaren Vale included the most modern types of transmitters and receivers available and in the intervening years the equipment has been replaced or upgraded to ensure a high standard of efficiency. By 1975 transmitters were operating with output powers between 300 and 2000 watts using AWA types CTH-P5J, CLH-IL and CTM-2k. These feed into a wide range of antennas including a vertical fan type with three 30 metre wire elements, a quadrant, an 18 metre vertical dipole, a 50 metre top loaded mast with radial earth mat, a 130 metre long wire antenna as well as various standby types.

Receivers include a fixed AWA type RCB-1B with Codan unit, AWA type CR3D and CR3E, Racal RA7915, Collins 651S1 and Plessey PR155. The antennas used with the receivers comprise horizontal dipoles, long wire and quadrants. All antennas are fed by open wire transmission lines with the exception of the 50 metre top loaded mast which is fed by 75 ohm coaxial cable.

Opening of new Coastal Radio Station VIA March 1963.
Messrs. H. Taylor, E.J. O'Donnell, D. Bartlett, L. Tweedle.

The station is normally powered from the ETSA mains using a 415 volt three phase feed but a 24 kVA Lister diesel engine generator set is available in the event of a mains failure.

During the 62 years that the station has been in continuous operation a great many officers have helped to man the facilities. Some stayed for only short periods on relief work while others worked there for many years. Unfortunately a complete record of all who served is not available but some of the names, additional to those already mentioned, which have been recalled by local serving and retired staff include Messrs. E.W. Coldwell, D. Fleming, J. Walters, F. Mulligan, L. Farnsworth, G. Smythe, R.W. Tymms, H. Oates, F.J. Gowlett, C. Northam, N. Clifford, C. Hutchinson, L. Fontaine, C.R. Waite, M.L. Weeks, J.K. Overbury and C.R. Anderson.

Coastal Radio Station — VIY Mt. Gambier

In 1912 the Federal Government purchased land in Mount Gambier to erect a second coastal radio station in South Australia. The land was purchased from Mr. A.J. Kilsby at a cost of £140 and was situated off what is now known as Wireless Road about 2km north of the city. The buildings comprised double stone structures with two main rooms, one for the radio equipment and office and the other for power plant. It was erected by the Works and Railways Department and located on the summit of the hill just east of the mast.

The radio facilities provided at the station were of the Balsillie design and were installed by Government staff. The total cost of establishing the station was £2438. The station was commissioned for public business on 1st March 1913, without any formal opening ceremony.

The installation of the facilities was superintended by Mr. F.J. Burgoyne who had earlier completed the Adelaide station. A few days before the completion of the work Mr. Burgoyne and his assistant Mr. Harry F. Coffey were involved in an accident when fuel caught alight while they were making adjustment to the engine set. The first Officer-in-Charge after commissioning the station was Mr. Coffey who was assisted by Mr. Geo. Bailey and Mr. A.S. Hart. Mr. Hart later became Officer-in-Charge and was there when the station closed down.

The transmitting and receiving facilities were similar to those installed at Adelaide but used a different antenna system and generated power on the station. The power plant comprised a 110 volt direct current 100 amp. generator directly coupled to a single cylinder internal combustion engine designed to consume either petrol or kerosene. It was rated at 15kW (20 horsepower) and was made by the Shaw Company. It had a flywheel about one metre in diameter. A small engine was provided to assist in the starting operations. The main engine was bolted to the same bed plate as the generator and joined by a leather coupling. The generator charged a bank of 45 accumulators which provided the power for operation of the radio equipment. Direct operation of the equipment from the generator was practicable but not very satisfactory as the variations in loading under transmitting conditions affected the speed of the engine which in turn caused a change in the supply voltage. To deaden the noise made by the engine a double thickness of green baize covered the doors of the engine room.

The antenna system was an insulated umbrella type using stranded phosphor bronze wires supported by a massive wooden mast some 51 metres high with a cross piece on top about 7 metres long. The mast was fabricated from laminated Oregon pine planks thoroughly creosoted for preservation purposes with the planks being held together with steel coach bolts. Altogether more than 2000 bolts were used in the fabrication.

Erection of Mast for Coastal Radio Station VIY Mt Gambier 18th December 1912.
[*Courtesy Mr. L.R. Hill*].

The mast was 52 cm square at the bottom and was fixed into a solid concrete block. The base was poured as a block 2.5 metres square and 2.2. metres deep resting on a limestone foundation. On top of the base two walls 1.6 metres high were cast as an integral part of the base. After erection of the mast the space between the walls surrounding the mast was filled with concrete. The mast was the tallest in the State and for many years was a well known landmark in the Mt. Gambier district. The weight of the mast was estimated to be about 18 tonnes and cost of the wood material alone was about £300.

Because of its weight, the task of erecting the mast was a difficult one. It was assembled on the ground in cradles of red gum sleepers and three jury poles of varying lengths were used to raise it to the vertical position. The longest of these poles was about 24 metres high, and they were attached to the mast at right angles and held in position by steel ropes. A hand operated winch located about 50 metres from the base on the eastern side was used for the erection. A strong steel rope was led from the top of the tallest jury pole to the winch. Eight men were required to turn the handle.

Erection operations commenced just shortly before 8 o'clock in the morning of Wednesday 18th December and by 3 o'clock in the afternoon it had been raised to a level of about 45 degrees. By 5 o'clock it had been put in an upright position and the permanent guys attached to the anchor blocks for the night. The following day the guy ropes were adjusted to give the correct tension. Four sets of guys were provided at 120 degree spacing and fixed to the mast with long eyebolts. At the ground point they were attached to eyebolts anchored to massive jarrah blocks fixed in concrete. The erection operations were under the supervision of the foreman rigger Mr. J. Ferguson.

Other major items of equipment at the station included a rotary convertor for providing power to the high voltage spark gap transformer, a battery of Leyden jars, an air compressor for the quenched arc and crystal receiving equipment. One of the crystal sets was of the loose coupler type.

On 6th July 1914 the station was used to convey medical advice to the captain of the ship Armadale for treatment of a seamen who had fallen down the hold and suffered severe injuries. A report in the Border Watch indicates that Dr. W. Sangster received a communication through the station from the captain of the ship asking for advice as to treatment to be given to the seamen until such time as the ship could reach Melbourne. The doctor's advice was transmitted to the captain whose ship at the time was about 320 km off Mt. Gambier.

Shortly after the outbreak of the war the staff was increased and continuous observations put into effect. On 10th October 1914, the station was placed under guard by the local militia. The guard of 21 men and two Officers were from C Company, 74th Infantry under the command of Captain R.M. Haig who was assisted by Lieutenant H.S. Cope and Sergeant R.M. Callander. One of the soldiers was Mr. S.O. Whitehead still active in Mt. Gambier in 1974. Another was Mr. L.J. Laslett who was living in Adelaide.

After the cessation of hostilities, operations began on a 6 a.m. to 8 p.m. basis with an Officer-in-Charge and two operators. The staff was later gradually reduced until it was a one man station providing service from 9 a.m. to 12 noon and 2 p.m. to 6 p.m. Monday to Friday, 9 a.m. to 1 p.m. Saturday with no service on Sunday.

In 1919 the coast station charge rates were 3d per word for radiotelegrams to or from ships licensed in Australia or New Zealand and 6d per word to or from other ships. Land line charge was 1d per word.

The station was originally intended to be a relay station between the Melbourne coastal station VIM and the Adelaide station VIA during daylight hours. In practice it did not appear to provide any great advantage as ships off the coast in the immediate

vicinity could invariably communicate with all three stations VIM, VIY and VIA. Later improvements in technology resulting in more efficient transmitting and receiving equipment at VIM and VIA also contributed to the eventual close down of VIY.

The station was closed down in 1920 when the coast station network throughout Australia was reorganised in an attempt to economise in operating costs. It lay idle for about three years before it was dismantled. Mr. Petherick of Naracoorte bought the whole of the installation except the mast. The engine was re-installed in the Naracoorte Electric Supply Company's power house and used to drive one of their generators.

The mast was sold to two local men and ended up in the local Rabbit Factory for case making. It was dismantled early in May 1923. The solid concrete base had to be blasted before the mast could be let down. The dismantling was carried out by Walker Bros. who used a steam driven traction engine to steady the pole during the lowering operations. When the mast fell it landed across a fence post and the great mass pushed the post into the ground out of sight. A section of the mast has been preserved in the Adelaide Telecommunications Museum.

The original building is now occupied as a private residence.

Limited Coast Stations

The limited coast stations are operated by organisations associated with the fishing industry. In 1975 there were eight stations in operation in the State. Initially the frequency 4620 kHz was used for ship to shore working and 4095 kHz for ship to ship working. As from 30th June 1969, 4095 kHz was withdrawn from all intership working activities and 2112 kHz substituted in lieu. The use of 4095 kHz was to be confined to initial calls to and from limited coast stations and for emergency communications. The arrangement was designed to relieve congestion on 4095 khz and to provide inter-communication on a channel which was considered to be more appropriate for intership operation. However in a subsequent change to regularise operations in the maritime radiotelephone service this frequency was withdrawn.

In accordance with international requirements coast and ship radio telephone stations operating in the maritime mobile band were required to change from double sideband (d.s.b.) mode of operation to single sideband (s.s.b.) as a means of relieving serious congestion in the high frequency radio spectrum and for the general improvement of the maritime radiocommunication services.

The plans for the changeover provided for the new mode of transmission and reception to be available from 1st July 1973 after which date no new or replacement d.s.b. equipment was to be authorised to operate in the maritime area. Existing ship stations were required to adopt the s.s.b. mode by 1st January 1978 where they used frequencies above 4MHz or by 1st January 1892 if they used only frequencies below 4 MHz. Opportunity was taken to provide that all coast and ship stations become equipped with the international distress and calling frequency 2182 MHz in order to assist in co-ordinating communications during search and rescue operations and at the same time increase the chances of ship stations obtaining early assistance in the case of emergencies at sea. At the same time it was decided that each coast and ship station should be operated only by persons who hold a Restricted Operators Certificate of Proficiency in order to ensure reliable ship-shore communications.

Robe

In May 1945 the Robe Freezing Works, Robe made representations concerning the installation of transceivers on fishing boats using Robe as a home port. A new system of fishing had been introduced whereby the boats were to stay out at distances up to 80

km from Robe for periods of 2 or 3 days and it was important to maintain communication with the individual boats particularly when there was concern for their safety. There were about 75 boats operating in the South East area at the time on crayfishing or shark fishing activities.

Little further development took place until June 1954 when a proposal was put forward by Wheelers Radio Service Ltd. of Adelaide to establish a base at the residence of the Robe Harbour Master.

However, the conditions laid down for operation of a limited coast station stipulated that the station should be established by agreement of the fishing industry in the area in which it was intended to service. Consequently the establishment of the base station by either Robe Freezing Works or Wheeler Radio Service Ltd was not acceptable. Following a public meeting an application was then submitted by the Robe Fishermens Association and approval subsequently granted on 8th October 1954. The base station call sign was VH5BR and frequency 4620 kHz was allocated.

In addition to the exchange of messages with the boats the station was permitted to transmit each day at prearranged times a short summary of the local weather position and to supply particulars of local weather in answer to requests from any ship station calling on the 4620 kHz frequency. Ship-to-ship contacts were to be carried out using 4095 kHz.

The station commenced operation on 24th December 1954 with Vaughan equipment VSR4 installed by Wheeler Radio Service Ltd at the residence of Mr. F.C. Went the Harbour Master. The crystal controlled transmitter had an output capability of 25 watts using a KT66 tube in the final stage with plate modulation. A Zephyr microphone was used and power for the unit was derived from a 12 volt accumulator with a vibrator providing the high tension voltage. The antenna was an inverted L type supported by two masts each consisting of a 15 metre wood and 9 metre galvanised iron sections spaced 23 metres apart.

Schedules were conducted at 7.45 a.m., 12.45 p.m., 3 p.m. and 7 p.m.

In 1964 the Robe Fishermen's Association relinquished control of the station and a new facility was set up by the South Australian Fishermen's Cooperative Ltd. about 100 metres west of the Post Office. The transceiver installed was a Crammond type CTR 20, the receiver of which tuned the bands 550-1600 kHz, 2-5 MHz and 5-10 MHz. The output power of the transmitter section was 40 watts. The transceiver was powered from a local 240 volt supply. The Officer-in-Charge of the station was Mr. C. Madsen. In 1971 the installation was replaced by a Mariner 60 transceiver.

Kingston

From March 1949 Mr. E. Backler operated a base station VH5AB from Kingston providing a service for the fishing fleet using Kingston as a home port. He used a type 101 set on 4620 kHz but ten years later replaced the installation with an ex RAAF type ATR-2A unit which gave an output of about 10 watts from an input of 38.5 watts. The set had a crystal controlled oscillator employing a 6V6 tube. Plate and screen type modulation was employed with an 807 modulator and 807 power amplifier. The mains supply was used to power the equipment. The antenna used an inverted L wire some 21 metres in length supported between iron pipes 8 metres and 5 metres high. The equipment had previously been used at a base station for the Mt. Gambier Fire Service.

In December 1963 Mr. Backler withdrew from operation of the base station and the South Australian Fishermens Cooperative Ltd took on the work with equipment installed in their packing shed at the end of the jetty using the same call sign VH5AB. The equipment was a mains operated Crammond CTR20 giving an output of some 40 watts into a long wire antenna. Mr. J.H. Osborne was the Officer-in-Charge of the base and a schedule was maintained at 9 a.m., 1.30 p.m. and 4.50 p.m.

Port MacDonnell

On 18th November 1955 the South Australian Fishermens Co-operative Limited sought permission to set up a radio base station at their factory in Port MacDonnell alongside the local power house. It had been found unsatisfactory to work boats working from Port MacDonnell through the Robe radio base station. There were some 42 boats operating from the port at the time.

Approval was granted on 22nd February 1957 for the establishment of the station using 4620 kHz, and call sign VH5DH. The equipment installed was a 14 tube mains operated Vaughan Model VSR25B transceiver manufactured by Weston Electronics Pty. Ltd. of Sydney giving a transmitter power to the antenna of 20 watts. The receiver was crystal locked on 4620 kHz. The antenna was supported by two 14 metre masts spaced 26 metres apart. A Vaughan carbon microphone was used for calling purposes.

The station commenced operation on 25th March 1957 with Mr. C.R. Carrison as Officer-in-Charge. Schedules were maintained at 9.15 a.m., 12 noon, 3 p.m. and 4.45 p.m. There were five boats using the service at the beginning of May but from that time the number rapidly increased.

In 1970 the equipment was changed, with a Crammond CRT20Ac unit being installed.

Cape Banks

On 3rd December 1955 a group of professional fishermen working a fleet of boats from Bucks Bay near Cape Banks (Carpenters Rocks) sought permission to establish a base radio station. Three of the boats were already equipped with radio and frequently worked the Robe limited coast station but this was not altogether a satisfactory arrangement.

The Cape Banks area is one of the roughest in the south east and is also subject to periods of prolonged fog. Instances had occurred where heavy fog forced fishermen to anchor at sea for several days and there was no means whereby they could communicate with the port to advise families of their plight. The centre was also isolated from the normal telephone facilities, the nearest telephone being some 32 km away.

Approval for establishment of the radio base was given on 7th July 1956 to Messrs. H. Stanke and Sons who worked six boats from the port in connection with their fishing business. The frequency normally used for this type of service 4620 kHz was allocated, and in 1961, 4095 kHz was added. The organisation arranged for working schedules at such times as not to conflict with those observed by other services in order to minimise the changes of mutual interference.

The service commenced operation on 25th March 1957 using call sign VH5CS. The base equipment was a crystal controlled Vaughan transceiver type VSR4 powered from a 12 volt storage battery. The operating power was approx. 25 watts and the unit was connected to an inverted L antenna 23 metres long supported by two 10 metre galvanised iron poles. A Vaughan carbon microphone was used for calling purposes. Mr. C.H.W.R. Von Stanke was in charge of operation of the station but in 1966 this role was taken over by Mr. V.C. McCarthy.

As from 1st September 1961 new operating procedures for fishing vessels applied and any ship station could communicate with any limited coast station in the area in which the ship was engaged. Although boats from many other ports worked off Cape Banks from time to time there was not a great deal of traffic with VH5CS.

Following the destruction of the base radio equipment during a fire in 1961, operations recommended with a Vaughan VSR40B transceiver. Later this was replaced by an Electronics Industries RC8 transceiver powered by a 24 volt accumulator. Further changes with the base equipment took place when a Weston LM6 unit was installed and then a Bendix RA-B.

Beachport

Towards the end of 1958 representations were made on behalf of a group of fishermen for the provision of a limited coast radio station in the Beachport-South End area. At the time there were 32 boats working the area and 12 were already equipped with radio. Although limited coast radio stations existed at Port MacDonnell, Cape Banks, Robe and Kingston they did not provide a suitable service for fishermen using Beachport-South End as bases.

Approval was given on 19th June 1959 for the establishment of a station to be controlled by the Beachport Fishermen's Association with call sign VH5FM using frequency assignment of 4620 kHz together with 4095 kHz in cases of emergencies affecting the safety of the boats and their occupants.

The equipment was installed during December in the premises of the South Australian Fishermens Cooperative Ltd which had a factory in Beachport about 400 metres from the Post Office. The Officer-in-Charge of the base was Mr. J.F. Kelly, the Secretary of the local Cooperative. Subsequent operators included Messrs. Botten, O'Reilly, Lewis, Walters and Harold.

The base equipment comprised a crystal controlled mains powered Weston Electronics Ltd. Type LM6 transceiver. The unit gave an output of 20 watts for an input of 30 watts and fed into an inverted L antenna supported by two 10 metre masts spaced 15 metres apart. A Weston carbon microphone was used for calling purposes. Schedules were kept at 8.45 a.m., 11.30 a.m. and 4 p.m.

In June 1971 the transceiver was replaced by a Marina 60 unit with an output of 40 watts.

Port Lincoln

Late 1959 the South Australian Fishermen's Co-operative Ltd. made representations to improve ship to shore communications for boats operating from Port Lincoln. A limited service had been in operation for some years through base station VH5BA operated by Mr. K.E. Bassham.

The Co-operative proposed, with Mr. Bassham's concurrence, that they take over and operate VH5BA from a new site at the Fish Factory about 2 km behind the North Side Hill which had an elevation of about 200 metres above sea level.

At that time the VH5BA base consisted of a commercial three band Electrosound receiver and a locally constructed transmitter comprising a 6V6 tube feeding two 807's. These were modulated by a 6SJ7, 6V6, and a pair of 807's. The unit was wholly encased in a metal cabinet about 75 cm by 75 cm by 30 cm with an external antenna tuning unit and an Acos type crystal microphone. The output power was about 43 watts.

Approval was subsequently given for the changed arrangement and the station began operation on 4620 kHz with a listening watch on 4095 kHz on 21st September 1960. The Operator-in-Charge was Mr. F. Crawford who carried out operations until 1961 when Mr. C. Meathrell took over. Other operators have since taken over the role.

Shortly after the Co-operative commenced the service, the original equipment was replaced with an AWA Teleradio type 5C transceiver with an output of 14 watts. In 1962 another change was made when a Crammond CRT 20 was installed with an output of 20 watts into a centre fed half wave antenna.

In 1965 a remote receiving station was established 8 km south of the Post Office because of electrical interference from high tension lines. Two new receivers both Eilco 601 types were installed and connected to a vertical antenna. One was fixed on 4095 kHz and the other on 4620 kHz. Both units were powered from the mains supply.

By the end of 1971 the base station was providing communication with 78 boats operating from Port Lincoln.

In 1973 plans were developed for the installation of single sideband equipment to meet changed operating requirements for maritime stations and changes in the operating frequencies. Opportunity was also taken to improve the overall efficiency of the station by the installation of a new antenna system.

Kingscote

In 1964 Southern Sea Products Pty. Ltd., with the support of the Kingscote District Council sought permission to establish and operate a limited coast station at Kingscote on Kangaroo Island. There were 28 boats operating in Kangaroo Island waters which would benefit from the station.

Permission was granted on 21st January 1965 to install a station using frequencies 4620 and 4095 kHz and call sign VH5Ot. The equipment was installed at premises in Elizabeth Street and comprised a Vaughan VSR5 transceiver with 8 watts output. A few months later the equipment was replaced by an A.W.A. Teleradio Type 60A transceiver and installed at the corner Esplanade and Rawson St. in the residence of the operator Mrs. D.M. Smith. The antenna was a centre fed long wire about 7 metres above ground.

When Southern Sea Products Pty. Ltd. ceased business operations on Kangaroo Island in late 1965 the management of the base station was transferred to A. Raptis & Sons, processors and exporters of frozen sea foods. Mrs. Smith continued to carry out the operating duties.

In 1969 an AWA Seafarer 20 transceiver was intalled as a standby unit.

Streaky Bay

Following representations from fishermen at Streaky Bay, the South Australian Fishermens Co-operative Ltd sought permission to install and operate a limited coast radio station at their factory at Streaky Bay. There were about 30 boats using the port at the time.

Approval was granted on 23rd February 1966 to set up the station with call sign VH5SE being allotted. The frequencies assigned for use by the service were 4620 and 4095 kHz, the former for working and the latter for calling and reply.

The equipment installed comprised a mains operated crystal controlled Crammond CTR20A transceiver with a transistor modulator and a switched automatic noise limiter to suppress noise peaks. The output was 35 watts feeding to a horizontal wire antenna about 10 metres above ground.

The station observed an operational schedule at 10.15 a.m. and 2.15 p.m. daily with Mr. F.A. Bellenger being Officer-in-Charge.

Radio Beacon

The first coastal radio beacon for merchant ships was placed in service at Cape Otway in mid 1938. The transmitter delivered a power of 50 watts into the antenna and operated under crystal control, on 1038 metres. The equipment was duplicated with automatic changeover and automatic machinery was used for keying the Morse Code characters. Extensive tests were carried out for the purpose of planning the design and location of other beacons throughout the coast line.

It was not until September 1952 that approval was given to install a beacon on the South Australian coast. It was to be located at Cape Borda on Kangaroo Island and to operate on a frequency of 304kHz with a tolerance of 0.02 per cent. The power into the antenna was set at 500 watts. Call sign AXC was allotted to the station.

The installation of the beacon was not completed until mid June 1955 and it went on the air after testing on 23rd June with a 500 watt Philips type 1620 transmitter. Using a modulation frequency of 800 Hz it had a signal characteristic period of 12 minutes made up of repetitions of AXC, and long dashes for two minutes and a silent period of 10 minutes. The service was continuous and commenced at 8 minutes past the hour. The installation team included Messrs Haselgrove of TCA and Don Beames and Arthur Capel of the Post Office.

The transmitting antenna comprised a vertical insulated lattice steel mast radiator about 53 metres high and located some 500 metres distance from the Cape Borda lighthouse. The mast has been struck by lightning on several occasions resulting in damage to foundations and the transmitting equipment.

In 1965 changes were made to the frequency of operation of many non directional beacons operating in the low frequency band and Cape Borda was changed to 317 Hz.

SECTION 6

SAFETY IN THE AIR

The Aeradio Services

The earliest attempts anywhere to use radio for communication from aircraft in flight to ground stations can be traced back to 1910 when the US Navy and Army used apparatus that was available at the time to communicate by wireless telegraph means. Ranges of 15 km were established but considerable improvement took place during the First World War when the great advantages of radio equipped planes for scouting purposes was realised. Research programmes to develop military aviation communications were later passed on to benefit commercial aviation. It is of interest to note that the Navy problems in developing radio for its aviation needs were principally those of long range communciation for scouting purposes and for direction finding bearings while the early Army problems were concerned with short range radio telephony for artillery observations purposes.

Although radio-telegraphy was used for many years for communication with civil aircraft, by 1930 most overseas airlines had adopted radio-telephony with the exception of some of the major international organisations who continued to use both methods to meet their needs.

In Australia progress in the development of civil aircraft radio services was comparatively slow. It was not until April 1935 that the first aeradio station was put into operation. This was installed at Melbourne at Essendon Airport. Communication was carried out in the low frequency band using 324 kHz. A direction finding system of the Bellini-Tosi type was installed to supply bearings on aircraft fitted with radio transmitters. The second station was commissioned in Tasmania at Western Junction 24 km south of Launceston in September 1938 to aid aircraft engaged on the Victoria-Tasmania run. This equipment had earlier been in service for the England-Australia Centenary Air Race in 1934 as a precaution against competing aircraft overshooting Melbourne.

Commercial aviation activity was on the increase and the Government sent Squadron Leader C.S. Wiggins of the R.A.A.F. abroad in March 1935 to investigate radio communication and navigation facilities used in other countries with the object of advising as to the nature of the organisation and facilities required to meet Australian conditions. He returned to Australia in December 1935 and shortly after prepared a report recommending that ground radio communication stations be set up at airports on the main air routes to facilitate air-to-ground and ground-to-air communication. He also recommended that the equi-signal radio beacon system operating in the then ultra high frequency band be set up on a trial basis to assess its suitability for Australian conditions.

Aircraft were flying in South Australia long before any organised radio facilities were provided in the State to assist in communication and navigation. One of the well known pioneers was Henry John (Harry) Butler. After serving in the R.F.C. during the First World War he returned to Australia in July 1919 and continued with his interest in aeronautics. He formed the Harry J. Butler and Kauper Aviation Co. Ltd. with Harry Kauper who also served with the R.F.C. Kauper later became a well known radio experimenter and played an important role in the development of radio for broadcasting

purposes and for the Flying Doctor Service in South Australia. The Company operated from a hangar at Northfield until October 1920 and then transferred to a site at Albert Park until the Company was closed down on 24th September 1921. This airfield was subsequently taken over by the Commonwealth Government and used for a time as the Adelaide Airport until Parafield was completed. During the lifetime of the company, mail was carried between Adelaide and Minlaton, Kadina, Victor Harbor and Jamestown.

In 1921 the Larkin-Sopwith Aviation Company won a Government contract to operate a regular service on a weekly basis between Sydney and Adelaide with stops at Cootamundra, Narrandera, Hay and Mildura. The service did not commence until June 1924. The company used a Sopwith Wallaby, a Sopwith Antelope and a DH4 as standby, none of which was fitted with operational radio. In 1929 an Air Mail service linked Adelaide with Perth and in 1937 Guinea Airways started operations between Adelaide and Darwin.

On 7th April 1936 the Civil Aviation Board came into existence, and replaced the Civil Aviation Branch of the Department of Defence set up on 16th December 1920. National responsibility for the control of civil aviation in Australia was formally accepted in December 1920 when the Federal Parliament passed the Air Navigation Act. The Civil Aviation Board consisted of the Controller General of Civil Aviation (Chairman), the Controller of Operations, the Controller of Ground Organisation and the Finance Member. One of the Board's first actions was to investigate the application of radio to aeronautical activities. The number of disasters had been of considerable public concern and it was clear that some form of radio should be provided. There was also criticism from aviators who had been overseas and had noted the extensive use of radio for aviation purposes.

About February 1937 Amalgamated Wireless (Australasia) Ltd. established medium frequency aeradio communication equipment at Parafield together with a direction finding station. This was the start of aeradio facilities in the State.

The direction finding station which was of the Bellini Tosi M.F. type was installed as a temporary aid to navigation because of delays in introducing a beacon system operating in the ultra high frequency band. One of the duties of the AWA operator was to check the electrolyte level and specific gravity of the battery of the Holyman Airways DC2 aircraft based at Parafield. This was part of AWA's responsibility under the Company's radio rental maintenance contract with Holyman's and was really the beginning of the Company's aircraft radio servicing organisation in Adelaide. In July 1937 Mr. Bill Gibbings, later Manager, Aviation Department of AWA in Sydney was transferred to Parafield to set up a full time radio servicing establishment. His brief was as follows:

(1) To install m.f. communication equipment in Guinea Airways Lockhead Electra 10 Passenger aircraft for the Adelaide-Darwin and Adelaide-Sydney runs.
(2) Maintain the radio equipment in Holyman's aircraft.
(3) Provide afternoon relief for the operator at VAD Parafield, Mr. Bill Launder-Cridge.

Certain basic spares were provided by the company including tubes, antenna wire and lead weights for trailing antennas, Brasso for cleaning commutators on wind driven generators and vaseline for lubricating send-receive and mode selector switches. The service depot gradually expanded with a total of four technicians under the control of Carlton Robinson.

In 1937 the Board approved the establishment of a network of ultra high frequency radio beacons throughout Australia and placed a contract for their installation. Installation took much longer than originally expected and commissioning was further delayed because of the absence of suitable aircraft for flight testing purposes.

The Civil Aviation Board did not possess a suitable aircraft of its own to flight test the beacons. In June 1938, two beacons were ready for flight testing, and by the end of August seven beacons throughout Australia were waiting flight testing. An aircraft was finally hired in October to start the work.

One 25th October 1938 before any of the beacons had been placed in service the Douglas DC2 aircraft 'Kyeema' owned and operated by Australian National Airways Pty. Ltd. while on a flight from Adelaide to Melbourne crashed on Mt. Dandenong killing all 18 people on board. Among those killed was Mr. C.A.S. Hawker, Member for Wakefield who at various times had held positions in the Federal Ministry. The accident involved a greater loss of life at the time than any other aircraft accident which had occurred in Australia and was one of the most serious in the history of regular air transport throughout the world. Although the ultra high frequency beacon system had been approved in March 1937, it had not been operating on the day the Kyeema crashed. It was the opinion of the Investigating Committee, that had the radio beacon been operating that day its use by the pilot would undoubtedly have prevented any error in navigation or reckoning being made. The disaster and subsequent inquiry sealed the fate of the Civil Aviation Board and the Government lost no time in setting up a Department of Civil Aviation.

The new Department was created on 24th November 1938. It subsequently included a Radio and Communications Branch to be concerned with the provision of all radio and landline communications services, radio beacons and direction finders required for navigation purposes and with the maintenance of this equipment. Many of the early technical staff came from the Postmaster-General's Department. The first Branch Head was Squadron Leader C.S. Wiggins.

It was many year later before D.C.A. in South Australia had sufficient technical staff to carry out major radio installations and maintenance works. These works were carried out by staff of the Postmaster-General's Department until 1947 when Mr. Stan Chapman set up the Airways Engineering (Radio) group in South Australia. Others on the staff included Messr Chris Comas, Eric Halliday, Dud. Wilkinson, Ken Turner and Ron Hall. In later years Mr. Comas transferred to the Post Office and Mr. Wilkinson transferred to the Australian Broadcasting Commission. In 1974 the engineering staff responsible for the installation and maintenance of the radio facilities in the State included Bill Chegwidden, John Ladbrook, Ian Stacey, George Wiencke and Richard Ollino.

Ground Stations

Ground stations play an important role in the aeronautical radio service. They are required for rapid communication between terminals and intermediate airports along a flight route, between isolated stations set up for radio range or direction finding purposes and of course between ground staff and the pilot during flight. While some links between fixed stations have in more recent years been established via fixed Post Office land lines, radio circuits are still widely used. In the case of communication with aircraft there is of course no alternative to a radio system. The ground stations were originally known as "aeradio" stations but are now known by international usage as "communication centres".

Communication between ground station and aircraft must be instantaneous and very reliable to the extent where a high degree of equipment redundancy and backup is supplied. This is a particularly important requirement for modern systems because of the high speed of jet aircraft, their inability to stop and wait for further information. and fuel restrictions requiring touch down within certain time limits. Weather information, airport conditions and other pertinent information must be passed on quickly to the captain during the flight. This is conducted via long range radio facilities.

For control near the airport, short range communication facilities are necessary to give the captain up to the minute information on landing sequence, wind data, runway condition and other relevant data. Before the establishment of a regular aeronautical radio service, communication from ground to aircraft was available from temporary stations installed either at coast stations or aerodromes. At first the marine wavelengths were used for aircraft communication but from about 1936 communication was being carried out on the international aeronautical wavelengths of 900 and 925 metres from Adelaide and other major centres in Australia.

Although working on 925 metres was reasonably satisfactory in southern parts of Australia it was subject to high noise in the northern latitudes. The Civil Aviation Board decided to use shorter wavelengths to overcome this problem and selected 115 and 119 metres for the internal aeronautical services with 45 metres being set aside for long distance working.

Early in 1937 Amalgamated Wireless (Australasia) Ltd. established medium frequency aeradio communications at Parafield. In the same year a landline link to the Coastal Radio Station VIA at Rosewater was put into operation to enable the operator at Parafield to communicate with aircraft either by c.w., m.c.w. or telephony using a transmitter located at VIA. A Bellini-Tosi direction finding system of AWA manufacture was also installed at Parafield at the same time. The receiving apparatus was installed in a small hut near the south-western area of the airport.

The direction finding station was originally established to provide bearings for the Holyman Airways DC2 aircraft operating on the Adelaide-Perth route via Ceduna and other airports in Western Australia. It was also available for assistance as necessary for the DH84 Dragon and the DH89 Rapide aircraft operating from Parafield to Kangaroo Island and Ceduna.

The Bellini Tosi system at Parafield and the link to VIA were installed by the late Harold Drake-Richmond an engineer of world wide experience dating back to Marconi's historic transatlantic transmitting station at Carnarvon and receiving station at Towyn. Drake-Richmond was Second-in-Charge of these installations in 1912. The following year he was in charge of the high power station at Leafield. During War War 1 as a Lieutenant Commander he was in charge of the Leafield, Poldhu and Chelmsford stations in England. Later he installed the first high power stations in the heart of China for the Chinese Government. He came to Australia as Marconi's installation engineer under contract to AWA to install the planned long wave high power station for communication with England. This plan however was superseded by the short wave Beam system so he superintended this installation. From 1937 Drake-Richmond was almost continually in the field supervising radio installations throughout Australia. Besides the Parafield installation, others in which he was involved in South Australia included Bellini-Tosi installations at Mt. Gambier and Pt. Pirie for the R.A.A.F. and aeradio facilities at Ceduna.

In August 1938 a 25 watt AWA aircraft type transmitter Type AS9 was installed by Post Office staff at Oodnadatta with an AWA receiver and a Bellini-Tosi direction finding system. The equipment operated from batteries and was of a temporary nature in order to meet an urgent communication need for aircraft on the Sydney-London Air Mail service. The Post Office installation staff comprised Messrs. Frank O'Grady Transmission Engineer, Ted McGrath Engineer, Cliff Moule, Pat Broderick, Jack Fineri, George Andersen and Harry Bowden. Metters windmill type towers were used to support the antennas.

In 1939 staff of A.W.A. installed stations at Parafield and Ceduna. Transmitters were A.W.A. type J2876 capable of transmitting on four frequencies 6540kHz, 2510kHz, 2600kHz in the high frequency bands and 325kHz in the low frequency band. Transmitters tuned to 6540 kHz were used for long distance communication while those tuned to 2510 kHz were used for short distances up to 150km. The 2600 kHz was

employed for the controlled area and the 325kHz frequency used for communication with international aircraft and for distress purposes. The antenna for the 325 kHz working was a "T" type suspended between two 50 metre high galvanised steel towers. A coupling hut was located midway between the mast bases.

The equipment which was capable of duplex operation and remote control gave an output of 400 watts into the antenna. The remote control facilities were operated by a telephone dial located in the airport control office and enabled the selection of four frequencies, the start and shut down of all equipment and the selection of the type of signal i.e. speech, c.w. or i.c.w. The tuning range of the transmitter was from 35 to 120 metres and from 600 to 1200 metres and was so designed as to allow easy maintenance with a high degree of redundancy to ensure high reliability.

The receiving equipment comprised a standard rack mounted communications receiver AWA type 2869 capable of operation from the a.c. mains or batteries in the event of a mains failure. The units employed 10 tubes and were continuously tunable from 15 to 3750 metres. Output was by headphones or loudspeaker as selected, and provision was made for simultaneous watch to be kept on three frequencies. This allowed a single operator to keep watch for calls on the International wavelength of 925 metres, the intra-Australian wavelength of 119 metres and the long distance wavelength of 45 metres.

The acceptance testing of the facilities at Parafield for the Board was carried out in March 1939 by Post Office staff which included Messrs. Ted McGrath Officer-in-Charge, Cliff Moule and Bill Smith. At the same time, some of the apparatus installed earlier was removed to a new tower and additional receivers installed. The work was completed by May 1939. Further re-arrangement took place in 1941 when equipment was transferred to a new building which is the existing Control Tower at Parafield.

In September 1940 aeradio facilities were installed at Mt. Eba by Post Office staff which included Messrs. Chris Comas, Cliff Moule and Norm Kelly. They were assisted by two riggers from Metters. Facilities included a radio transmitting station for point-to-point working and for communication with aircraft and a radio receiving station for point-to-point working and for communication with aircraft. Also Bellini-Tosi direction finding antenna loops and transmission lines were installed in readiness for the complete system. Receiving equipment was not available at the time. The station transmitter was an AWA AS9 25 watt battery operated unit. It was replaced in October 1942 by a 400 watt unit which was installed in a new building erected for the purpose.

The Mt. Eba transmitting antennas comprised three 31 metre guyed wooden masts located at the vertices of an equilateral triangle having sides 62 metres long and from which were suspended antennas cut for 3,5, 6 and 8 MHz and a low frequency antenna for 325 kHz. The high frequency antennas were fed via open wire transmission lines while the low frequency antenna was fed directly from the transmitter, the antenna being located immediately over the transmitter building. The high frequency feeder system comprised four pairs of 2.5mm copper wire supported on four 7.6 cm diameter galvanised iron poles set in concrete foundations with a crossarm clamped to the top of each pole. The poles were spaced about 10 metres apart and the lines terminated on the building on J spindles fixed to a crossarm bolted to the wall. Entry to the building was via lead-in porcelain insulators and bypass horn gaps. The building earth comprised a copper wire system laid in the ground 13 to 20 cm deep attached to earth stakes driven 2 metres into the ground. One of the radio linestaff who assisted in the diversion of feeders to the new building in October-November 1942 was Mr. Aub. Johns now Line Inspector in charge of the radio lines installation group in Telecom, Australia.

At the receiver location the antenna system comprised an outdoor receiving antenna dipole with feeder and direction finder loop with feeder. The dipole was made from 2.5

mm cadmium copper wire insulated by egg type insulators. The copper wire feeder was attached to wooden crossarms 20 cm x 7 cm x 7 cm fixed to the top of 5cm diameter galvanised iron poles. The receiving station earth system consisted of copper wire laid 13 cm in the ground in a herringbone layout under the antenna and fixed to star section stakes. The receiver was an AWA type and in October 1942 an additional receiver was installed. This was a Kingsley AR7 unit, being one of the first of this type installed outside of Adelaide.

For the direction finder feeder line, a pole was erected in the centre of the receiving tower for the purpose of terminating the loop and transmission line. The transmission line consisted of four cadmium copper wires attached to pin type insulators on spindles in a roll transposition to the receiver building. The terminal pole was a 7.6 cm diameter galvanised iron pole and the intermediate poles were 5 cm diameter. The wires were attached to the building by insulators attached to wooden crossarms and the line fed inside via a porcelain lead-through insulator.

Leigh Creek subsequently replaced Mt. Eba as a commercial airport and installation of radio equipment commenced there during 1947.

In November 1941 upgraded facilities were completed at Oodnadatta in a new building to replace the temporary facilities. The construction party was under the control of Cliff Moule and they installed an AWA type J6924 400 watt transmitter, three 31 meter masts made from hardwood to support four high frequency dipoles and a 325 kHz low frequency antenna. Three AWA C7000 type receivers replaced the original facility.

The transmitter type J6924 was designed for operation between 2 and 20 MHz in the h.f. band and between 150 and 560 kHz in the l.f. band. The output was 700 watts on c.w. and 400 watts on tone or speech modulation. Eight frequencies in the h.f. range and one in the l.f. were available, changing from one to another being achieved by means of motor operated variable capacitors, inductances and switches. Remote operation was provided by a dial and 25 point rotary switch. The r.f. unit was housed in a fabricated steel framework 175cm x 87cm wide by 87cm deep. It included all the r.f. circuits and the voice control unit. The modulator and control unit was housed in a similar cabinet and included power supplies, rectifiers, all audio equipment, line filters and control equipment. The output stage of the modulated amplifier used four 810s in parallel push pull on h.f. ranges and in parallel on l.f. Modulation was applied via the plate supply voltage.

The communications receiver type C7000 was an eight stage superheterodyne type incorporating two radio frequency stages, a converter stage, three stages of intermediate frequency amplification, diode detector and two audio stages. A separate unit consisting of power supply, speaker and two amplifier tubes was normally used with the C7000 to provide the line and speaker outputs. The receiver included tone controls, a separate h.f. oscillator, and individual tubes for beat frequency oscillator, a.v.c. amplifier and detector, muting, limiting and 'S' meter operation. Facilities were provided for reception of telephony, and m.c.w. and c.w. telegraphy, in the range from 150 kHz to 20.5 MHz by means of six switched built-in coils. A dual ratio tuning mechanism provided direct drive and approximately 55 to 1 reduction for fine tuning. Power supplies of 4.6 amps at 6.3 volts and 105 milliamps at 285 volts were derived from a 1D7001 speaker and power unit which could be switched to operate either from 240 volt a.c. mains or from a battery and vibrator unit.

Other facilities installed during the 1940's by Post Office staff included three AR7 receivers and associated antennas for use in ground to air communications. The receivers were tuned to a fixed output level and installed in a hut at Mt. Lofty. A reactance tube varied the pitch of the beat frequency oscillator for c.w. reception. It was controlled by the operator at Parafield by varying the d.c. potential fed to the control line.

The first radio facilities installed for the R.A.A.F. were at Parafield. The station was known as the Adelaide Wireless Telegraph Station. It was placed in operation on 1st March 1942 under the control of Sergeant K.S. Martin. The initial equipment comprised AR7 type receivers and AT13 transmitters. Antennas included dipoles, double doublets and rhombics. On 23rd November of the same year, AT8 transmitters were installed and on 30th July 1943 further additions were made with the commissioning of AT14 type transmitters.

In February 1943 work commenced on the installation of a communication network at Gawler for the R.A.A.F. The work comprised the establishment of transmitting and receiving facilities and a Marconi Adcock direction finding system. At the transmitting site a cluster of rhombic and dipole antennas were provided together with transmitters and remote control facilities for controlling the transmitters. Similar types of antennas were installed at the receiving site and covered the range 3-21 MHz. The control facilities were installed at the Headquarters communication centre. The work was completed during September 1943 and the station put into operation on the 15th October. The original transmitters were AT13-B types and on 20th April 1944 additional transmitters of AT15 types were installed.

During 1943, additional high frequency transmitters were installed at Parafield, Ceduna and Oodnadatta using type 500 C transmitters which were combined point-to-point and radio beacon units. After several days of test transmissions the Parafield transmitter on 5320 kHz was put into operation on 19th July. Ceduna followed soon after and was commissioned on 1st August. Oodnadatta went on-air on 24th August. The beacon section was not put into service until the following year.

On 23rd June 1944 the operations of the Adelaide Wireless Telegraph Station at Parafield were moved to Gawler and on 1st February 1945 the station was renamed the Gawler Telecommunications Unit. The unit was subsequently disbanded on 31st May 1946 following the cessation of hostilities.

The No. 2 Bombing and Gunnery School at Pt. Pirie was another R.A.A.F. station with an extensive communications system. The station was formed on 15th June 1941 with the Commanding Officer being Wing Commander R.F. Dalton. Facilities were provided for air-to-ground communication for gunnery training purposes. The main items of equipment included AT5 transmitters and AR8 receivers. The school was disbanded on 9th December 1943 and replaced by the No. 3 Air Observers School on the same date under Commanding Officer, Wing Commander F. Headlan. The equipment was removed when this school was disbanded on 31st January 1946.

The D.C.A. took over Port Pirie airport and installed its own radio facilities. In 1947 Eric Halliday and Dud. Wilkinson assisted by others carried out the installation. They installed a U.S. Signal Corps BC191 transmitter modified to operate from the a.c. mains in the former R.A.A.F. transmitter building. The transmitter was used as a Non Directional Beacon. The antenna system was supported by two 30 metre Kelly and Lewis guyed masts. In a building adjacent to the tarmac a Bendix aircraft TA-2-J high frequency transmitter was installed. It was powered from the a.c. mains and operated on 325 kHz, 3160 kHz and 6565 kHz for ground-to-air traffic and frequencies in the 2 MHz and 5 MHz aeronautical bands for point-to-point work. Receivers were AR7 types for both air-to-ground and point-to-point activities. There were four AR7 types and one BC312 type.

In 1951 further installation work was carried out when an operating console and racks for remote control of all transmitters and receivers were installed together with v.h.f. equipment. The v.h..f. facilities included a BC624A receiver and a BC625A transmitter (122.1 MHz). These two comprised the SCR522 v.h.f. transceiver. They were modified and provided with power supplies to enable operation from the a.c.

mains. The antenna was a J-type erected on the old transmission line gantry outside the building. This v.h.f. equipment was used mainly for air-to-ground work with the daily aircraft from Parafield to Port Pirie and Whyalla.

The Port Pirie aeradio facilities lasted only for a few years. With the improved v.h.f. communication from Adelaide, through the Summertown site near Mt. Lofty, the Port Pirie service was no longer required.

At. Mt. Gambier, the R.A.A.F. established the No. 2 Air Observers School on 1st July 1941. It was situated on the site of the present day civil airport. The function of the school was essentially to teach navigation and provide continuity of wireless telegraph training which had been carried out at Ballarat in Victoria and elsewhere. Consequently it was equipped with the then current types of aircraft wireless telegraph transmitters and receivers including R.A.F. Marconi Types T1154 and R1155 together with R.A.A.F. AWA Types AT5 and AR8. These units were set up in classrooms in similar layout to the installation in the aircraft in which the operators would be required to operate. The first Signals Officer was Pilot Officer Prosser.

In addition to facilities required to serve classroom training a very comprehensive array of communication equipment was provided plus radio aids to navigation, airport control etc. For point-to-point communications, transmitter types A.T. 13, A.T.14, A.T.15 and A.T.17 were installed in a building situated adjacent to a Flax Mill about 3 km north west from the control tower. The A.T.13, A.T.14, A.T.15 transmitters were employed for high frequency working and the A.T.17 for a v.h.f. beacon system. Antennas used for the high frequency bands were mainly centre fed dipoles while the v.h.f. beacon employed a vertical ground plane type. All equipment was of Australian manufacture having been supplied by A.W.A., S.T.C. and Thom and Smith. Transmitter powers varied between 150 and 500 watts.

The main receiving centre was located in the Headquarters building and equipped with A.R.7 communication receivers manufactured by Kingsley Radio Pty. Ltd. of Melbourne. Early in 1942 an underground remote receiving station was built about 3 km east of Penola Road with equipment being placed in a concrete structure. It contained a duplicate set of A.R.7 receivers, monitor scope etc. and was operated from the main receiving station by wireless telegraphists using remote control facilities. The A.R.7 was one of the most versatile receivers produced in Australia during the war and for many years after the cessation of hostilities it was the standard receiver with D.C.A. It was a seven stage superheterodyne receiver incorporating two stages of radio frequency amplification, a converter stage, two stages of intermediate frequency amplification (including a crystal filter), diode detector, delayed automatic volume control, audio amplifier with a.v.c. and a power output tube. A separate twin high-mu triode tube was used for the beat frequency oscillator and vacuum voltmeter type signal strength meter. Stable operation was provided throughout the band 138 kHz to 25 MHz with the exception of a gap of 45 kHz on either side of the 455 kHz i.f. channel. The crystal filter enabled variable selectivity to be effected. A phasing control permitted rejection of heterodyning signals whilst copying c.w. The frequency range was covered in five bands with a plug-in coil being provided for each band. Each coil unit consisted of four separate coils (antenna coil, two r.f. coils and oscillator coil). Each coil was separately shielded and mounted inside the coil box with its associated air trimming condensers and iron core slugs. The face of each coil unit had a curve engraved on it. The curve represented the dial reading plotted against frequency and allowed a fairly accurate setting of the receiver to any predetermined frequency. One of these receivers is in the Telecommunications Museum.

Limited radio facilities were also installed in the Control Tower. The basic equipment was an A.T.R. 2B transceiver which had a range of about 40 km. An AT5/AR8 unit was also installed for emergency aircraft landings (talk-down). V.h.f. transceivers built by local R.A.A.F. staff were installed at various gun emplacements for airport defence purposes with the master control set being located in the Control Tower.

Staff on the station included about 20 WAAF telegraphists, three or four RAAF telegraphists, three technicians at the transmitting centre, three HF/DF operators, six technicians servicing aircraft wireless telegraph equipment and two on maintenance of training facilities. Included in the radio staff were Flight Lieutenant Bill Heinrich, Chief Instructor Signals, later Safety Officer in the Post Office, Warrant Officer Fred Martins later with ETSA, Sergeant Don Caudle now Superintendent, Regulatory and Licensing in the Postal and Telecommunications Dept., Warrant Officer Dave Wood who later worked at the Local Power House, Flight Lieutenant (later Squadron Leader) Jack Reid, retired and now living at Ballarat and Flight Sergeant Jim Combe who was in charge of the transmitting station. Jim Combe who retired in 1973 served two periods at the station, the first being in 1941 just after graduation from training school and the second towards the end of the war after returning from the Middle East. After discharge Jim worked at broadcasting stations 5SE, 5PI and 5CK.

The Mt. Gambier airport was taken over for civil aviation puroses after the war and aeradio equipment installed. An AWA multi channel transmitter which comprised 12 cabinets of equipment was provided and catered for the Non Directional Beacon, three ground-to-air frequencies and two point-to-point frequencies. V.h.f. communication with aircraft was via modified SCR.522 equipment (BC624A receiver and BC625A transmitter). Kingsley communication receivers type AR7 were used for high frequency receiving purposes.

In the early 1950s one of the 50 metre towers which had been erected for the R.A.A.F. at the station was dismantled and transferred to Adelaide where it was re-erected at the D.C.A. Summertown site which was provided for v.h.f. facilities for Parafield and subsequently West Beach.

In 1952 a plan called the VHF Communications Plan was prepared. This was followed in 1955 by the HF Communications Plan. These plans provided a basis for rationalising the aeronautical communications system to satisfy the operational requirements as they were viewed during those periods. By the end of 1959 about 70 per cent of the plan had been completed but because of rapid changes which had taken place particularly with the advent of commercial jet operations and the large increase in the number of radio equipped light aircraft, the balance of the plan was dropped and a new plan called the Australian Aeronautical Communications Plan introduced in 1959.

The new plan catered for:

(1) the provision of two way communication between aircraft, regardless of where they were operating, and the appropriate ground unit of the D.C.A. responsible for air traffic.

(2) The development of the static free v.h.f. system as the primary means of air-ground communication in particular in areas of high traffic density to meet the more precise requirements of air traffic control. The h.f. system was to be developed as a back-up to the v.h.f. system and as the primary means of communication where v.h.f. coverage could not be obtained.

(3) The provision of point-to-point communication (including direct speech) which would allow an adequate exchange of aeronautical information between ground units responsible for providing services to aircraft.

The plan at the time was expected to take six or seven years to fully implement at a cost of some £5.5 million spread throughout Australia and its Territories.

V.h.f. communication facilities had however been in use a long time before the preparation of the Communications Plan in 1952. About 1949 v.h.f. equipment was installed at Parafield. It consisted of three BC624A receivers and three BC625A transmitters, all being part of SCR522 equipment, a BC639 receiver and a BC640 transmitter. Frequencies were 118.1, 119.7, 121.7 and 122.1 MHz.

Although the v.h.f. worked satisfactorily as regards aerodrome and approach control were concerned, its range on the on-route frequency 122.1 MHz was too limited mainly because of the low elevation of the antennas and shielding by the Adelaide Hills. It was a real problem on the busy Adelaide-Melbourne route.

In 1950 a site at Summertown near Mt. Lofty was developed as a v.h.f. repeater station and the on-route transmitter-receiver relocated there in a wooden and iron shed. Control from Parafield was by a v.h.f. radio link with a land line being available for back-up purposes. The site proved highly successful and enabled communication with aircraft for distances of some 200 km. On the Adelaide-Melbourne route the range extended beyond the border.

The success of Summertown led to more and more equipment being installed there to meet increasing demands for v.h.f. facilities. The station was rebuilt in 1962 and equipment housed in a brick building. In 1974 a multi-channel v.h.f. link was installed to handle the large amount of traffic passing between the site and the Adelaide airport.

Direction Finding Stations

Before the advent of modern direction finding equipment on aircraft, the ground based direction finding station was an important navigation aid provided for early pilots. It enabled a ground station to pinpoint the position of an aircraft if the aircraft transmitter was in operation. Two d.f. receiving points could ascertain the approximate position of the aircraft. The two main systems in use in South Australia for many years were the Bellini-Tosi and the Cathode Ray Adcock systems. All stations have since been removed.

The Bellini-Tosi system was invented in 1907 and consisted of two separate fixed antennas, one of which was placed in a north-south plane and the other in an east-west plane. The standard installation took the form of two equal triangular loops having the same vertical axis with the two vertices being uppermost and brought close together at the apex and the two bases positioned horizontally. The bases were fed by balanced feeders at the centre point with the feeders being taken away to a radiogoniometer instrument in an equipment hut. The feeders associated with the loop lying in the north south direction were connected to the fixed coil of the radiogoniometer and the feeders of the east-west loop connected to another coil fixed at right angles to the first. Inside these two fixed coils was a search coil which was rotatable about the same vertical axis. A pointer on the search coil spindle was mounted just clear of a dial graduated in 360 degrees.

Because of the displacement of the loops a signal being received along a north-south path induced a voltage in the north-south loop of high level compared with that induced in the east-west loop. Similarly a signal along the east-west direction induced a high level signal in the east-west loop compared with that in the north-south loop. The search coil indicated maximum signal when it was in the same direction as the loop located along the direction of the signal. A signal coming in at an angle with the antenna loops caused the signal voltage to be distributed in a certain proportion so that the search coil indicated maximum signal intensity when it was pointing along the same direction as the incoming signal. As it was easier to identify positions of minimum signal strength than those of maximum strength the pointer was frequently set at a position at right angles to the plane of the search coil so that the position showed the correct direction of the received signal.

The earliest Bellini-Tosi systems in South Australia for civil aviation purposes were installed at Parafield, Ceduna, Mt. Eba and Oodnadatta. Systems were also installed at Mt. Gambier and Port Pirie for the R.A.A.F. The Parafield and Ceduna installations were put in by staff of A.W.A. and the Oodnadatta and Mount Eba installations by Post Office staff. The Oodnadatta system was of particular interest as it was the first to use a steel tower for loop support purposes. Previous installations of Bellini-Tosi systems called for a wooden structure in order to minimise errors. The modified steel windmill tower of the Metters type, however, showed that no serious error was introduced by using a metallic support structure. Steel poles were also used to carry the feeder lines to the equipment building. The four insulators on each post were arranged so that the points of attachment of the copper wires formed a square, with the two wires forming the leads from any one antenna loop being at diagonally opposite corners of the square. The four leads were transposed along the full length of the lead-in. This type of transposition was adapted from telephone practice where it had been used to minimise crosstalk interference between adjacent circuits. Also the transpositioning of the wires enabled the electrical balance of the antenna wires to be maintained. The Parafield system was shifted from its original location during June, 1940 to the control tower and in the process it was modified considerably. Because of the difficulty in obtaining an adequate base length from the control tower roof, four booms or outriggers were used. Although the base lengths were much less than the original installation, tests showed that the system worked satisfactorily.

One of the problems of the medium frequency direction finding systems employing loops is that they are subject to considerable error due to "night effect". The indication is controlled by the degree of polarisation of the incoming wave, combined with its direction of arrival. When this is normally polarised the indication coincides truly with the great circle path linking the transmitting and receiving stations but if as is the case during night periods, any abnormally polarised component exists in the radiation, the indication bears little relation to the true bearing of the transmitter. This problem has been almost entirely eliminated by the Adcock antenna system.

Several Adcock systems were installed for high frequency direction purposes at South Australian airports including Air Force stations at Mt. Gambier, Pt. Pirie and Gawler. The Mt. Gawler and Pt. Pirie equipments were put in small buildings while the Gawler equipment was installed in a pill box. Work on the Mt. Gambier project commenced on 27th November 1940 and was completed about June the following year. The Gawler installation commenced in February 1943 and was completed in September of the same year with Cliff Moule in charge. One of the R.A.A.F. operators at Gawler was Arthur Bate, who later worked with the Post Office Radio Section.

Four insulated 9.4 metre tubular steel masts were erected on cardinal points 3.1 metres from a centre peg. Earth wires with terminating plates were extended about 30 metres beyond the masts along two metre deep trenches. A one metre test mast and coupling box was fitted on a concrete base about 10 metres north east from the centre peg. The antennas were connected to the radiogoniometer by four low capacity feeders. The r.f. cables were buried in a two metre deep trench between masts and the receiver and entered the building through the centre of the floor on to an iron gantry. The cables were run in 7.6 cm diameter galvanised iron pipes, and owing to the liability of poor electrical contact the pipe sections were bonded across each point. The power and telephone cables were also run in iron pipes from the centre of the building to a point just beyond the mast pier.

One of the unusual features associated with the installation of the Adcock system was the great amount of excavation involved. This added significantly to the overall cost. Trenches to a depth of nearly two metres were required for a distance of 30 metres north, south, east and west from the centre peg for setting of mast foundations, laying

of cables from masts to equipment and for the earth system. One of the trenches was extended to nearly 100 metres at the two metre depth for entry of power and control cables. In 1945 tests were conducted at the Adcock station at Mildura in Victoria to determine whether the amount of excavation work normally required with this type of installation could be reduced without materially affecting the performance of the station. The tests showed that no appreciable increase in error was obtained with power and telephone cables laid at one metre depth in lieu of the usual two metre depth. In fact they could be laid at shallower depth but the one metre depth was maintained to minimise damage.

The Adcock system required an extensive earth system. Ten copper earth plates, each plate about one square metre, were buried to a depth of two metres. One was buried at the base of each mast including the test oscillator mast, one under the centre of the building and one in each cardinal direction at a distance of 30 metres from the centre of the building. All the earth plates were connected together and to an earth terminal in the receiver building using wires run at a depth of two metres along the cardinal points and north-east in the case of the test oscillator. In addition, earth leads were connected from the earth plate at the base of each mast foundation to the earth lead in the coupling box located at the base of each mast.

When the Adcock systems were being first installed it was found that although the cables and feeders were buried deeply in the ground it did not always stop the production of stray currents in them. Errors of considerable magnitude remained even at sites where the soil conductivity was high. The error was reduced significantly by the installation of a large galvanised wire mesh over the ground. This was first tried at Mt. Gambier and subsequently became standard practice for other station installations. Mr. Chris Comas in charge of the Mt. Gambier project staff devised special tools for crimping adjacent strips of mesh to facilitate soldering and also a tool for pegging down the mesh to minimise buckling. Although original plans called for covering the mesh with several centimetres of soil this was not carried out because of cost considerations.

A typical wire mesh system involved the following:

(a) A mesh of 4 cm galvanised iron wire netting laid over an area to a radius of 47 metres from the centre of the building.
Strips of netting laid side by side in an east-west or north-south direction with adjoining strips being overlapped about 2.5 cm and then bonded and sweated every 2 metres.

(b) The outer circumference of the earth mat and the inner circumference around the building and around mast piers being connected to a copper wire backbone with sweated connections between the netting and backbone being made at intervals of one metre.

(c) The earth mat being connected to all earth plates by a thick copper conductor.

(d) Star section stakes 75 cm long being driven into the ground to just below ground level at two metre intervals around the outer circumference of the earth mat with each earth stake being bonded and sweated to the outer backbone of the earth mat.

As an indication of the materials used in the mesh earth system, the works stores sheets showed the following materials as having been delivered to one of the jobs.

350 hairpins
40 kg wire netting clips
144 earth stakes
72 rolls wire netting
7 km galvanised binding iron wire
30 kg solder

The building was a three metre cube and contained an electrostatic screen within which was housed the receiver, operator and power circuits and lights. It was important to ensure that during the construction stage no nails or screws penetrated the screen. The buildings were of two types, reinforced concrete pillbox type and a fibrocement type.

The receiver contained three stages of radio frequency amplification and four stages of intermediate frequency amplification at a frequency of 100 kHz. High amplification was necessary to cater for deep fading which was sometimes experienced during night time. Because of the nature of the Adcock antenna the average depth of fading was much greater than that experienced with systems employing loop antennas.

In 1944 an antenna amplifier/cathode follower unit was developed for installation in the base of the mast. This involved some modifications to the standard method of installation then in use but resulted in considerable improvement in performance. Port Pirie airport was the last Adcock system installed in South Australia and it incorporated the amplifier unit.

Bearings were indicated on a cathode ray tube by a line of light on the screen and read with the aid of a rotatable cursor and an azimuth scale. An experienced operator was able to judge from the indications on the screen when bearings were likely to be in high error. A steady straight line indicated best quality bearings. Bearings likely to give considerable error were those showing combinations of linear and elliptical traces which oscillated erratically.

The Adcock high frequency system found its greatest use for Air Force purposes during the Second World War although it was used on many occasions to assist civil aircraft on long distance flights. Because of the use of high frequencies its range was very much greater than the low frequency Bellini-Tosi system. However, the Adcock had a major deficiency, and that was that it was most unreliable in the skip distance zone of 150 km to 500 km. The Bellini-Tosi on 300 kHz had good accuracy and reliability in this area so the two systems were complementary. The range of high frequencies normally provided on civil aircraft did not permit pilots to use the best frequency at all times and it was not always possible to obtain good results. The lowest available frequency in the vicinity of 3 MHz was used wherever possible but 6 MHz also gave good bearings under suitable propagation conditions. International aircraft had a wider selection and could call on 8 and 11 MHz frequencies if necessary.

When the direction finder was first introduced it was thought to be the answer to navigational cover of the vast land mass of the country. It had been extensively used in Europe, Africa, the Middle East and India. By 1939 some twenty three Bellini-Tosi medium frequency direction finding stations had been established throughout the country. The system was, however, not greatly used even though its disadvantage during twilight and night conditions could have been overcome by the use of the Adcock system. Consideration was then given to the American navigation system which relied on the medium frequency radio range. However, the inherent limitations of the medium frequency ranges prompted the use of the higher frequency bands for track guidance, and the 33 MHz radio range was introduced as the first basic en route navigation aid.

Mr. A.H. (Harry) Kaye, as Divisional Engineer was the Post Office Headquarters representative who co-ordinated the work of these direction finding stations by the local Post Office technical staff. At the time he co-ordinated radio construction works throughout Australia including those required by the Armed Services. In 1968 Mr. Kaye was appointed Assistant Director, (Engineering) in charge of the Engineering Division of the South Australian and Northern Territory Post Office administration. In 1973 he became Director, the highest position in the Post Office in the State.

After the war the Department of Civil Aviation took over many of the high frequency direction finding stations which had been provided for the R.A.A.F. Many were gradually closed down but by international agreement the Department was required to retain the stations until such time as an international commitment could be met by providing high power non directional beacons for the use of international aircraft. By 1947 most of the HF/DF stations in South Australia had been closed down and by 1952 all stations throughout Australia had been decommissioned.

One of the interesting stories in the use of direction finding stations was recalled by Squadron Leader Jack Reid (Rtd) who was stationed at Mt. Gambier. In the middle of a stormy night he was called from his bed to be told that the DF operator was in trouble. He phoned the operator and found him to be in a state of panic following receipt of a distress call from an aircraft with a strange call sign. Mr. Reid took over the watch and contacted the aircraft by special identification procedure to discover that it was a U.S. Air Force plane completely lost on flight from New Guinea to Melbourne. He called up other direction finding stations to assist in preparing cross bearings and transmitted to the plane a course to fly. The plane eventually landed safely in Melbourne.

Ultra High Frequency Beacon

The use of an ultra high frequency beacon for air navigation purposes can be traced back to the recommendations of Squadron Leader C.S. Wiggins who was sent overseas by the Government in 1935 to study radiocommunication and navigation aids. He recommended that a system be installed to assess its suitability for Australian conditions.

In May 1936 the Australian agents of the Lorenz Company in Germany, Standard Telephone and Cables Ltd., of Sydney advised the Civil Aviation Board that they proposed to bring out for demonstration and testing, a u.h.f. Lorenz beacon. The beacon originally developed in Germany as a blind landing system was the first of its kind, and was used extensively in Europe. It operated in the 33 MHz region then considered to be part of the u.h.f. band and provided two courses oriented at roughly 180 degrees to each other from the station.

The beacon was installed at Essendon, Melbourne and flight tested during late 1936 and early 1937. The trials were successful and on 22nd February 1937 the Board recommended the adoption of the beacon in preference to a medium wave system which was also under consideration at the time. The Government purchased the experimental beacon erected at Essendon and ordered three more similar beacons. A few weeks later, orders were placed for seven additional u.h.f. beacons. These last seven units included one for Parafield to be installed by 14th October 1937. The installation was not completed however until 1939. It was an AWA type transmitter using American type tubes. The transmitter operated on 400 watts when first installed but the output was later reduced to 200-250 watts. Associated with the radio range system was a boundary marker beacon system to indicate to the pilot when he had reached the airport. The Lorenz system was never used in Australia as a blind landing system.

The main radiator was attached to a 25 metre high tower and consisted of a vertical dipole mounted in between two reflectors in a plane at right angles to the required courses. The two reflectors were remotely keyed alternately with relays at their electrical centres. The resulting radiation patterns obtained were two overlapping cardioid shaped patterns. The two courses were in the directions where the patterns overlapped and gave a continuous aural on-course signal.

Keying was arranged so that the dipole of one reflector radiated the pattern for 7/8 second after which the relays changed over and the dipole and the other reflector radiated the pattern for 1/8 second.

Course width was about three degrees. The dot pattern was radiated to the seaward side and dashes to the land side. This convention indicated to pilots using the range which direction he had to fly to get the on-course signal. The course pattern was interrupted periodically with the range identification transmitted in Morse Code. In the case of the Parafield system this was characters for AD.

On the western leg of the Parafield range — towards Ceduna — the course was usable to about 150 km. Range on the eastern leg towards Melbourne was restricted to about 80 km due to the presence of the hills. Range was very dependent on the height of the aircraft which in the 1940s seldom flew at heights in excess of 3000 metres.

The original antenna installation at Parafield was provided with a steel tower to support the radiator but caused problems with the beam and was replaced with a wooden support.

Parafield was also equipped with a low power boundary marker beacon operating on 38 MHz. Radiation from the beacon was arranged to take place principally in the vertical plane so that reception was limited to the zone immediately above the beacon. A horizontal radiator of crossed dipoles was employed for this purpose. The beacon was originally an AWA 25 watt unit located in a hut slightly west of the radio range tower. Towards the end of the war the unit was replaced by a British Air Ministry type with an output of about 10 watts.

Radiation from the radio range transmitter was vertically polarised and the aircraft were fitted with vertical antennas somewhat less than one metre in length. The marker beacon signals were received by a horizontal antenna. Two separate receivers were employed to handle the two systems.

This radio range and boundary marker equipment was superseded about 1950 by the Visual Aural Range, a four course range which was superior to the two course Lorenz system.

Non Directional Beacon

The non-directional beacons were installed along air routes to operate in conjunction with the radio compass. They were introduced to relieve the bottleneck of ground stations taking bearings and then passing the information on to the pilot. Using the ADF receiver, originally Bendix type MN26, pilots are able to determine their own bearings from ground stations whose locations are known. The beacons operate within the frequency band 200-400 kHz and the transmitters are conventional medium frequency types modulated by a keyed tone for beacon identification purposes.

The first NDB installations in South Australia were put in during the war period about 1943 by Post Office staff under Ted McGrath. Beacons were installed at Parafield, Ceduna and Oodnadatta. The transmitters were Airaco type 500C giving an output of 500 watts with capability of operation in low frequency and high frequency bands. Power requirement for the transmitter was 6.3 kW single phase at 240 volts and this caused problems at some stations because of unbalancing of phase loads. The transmitter was manufactured in the United States and was a combined radio beacon (275-400 kHz band) and point-to-point communication type (2.5-15 MHz band) with both channels being crystal controlled. For high frequency purposes it operated into a 600 ohm open wire transmission line and for low frequency beacon operation it worked into a 100 ohm coaxial cable. It was supplied with a local control unit and an automatic keyer. Facilities were also available for remote control working.

The transmitter had an external blower to carry cooling air to the base of the power and modulator unit. This extra cooling was necessary because the equipment was designed for 60 Hertz operation and consequently the local 50 Hertz supply caused considerable heating of transformers. To minimise the heating the transformer tappings of the high tension circuits were adjusted to give lower output voltages. This resulted in a reduction of output power.

The identification signal of the beacon used a long dash followed by the call sign twice at a speed of about 12 words per minute. The length of the dash was about 20 seconds. Parafield with call sign AD on 365 kHz was commissioned first, followed by CD Ceduna on 310 kHz and OD Oodnadatta on 380 kHz. When originally installed the transmitter used a 110 volt McElroy keyer. Speed variations of the keyers was a problem and in 1946 they were all replaced by locally manufactured units.

The antenna for the beacon consisted of a cage of copper wires supported by an insulated tubular steel mast. The structure fabricated from 10 cm diameter galvanised iron pipe on the lower two sections and 7.5 cm pipe on the rest was 40 metres high and insulated at the base by a cylindrical porcelain insulator. Guy ropes spaced at 120 degrees at five levels were broken up with egg type insulators. A copper radial earth mat completed the installation. Matching equipment was installed in a small wooden tuning hut near the base.

The first mast was scheduled for installation at Essendon but unfortunately it collapsed after being raised about 70 degrees from the ground. Failure was due to the collapse of the lowest screwed joint in bending and was contributed to by excessive release of the back guy at that point. It was a happy day in March 1943 when the erection staff under Chris Comas successfully pulled up the Parafield mast without incidence. The erection was carried out using a 12 metre wooden jury pole and a winch. A staff of 14 were employed on the work.

When the NDBs were installed, facilities were provided to interrupt the tone and identification signal and to voice modulate the beacon. This did not interfere with its function as the ADF receiver operated from the radio frequency component of the signal. At Parafield the voice modulation facility was operated by the airport control operator in the tower. It enabled him to have voice communication with the pilot on the ground and on his approach and take off phases of the flight. Pilots were instructed to establish contact with the control tower officer 10 minutes before landing. When departing from Parafield the aircraft was cleared to aeradio frequencies as soon as they were on course.

This was the first time radio had been used at Parafield in this manner as previously the control tower officer had only Aldis lamp or indirect contact with the pilot via the aeradio operator. This change was quite significant as it represented the first time that transmissions were originated by persons other than the conventional radio operator. The operator no longer took any part in the arrival or departure of aircraft but merely maintained contact on route.

In 1953 there were 23 NDB transmitters of 100 watt output and 62 of 500 watt output operating throughout Australia. At the time, plans were also being drawn up for the installation of six 300 watt transmitters to serve as long distance navigational aids on the major international air routes. In 1975 there were three 500 watt, eleven 100 watt and eight 15 watt beacons in operation in South Australia.

The original insulated vertical antenna with its wire cage has since been replaced for NDB purposes and a new type provided. One of the problems associated with the antenna for operation at this frequency is that the physical dimension is only a small fraction of the electrical wavelength resulting in very low radiation resistance and frequently high capacitive reactance. One of the techniques employed to overcome this has been to top load the vertical element with a horizontal flat top. The dead losses of the system vary between about 2 and 20 ohms depending on the frequency of operation, the area covered by the earth mat and the soil conductivity at the site. In some typical installations antenna efficiencies have been found to be as low as 3 percent at 200 kHz increasing to about 15 percent at the highest frequency in use. For the high power beacons a higher antenna has been employed and the efficiency rises to about 30 percent. One of the problems with sites near an airport is that heights are restricted

owing to airport safety clearance requirements. A typical antenna uses two lattice steel towers 21 metres high spaced 80 metres apart. Where additional radiation efficiency is required the height may increase up to 50 metres. Ceduna and Oodnadatta are two airports where these taller towers have been installed.

Non directional beacon stations have been expanded by the introduction of transistorised equipment in South Australia and are now located at Adelaide, Mt. Gambier, Bordertown, Meningie, Tailem Bend, Stonefield, Ardrossan, Whyalla, Leigh Creek, Oodnadatta, Pt. Lincoln, Mount Hope, Ceduna, Woomera, Edinburgh, Kingscote, Parafield, Modbury, Moomba, Andamooka, Coober Pedy and Minnipa.

Visual — Aural Radio Range

The visual aural radio range (VAR) was introduced about early 1950 as a navigation aid. The transmitters were of American origin being made by Airaco and Wilcox Gay. The first VAR in South Australia was installed at Parafield on a site almost opposite the main entrance gates. The facility was badly sited and was never placed in service as the courses and coverage were unsatisfactory.

After a series of tests and experiments lasting several months decision was made to shift the system to the new Adelaide Airport, construction of which at the time was well advanced. The VAR thus gained the distinction of being the first radio equipment installed at the Adelaide Airport and was used for aircraft operating in and out of Parafield before the opening of the new airport. It was located on a site midway along the western boundary of the Adelaide airport and operated there until decommissioned when its function was taken over by the VOR.

When initially installed at Parafield the VAR used an array of five quarter wave vertical antennas which were fed from the transmitter by rigid gas filled coaxial lines. These were subsequently discarded and the standard antenna became an array of five Alford loops giving horizontal polarisation and fed with flexible coaxial cables.

The antenna array was mounted inside a wooden weatherproof structure at the top of a square tower about 7 metres high. A counterpoise some 9 metres in diameter was also provided at the top of the tower. The roof of the wooden antenna hut was covered with Malthoid as iron or other conductive materials were not to be used. This presented a problem at Oodnadatta where the Malthoid often suffered from the depredation of the local crows.

The system furnishes definite visual and aural track guidance for distances up to about 160 km when an aircraft is flying at an altitude of 2500-3000 metres. The system operates in the 112-118 MHz band and consequently its usefulness is limited to line of sight conditions. The aural systems provide the pilot with sector and station identification. Each station is identified at 30 second intervals by alternately keying the two aural patterns with the station call letters.

Associated with the VAR are two types of marker beacons. These are a fan or airway marker and a cone or Z marker. These marker beacons are located at strategic places on the VAR tracks to furnish accurate positional information for the pilot. These beacons also operate in the v.h.f. band but in the spectrum below that used for the VAR equipment. In South Australia these markers are only used to indicate to the pilot when he is directly over the VAR. At Parafield an AWA fan marker operating on 75 MHz was installed close to the VAR. At Adelaide an AWA cone marker on 75 MHz was installed adjacent to the VAR.

The VAR provides two visual and two aural tracks. The visual tracks can be set up on straight through directions with 180 degree separation or displaced according to operational requirements. These visual tracks are produced by the radiation of two overlapping patterns. One pattern is modulated by 150 Hz tone and the other by 90 Hz tone. The visual tracks are determined by the points of intersection of the two patterns.

The strength of the two tones is equal at these points. The sectors are known as the blue sector where the 150 Hz tone predominates and the yellow sector where the 90 Hz tone predominates. On the instrument associated with the aircraft's receiving apparatus a vertical pointer remains centred and indicates "on track" when the tones are of equal strength. Should the aircraft deviate into the 150 Hz pattern a proportionally large amount of 150 Hz tone is produced in the output of the receiver. This causes the vertical pointer to move into the blue sector of the indicator. Conversely if the aircraft moves into the 90 Hz sector this tone predominates and the pointer moves into the yellow sector.

Like the visual tracks, the aural tracks are produced by the radiation of two overlapping patterns. The signal of the aural pattern is modulated by 1020 Hz tone. One pattern is keyed to the Morse Code letter A and the other to N. The two codes interlock to give a constant 1020 Hz tone at the intersection of the two paths. When the aircraft is on the aural track, the pilot hears a constant tone through his phones. Deviation from the track results in a predominance of letter A on one side and N on the other. The tracks of the VAR are oriented so that the visual tracks are aligned along the major airways routes.

In South Australia VAR's were provided at Bordertown, Leigh Creek, Oodnadatta, Adelaide and Ceduna. Today the VAR is regarded as an obsolete navigational aid and by 1976 had been phased out and replaced by the VOR.

Distance Measuring Equipment

The double pulse DME is an integral part of the short range navigation system in South Australia. Since 1955 all internal regular public transport aircraft have been equipped with the system. It operates in the band 200 to 235 MHz, the air-to-ground frequency being 206 MHz and the ground-to-air 224 MHz.

The system which is a secondary radar sysem supplies a pilot with a continuous meter indication of the distance to a maximum of about 320 km from a selected beacon station. It employs radar type ground beacons which reply to interrogations by an airborne interrogator. The distance between the aircraft and the beacon is a function of the time interval between the transmission of the interrogation and the arrival of the reply.

The DME is a development of wartime distance measuring systems and was developed for Australian conditions by the Radiophysics Division of the C.S.I.R.O. During 1945-46 a number of experimental airborne equipments were produced and aftr successful flight tests the Department of Civil Aviation in 1947 decided to adopt DME as a navigation aid.

In January 1949 Amalgamated Wireless (Australasia) Ltd. were awarded a contract for the supply of 95 ground beacon equipments for installation at various locations throughout Australia. The airline operators followed shortly after with a contract for the supply of airborne equipment. The first operational beacon was commissioned in 1953 and the network has been gradually expanded throughout the country. In South Australia DME beacons are installed at Adelaide AD Channel 3, Ceduna CD Channel 5, Leigh Creek LC Channel 1, Meningie MII Channel 9, Mt. Gambier MG Channel 12, Mt. Hope MTP Channel 11, Oodnadatta OOD Channel 10, Whyalla WH Channel 8, Woomera WMA Channel 6 and Pt Lincoln PLC Channel 2.

The progressive installation of Distance Measuring Equipment has given an impressive boost to the efficiency of aviation. The availability of distance information in the cockpit in addition to the directional information provided by the VAR, the NDB or the VOR has enabled flight crews to navigate much more accurately and therefore more safely under all weather conditions.

The system is a primary navigation aid and beacons at these places are required to operate continuously and unattended at remote locations. The beacons and power plant are duplicated at some places and a monitor is provided to measure those beacon parameters of operational significance and to switch the standby facility into operation when necessary.

The antenna consists of three vertically stacked biconical radiators designed to produce an omnidirectional radiation pattern in the horizontal plane. The antenna is usually installed at a height of about 22 metres above ground.

Several years ago the DME channel capacity was extended from 12 to 48 and a new feature called 'Rate of Closure' developed for the airborne equipment to facilitate homing on DME beacons.

Visual Omnidirectional Radio Range

The Visual Omnidirectional Radio Range (VOR) has replaced the VAR at most places. It enables the pilot to determine the direction of his aircraft from any position to or from a VOR beacon, and if necessary, track to or from the beacon on a selected bearing. The beacon operates in the 112.1—117.9 MHz band and like the VAR its ground-to-air range is limited by line of sight reception.

The VOR beacon transmits two signals. One of these signals called the reference phase is omnidirectional and radiates from the station in a circular pattern. The phase of the signal is constant throughout 360 degrees of azimuth. The other signal is transmitted as a field rotating uniformly at 1800 revolutions per minute. It varies in phase with azimuth and is called the variable phase. Therefore, there is a different phase of this signal at each separate point around the station. The antenna system employs four slot antennas spaced 90 degrees around a cylinder.

Magnetic north is used as a baseline for measuring the phase relationship between the reference and variable signals. The two signals are aligned so that at magnetic north they are exactly in phase. A phase difference exists at any other point of azimuth around the beacon. This phase difference is measured electronically and converted to degrees of angle by the aircraft equipment thus identifying the aircraft position in azimuth around the beacon. The information is presented visually by an indicator on the instrument panel. The particular beacon is identified by two or three Morse Code letters transmitted every ten seconds. The system has also facility for transmitting other information such as meteorological information by speech.

The first VOR's supplied by the manufacturer in France were delivered early in 1964 and the first unit was installed in Melbourne. Adelaide followed soon after and later installations were commissioned at Mount Hope, Leigh Creek, Bordertown and Mt. Gambier.

Radar

The overall plan for an air warning system prepared in late 1940 by the RAAF called for an almost complete coverage of the Australian coastline by Radar stations. Particular emphasis was given to areas near capital cities and large industrial complexes including Whyalla in South Australia.

Sites were selected under the guidance of Wing Commander A.G. Pither of RAAF Headquarters, and the Department of the Interior was commissioned to provide the blast proof buildings, power generating plant and to erect the antenna structures. By mid 1942 most of the construction work had been completed.

Two types of fixed stations were ordered from England. They were the C H type which required two huge wooden towers per station and the COL V type which had a rotating beam antenna. There was also a need for a transportable station and the CSIRO in Australia developed a light weight air warning system (LW/AW) which became operational towards the end of 1942.

Shortly after the Battle of Midway in 1942 it became evident that the Japanese were unlikely to mount a sea borne air strike against southern regions of Australia and decision was made to abandon the installation of the fixed station sites even though the equipment building and towers had been installed at three sites in South Australia. These sites included Wilson's Hill about 8 km west of Victor Harbor, Robe and Ceduna.

However at the request of the Navy, two stations were erected to provide warning of the movement of surface vessels through Backstairs Passage and Investigator Strait, the main concern being the safety of the ore landing jetty at Whyalla.

The first of these stations, No 7 Radar Station was formed at Parafield on 1st March 1943, and equipped with a LW/AW system. The Commanding Officer was Pilot Officer A.J.C. Glover. On 12th April 1943, the unit was moved to Wedge Island near Port Lincoln. The station was operational until 15th September 1944, when the equipment was removed and the unit disbanded. Another station was commissioned on 6th March 1943. It was No 10 Radar Station with a COL V unit and was located at Yankalilla under Commanding Officer D.G. Coldwell. This unit was also disbanded on 15th September 1944. It was installed on what is known as Campbell Hill near Delamere overlooking Backstairs Passage. The radar unit was installed in a concrete building camouflaged as an old ruin. Three diesel engine sets for power generation purposes were housed in an underground room nearby and also made to look like the remains of an old building. The staff quarters were in the head of a nearby gully with the huts being laid out to resemble a sheep station homestead complex of shearing sheds, implement sheds, etc. A staff of about 50 operated the facilities including a group of WAAF. An armed guard under guard commander Cpl Harry Caudle patrolled the property. After the war the equipment was removed and the buildings sold. In 1977 the site was being used for grazing purposes.

The war gave great impetus to the development of radar and by the end of hostilities the system had reached a high degree of efficiency. It was soon realised that there was a peacetime role for radar but it was many years before it became a standard facility at the capital city airports. In fact 20 years was to lapse between the installation of the first radar for military purposes and the first for civil purposes in Adelaide. The civilian application was however much more involved than for military purposes. Even in England where radar was developed, the first long range air traffic control system was not installed until 1950. The equipment weighed about 60 tonnes and contained 1000 tubes. It used two large antenna systems 8 metres in length mounted on an 8 metre high tower.

The development of improved techniques for air traffic control led to the concept of what is known as a Terminal Area Unit, operation of which depended very largely on providing the air traffic controllers with a radar picture presented on a bright display unit. In the practical system the radar indicates the position of aircraft within a radius of 240-250 km from the airport. The picture is relayed to both the control tower and the terminal area unit with a television type presentation. Whereas in the earlier type of air traffic control the picture of the position of the aircraft near the airport had to be built up mentally by the controller from information given by pilots about their position in space, the radar installation enables much of this information to be presented visually to the controller directly by the equipment.

The need for improved supervision of air traffic was most pressing in those areas where there was substantial defence aviation activity adjacent to civil terminals. At Adelaide the problem had arisen because of the development of defence activity immediately to the north at Salisbury and Woomera.

During 1961 a great deal of work was carried out in preparation for the installation of radar and associated equipment in Adelaide. The high power 1.2 GHz equipment was ordered from France on 30th December 1960 and was commissioned during August 1963. A similar unit was installed at Sydney just prior to the Adelaide system with equipment and installation costs at the two stations totalling $770,000.

The radar system is categorised as primary radar which presents the range and direction of aircraft. This was the fundamental work for which radar was developed. There is however, a major shortcoming with the system which limits its usefulness. It is unable to identify one aircraft from another when they are flying in the same area. To overcome this problem plans were developed in the early 1970's for the introduction of Secondary Surveillance Radar at the major city terminals. The SSR system operates on the principle of ground based equipment interrogating its counterpart equipment in the aircraft, enabling the controller to positively identify aircraft and at a later stage, determine its altitude. The interrogation facility is a development of the technique employed during the war to identify friendly aircraft.

During 1974 major changes were made to the radar facilities at the Adelaide terminal to incorporate the modern facilities provided earlier at the terminals in the Eastern States, including the provision of an SSR system.

Instrument Landing System

The Instrument Landing System (ILS) is a simple combination of radio ranges and marker beacons. Developmental work on ILS was commenced by DCA soon after the war and in 1946 an experimental system using American equipment was set up at Essendon airport. Results were satisfactory and decision was made to proceed with the installation of ILS at major centres.

In 1949 approval was given to a programme of work which was aimed at providing instrument landing systems at 13 airports throughout Australia, the purpose being to obtain full utilisation of the more important airports with the use of this precision type approach aid under conditions of reduced visibility and low cloud ceiling.

A specification was prepared based on the standard ILS system recommended by the International Civil Aviation Organisation and in 1956 fourteen systems were purchased from an Australian manufacturer.

In order to make an instrument descent to landing three things are necessary. Firstly a method is required whereby the aircraft may be flown so that its path is directly in line with the runway to be used, secondly a means has to be provided by which the aircraft may be flown along a proper line of descent with certain clearance of all obstacles until touch down and thirdly there is a need for suitable reference points during the descent.

The system installed at the Adelaide airport consists of two main elements, the localiser being that element which provides azimuth guidance to the aircraft and the glide path which determines the path in the vertical plane, down which the aircraft makes its descent to the runway. In addition, two markers are provided which are situated at specified positions on the approach path and which indicate to the pilot the distance to touch down. These are located at Medindie and Press Road. The system was installed and flight tested in 1958.

The aircraft is fitted with an instrument which has two pointers. One pointer hangs vertically and moves to the left or right of the bottom centre mark to indicate whether the aircraft is right or left of the approach path to the runway, while the second pointer is mounted horizontally and rises above or falls below the horizontal position to indicate whether the aircraft is below or above the correct approach glide path of the runway. Marker locations are indicated by lamps and aural tones in the pilot's head phones.

Operational Standards

Modern air transport demands very high standards of performance of navigation aids, radar and communication facilities. Many of the navigation aids are installed at remote centres and are operated unattended but monitored. Technical staff located at a number of centres throughout the State are responsible for the regular inspection and maintenance of the many aids in service. Despite difficulties arising from the remoteness of some equipment, the required availability standards of the order of 99 percent must be maintained. Hence great emphasis is placed on obtaining the best possible standards of equipment reliability and maintenance efficiency, to cater for electric power failure reliable standby power plant in the form of auto-start diesel alternators are provided.

The radio maintenance staff are called on to maintain a wide variety of navigation and communication equipment and consequently a high degree of skill is required of the staff. In all there are about 100 radio technical staff located at Adelaide, Mt. Gambier, Whyalla, Ceduna and Leigh Creek to provide this maintenance service.

Statistical analysis of fault reports submitted by field staff are used in the determination of actual performance of all operational facilities. The reports are processed by computer and routine analyses are produced highlighting those facilities which fell below the prescribed standard in the preceding period of study.

SECTION 7

PEDAL WIRELESS

— The Flying Doctor

Royal Flying Doctor Service of Australia — (S.A. and N.T. Section) Incorporated

The Royal Flying Doctor Service of Australia is a non-profit and honorary organisation which provides an emergency medical service to outback settlers throughout Australia. It is an organisation of doctors, nurses, pilots and radio operators who are dedicated to their work to bring medical attention to anyone irrespective of colour, caste, creed or financial position. It is an organisation also of other helpers who work tirelessly in assisting to throw a mantle of safety over everyone in the remote and sparsely settled areas of Australia.

It was originally incorporated in 1937 as Australian Aerial Medical Services (S.A. Section). In 1942 the name was changed to Flying Doctor Service of Australia (S.A. Section) Incorporated. Following the Royal Visit to the Broken Hill base station in May 1954, Royal assent was given and the name changed to Royal Flying Doctor Service of Australia (S.A. Section) Incorporated. In 1977 the name was changed to Royal Flying Doctor Service of Australia (S.A. and N.T. Section) Incorporated.

Many years before the establishment of the Service, the accredited founder, the Very Rev. John Flynn, O.B.E., D.D., had shown a keen interest in the application of radio in providing communication for people living in remote areas of Australia. Dr. Flynn served on the teaching staff of the Victorian Education Department from 1898 to 1902 and on the staff of the Home Mission Department of the Presbyterian Church until 1910 when he committed himself to a two year term with the Smith of Dunest Mission which was centred at Beltana in the north of South Australia. In 1912 he was commissioned to visit what was then known as the Northern Territory and Central Australia. Following publication of the report, the Australian Inland Mission was formed, and Dr. Flynn was appointed Superintendent.

The possibility of a joint radio-Flying Doctor scheme first began to take shape early in 1917. Some experiments were carried out with the various types of medium wave transmitters and receivers then available but the wavelength and equipment were not suitable for long distance communications and the isolated outback conditions. Short wave techniques had not at that time been properly developed. This was the beginning of a long association with the development of radio for outback purposes and in 1947 Dr. Flynn's work was recognised when the Institute of Radio Engineers Australia, elected him as Honorary Life Member. Dr. Flynn hoped to provide a transceiver costing no more than £50 for the outpost equipment. By 1937 the cost of a set was £75 and by 1974 with the introduction of single sideband equipment the overall cost was about $1,000.

By 1925 considerable progress had been made in radio communications technology and with the help of Harry Kauper well known radio experimenter of Adelaide, apparatus was assembled for a trip which Dr. Flynn proposed to make to remote areas of the State. The trip was to take in Beltana, Innamincka, Cordillo Downs, Birdsville, Marree, Oodnadatta and Alice Springs and its environs.

In order to drive the generator to power the transmitter, a belt was made to fit over the jacked up rear wheel of a Dodge buckboard which was to be used for the trip. With the car engine running at a speed which normally gave 60 km/h the generator gave an output of 600V. The generator was purchased from Alfred Traeger, who was later to play a key role in the development of outback radio equipment.

The apparatus included a 10 watt continuous wave and telephony set capable of operation on 600, 250 and 80 metres together with a 20 metre set, two "low loss" short wave receivers, a four tube broadcast band receiver and all the necessary additional equipment in the form of 'A' and 'B' batteries, collapsible masts etc.

The medium wave set was made in Sydney and was used with a collapsible 12 metre mast, single wire antenna and counterpoise. The mast comprised four three metre sections of light steel tubing. Erection was carried out using a length of light Oregon timber and block and tackle. Erection of the mast, setting up the vehicle to drive the generator and all the other miscellaneous activities took 20-30 minutes.

The 20 metre set built by Harry Kauper employed one UV202 Radiotron tube with high tension being supplied by a small Esco motor generator. By supplying 12 V d.c. from the high capacity car battery to the motor part of the set, the generator gave an output of 300V d.c. The antenna was a vertical copper tube 6 metres high in two sections enabling it to be packed in a small space for transport. The lower section was slightly more than 3 metres long and 2 cm outside diameter, while the upper section was slightly less than 3 metres long and 1.6 cm outside diameter. The tube was maintained in an upright position by three cords attached to an insulator at the top of the antenna. The counterpoise was a single copper wire about 4.5 metres long supported 30 cm above the ground on wooden pegs and insulators.

The set which gave an output of 10 watts was very compact measuring only 23 cm long 17 cm high and 17 cm wide. The whole outfit and antenna could be set in operation in only 5 minutes and a practical demonstration of its possibilities was given on Sunday 21st June 1925 when on its first test it was taken by car to a paddock some distance out of Adelaide. Communication was immediately established and carried on for about an hour at noon with a Sydney experimenter.

During the trip Dr. Flynn was accompanied by George Towns a former operator with a New Zealand wireless unit during the war. For months the two men travelled throughout the outback erecting the radio gear, carrying out tests, then dismantling and proceeding on to the next site.

The experiment was an outstanding success, despite the many occasions on which trouble was experienced with the equipment. Telephony transmissions were picked up at stations hundreds of kilometres away and lengthy messages in Morse Code exchanged with Adelaide and it was successfully received by Mr. R.M. Barker of Prospect. Mr. Earle of St Peters received three messages from the party while they were in Birdsville. Mr. Hall another Adelaide experimenter heard Mr. Towns using radio telephony from a site near Cordillo Downs about 400 km away. Speech tests were heard on many other occasions sometimes with reception being at loudspeaker strength. However, much work remained to be done. To be acceptable for outback conditions a better power drive arrangement had to be found in place of the jacked up rear wheel of a car, the problem of charging batteries had to be overcome and the efficiency of the telephony transmitter had to be considerably improved.

On the recommendation of Kauper, Dr. Flynn sought the assistance of Alfred Traeger an electrical engineer and radio experimenter in the development of apparatus which would be easy to operate and would provide reliable service at isolated homesteads.

Alf Traeger and pedal wireless set.

Towards the end of 1926, Dr. Flynn and Traeger went to Alice Springs where they installed a 50 watt transmitter donated by A.W.A. Sydney, in a building at the hostel. A 20 metre antenna was erected and using call sign 8AB they were able to establish telephony contact with Kauper in Adelaide on a wavelength of 89 metres.

Then they proceeded to Hermannsburg Mission some 130km west of Alice Springs where they installed a telegraph spark transmitter and a 10 metre antenna. The call sign of this station was 8AD but they were unable to contact the Alice Springs terminal at the scheduled times. On returning to Alice Springs, Traeger soon found the trouble and was able to establish communication with Hermannsburg.

Shortly after installation of the link it was used to pass messages between the Superintendent of the Mission and his wife who had gone to Tanunda for the birth of a daughter. It was the first field radio telegram handled over what ultimately became an Australian wide network dealing with some 300,000 similar radio telegrams per year 40 year later. This first message was handled on 24th November 1926. The network was soon increased to the point where there were two outstations. The other being 8AE Arltunga. The arrangements were that the Alice Springs base transmitted on telephony on 175 metres on a morning and evening schedule and the outstation transmitted in Morse Code on about 85 metres.

Unfortunately the network did not last long enough because of the problem of keeping an operator at Alice Springs. However development of an improved set was pushed ahead. Two major technical problems which had to be overcome were to find a more suitable alternative to the large wet batteries and the educational problems associated with the learning of the Morse Code.

Traeger subsequently resolved the battery problem with a pedal operated generator which produced an output of 20 watts at 300 to 400 volts. The gears were enclosed in a sealed case filled with oil. The 3 watt double sideband transmitter was capable of operating on one of three crystal controlled frequencies. A two tube regenerative receiver comprised the receiver portion of the transceiver. By 1950 most of the pedal operated units had been replaced by vibrator units which operated from accumulators. By comparison modern double sideband transceivers in use are substantially 20 to 25 watts output although a great many of the portable stations are in the 5 to 10 watt capacity. Most of the outposts are now powered from 12 volt batteries but some 240 volt powered units are in service.

In 1928 the first Flying Doctor Service in the world was founded by the Australian Inland Mission at Cloncurry in North West Queensland and in 1929 the first Traeger transceivers were installed at strategic centres. Number 1 of the type was installed at Augustus Downs on 19th June 1929.

With improvements in technology the outback transceiver became telephony operated but an automatic keyboard was supplied for emergency purposes for use when atmospheric noise conditions rendered telephony unreliable. The keyboard obviated the necessity on the part of the operator, of being able to send and receive the Morse Code. The keyboard introduced in 1932 was adapted from the standard typewriter and used a spring operated drum and a perforated strip to automatically reproduce the Morse characters when the corresponding letter on the keyboard was pressed.

The success of the Cloncurry experiment soon led to the establishment of further radio control stations at other remote parts of the country. In 1937 the South Australian section of the Service entered into agreement with the New South Wales section to share the cost of establishing a centre at Broken Hill which was to serve homesteads in the north east part of South Australia as well as New South Wales. While still assisting with the Broken Hill facility, planning was going on to establish a base at Alice Springs and with the help of a $10,000 donation from the S.A. Womens Centenary Council, a $1,000 donation from the S.A. Country Womens Association and

assistance from the South Australian Government, the Alice Springs station went on the air officially in November 1939. It became the fifth Flying Doctor base in the organisation.

Even before the establishment of the Alice Springs base the S.A. Women's Council had given earnest consideration to setting up a Flying Doctor base at Port Augusta. In August 1937 the Council announced the basis of their scheme which was to serve as a memorial to the women of the State. However, with the support given to Alice Springs very little further development for Port Augusta took place until about 1946 when a proposal was considered for a radio control station to be operated by the Flying Doctor Service. In the coverage of the outback area of South Australia for medical purposes there was an area situated to the north west of Port Augusta and the near vicinity north to north east of the town which while being partially served medically by the Bush Church Aid Society was at the same time without the means of immediate communication with a radio control station. Several centres had been considered but after consulting the Premier, Port Augusta was chosen.

Formal application to establish the base was made on 12th November 1952. In addition to medical aid and public telegraph service it was proposed to offer a School of the Air service to the outback children in conjunction with the educational authorities in South Australia. Plans for the base were approved in 1953 and the foundation stone laid on the 16th February 1954, by the Premier of South Australia, The Hon. Sir Thomas Playford with the minimum of proceedings during a very hot day when the temperature stood at 41°C.

The frequencies assigned to the control station and the associated outpost stations were 1690 kHz call sign VNZ2, 4010 kHz call sign VNZ and 6890 kHz call sign VNZ3. The 4010 kHz was to be shared with Darwin and Meekatharra networks while 6890 kHz was to be shared with Carnarvon.

The response to the proposal was encouraging and many station owners connected to the Broken Hill and Alice Springs bases sought permission to work into Port Augusta. Among the early changeovers were 9CP Anna Creek, 8HP Arckaringa, 8AK Ingomar, 8HS Mt. Barry, 8ZG Mt. Clarence, 8WF Mt. Willoughby, 8HU Pernatty, 8TV The Twins, 8QT Mt. Sarah, 8RU Welbourn Hill and 8HO Wintinna. By mid October 1954 they had all had their transceiver equipment changed for working with Port Augusta.

By September 1954 considerable progress had been made with the construction of buildings and the installation of the control station radio equipment. On 15th September frequency checks were carried out on the 4010 kHz transmitter and on the following day the 6890 kHz transmitter was checked. No outpost stations had operated through the base at that stage.

The station was opened for traffic on 16th October 1954 and the official opening ceremony which was broadcast over the 6890 kHz channel performed on 4th July 1955, by the Chief Secretary and Minister for Health, the Hon. Sir Lyell McEwin K.B.E. The ceremony had been deferred pending the completion of the permanent station building and residence for the base director Mr. R.G. Pitts. The technical equipment was housed in a temporary structure of fibrous plaster and transferred to the new red brick building shortly after.

The first medical call was received on 18th October 1954 from 9CP Anna Creek. Advice was given over the network and eliminated the necessity of sending an aerial ambulance. The hours of operation were as follows:-

Monday to Friday	0800-0830; 1100-1130; 1400-1430; 1630-1700
Saturday	0800-0830; 1100-1130; 1630-1700
Sunday	0900-0930; 1200-1230

Medical calls were handled at the beginning of each session. By 1973 the station was in continuous operation between the hours 0800-1715.

The radio service provided the only contact with the outside world for many homesteads and it naturally soon became the channel through which a considerable amount of communication was being conducted. Telegrams to and from the outposts are passed through the base and handled by the normal Post Office telegraphic system at Port Augusta. In 1977 the number of radiograms handled was 7569 made up of 3434 outgoing and 4135 incoming messages. There were 187 outposts in regular communication comprising 75 fixed, 66 portable and 46 School of the Air stations. A total of 457 consultations by radio was handled during the year.

The transmitting station was located about 2 km south of the Port Augusta Post Office on a site offered by the Port Augusta Corporation. The South Australian Country Womens Association donated four transmitters which Mr. Pitts obtained through a war disposals sale. The four transmitters were ex R.A.A.F. AT-13C type modified for speech operation. One of the transmitters was kept on standby for operation on any of the assigned frequencies, while each of the others was set up on a single frequency for normal operation.

All the transmitters were tropic proofed with transformers being oil filled. They were remotely controlled from a panel in the studio and relay switched. A high tension delay of 45 seconds operated for each transmitter.

A cathode ray oscilloscope was provided for checking of modulation depth. The crystal controlled oscillator stage employed an 807 tube with three 807's in the intermediate stages and a pair of 813's in push pull for the final stage. The input to the r.f. stage was 465 watts giving 300 watts to the antenna. Plate type modulation was employed with two 813's in push pull. The rectifying section employed four 866A tubes. Input was via an A.W.A. limiting amplifier with an S.T.C. dynamic type 4035 microphone.

The receiving station was located 3 km east of Lincoln's Gap and about 11 km from the transmitting station. The main receiver was an Eddystone 640 with variable tuning over the range 1.8 to 31 MHz. Two locally manufactured crystal locked receivers were also provided. Three EILCO receivers subsequently replaced these units. The receiving station was linked to the control room by three land lines for communication purposes together with a standard telephone service. The building cost £480 to erect.

The transmitting antennas were supported by one 21 metre tripod steel tower and four 7 metre steel masts. The antenna lengths were cut to be resonant at the appropriate frequency. The 1690 kHz antenna was end fed with a coupling unit and connected to the transmitter via a 600 ohm transmission line. The others employed 300 ohm open wire lines. The three receiving antennas were centre fed half wavelength dipole types supported by three 14 metre towers.

An attractively built operator's control panel was installed in the studio. The panel accommodated transmitter switches, remote receiver channel selectors, remote receiver line amplifier controls, monitoring amplifiers, speech mixers and two microphone controls. The studio also housed a rack mounted patching panel used for test purposes. In 1973 the studio was extensively upgraded and modernised.

A Traeger 48S3 type receiver was provided for emergency purposes in the event of power failure or major equipment failure.

The first School of the Air in Australia was officially opened at Alice Springs on 8th June 1951 and culminated seven years of planning and assembly of the necessary facilities. Graham Pitts who was in charge of the Alice Springs base station at the time was instrumental in solving many of the technical problems associated with establishment of the service. The Port Augusta School of the Air commenced lessons on 7th July, 1958 with 34 pupils enrolled.

New studios were later provided by the Education Department and officially opened by Mr. J. Whitburn the Assistant Superintendent of Primary Schools on 9th October 1959.

A tablet at the R.F.D.S. base station commemorates the inspiration and work of Miss Adelaide Miethke as founder of the School. The inscription on the table reads:-

"This tablet commemorates the life and work of the late
Miss Adelaide Miethke O.B.E., B.A.
The originator and founder of the first School of the Air
and for many years, a member of the Council and executive
of the Royal Flying Doctor Service of Australia (S.A. Section).
15th March 1963"

The School of the Air in 1974 was being conducted from the Port Augusta Primary School by three full time teachers with Mr. Starr as Headmaster. Forty stations were linked in the scheme involving 80 pupils. The hours of transmission on a Monday to Friday basis were 9.30 a.m.—11 a.m. 12—2 p.m. and 3 p.m. to 4 p.m. The most distant pupils were located at Macumba about 700 km north of Port Augusta. In 1977 there were 97 pupils receiving instruction over 51 stations.

The School of the Air supplements the lessons prepared and despatched by the South Australian Correspondence School and brings personal contact with teachers per medium of radio.

In 1968 the R.F.D.S. accepted the responsibility for the operation of the area being covered by the Flying Doctor Medical Service of the Bush Church Aid Society. This covered medical, aviation, telegraphic and School of the Air type activities. This involved Port Augusta in the additional frequencies 2020, 5145, and 8165 kHz previously operated by the Ceduna control station and its outposts.

About this time the network comprised 110 fixed stations including 30 School of the Air stations and 290 mobile stations. About 20 of the fixed stations were located some 500 km from Port Augusta. Telegraphic traffic was about 20,000 messages per year and medical radio consultations exceeded 1500 calls for the year.

A few years after the Port Augusta base station began operation, the noise level from electrical interference became excessive and plans were developed for relocation of the receiving station. One of the early sites investigated was Mt Brown some 20 km east of Port Augusta but was rejected because of accessibility problems. The site finally chosen was on Horse Shoe Range about 32 km west of Port Augusta and about 210 metres above see level. The facilities at the new station were officially placed in service on 28th November 1973.

The receivers are Codan units type 7004 linked back to Port Augusta by v.h.f. radio links. The receivers are dual function units capable of receiving double sideband, single sideband and carrier and single sideband without carrier. There are two outputs from each connecting to the appropriate emergency decoder and other radio facilities. The base station has facility for clarification of the single sideband plus carrier and the single sideband without carrier signals. This solves the problem of mixture of three different modes of operation and allows an easy changeover to single sideband only, in the future.

Five v.h.f. channels carry the receiving station signals to the base. Another link in the Port Augusta-Receiving Station direction gives facilities to enable remote control from the studio in Port Augusta. The link equipment comprises Vinten MTR 30B units modified by separating the transmitter and receiver sections. Five transmitters and one receiver are grouped in one standard rack cabinet together with its associated control circuitry. Five receivers and one transmitter are grouped on the rack installed at the control station end. The primary source of power is a thermo electric generator running off a bottled gas supply. Antennas are six element Yagis.

The receiving antennas are four half wave horizontal types located a quarter wavelength above the ground. Each is centre fed to a balun at ground level and then via coaxial cable to the equipment hut. Separate dipoles are provided for 4010, 5145, 6890 and 8165 kHz. End fed quarter wave vertical antennas are also provided for each of

these frequencies with antenna selection being carried out remotely from the control station. A quarter wavelength top loaded 21 metre vertical antenna is provided for 2020 kHz reception and connected to the equipment by a coaxial cable and matching network.

When the base is not being manned it can be raised by an Emergency Call facility. The outpost caller originates a signal consisting of two audio tones which are transmitted simultaneously for a controlled period of about ten seconds. These two tones, 780 Hz and 1320 Hz pass through a unit which produces sum and difference frequencies of these tones. The difference frequency, 540 Hz, closes a relay circuit to operate the station alarm system. To minimise false alarms the 540Hz tone has to be established for at least 5 seconds before it will operate the alarm.

In accordance with an International Telecommunications Union agreement of 1959 all fixed point-to-point radiocommunication networks in Australia were required to change from double sideband operation to the more efficient single sideband method by 1970. For various reasons the changeover date was delayed but the Port Augusta base station was successfully cut over during November 1973, following the establishment of a new transmitting centre at the former receiving station site on the Whyalla Road. The site has an area of 28 hectares and ample space was available to set up a new transmitting centre without disturbing the original receiving facilities.

Although decision had been made to change the base transmitters over to s.s.b. operation it was not practicable to change every outpost station at the same time so that the new system had to be operable with the old one. This was accomplished by transmitting one sideband and the carrier so that signals could be received equally well by receivers requiring double sideband, one sideband and the carrier and single sideband with no carrier. By this means a compatible arrangement was provided for all systems and when the date arrives for the conversion of all outpost equipment to s.s.b. it will be only necessary to remove the carrier from the Port Augusta base transmitters.

The cost of the building and facilities, but excluding the new single sideband transmitters was $30,000. A thermostatically controlled ceiling fan removes heat given out by equipment and air drawn in for cooling purposes is cleaned by an auto roll filter mat.

Tenders for supply of the equipment were called in July 1969. Tenders were received from four organisations and a contract placed with the Adelaide based firm, The Electronic Instrument and Lighting Company in June 1970. The contract called for the supply of equipment for all the R.F.D.S. bases throughout Australia.

Five Codan types transmitters were provided under the contract for Port Augusta. Four are single channel units which serve the frequencies in common use and the other is a six channel unit similar in other respects to the single channel units. This arrangement eliminates the need for a standby transmitter for each working frequency. The multi channel transmitter can be remotely switched to any selected base frequency when required. In addition to catering for a breakdown situation the transmitter enables routine maintenance to be carried out at convenient periods.

The transmitter uses a linear amplifier to follow the exciter unit which has a power output of 25 watts p.e.p. arranged so that it can be bridged direct to the antenna feeder circuit in the event of failure of the linear amplifier. The linear amplifier has a rated output of 1000 watts p.e.p. in single sideband mode and in 1974 was being used to radiate 1000 watts p.e.p. with one sideband and carrier. When all outpost stations have been converted to single sideband the carrier will be removed, and 300 watts of s.s.b. will be transmitted.

In addition, a Zephyr type 300 watt transmitter is available on 1690 kHz. The mercury vapour rectifiers in this transmitter were replaced by solid state rectifiers to improve reliability. In 1974 a Non Directional Beacon transmitter on 1640 kHz was in the process of installation to assist R.F.D.S. aircraft pilots in navigation.

The antennas at the station comprise horizontal half wave centre fed dipoles for the 4,5,6, and 8 MHz bands fed via coaxial cables and centre fed baluns. Three triple sided Metters towers support the antennas. For the 1690 and 2020 kHz frequencies, a 32 metre triangular steel lattice mast insulated at the base and provided with radials each 60 metres in length and fed by an underground coaxial cable has been provided. The Non Directional Beacon transmitter is linked to a 30 metre high base insulated mast of 17 cm sides. This antenna also has a radial earth system.

One of the popular features of the outback service is the "chatter" or "Galah"sessions. Not only do outposts talk to the base but they talk to each other. Frequencies 1610 kHz, 1690 kHz and 2020 kHz have at various times been used for inter post traffic but 1610 kHz and 1680 kHz were not popular from a technical point because of the complexities they introduced in the transceiver equipment and the antenna. Also propagation difficulties were frequently experienced during some parts of the year. Only the 2020 kHz frequency is now being used.

During 1977 a radio paging system was installed at the Base Station to upgrade the service. Difficulties had been experienced in co-ordinating personnel when an emergency flight was required. The paging system enabled the simulataneous contact of doctors, pilots and sisters.

Mr. Graham Pitts the Base Station Director and Technical Supervisor has been with the station since it went on the air in 1954. He trained with the Marconi School of Wireless and for many years worked as a ships operator. Following a period as instructor with the A.W.A. Marine group schools in Melbourne and Sydney he returned to the sea just before the outbreak of the war. In 1943 he spent a short period in commercial radio while working with 5KA in Adelaide but in 1944 transferred to the R.F.D.S. base station Alice Springs where he spent 10 years before moving to Port Augusta. In 1977 Mr. Pitts was being assisted by Mr. R. Cranwell Asst Base Director in the operation and administration of the base.

Bush Church Aid Society

In 1952 the Bush Church Aid Society for Australia and Tasmania made representations for the establishment by the Society of a radiocommunications station at Ceduna. The station was to be used for medical aid communication with the Society's hospitals, its aircraft and with stations at outpost centres where radio equipment was available within a radius of about 500 km. It was also to handle public telegrams.

Since 1924 the Society had catered for the medical need of the settlers in the western part of South Australia. By 1952 it had hospitals at Ceduna, Penong, Wudinna and Cook. The Cook hospital together with nursing homes situated at Tarcoola and Rawlinna provided for the needs of railway and other workers along the East West line. In 1937 the Society added a complete flying medical unit to the organisation.

The Flying Doctor Service of Australia had earlier shown interest in the establishment of a base station at Ceduna but subsequently set up at Port Augusta instead.

Approval was granted for establishment of the station and three frequencies allocated. They were 2020 kHz call sign VKB, 5110 kHz call sign VKB2 and 8165 kHz call sign VKB3. During normal operations only the letters VKB were used for calling purposes. These channels were assigned on a shared basis with similar networks operating in remote areas with radio control stations located at Cloncurry, Charleville, Charters Towers, Alice Springs, Pt. Lincoln and Broken Hill. However, shortly after commencement of operations, interference was experienced with the Flying Doctor Service at Cloncurry and the 5110 kHz Ceduna frequency was changed to 5145 kHz.

The licence conditions imposed no charges on messages relating to medical aid and advice but commercial traffic circulated through the control station and thence through the Ceduna Post Office was subject to a minimum payment of 2/6 for 12 words and 2d

for each additional word. The amounts were apportioned equally between the Post Office and the radio service, the latter being divided between the Society and the licensee of the outpost station on such terms as mutually agreed upon. The annual licensing fee of the control station was £1.

On 12th November the Society's organising Secretary, Rev. Tom Jones announced that the radio base station was to be established at a cost of £12,000 and that the station was expected to be in operation in a few months. However due to delays it was not until 10th September 1953 that the centre became fully operational.

In July 1953 approval was granted for the installation of fixed stations at the Society's hospital at Cook and Tarcoola for the purpose of communicating with the control station at Ceduna. The approval was subject to the condition that messages exchanged between the stations were restricted to matters relating to medical aid and advice. Calls were scheduled for 9 a.m. and 6 p.m. each day. The equipment installed was Weston transceivers type BCA 53 with 4 watts into the 6CM5 tube final stage. The call sign for Cook was 9RO and for Tarcoola 9RP. The same frequencies assigned to the Ceduna station were assigned to these outposts. The permanent Ceduna control station facilities at this stage had not been installed and a Weston transceiver was used as an interim measure. The Cook station was put into service on 6th August after completion of trials with VKB at Ceduna. The Tarcoola station was commissioned on 18th August. Mr. George E.A. Cameron was the radio officer in charge of the technical facilities at the time and remained with the Society at Ceduna until January 1963. In 1956 Mr. Jim Ward took up duty as an assistant to Mr. Cameron. Mr. Peter Mayne took control of operations in 1963 and he was followed by Mr. Kevin Ellis. Finally there was Mr. Allan Chadwick after he retired as Chief Pilot in 1965 a position he had held since the inception of the BCA Flying Medical Service in 1938. Mr. Cameron is now in the Anglican Ministry and in 1974 was Rector of the Parish of Willunga in the Diocese of The Murray.

When the Ceduna control station facilities were put into service the transmitter was of RMCA manufacture of modified TDF type using a crystal controlled oscillator with a 1624 tube. This tube was later replaced with an 807 owing to the difficulty of obtaining replacement 1624 tubes. Another subsequent modification was the employment of a half frequency crystal oscillator using a 6M5 tube which fed to the 807 arranged for frequency doubling operation. Modulation was by plate and screen method on the final stage. The output stage employed an 813 tube and had an input power of 180 watts resulting in just over 100 watts into the antenna. A 90 MB Zephyr dynamic microphone was used in the speech input circuit. It was later replaced by a Philips type. The speech input equipment was made by Mr. Cameron with assistance by Weston Electronics of Sydney. The output of the speech input equipment fed a pair of 811 modulator tubes in push pull mode. The transmitter was powered from the 240 volt a.c. mains. Rectifiers included two 866A, two 83 and four 5Z3 type tubes. On 14th October 1959 an additional transmitter with an antenna power of 300 watts was installed to increase flexibility.

A standby installation employing a Weston crystal controlled transceiver was also provided. It was powered from a 6 volt accumulator by a synchronous vibrator power supply unit. An STC carbon microphone was used for speech input purposes and the transceiver was linked to an end fed antenna 33 metres long and 12 metres high.

Three receivers were in service to enable the operator to keep watch simultaneously on three frequencies. There was one Marconi R1155 type with tuning capability of 75 kHz to 18 MHz and two CRV-46151 types with tuning capability of 195 kHz to 9060 kHz. Because of the high level of electrical interference in Ceduna a remote receiving station was erected some 3 km out of town. EILCO transistorised remote receivers were later installed. The antennas were centre fed dipole types supported by 20 metre steel masts.

The transmitting antennas were supported by one 20 metre three sided tower and three 6 metre steel masts. An earth mat was installed beneath the antennas. Distances between masts were 55 metres, 91 metres and 121 metres. The antennas were initially fed by single wires through a match network from the tank coil. Later, centre fed dipoles were used. The same antennas were used for receiving purposes via a change over switching system.

The first aircraft the Society purchased was a DH-83 Fox Moth taken over in 1938. It carried no radio equipment. Allan Chadwick took delivery of it in Sydney and flew it to Ceduna to inaugurate the first Flying Medical Service to Penong and Cook. The aircraft remained at Ceduna until 1947 when it was replaced by a twin engined ex-RAAF De-Havilland DH-84 Dragon. Late in 1953 with the work of the Ceduna base expanding, a second aircraft a Percival Proctor Mark III was acquired. About this time the Dragon which previously had no radio was equipped with a Traeger 51MA transceiver feeding a wire antenna fixed above the cabin. The installation was never very successful because of power supply problems. The Dragon had no electrical generating system and the 12 volt battery had to be removed frequently for recharging purposes.

Although it had been intended that the Proctor should be fitted with radio this never eventuated. The machine had been fitted out with a high frequency system in readiness but no suitable radio equipment could be located. Space limitation was a major problem.

In November 1953 the hours of operation of the Ceduna station were changed so that service was given between 8 a.m.—8.30 a.m., 10.30 a.m.—12.30 p.m. and 5 p.m.— 6 p.m. Soon after, a further change was made whereby operations commenced at 7.45 a.m. and continued until 9 a.m. At 10.30 a.m. there was a fishing boat session followed by the normal 11 a.m. session. Further services for fishermen were provided at 12.30 p.m. and 2.30 p.m. with the forecast sessions.

The official opening of the station was performed by the Primate of Australia the Most Reverend H.W.K. Mowll C.M.C. at 3.00 p.m. on 22nd May 1954 in the presence of a large gathering. Canon Cameron Chairman of the B.C.A. and father of the station control officer, presided at the cermony. He said that some years ago it had been decided that Ceduna was the natural centre for a radio control station for the great inland area of South Australia. Certain arrangements had been made and certain actions taken but unfortunately the arrangements had broken down and the Society decided to go ahead with the building of its own station at Ceduna with funds provided under the will of the late Sydney William Jones. The completed station was a memorial to his wife Anna. Canon Cameron also said that the Society could be proud of the fact that it had the only complete flying medical service in Australia with its own hospitals, doctors, nurses, aircraft, pilots and radio staff. Only two months earlier Mr. MacArthur Job had taken up duty as a second pilot.

In declaring the radio control station open, the Primate said that it was nine months since he came to dedicate the building but during those months great progress had been made in establishing the technical facilities and in making the station an attractive setting. He further stated that at first only the out-hospitals of the Society at Cook and Tarcoola were in radio contact but month by month outposts at homesteads and small communities had linked up until there were 20 outposts that had been granted licences to operate transceivers to the control station. This was the number set as the minimum by the Society to justify the establishment of the venture and the employment of a full time radio operator. Some of the centres which had been granted licences were so remotely situated that the installation of transceivers was a very slow business and because of this, decision was made to delay the opening ceremony.

The ceremony was broadcast over the network and the outstations reported back that the reception was excellent and that the medical and radio services were greatly appreciated. Stations as far as Eucla in the west and Coober Pedy and Evelyn Downs near Oodnadatta were clearly heard by the official party when they visited the control room.

On 20th January 1955 the Society increased its facilities to allow operation of a limited coast radio station for fishing vessels which used Port Lincoln, Ceduna and Streaky Bay as base headquarters. They operated along the coast from Head of the Bight to Kangaroo Island. Many of the vessels were fitted with BCA54 transceivers installed by Mr. Cameron. The frequency assigned for the service was 4620 kHz. A separate 30 metre antenna was erected for the service but otherwise the existing facilities were employed.

The BCA 54 transceiver was originally produced to meet a need for land mobile working, particularly by prospectors, fence riders and in mission work. Mr. Cameron constructed a prototype at Ceduna with plug in crystal controlled tuning boxes. The sets were later produced in commercial form by Weston using a 6M5 output tube with 7 watts input to the final tube. The set which operated from a 12 volt battery supply had adjustable output tuning to cater for the wide range of antenna types usually encountered in mobile working. The standard antenna was an ex Army vertical whip type loaded for 5 MHz.

In December 1954 the Society submitted a proposal to the State Education Department for a Radio School to supplement the Correspondence School, using the Society's radio control station and making available transceivers which would be rented out to outstations for a nominal charge. Within a radius of 450 km of Ceduna there were 150 pupils undertaking correspondence studies ranging from 34 at Grade 1 level to 6 at Grade 8 level. Over 60 of the pupils lived on properties in areas remote from the railway, towns or villages.

The scheme was approved in 1955 and within 12 months there were 16 stations fitted with transceivers. By 1958 the number of stations had increased to 25 with some 60 pupils. By 1958 the number of stations had increased to 25 with some 60 pupils. As well as pupils from cattle and sheep properties, pupils from lighthouses participated. These included Althorpe Island, Neptune Island, Cape Borda and Troubridge Shoal. The outstation equipment comprised a Weston BCA 56 transceiver operating from a 12 volt battery on a frequency of 5145 kHz.

Early in 1957 the Dragon aircraft was replaced by a magnificent twin engined all metal Lockhead 12A which the Society purchased from the Zinc Corporation. Its Bendix radio equipment both v.h.f. and h.f. was identical with that fitted to most DC3 aircraft at the time. Its high frequency transmitter mounted in the tail was enormous and took some 750 watts to power it. In addition radio facilities included a Marconi Radio Compass, a VAR radio range receiver and a Marker range receiver. The Lockhead remained in service until 1960 when it was damaged in an undercarriage collapse accident. It was replaced by a pair of single engined Cessna 210's which in turn were replaced by a twin engined Beach Baron the Society's last aircraft.

In October 1959 a BC-610-E transmitter of increased power — 300 watts — was installed at Ceduna to improve service to the network. In addition a frequency 8165 kHz was introduced to cover periods when propagation conditions rendered 5145 kHz unsatisfactory.

By 1967 the number of children enrolled in the School of the Air service had fallen to 35. On 15th February 1968 the Society handed over all its radio activities to the Royal Flying Doctor Service in Port Augusta. The Ceduna equipment was dismantled and some items transferred to Port Augusta.

SECTION 8

CRYSTAL SETS AND BATTERY RECEIVERS

— Exhibitions and Displays

EXHIBITIONS

As early as January 1924 a proposal was put forward to hold a Grand Wireless Exhibition in Adelaide. The proposal was strongly supported by the great many traders who considered that a first class display of wireless equipment on the eve of the following Christmas shopping season would stimulate public interest and also increase sales. The Wireless Institute also gave its support. Many people at the time regarded wireless or radio as it was becoming known, as magic and the traders were anxious to initiate these people into its mysteries.

Sydney and Melbourne groups had already put on shows both of which were tremendously successful and when a Brisbane group announced that a show would be mounted there in connection with the Centenary Exhibition, interested Adelaide bodies were keen to follow suit. The 1923 Sydney Exhibition had resulted in a profit of £800 to the organisers.

The Railways Institute Radio Club took the initiative and was fully supported by the traders, broadcasters and experimenters. The first major Radio Exhibition in South Australia was opened on Saturday afternoon 12th December 1925 in the Cheerup Hut behind the Adelaide Railway Station. The exhibition was an outstanding success and so keen was public interest that the organisers extended the display for a further two days.

The following year the South Australian traders promoted their own exhibition. It was held in the Adelaide Town Hall which was barely large enough to cater for the large number of displays and the 10,000 people who thronged to see it during the five days it was open.

In 1927 the traders followed up with their second display but this time it was held in the much larger Exhibition Building in North Terrace. The site proved to be ideal and further annual displays followed.

Nearly 50 years after the first exhibition, a display was organised in the Postal Hall of the General Post Office to mark the Golden Jubilee year of broadcasting in Australia. The display differed from the earlier arrangements in that no traders' stands were there. The theme was nostalgia, to recall the humble crystal sets and their catswhiskers, the squealing regenerative receivers, the magnificent neutrodynes and superheterodynes, the rattling metal horn speakers and the smelly acid batteries stuck on the floor with acid causing great holes to appear in the living room carpet.

This display enabled people to look back and see how radio receivers and other equipment had developed from the comparatively crude home made crystal set to the highly efficient transistor receivers in use in modern times.

Prior to 1924, the year broadcasting commenced in South Australia, there were not many tube type receivers in use. Broadcasting stations as we know them today did not exist and the only transmissions which could be heard besides the VIA Coastal Radio Station with its Morse Code, were the experimental stations. Considering the limited facilities available the experimenters were able to provide attractive entertainment

including live concerts and gramophone recordings. The really keen enthusiasts were however not content to just listen to Adelaide transmissions. They built better sets and erected higher antennas in the backyard. To be able to hear 3LO Melbourne or 2FC Sydney was a proud boast for an Adelaide enthusiast.

With the commissioning of 5CL and 5DN the fad was to get loud volume and a receiver was judged by the level of signal produced by the loudspeaker. The owner of a set whose loudspeaker could be heard in the next block, was the envy of the neighbourhood.

At the time 5KA commenced transmission in 1927, another element became important in the design of the receiver. It was necessary to prevent overlapping by improving selectivity. This meant greater attention to the quality of components, layout, shielding and wiring. Also, careless operation of receivers by inefficient handling of reaction frequently resulted in interference with the neighbour's reception. When 5AD came on air in 1930 the problem of selectivity was serious as there were then four stations to separate.

In addition to improved selectivity with reasonable volume, greater emphasis began to be placed on quality of reproduction and economy of maintenance. High tension 'B' batteries were very expensive and the chore of regularly carting the 'A' battery to the local garage for a recharge was to say the least, an irritant. The battery eliminator was the answer, and battery operated sets quickly disappeared from the scene where a.c. mains supply was available.

As the broadcast quality became better so did the loudspeakers. Horns were commonly made of wood, metal, papier mache and hard rubber. The inherently deficient moving iron loudspeaker was soon replaced by other types. In 1926 the electrostatic Statophone made its appearance. The magnetic system with its delicate windings and heavy diaphragm or reed gave way to a very light metallized membrane which was capable of following the slightest impulse. Then the moving coil speaker appeared. The RCA dynamic speaker which became available in Adelaide about 1927 was a great improvement over all the others.

The arrival of the screen grid tetrode tube which provided r.f. amplification without the problems of neutralising adjustment soon resulted in the decline of neutralised sets. The pentode about 1928-29 overcame the secondary emission problems of the tetrode and saw the design of more complex receivers. This was helped by the development of the indirectly heated cathode. The kit set so popular up to this time began to disappear. The demise resulted from the need for much higher performance in all respects and the impossibility of fulfilling this by the unskilled assembly of the average do-it-yourself enthusiast.

The early 1930's saw the superheterodyne circuit come back into favour as a result of the availability of improved tubes, ganged tuning and mains operation. The ganged tuning was aided by a great deal of development in the form of shaped capacitor vanes and iron dust cored radio frequency transformers. Nevertheless, straight receivers persisted right up until the start of the war with the Philips superinductance receiver being representative of the highest state of the art.

Tremendous development in technology took place during the war years and soon became evident in post war receivers. However when the transistor radio receivers appeared in a practical form and in large quantity in the mid 1950's using germanium transistors the portable radio came within the reach of everyone and created a tremendous impact. The performance of transistors improved and by the early 1960's the transistor receiver was fully comparable with anything achievable with tubes for broadcasting purposes.

THE RADIO AND ELECTRICAL EXHIBITION

The Exhibition organised by the Railways Radio Club, a branch of the South Australian Railways Institute in the Cheerup Hut was opened by the Premier (Hon. J. Gunn) at 3.00 p.m. on Saturday 12th December 1925. The Secretary of the Railway Radio Club, Mr. S.A. Johnson was also secretary and organiser of the exhibition. With the President Mr. R.B. Caldwell, Treasurer Mr. A. Read and Controller Mr. G. Murray all playing a leading part in the organisation, the show was voted a great success.

The prize list included sections for both trade and private constructors. The classes for trade included (a) best receiver, or as specified employing one tube (b) best receiver, or as specified employing two tubes (c) best receiver, or as specified employing three tubes (d) best receiver, or as specified employing four tubes (e) best receiver, or as specified employing five tubes (f) best receiver (reflexed) employing two tubes (g) best receiver (reflexed) employing three tubes (h) best trade display and (i) receiver giving best results on distance either as a multitube or superheterodyne type. The conditions of judging set down that volume, selectivity, design, range and ease of operation were to be taken into account. Each set was to be demonstrated, by an operator of average experience, over the broadcast band 300 to 1200 metres when connected to an external antenna or loop.

The prize list for the amateurs was also extensive and covered a wide field ranging from crystal sets to superheterodynes. Prizes in the crystal set section were offered for (a) the best crystal set (b) the simplest crystal set (c) the best crystal set employing home made parts and (d) the most novel crystal set. In the tube set section prizes were offered for the best one, two, three and four tube sets in either straight or reflexed configurations as well as for the best "low loss" short wave receiver. In addition, a section was set aside for the best transmitting set of one tube open to both trade and amateurs. Special prizes were available for boys and girls in various age groups.

The judges in the trade exhibits were Professor Kerr Grant, Messrs. T.E. Bagshaw and T.K. Churchward while the amateur section was judged by Messrs. H.A. Kauper, J. Honnor and V.R.P. Cook.

In the trade section Messrs. Harris, Scarfe Ltd received the Champion Prize for the best display. The best trade crystal set prize was awarded to Messrs. Edison Swan Electric Coy, the champion two tube reflex receiver award went to an Ediswan Cabinet set and the Transatlantic Wireless Coy took the prize for the champion three tube set with an Armstrong circuit arrangement. The four tube reflexed receiver prize went to Wireless Supplies Ltd while the champion four tube ordinary set was awarded to Messrs. Harrington Ltd and Andrews Radio Store with a Gilfillan neutrodyne receiver. The judges gave special mention to the multitube receiver exhibited by Mr. H.L. Austin.

Sets exhibited in the amateur section were generally of a high standard and some very novel crystal sets received a lot of attention from the visitors. One of the simplest sets was made with two safety pins, one nail detector and cup with two coils and it brought in 5CL very well. Another set employed a cotton reel, one meat skewer and a crystal detector. It also impressed the judges with its reception capabilities. One set was constructed in the shape of a book while another made in the shape of a cat also drew a lot of attention. The prize for the most novel crystal set went to Mr. E. Fisher while the best crystal set award for boys under 12 years went to Master R. Cox. Miss A.M. Cummins took the prize for the best crystal set entered by a lady. The best receiver award went to Mr. J. Bartholomew for a five tube neutrodyne set.

The stands prepared by the traders were a credit to the young industry and revealed a multiplicity of goods and apparatus. The array created a deep impression upon many of the visitors, many of whom had had very little idea of the extensive growth of the industry. There were literally thousands of different parts and components made by an ever increasing number of manufacturers, some big and some very small.

The stallholders at the exhibition included Harris, Scarfe Ltd; Lademan's Dependable Radio; Duncan and Fraser; Andrews Radio Store; Wireless Supplies Ltd; Colton, Palmer and Preston Ltd; Eddys; Harringtons Ltd; Signal and Telegraph Department, S.A. Railways; New System Telephone Co; James Marshall & Co Ltd; Newton, McLaren Ltd; Paroso Ltd; Edison, Swan Electrical Co Ltd; Transatlantic Wireless Co and Millswood Auto and Radio Co. Records of some of these exhibits have been preserved and are worthy of mention.

Harris, Scarfe Ltd.

The Champion Prize for the Best Trade Display was awarded to Messrs Harris, Scarfe Ltd., Rundle Street, with a well laid out display of components and radio receivers. The wide range of components neatly displayed included Sterling, Igranic, Brown, Condor, Cardwell and King Radio. The whole of the display was under the control of Mr. A.R. Clarke, in charge of the Radio Department of the company for some 14 years.

Exhibit of Harris, Scarfe Ltd 1925. [*Courtesy A.R. Clarke*].

A complete range of the Sterling Telephone and Electric Coy's radio sets were on show including their special four tube long range receiver, the Threeflex receiver using a frame antenna, two tube sets in cabinet and the Anodion types. The four tube long range cabinet set type had a normal tuning range of 300-500 metres. The circuit was so arranged that by using special antenna coupling units in conjunction with appropriate reaction units reception of the short wave transmissions (40-300 metres) was possible, whilst with larger inductances and the correct reaction units the range could be extended to 5000 metres. The receiver was fitted with "Non-Pong" shock absorbing tube holders and a battery base to accommodate the high tension battery etc. was available as an accessory. The Anodion version of the long wave receiver had facility to enable the switching in of the third or fourth tube automatically by turning the appropriate filament resistance control knob. Thus it was possible to use either two, three or four tubes as desired.

The popular Sterling Threeflex cabinet set was particularly suitable where it was not desirable to erect the orthodox antenna. Using only a collapsible loop antenna it was designed to give loudspeaker reception within 40 km of a major broadcasting station. Simplicity of operation was a feature since after setting the crystal it was only necessary to manipulate one control knob. The battery was automatically disconnected on closing the doors. The Anodion version of this three tube receiver covered the band 300 to 500 metres with adapter for lower and higher wavelengths. The circuit was similar to the company's two tube Anodion but included a stage of transformer coupled low frequency amplification. Using all three tubes, loudspeaker results of highest quality were obtainable from 5CL and 5DN and also from experimental stations favourably situated.

A range of Sterling loudspeakers and headphones was also displayed. The loudspeakers ranged from the "Dinkie" a neat, graceful in outline unit attractive in its brown tinting and the "Baby" in both black enamel and brown tinted finish to the large "Magnavox" speaker. The moving element of the Magnavox consisted of a very light coil which floated in a magnetic field generated by an electromagnet. Any slight change in the current flowing in the coil produced a corresponding movement in it and this movement was communicated to a special diaphragm which thus vibrated with the coil. The Primax quilted diaphragm speaker was also shown. The outstanding feature of this speaker was that it was hornless and was claimed to be virtually distortionless. Due to the shape of the diaphragm the sound was projected in all directions.

In addition to Sterling receivers the display featured a King five tube neutrodyne set and a Radiola super six receiver. The King was a product of King Quality Products in the United States, well known for their quality kit sets which were very popular with the do-it-yourself enthusiasts. The sales literature spelt out six reasons why the King neutrodyne kit was supreme.

These were: —

1. bus wires are cut to proper length and bent to shape
2. by means of switchboard type of cable all wiring goes into the set as a unit
3. tube sockets are supported by scientifically designed metal brackets
4. neutrodon is operated by micrometer screw so receiver can be properly neutralised
5. instructions are easy to follow, no technical knowledge is needed
6. all parts are specially built for the kit and are not a collection of open market parts. Price of the kit was £18.18.0.

The Radiola set exhibited was a six tube receiver contained in a massive cabinet which was rotatable to obtain a directional effect on the broadcasting station. It could be adapted to use an external antenna for Interstate reception.

King neutrodyne console receiver in Adelaide home 1926. [*Courtesy A.R. Clarke*].

Radio accessories were also prominently featured. These included variable low loss condensers made by the Cardwell Manufacturing Corpn., King rheostats, dials and kit sets, Brown loudspeakers and headphones, Igranic radio accessories, Condor tubes, Prestrolite 'A' and 'B' accumulators and Hart 'A' and 'B' accumulators.

Batteries were of very great interest to the visitors as batteries were probably the greatest problem for a set owner because of the continual need for recharging. Two popular types in the Hart low tension series were the M E type and the Magno Radio Accumulator. The M E Type was in a box made from transparent celluloid with terminal bolts fitted with a special grease cup which prevented corrosion. Ebonite covered terminals were fitted. The Magno Radio Accumulator was specially made for use with dull emitter tubes but was equally suitable for discharging on any type of bright emitter tube. It was fitted with seven plates of a type which maintained a steady discharge at constant voltage for long periods. A strong glass box was used with internal ribs between which the plates were fitted. The Hart high tension accumulator was known as the "Rao" Type and had a capacity of 1.0 ampere hour at the 10 hour rate. The standard battery was 50 volts and for voltages above this, groups were placed in series to give the required voltage. Where voltages other than multiples of 50 were necessary, a regulator flexible lead was fitted with a suitable terminal connection for attaching to any cell.

Duncan and Fraser Ltd.

Duncan and Fraser Ltd of Franklin Street entered the radio trade in September 1924. Mr. Hugh Duncan one of the partners had been interested in wireless since about 1910. He was a member of the party which fixed the S.A.— W.A. boundary by wireless means. It was the first time that wireless had been used to girdle the world in fixing a longitude.

The company quickly established contact with some 30 manufacturers in Europe and United States and built up a comprehensive stock of components and fully assembled receivers. They also manufactured receivers on an extensive scale producing a standard range of sets that could be marketed cheaply yet at the same time they maintained high quality workmanship. Crystal receivers were prominent among their sets.

The display featured locally manufactured two, three and four tube receivers. A beautiful cabinet receiver incorporating a loop antenna in the cabinet was examined with interest by the large number of people who visited the stand. The two tube receiver was designed for headphone operation but gave good loudspeaker volume on 5CL and 5DN. The three tube receiver was the standard loudspeaker model while the four tube set brought in Interstate stations at good volume. One of the earliest portables to be seen, the Operadio was on display. It was a six tube unit using dull emitter tubes and a folded loop antenna. The case was finished in black leatherette and performance was such that Interstate station could be easily received with an external antenna.

Andrews Radio Store

Andrews Radio Store of Bowman Arcade, King William Street, exhibited and entered only one receiver in the competition and it secured a Championship Prize. The set was constructed of Gilfillan parts imported from Gilfillan Bros Inc. of California makers of a well known neutrodyne receiver. The company produced high quality components and fully assembled receivers. In 1923 they produced a crystal set and a three tube box type receiver. In the following year they marketed sets and kits for a single tube and two tube sets and two five tube neutrodyne models. The five tube table models had two stages of tuned radio frequency detector and two audio stages.

During the demonstration the neutrodyne had a great many interested admirers and in addition to giving first class performance with the local Adelaide stations it tuned in 3LO at full speaker volume. The set was fitted with Radiotron 201A tubes powered by Burgess 'B' batteries and a P and B hard rubber base 'A' battery. The Burgess 'B' batteries had a guaranteed shelf life of 12 months.

Other items on display included a large loudspeaker of the True Music brand with an electric light bulb illuminated in the throat, and "Celeron" artificial crystals. The True Music speakers were unique in that their horns were built up of copper by an exclusive electrolytic deposition process. No mechanical pressure was used in forming these horns so resonance or metallic ring caused by spinning or stamping was greatly reduced. They were enamelled matt nigger brown with the inside of the horn being polished and lacquered copper. There were three models available, Junior, Standard and Concert Grand. All were 4000 ohms impedance.

Edison, Swan Electrical Co Ltd

A wide range of equipment and components produced by the parent company in England was on display. These included a crystal set, one and two tube reflex receivers, a two tube portable and four tube tuned plate and reflex sets. A wide range of components and tubes including the popular V24 tube were also shown. Power amplifiers created much interest.

The Edison crystal receiver on show had a band extension capability to 1800 metres by using a plug-in loading coil. The set was very compact measuring only about 15 cm long, 10 cm wide and about 9 cm in height. The box was made from mahogany and contained a tuner which was mounted on the underside of an ebonite panel, the horizontal ball pattern crystal detector and terminals being mounted on top of the panel. Tuning was effected by a variable inductance of the slider type. The coil was wound on a rectangular wooden former using enamelled copper wire. The set normally gave good reception up to 40 km from 5CL with a 4000 ohm pair of headphones and outside antenna. This receiver and two others shown were awarded prizes.

The company's Toovee Radiophone two tube set covered the band 300 to 4000 metres and gave loudspeaker strength up to 60 km from 5CL. One or two tubes could be used at will by means of a switch, the 'off' position of the switch disconnecting the battery supply. The tubes were mounted inside the cabinet which was made of mahogany French polished to a high luster. The accessories provided with the set included two A.R. tubes; one pair of range blocks 300-500 metres; headphones; 60V high tension battery; four volt accumulator in teak case with carrying strap and grid battery.

The four tube long range Radiophone had a range of 300 to 500 metres with adapter to cover the longer wavelengths. The receiver was designed to operate at loudspeaker on Interstate stations and exhaustive tests showed it to be highly reliable. The circuit was of the dual tube type (4 tubes — 5 stages). The first tube was used as high frequency and low frequency amplifier, the second tube as a detector and the third and fourth tubes as low frequency amplifiers, the last being resistance capacity coupled. Reaction was obtained by means of a variable condenser. The plate voltage on the low frequency tubes was 120 volts. Fixed bias potential was applied to the grid of the first tube and a variable bias to the last two tubes. The receiver unit was mounted in a highly polished walnut cabinet with hinged doors. The high tension and grid batteries were supported on a shelf fixed inside.

The show piece of the display was a massive cabinet receiver made in Jacobean style using the four tube reflexed circuit of the standard Radiophone. Switching devices enabled the use of any number of tubes and one unusual control was associated with a tone modulator. The tuning range was 190 to 4000 metres with tuning being accomplished by means of tuning blocks which fitted into position at the side of the receiver.

In addition to the V24 which was a versatile high frequency tube the company produced the Type R a general purpose tube of the bright emitter type in a spherical bulb with vertical filament, grid and plate, the Type AR a bright emitter which could be used as a detector or amplifier, the type ARDE a low temperature dull emitter giving long life and having high sensitivity and amplification and the type AR06 a low filament current tube suitable for ordinary dry cell working. In the power tube range there was the type PV6DE especially designed for receivers using Type ARDE tubes in the preliminary stages and the Type PV5DE a dull emitter tube requiring a filament voltage of five volts and suitable for use in sets employing bright emitter tubes of either type AR or R in the other stages. A tube requiring three volts for filament, the type PV8DE was also available. It required a 20 ohm rheostat and was designed for use with the AR06 type in the preliminary stages.

Newton, McLaren Ltd.

Newton, McLaren Ltd., Leigh Street, had the distinction of manufacturing the first radio receiver for commercial sale in South Australia in 1921. The purchaser was a Doctor living in Gawler. It was a three coil unit with loudspeaker and was the forerunner of a wide range of sets which the company subsequently produced.

A great variety of components, loudspeakers and fully assembled receivers were displayed. These included Hellesen low and high tension batteries, Fuller low and high tension batteries, Valley chargers, a range of Philips tubes, Jewell panel meters, various patterns of Stevens & Co., Sterling and Amplion loudspeakers, General Radio Co. components etc.

The Hellesen high tension batteries were in wide demand when the company produced the Capacity Nos. 1 to 5 range to replace the earlier Standard unit. High capacity high tension batteries became an economical necessity with the advent of multitube sets, power tubes and other apparatus demanding an increased current consumption also to the fact that when 5CL and 5DN both began operation the average listener used the set for longer periods. The Capacity No 1 unit had a recommended

maximum discharge current of three milliamps while the No. 3 was rated at 15 milliamps. Many experimenters preferred to build up their own high tension batteries or replacement units and separate cells were available in the range. The first cost of this arrangement was greater but the battery was exceedingly economical in use because individual cells in the normal high tension battery failed before others and if not replacable usually rendered entirely useless other cells still able to give a satisfactory output.

The Fuller accumulator was popular, particularly for filament supplies. There was a standard plate type accumulator and what was known as block batteries. The standard accumulator was made of the best quality materials with all cells being fitted with non corroding grease cup terminals. They were assembled in transparent celluloid or ebonite containers. The ebonite containers were in great demand as they were claimed to be both fireproof and leak proof. In the Fuller Block Batteries, accumulators were fitted in strong ebonite containers with splashproof vents. The cells were supplied separately or securely fixed in strong teak cases. Metal carrying cases with leather handles were also available. The maximum capacity available in the standard accumulator was 200 amp. hours while the block types could be obtained in capacities up to 110 amp. hours.

The fine speaker on display made by A.J. Stevens & Co. did not require a step down transformer as it was specially wound to a correct impedance to match the receiver. It came in two forms, a metal horn or a mahogany horn. The accurate proportions and smoothly blended curves of its non resonant horn gave the speaker qualities which made it one of the best available. It was sensitive yet could handle a high level of input.

In the component side the General Radio Co. accessories attracted a lot of attention. A Type 63 variable square law and low loss condenser was about the thickness and diameter of an ordinary dial with a capacity range from .00001 to .001 mfd. Used in any circuit as a vernier or to replace any variable condenser, it greatly increased the wavelength range of most coils. The capacity variation was controlled by two complete revolutions of a 360 degree dial with a finger tip control. The G.R. inter-stage transformer was the subject of considerable comment by set constructors. It could be used in the first, second and third stage of any low frequency amplifier. It was well shielded and constructed on the hedgehog principle having a high grade silicon steel wire core. Ratio was 2:1.

The complete receivers on display comprised a five tube and a seven tube model using two and three tuned plate high frequency stages. The receivers were de-luxe models mounted in beautifully finished cabinets.

Harringtons Ltd

Harringtons Ltd of 10 Rundle Street, self styled "The House for Radio Service" had a magnificent display of receivers, Amplion loudspeakers including a giant Concert Grand and Gilfillan receivers and components. Championship prizes were awarded for their well known "low loss" short wave receiver and for a Gilfillan neutrodyne.

Components of particular interest in the Gilfillan range were the R350, R375, R400 and R245 variable condensers. These were of special low loss types with new shaped plates, producing a straight line curve. Stator plates were fixed in the block by high pressure and swaged to a positive contact. Bearings were of an unusual cone type. The insulated end plates were of polished nickel brass.

The Amplion speakers on display were widely used throughout the State and very popular. The small speaker range included the Dragonfly, a miniature loudspeaker of good reproduction qualities, the New Junior a curved horn table type which incorporated non resonating sound conduit and an electromagnetic unit with floating diaphragm allowing high quality reproduction under varying conditions of reception and the New Junior De Luxe model which incorporated all the advantages of the New

Junior model but included a wooden trumpet of unique design in which the oak or mahogany panels were united by a series of metal ribs affording an assembly of particularly attractive appearance. All three models were available in impedances of either 120 or 2000 ohms. The larger speakers in the Amplion range included the Dragon, a curved horn table type with a metal-ribbed wooden horn, improved sound conduit and free of resonance in the audio frequency band. The other unit, the Concert was designed specifically for use in large rooms. It was an enlarged model of the Dragon and possessed all its good features with greater volume in reproduction due to the proportions of the sound conduit and wooden horn. The Concert speaker was provided with a switching device so that alternative windings could be connected to the output terminals of the receiver. A 250 ohm winding was utilised in conjunction with a telephone transformer and a 1000 ohm winding was recommended for use in association with tubes such as LS2 or LS5.

Other items on display were Ever-ready and Hellesen batteries, Sterling products, Radiotron tubes and Brandes phones. The Brandes phones were popular with crystal and single tube sets owing to their good sensitivity. The Matched Tone feature meant that the joint energies of both ear-pieces were perfectly synchronised — they both produced tone sensitivity and volume in exactly the same degree.

Transatlantic Wireless Manufacturing Co

The Company located at Kintore Avenue, Prospect, had a large range of receivers which it manufactured locally. The receivers were well known by their patented glass panels on which the components were mounted. It was claimed that surface leakage on glass panels was negligible compared with that experienced with the widely used ebonite panels. A reflecting silvered mirror at the rear highlighted all the components in the set as well as acting as an electrostatic screen.

The receivers produced by the company were called Newkrodyne models which employed well known neutrodyne principles. They were produced in three, four and five tube models and so great was the demand that sales rose to nearly £6000 in one month. The workshops had capacity for producing 200 receivers per month.

Literature handed out explained the various stages through which the receiver passed during manufacture. Firstly, the panel was scientifically treated to ensure non-hygroscopic effects and then passed on to have lettering and calibration signs engraved. This was done by transfers and electric heating. The panel was then sent to the assembly benches where after each component had been subjected to a breakdown test it was mounted and wired. The baseboard which was specially treated to ensure absolute immunity from moisture was then mounted, assembled to the panel and the bus wiring completed. The receiver was transferred to the laboratory and dual testing department where it was subjected to a rigid test and the special neutralisers so adjusted that the set was capable of receiving 3LO in daylight at maximum strength. The receiver was then ready for the cabinet of the Company's special design fitted with aluminium screen to eliminate outside capacity effect caused by the operator. The aluminium screen and silver plated mirror ensured a stable receiver under all conditions.

In addition to their standard Newkrodyne receivers, the display included an eight tube superheterodyne model with beat frequency transformer or multi-former combination, with separate tuned oscillator and antenna circuit to give wide band coverage. Others included a four tube neutrodyne portable with detached speaker, a three tube Armstrong receiver for all-band reception, and a two tube receiver. Their three tube Armstrong receiver won the Champion Prize for its class.

Wireless Supplies Ltd

Wireless Supplies Ltd were awarded two prizes for their exhibits. The company which conducted business at 109 King William Street was awarded prizes for the Champion Four Tube Reflex Set and the Champion Multi Tube Receiver (including Superheterodyne). The superheterodyne receiver was a very attractive unit built into a writing desk. It was completely self-contained with accumulators mounted inside the cabinet for both low tension and high tension supplies. The charging unit was also enclosed within the cabinet.

The company with Mr. W.J. Bland in charge specialised in a locally manufactured four tube set of the tuned plate type.

A range of components which were in stock at the shop was also on display.

James Marshall & Co Ltd

The display included a wide range of receivers and components. The pride of place was given to a large seven tube receiver using a tuned plate and transformer coupled circuit. The panel was neatly laid out and the judges voted the performance as being excellent. An item of particular interest was a combined gramophone and radio receiver. The receiver used two tuned plate stages and produced a clear loud tone.

Components and parts included in the wide range normally in stock by the Company were also prominent on the stand. These included tubes, rheostats, grid leaks, variable condensers, headphones, transformers, batteries and all models of Amplion and Magnavox loudspeakers. Included in the Magnavox speaker range were the R3, M4 and the Bell Models. These speakers were imported from the Magnavox Co. California.

Other Stands

Stands by other companies also had high class displays and created considerable interest. Those with items of particular interest included Paroso Ltd with an exhibit of Neutron crystals, Millswood Auto and Radio Co. with two very fine receivers, Eddy's who displayed a combined gramophone-receiver set, the B Battery Co. with a range of rubber box batteries and the New System Telephone Co. with a wide range of loudspeakers, tubes and low loss tube sockets. Another item which received a lot of attention was the sample of big 1.5kW transmitting tubes used at 5CL's broadcast transmitter at Brooklyn Park.

It was the general opinion of many technical experts that the show indicated that the tuned plate system of high frequency amplification was by far the most popular method at the time. The neutrodyne circuits were also well patronised but were limited in their wavelength range. Although the reflex receivers were popular among the younger groups, it was not always possible to achieve constant performance results over a long period of time. The superheterodyne receiver was the up and coming favourite and it was mainly its high price that was preventing it from sweeping all other types aside as the most popular receiver.

THE FIRST RADIO TRADE EXHIBITION

The first exhibition promoted by the radio trade of South Australia was opened on Tuesday 22nd June 1926 in the Adelaide Town Hall. The ceremony was performed in the presence of a large crowd by the Lord Mayor (Mr. J. Wallace Bruce).

Under the guidance of the Radio Traders Association with Mr. J.W. Burnard as organiser the main objective was to bring under public notice the vast technical improvements that had taken place in receivers, the latest designs in cabinet work and the great range of radio accessories available. Mr. H.L. Austin was controller in charge of demonstrations to ensure that receivers could be demonstrated to visitors when they wished to listen to particular models. The Chairman of the Radio Traders Association

Mr. D. Eardley McLaren together with the broadcasting companies, the traders, the amateurs, the Wireless Institute and the Listeners League pooled their resources to make the five days memorable ones.

The doors opened at 7.30 p.m. on Tuesday and the formal opening took place at 8.00 p.m. from the temporary 5CL studio which had been erected on the stage. Mr. McLaren introduced the Lord Mayor and after the completion of speeches musical items were provided by 5CL up until about 9.15 p.m.

The quality of equipment displayed and the wide range surprised even those who were associated with the trade and who had been involved in the exhibition promoted the previous year by the Railway Radio Club. Nearly 10,000 people attended during the five days and it was soon evident that radio had progressed from a novelty to a genuine public service. Compared with the earlier exhibition, the crystal receiver was conspicuous by its absence with the trend being towards four, five and six tube receivers. The superheterodyne was showing its superiority by the great number exhibited and the large number of enthusiastic purchasers. The technological advancement had resulted in receivers of improved frequency response and lower distortion. Many sets employed standard transformers in place of plug-in coils for extended range coverage. In one tuned radio set uni-control was achieved with small compensating condensers by means of which slight differences in the electrical constants of circuits were adjusted to give exact synchronisation of dial readings. In another receiver on display the same result was achieved by varying the coupling of the primary and secondary coils of each transformer.

Improvements were also evident in loudspeaker response and power handling capability. The papier mache horn almost eliminated the "tinny" resonance of the spun metal units. Also they could be moulded into various shapes to allow mounting inside the confined space of a cabinet. Broadly, there were five types all with either metal or mica diaphragms. The first were conical or exponential in shape with horns made of papier mache or fibre, then there were conical horns of thin metal, exponential horns of thin metal, exponential horns of heavy metal or heavy metal and wood or hard rubber or special hard fibre or bakelite, and finally a speaker with conical throat, exponential body and bell with the horn being made of wood with drawn brass throat.

The exhibition included an amateur section and many interesting items were on show. Although the number of entries was below the number expected, the quality of workmanship and performance of most was high class. Some well known experimental transmitters attracted considerable interest. The banqueting room was set aside for clubs and amateur competitions.

Some 22 stands were occupied by the various exhibitions with some of the larger firms occupying several stands to properly display their wide range of equipment and components. Many had occupied stands at the earlier exhibition but had much more comprehensive displays at the Town Hall.

W.H. Rook and Co.

The main feature of the stand was the display of Kellogg receivers and a Kellogg papier mache loudspeaker. The sets were made by the Kellogg Switchboard and Supply Co. in the United States, a very old manufacturing organisation who produced quality materials and components. The receivers were called Wavemaster Models, the first being a single tube regenerative set produced in 1922. In 1925 no fewer than eight models were produced all using five tubes except one model which employed seven tubes. The five tube sets were all tuned radio frequency types with the seven tube model using a "Radio Frequency Laboratory" TRF circuit. The seven tube RFL model created considerable interest at the display. It was enclosed in a handsome cabinet on the outside of which were matched control knobs and an illuminated wavelength

indicator. The wood was antique finished. The receiver pulled in Interstate stations at good strength and high quality with the papier mache speaker. One of the five tube Kellogg sets was also shown in action with an expensive Brown speaker.

Components included Radiotechnique tubes, C.A.V. rechargeable 'A' and 'B' batteries and speakers, Volton heavy duty 'B' and 'C' batteries and a wide range of Kellogg and CAV parts. The Radiotechnique tubes were manufactured by La Radiotechnique and Societe Francaise Radio Electrique in France. The whole of the company's activities were devoted to the study and manufacture of tubes at its factory in Suresness reputed to be the largest in Europe. Although the tubes had a high reputation in Europe there were not many used in South Australia.

The C.A.V. loudspeakers were very attractive, there being four models available. A feature of the speaker systems was that the diaphragm was securely held in the head of the base, which when rotated gave a very fine adjustment and kept the diaphragm in a parallel plane to the magnets. The largest model was the Standard capable of sufficient volume and quality characteristics to make it suitable for outdoor purposes or for extra large halls where considerable volume was required. Impedances ranged from 120 to 4000 ohms and finish was available in black satin enamel or with an imitation tortoise shell flare. The Junior model had similar appearance but had a flare diameter of only 25 cm compared with 36 cm for the Standard. The Tom Tit model was very popular and there are still many of these in the homes of Adelaide collectors. Like the bird whose name it bears it was undoubtedly the liveliest performer of its size. It gave ample volume for the average size room with reasonably good reproduction. The flare diameter was 18 cm and impedance was 2000 ohms. Another speaker in the range was the Hornless model. It was designed for those who required an inconspicuous speaker unit to harmonise with the furnishings of the room. It was compactly encased in a highly polished mahogany case with dimensions approximately 24 cm wide, 24 cm high and 40 cm long.

The C.A.V. low and high tension batteries were used with many receivers in Adelaide and several enquiries were made about the different models on display. The low tension sets included the Acton and the CW ranges. The Acton was a soundly designed well made battery and maintained a high standard of performance with little attention. Constructed on the unit principle, each two volt cell was separately built up in stout celluloid cases. The CW unit was a de luxe model and employed thicker plate construction with ebonite separation, large moulded terminals fitted to each cell to provide tappings, grease cup glands assembled with non corrosive terminal stems and independently cased two volt units. Hardwood varnished boxes and crates with carrier straps were also provided.

The C.A.V. range of condensers, resistances and transformers were also the subject of many enquiries as these were widely used by set constructors and experimenters. The multiple fixed condenser gave a range of capacitance by combining several condensers in one case with convenient tapping points. This enabled the selection of any required capacitance value within stated limits by simply connecting tappings in parallel. The unit was totally enclosed in ebonite casing and screened from stray capacitance effects. The C.A.V. external mounting resistance was an ingenious resistance which gave a great saving of space at the back of the panel because the whole of the resistance which was totally enclosed was mounted on the exterior of the panel being fixed by means of locking nuts. It was constructed from solid turned ebonite and came in values 7, 15 and 30 ohms. The company made three transformers, all of which were popular. The de luxe low frequency transformer was capable of a high degree of step-up voltage over a wide range of frequencies. The primary and secondary were on separate bobbins placed side by side ensuring a high degree of insulation and a very low value of self capacity between windings. It was completely shrouded to prevent interaction between adjacent transformers. The transformer was available in a high ratio winding for first stage

working and low ratio for second stage working. The All Purpose transformer had a ratio of 3 to 1 which enabled it to work equally well in a first or second stage amplifier. The C.A.V. Aperiodic Intermediate Frequency Transformer was designed specially for use with superheterodyne receivers. The windings were of 44 gauge silk covered wire carried on a slotted ebonite former.

Bullock Cycle and Radio Stores

Bullock Cycle and Radio Stores demonstrated a range of the high class Reactodyne receivers manufactured in their up to date radio factory. Development of the receivers was under the personal direction of Mr. C.A. Maddern who had been associated with radio for many years overseas. They also exhibited a Reactodyne kitset and a wide range of components from their extensive stock. These included the Croix L.F. transformer, a transformer of French origin which caused a considerable stir overseas, a range of AJS loudspeakers, Thordarson transformers, Star tubes, Pilot radio parts, Therla fixed condensers, and Liberty, A.B., and Newey and Ormond variable condensers. A wide range of headphones was also on display and included Gecophone, N and K, Brandes Matched Tone, Ediswan, Brunet, Brown and Sterling models.

The four and five tube Reactodyne set received a lot of favourable comment. The four tube model employed the well proven tuned radio frequency circuit and demonstrations showed it to be a very efficient and sensitive receiver of long distance stations. Filament rheostats were provided to enable the correct voltage to be applied allowing for a wide range of conditions of accumulators from the fully charged condition to the point where recharge should be effected. Switches allowed the set to operate on either three or four tubes. Three dials were provided for tuning purposes. One controlled the reaction. The five tube set had an extra radio frequency amplifier to improve performance with Interstate stations. Both units covered the band 200-600 metres and were available in a wide range of cabinets. Their tuned plate receiver which covered 20 to 2000 metres was popular with country people who attended the exhibition.

The company's large showroom was at 65 Rundle Street and only a comparatively small part of their full range of components could be displayed on their stand. The range of headphones were closely examined. The cheapest was a Gecophone headset with bakelite cases and pigskin leather headband. Impedances varied from 2000 to 6000 ohms in this model. The Sterling Lilliput was also a favourite. The bobbins were impregnated with insulating material to avoid corrosion. Another feature was that there were no external nuts. The terminals were totally enclosed thus preventing any danger of short circuiting. The Ediswan headphones were also sold in large quantity. These double head receivers embodied the two most sought for qualities namely efficiency and comfort. The cases were of polished pressed aluminium with moulded earcaps. The headband was of the double pattern, highly polished and the receivers were attached by means of ball and socket joints.

Adelaide Radio Company

The exhibit of the company included specially selected importations of some of the finest overseas receivers together with products from their own workshop well known to South Australians under the trade mark Arcoflex.

The Adelaide Radio Co. of 146 Rundle Street had been associated with the radio industry in South Australia since the first efforts were made in experimental radio transmission and was in fact the first house in the State entirely devoted to the sale and manufacture of radio equipment. The General Manager was Mr. L.C. Jones acknowledged as one of the foremost radio engineers of the period.

The prominent position was occupied by a Silver Marshall six manufactured by the Silver Marshall Inc. Company of Chicago. It was a mangificent receiver of six tubes using a tuned radio frequency circuit. It was the only model made by the company in

1924 and was so well received that it was followed up the following year by a seven tube superheterodyne receiver. This was also highly successful and soon after the company produced 21 different models of its receivers in a single year. One feature of the set was that it was adaptable for all wavelengths from 50 metres upwards. The r.f. transformers were wound on special bakelite formers which plugged into hexagonal sockets. In addition, the antenna coupling was adjustable and a high degree of selectivity was easily obtainable. In order to preserve the best possible fidelity of tone, a resistance coupled amplifier was used. A new straight line wavelength condenser entirely silverplated was used. It had very low loss and ensured good separation of stations on nearby channels. The set was marketed by the Adelaide Radio Co. as a kit set and many were purchased by Adelaide enthusiasts.

Other exhibits were Mr. G.A. Miller Randle's eight tube superheterodyne receiver in an attractive cabinet and a combination radio gramophone set with a common horn for radio and gramophone.

Several of the Arcoflex models were on show in their very attractive cases. The Arcoflex Five was an exceptionally fine receiver with demonstrations showing its capability of receiving Interstate stations at good volume.

The display also included a Farrand cone speaker, one of the best available, various other types of speakers and a range of Ormond variable condensers and filament rheostats. These components were widely used by set constructors who desired to build quality components into the unit. The low loss square law condensers were a new departure in condenser design giving very low loss and one hole fixing to the panel. The plates were of thick aluminium perfectly flat with the fixed vanes being supported by ebonite strips. Smooth action and tight spindle tension were maintained by a specially designed friction washer. The six ohm rheostats were of the frame type, smooth and noiseless in action.

Andrews Radio Store

The display on Stand No. 5 by the Andrews Radio Store of Bowman Arcade, King William Street was very well received. They exhibited three models of the Fada neutrodyne receiver one of the most popular types in the United States.

The Fada sets were manufactured by the F.A.D. Andrea Inc. company New York and employed the neutrodyne circuit invented by Professor L.A. Hazeltine. Fada brought out their first neutrodyne set in the Spring of 1923 and it was an immediate success. For about two years any set carrying the name neutrodyne would sell. During 1925 more Fada receivers were sold in the U.S. than any other make. Total sales were some 20,000 above the nearest competitor and it was natural that great numbers should find their way on the South Australian market. There are still many in Adelaide today as prized collectors items.

The three models displayed were the 195A Neutro Junior, the 192A Neutrolette and the SF30-70 Queen Anne Desk. The Neutro Junior was a three tube receiver with two controls and sold at the time for £17.10.0 without accessories, and £30 complete. The Neutrolette was a five tube model with two radio frequency and two audio frequency stages and sold for £55 complete. The Queen Anne Desk model was a magnificent five tube receiver selling for £110. It was period designed in the form of a lady's writing desk and when closed was a handsome piece of furniture. When opened, the panel of the receiver was revealed with pigeon holes on either side together with other accessories for writing. All three receivers were produced in 1924.

The literature handed out at the display made these claims for the Fada:-

(1) Practically perfect reception of whatever the air has to offer — clear, tonally true and fundamentally human.

(2) The ability to tune in whatever you want just as easily as you can tune out what you do not want.

(3) Absolute control of volume at all times.
(4) A command of real distance for those who measure radio results in miles.

The company also distributed the A.R. honeycomb coil which had several novel features. Air gaps were placed at an angle giving what was claimed to be duo-lateral effect and the former was made much heavier in the middle than at the edge thereby securing the former so that it could not slide off. The coil was covered with a highly glazed black celluloid coil strip while the side plates of the holder had a strong grip on the coil. The coils were wound with double cotton insulated wire which went through an insulating process while the wire was being wound thereby making it unnecessary to dip the coil in paraffin wax or shellac.

Duncan and Fraser Ltd.

Duncan and Fraser Ltd. were one of the several exhibitors who displayed complete receivers designed and constructed in Adelaide. Their receivers were marketed under the trade name Dunfra and were produced in three ranges, all of which were demonstrated. They were tuned radio frequency types with good reception being obtained from eastern Interstate stations. Four, five and six tube models were examined by the interested visitors and many orders were placed with the attendants. The six tube de luxe cabinet set was particularly well received with several orders being placed by country visitors.

An American portable, the Operadio was also on display. It was a compact six tube set with an inbuilt antenna. The American company which built the set specialised in portables. In 1924 it produced a six tube model followed this in 1925 with another six tube model and two seven tube models.

Noyes Bros. Pty. Ltd.

The display was under the charge of Mr. P.L. Morcom and included a complete range of Igranic parts and a fully assembled receiver and also Brown speakers. At the time the demand in Europe for the Igranic kit sets and components was so great that only a few were available in South Australia.

The kit was made by the Igranic Electric Company, England and was suitable for amateur assembling and construction. It consisted of a frequency changing unit, intermediate frequency transformers, audio frequency transformer, various fixed condensers, tube sockets, terminals etc. In addition to the kit it was necessary to purchase material for the control panel which included the tuning condensers, rheostats and resistances.

The receiver consisted of six tubes, the first operating as a combined oscillator and first detector on the tropadyne principle, the second, third and fourth acting as intermediate frequency amplifiers, the fifth as second detector and the sixth as the audio frequency amplifier. Reactance capacity couplings were employed in the intermediate frequency units. They were very neatly made and enhanced the appearance of the receiver, the coils being hidden by a casing of polished brown bakelite. The oscillator took the same form and was specially designed to prevent radiation into the closed loop antenna circuit. Three variable condensers were used for tuning the oscillator, frame antenna and outside antenna respectively.

The introduction of the Igranic to Adelaide was so enthusiastically received that demand for neutrodyne and other systems declined to the extent that by about 1929 superheterodyne receivers predominated. Several of the early Igranic sets are known to be preserved in private radio collections in Adelaide. One is displayed in the Telecommunication Museum.

The company held a large range of Igranic components at its show room in Darling Building, Franklin Street and an interesting selection of coils, condensers, couplers, rheostats, transformers and variometers were on display at the exhibition.

Honeycomb coils were available as either plug mounted or gimbal mounted. The duolateral coils were most efficient and were widely used. They were wound on automatic precision machinery giving a high standard of accuracy and uniformity. The coils had negligible self capacity, a low absorption factor, a minimum of high frequency resistance and owing to their different sizes and ranges an absence of "dead end" effect. In the gimbal mounted coils an ivorine scale was fitted around one gimbal which enabled any setting once determined to be easily repeated. Fitting at the other gimbal was a disc of hard insulating material which formed one member of a friction reduction gear operated by means of a vernier friction device.

The Igranic variometers were popular components with experimenters. The B type which covered 280 to 650 metres and the BL type which covered 700 to 2400 metres employed an unusual principle in variometer design. The windings were made self supporting without the aid of moulded insulation supports. This resulted in an efficient variometer. The self capacity was very low and the mutual inductance high, thus giving remarkably selective tuning and good signal strength at all frequencies within their ranges. A paxolin tube surrounded the windings to give mechanical protection.

Harringtons Ltd.

Harringtons Ltd of 10 Rundle Street occupied No. 12 stand and created considerable interest with their display. Being both wholesalers and retailers they carried a large stock of a wide range of items and were able to mount a very interesting display. At their showrooms they had over 50 different types and makes of loud speakers.

In addition to being manufacturers of Imperia radio receivers and products, Harringtons Ltd. were agents for the famous Gilfillan neutrodyne sets and components. Other equipment they stocked included Hercules products, Amplion speakers, Marco radio products, Eveready batteries, Fuller accummulators, Hoyt voltmeters, Jewel voltmeters, AWA products, Davin radio products, Radiotron tubes, Burgess batteries, Philips tubes, Thorola products, Exide accumulators, Brown speakers, Dubilier condensers, Grodan radio products and Bradley radio products.

The display was supervised by Mr. W.S. Corfield and an interesting feature was a comfortable audition salon in which visitors enjoyed broadcasts. It enabled music to be heard without distraction from other receivers operating in the hall. The salon included a well laid out display of Gilfillan neutrodynes and a number of leading makes of speakers. Hundreds took advantage of the facility. A centre piece in the outside display was an eight tube Imperia superheterodyne receiver. A Thorola enclosed cone also drew a lot of attention. In this speaker no cone was visible. The Thorola had the appearance of a shallow cylinder or drum of which one end — the back — was solid, while the other was covered with gauze and fluted. The whole was done in harmonious shades of brown suitable for blending with the decorations of almost any room.

Louis Coen Wireless [S.A.] Ltd.

The display mounted by Louis Coen Wireless (S.A.) Ltd. of 75 Rundle Street occupied two stands and created a great deal of favourable comment with the large range of equipment and components. Although the company had only started business in Adelaide some 12 months before the exhibition it had made a great impact. It was sole agent for several leading makes of overseas components and carried a large supply. It claimed to stock everything in wireless and to carry the largest and most varied stock in Australia.

A team of attendants was under the control of the Manager, Mr. Fred Isaacs and it was reported that during evening periods the crowd was three to four deep around the stand.

Prominently displayed was a seven tube Pinnacle superheterodyne receiver which attracted an attentive audience every time it was switched on. The cabinet work was highly commended and working off a loop antenna it gave a high quality performance. The company specialised in the distribution of Pinnacle superheterodyne kit sets. A five tube Pinnacle receiver was also demonstrated and worked at loud volume on Interstate stations.

Parts and components of many makes were on show. These included components by All-American, Ormond variable condensers, Sferavox speakers, Grodan folding loop antenna, Pinnacle coil holders, rheostats and potentiometers, Na-Ald sockets and dials, Advance products, Scientific, Brunet and N and K headphones.

5CL Radio and Electrical Co.

The 5CL Radio and Electrical Co. of Norwood and later North Terrace displayed a complete range of the famous Demon receiving sets together with a range of Lucas radio batteries. The high quality reproduction of the Demon acclaimed it as a winner and many complimentary remarks were made concerning its performance. The following year the company produced a range of Eagle models.

A feature of the set was the use of a glass panel considered by many to be superior to the ebonite panel. The circuit was the well tried neutrodyne system employing five tubes. Three forms of cabinets were exhibited. The table model was very popular and so were two de luxe cabinet models. Two beautiful table models have been preserved in the Telecommunication Museum.

The company realising problems with charging batteries provided a service for purchasers of Demon sets whereby batteries would be picked up and replaced at regular intervals for an annual service charge. This was provided by the Eagle Battery Service.

Newton, McLaren Ltd.

Unlike many others who had stands at the earlier Railways Radio Club Exhibition, Newton, McLaren did not repeat its display. Practically all items had not been seen before by many and created a great deal of comment. The company occupied the largest area, taking up three stands.

An interesting and wide range of the famous General Radio components and receivers were on show. The four tube Universal receiver constructed from General Radio parts was a great attraction and was unsurpassed in its field. With only two dials for tuning the set produced good quality loud speaker results from Interstate stations without interference or breakthrough by the local 5CL and 5DN stations. A complete supply of accessories including loud speaker and two headphones cost £48.10.0.

An eight tube General Radio superheterodyne set also received a lot of attention from the show visitors. First class results were achieved using a frame antenna. The set was billed as the "Rolls Royce of Radio."

A six tube Stromberg-Carlson set using a neutrodyne circuit was also on display. It had three tuned radio frequencies stages and two audio frequency stages. It was completely shielded and the high standard of workmanship impressed all those who inspected it.

Newton, McLaren also produced a range of locally produced receivers under the trade name Mak. They were produced in various ranges from a crystal set and one tube set through to five tube models plus a superheterodyne model. In the sets up to the three tube models, coils and tubes were mounted externally on a sloping panel but in the four and five tube models a standard rectangular box type cabinet was provided with coils and tubes mounted internally. The five tube long wave receiver and also the superhet. were on display.

A multitude of components and parts were on show. Sterling loud speakers were there in all sizes and the great range of General Radio parts was conspicuous. Other items included Peerless headphones, a new Raytheon tube, low loss coils and condensers, a high tension battery eliminator, Amplion speakers, Philips tubes including the latest to arrive, the B406 and C509, Hellesen dry batteries, Fuller accumulators and Jewel meters.

A point of particular interest with many visitors was the Sterling Baby loud speaker unit. This was a great favourite in many homes. Although the instrument consisted of the usual magnets, pole pieces, diaphragm and coil the method of mounting the components was the subject of a Patent which gave the speaker its fine tone, sensitivity and volume. The magnets and pole pieces were mounted in a unit which was double sprung on two pillars on a solid base, the adjustment being obtained by a vertical movement against the pressure of the springs.

United Distributors Ltd.

United Distributors of 27 Chesser Street were the makers of the well known Udisco receivers. The sets used the Capacidyne circuit claimed to be a purely Australian invention and gave reception of stations operating on any wavelength between 20 and 2000 metres. The features included good selectivity, high volume with low distortion, extremely good tonal qualities and easy control. Tuning dials were synchronised and wavelengths were controlled by a switch. In accordance with the firm's policy the sets were made so that coils for different wavelengths were changed by switching instead of un-plugging and plugging coils. Special arrangements were made to prevent endturn losses. To increase both selectivity and efficiency two button switches were fitted which varied the coupling to the antenna and the coupling between two tubes, thus enabling any degree of selectivity regardless of the size of the antenna to be obtained without additional controls. The voltages were so arranged that one filament rheostat was sufficient to operate all tubes. In the four tube receiver one tube worked as a radio frequency amplifier and two as audio frequency amplifiers. In the five tube set there were two stages of radio frequency amplifiers. Transformers throughout were of the Signal type made by the Signal Electric Manufacturing Co. of Michigan in the U.S.

On the stand at the display, the eight tube receiver was demonstrated with a Quam Radiovox loudspeaker, Clyde United accumulator, and Ray-O-Vac high tension batteries. It was priced at 110 guineas complete with tubes and antenna equipment. The six tube model was fitted out with the same accessories while the five tube set operated with a Hawley speaker and the three tube set worked into a Hawley Junior speaker.

A large range of radio parts and accessories was also exhibited. These included Centralab resistances and controls, Muter lines, Bremer-Tully radio products and sets, Kurz Kasch dials and knobs, Mack sockets, Ray-O-Vac batteries, Carter jacks, plugs and rheostats, Pilot condensers, Quam loudspeakers, condensers and transformers, Hawley loudspeakers, Pyrex insulators, Signal transformers, Philips tubes, Condon tubes and the Music Master De Luxe loudspeaker.

Of the accessories displayed the items made by the Bremer-Tully Manufacturing Co. of Chicago created a lot of interest. The company was well-known for its kitsets for the Counterphase receiver, a six tube set with three stages of radio frequency amplification. It sold well in Adelaide. The heart of the Counterphase was a specially wound Torostyle coil that reduced local pick up to a very low value. It eliminated intercoupling and stray feed backs. It was supplied as an antenna coupler Type TA and interstage coupler Type TC. Another feature was the Lifetime variable condenser in tandem assembly. One dial controlled two separate condensers with close balance between units being obtained by a specially designed trimming arrangement.

Behrens-Thiem Co.

The Behrens-Thiem Co. occupied stand No. 7 and displayed one of the most beautiful cabinet receivers at the exhibition. It was the five tube De Luxe housed in a genuine French polished blackwood cabinet with Queen Anne period legs. The cabinet which stood 130 cm high also accommodated the batteries. The set consisted of two stages of radio frequency amplification, a detector and two stages of audio amplification. One of the features of the set was the ease of tuning. The variable condensers were of the straight line frequency design spreading the stations uniformly over the dial and preventing the bunching together of local and distant broadcasting stations. Specially constructed dials clearly showed variations of half a degree and were provided with logging slots.

Each set was calibrated separately on actual broadcast from five main broadcasting stations throughout the country and all that was necessary to tune the set to a given station was to set the dials at the positions nominated and turn on the switch. The switch provided a positive contact eliminating noises from varying filament current and also provided a small indicator which showed whether the set was on or off thereby protecting batteries from wasting while the receiver was not in use.

The Company whose headquarters were situated in Devon House, Chesser Street also manufactured a set similar to the De Luxe but in a smaller cabinet. It was called the Serenade model.

Metro-Electrical Radio

Metro-Electrical Radio of 113 Gawler Place featured the Gilfillan Five neutrodyne receiver, one of their specialty lines together with a four tube tuned plate Concert Grand model a set of original construction. The Concert Grand was one of eight receivers produced in 1925 by the Concert Radio Phone Co. in U.S.A. The tuned plate circuit was popular with South Australian country listeners.

The company also had on display Lincoln phonograph equipment, Fada loudspeakers, Sylvannia tubes, Peto and Radford batteries and a line of Siemens radio equipment and accessories.

The receivers were demonstrated using Peto and Radford batteries a very popular form of power at the exhibition. The P and B Battery Co. had offices in 31 Ackland Street just past Hindmarsh Square and supplied units to many of the major radio dealers.

Several Siemens radio products were on display and were the subject of much favourable comment. The Siemens three tube receiver was installed in many Adelaide homes. It consisted of an antenna tuner, one high frequency tube, one detector and one low frequency amplifying tube which could be cut out at will. The filament of each tube was separately controlled thus increasing the selectivity of the set. The high frequency amplifying tube which was arranged for a sensitive grid control by means of a potentiometer whilst the plate circuit of the same tube was tuned to the wavelength of the incoming signal by means of a ten position switch and a tuning condensor. The detector contained in its plate circuit a reaction coil which was coupled to the tuning inductance of the plate circuit of the high frequency tube. A two way switch was provided for varying the inductance value of this coil whilst the coupling could be varied by means of a handle mounted on top of the cabinet. The tubes and high tension battery were inside the set which was self contained except for the filament accumulator and antenna.

L. Whibley

Mr. L. Whibley of Torrens Road, Cheltenham showed two very fine receivers on his stand. One was a five tube tuned radio frequency model and the other an eight tube superheterodyne set.

Mr. Whibley's aim was to make the radio cabinet an attractive piece of home furniture with the radio receiver being entitled to just as worthy a beautiful setting as the gramophone.

The five tube set was housed in an Elizabethan period cabinet of generous dimensions designed to add distinction to any room. Cabinet design was carried out by Mr. Whibley and the construction by a well known Port Adelaide factory. The receiver was designed and built by Mr. Whibley and was fully self contained requiring no external antenna. Self charging equipment was installed to cater for battery drain.

The eight tube superheterodyne set was enclosed in a solid blackwood cabinet of beautiful lines and was also self contained. Demonstrations showed the receivers as being capable of high performance with local and Interstate stations.

Philips Glowlamp Works Ltd.

The display demonstrated a wide range of Philips radio products with emphasis on the latest tubes, battery chargers and a 'B' battery eliminator. Prominent was the B406 tube described as a wonder tube in view of the very low filament current. Others made by the company included a C509 a general purpose tube, an improved 201A type which gave good service as a high frequency detector and power amplifier, A109 type for portable work and the D1 and D4 types.

There were a lot of enquiries about the 'B' battery eliminator which was shown in operation. It was designed to work from the household a.c. mains with provision for a separate supply of current for the use of the detector tube. The a.c. current was transformed into pulsating direct current and smoothed to an almost pure direct current. In addition to materially helping to reduce the cost of running a radio it resulted in improved reception because a constant plate voltage was ensured.

Edison, Swan Electric Co.

The local branch of the English Company in Gawler Place mounted an interesting display of receivers, tubes, speakers, condensers, accumulators etc. Some of the receivers on display had been shown at the exhibition the previous year but a novel two tube Compactum receiver was seen for the first time. This receiver had been evolved by the Company with the sole purpose of producing a highly efficient low price receiver. The unit easily fitted into a capacious vest pocket and gave excellent loudspeaker performance up to 40 km from 5CL.

Components of interest included variable condensers, transformers, variometers, and batteries. The variable condensers had cam shaped vanes of hard brass, which because of their design gave a capacity value varying proportionally to the square of the angle through which the spindle bearing the moveable vane was turned and gave a wavelength curve which was functionally straight.

The Ediswan low frequency transformer was specially designed to minimise distortion of speech and music. The windings were of high conductivity silk covered wire for the primary and high conductivity enamelled copper wire for the secondary. The ratio was 1 to 3.5. The closed iron core was formed from Stalloy laminations.

In addition to accumulators for filament power, the Company produced a dry battery specially designed for use with dull emitter type tubes which functioned at a filament potential of two volts. As the normal voltage of the battery when new was three volts, a special self contained resistance was fitted in the battery, which ensured the correct pressure being applied to the tube filament when used in series with an ordinary type of filament rheostat. As the battery voltage dropped this special resistance could be easily cut out by the insertion of a plug, with which the battery was fitted, into a socket provided. The battery which was designated a type DE 201 had a life of about 150 hours for a single tube receiver. The Ediswan high tension radio batteries were made in ranges of from 15 to 100 volts with wander plugs for selecting the exact voltage required.

New System Telephones Pty Ltd

The company which operated on a world wide basis was well known for its intercommunication telephone services. It had also built up a favourable reputation with its True Music loud speakers made from a built up copper process. These came in Junior, Standard and Concert Grand models all of 4000 ohms impedance.

Associated with its own products the stand contained Philco dynamic 'B' batteries, Burgess dry battery one of the world's best sellers, Eureka transformers and Yaxley parts. The Eureka reflex model low frequency transformer was widely used by small set constructors in Adelaide. It met every requirement of the reflex circuit and was thoroughly screened against interaction. One of the best known components in the Yaxley range in 1925-6 was the exposed coil rheostat. It was air cooled on all four sides of the winding with an adjustable contact sliding lever. The resistance unit was held in place by Bakelite posts. The unusually long contact surface permitted the filament voltage to be built up slowly and held at just the right point to facilitate tuning.

The display was organised by F.A. Pennington and Co. on stand No. 21.

A.W. Dobbie and Co. Ltd.

Messrs A.W. Dobbie and Co. of Rundle Street had a full display of King neutrodyne receivers. These sets assembled by them were well established in Australia and New Zealand and had given high class performance. A five tube King Radiodyne model was demonstrated and picked up Interstate stations with good quality. Alphadyne receivers were also on show with two, three and four tube models being closely examined by the visitors. A special feature was a Strad speaker. It was an elongated cabinet upon which the receiver was attached giving a unit of one piece appearance. Other sets on display included crystal sets and several tuned plate receivers.

Harland Radio and Electrical Co.

The Harland Radio and Electrical Company successors to Wireless Supplies Ltd. were located in Grenfell Street and produced an attractive display on Stand No. 19. The company manufactured Harland receivers under the supervision of Mr. W.J. Bland who later founded the Bland Radio Co. and produced the Operatic range of receivers.

The chief exhibit was a handsome cabinet containing a five tube tuned radio frequency receiver. The cabinet work was by Mathias and technically the receiver performed in a creditable manner. Several smaller receivers were also on display.

The Amateur Section

The number of entries in the Amateur Section was a disappointment to the organisers. A large area was set aside in the Banqueting Room but only a quarter of the space was occupied. However, the quality of the exhibits was high and reflected great credit on those who constructed equipment for the show. In all, twenty seven sets were entered including eight transmitters.

Transmitters which attracted considerable attention but not entered in competition included Mr. Harry Kauper's 5BG transmitter which he used in the world record low power transmission to the USA with a single 201A tube and the original 5BQ transmitter of Mr. Lance Jones used in early speech and music broadcasts. One of the best club displays was put together by the Southern Suburban Radio Club. The effort was rewarded with several major prizes. Altogether, members and the club were awarded second prize for a broadcast receiver and second prize for a crystal set. The club receiver, a Browning Drake four tube set was also a prize winner. The second prize broadcast receiver was a two tube 5BG circuit constructed in a tall cabinet with battery cupboard below. The first prize short wave receiver employed three air wound coils which plugged into ebonite sockets and which were capable of lateral movement on an ebonite rod. The choke coil was wound on a glass cylinder. All wiring was carried out with copper ribbon.

The broadcast Listeners League had a small show but took out two first prizes — the crystal set and broadcast receiver. The broadcast receiver was a standard three coil set with two stages of audio amplification with all components being laid out on a panel baseboard with wiring being concealed.

One of the interesting sets displayed by members of the Port Adelaide Radio Club was a crystal set built inside a burnt out tube.

Other equipment included a home made wavemeter, a five tube receiver and a short wave transmitter.

The judges for the amateur competition were Professor Kerr Grant, Mr. Harry Kauper and Mr. Lance Jones.

THE SECOND RADIO TRADE EXHIBITION

The second annual display of radio equipment by Adelaide traders was held in the Exhibition Building, North Terrace in April 1927. Space was at a premium at the first display in the Town Hall and the much larger area of the Exhibition Building enabled many more stands to be made available by the organisers and also relieved congestion around many of the stands. The exhibition was highly successful and set the pattern for a succession of annual displays in the same building.

The display highlighted the great improvements which had been made in radio over 12 months. It was evident that manufacturers had given a lot of attention to the simplification of tuning radio receivers. The multi tuning sets had given way to the single tuning sets. Cabinets had been made even more elaborate by following the lead of the gramophone manufacturers.

The tuned radio frequency receivers still retained their popularity with nearly every stand showing the latest in straight tuned radio frequency or neutrodyne receivers. The number of three and four tube sets showed a decline in favour of multitube sets with five plus tubes, to include additional high frequency stages in order to improve selectivity. The number of broadcasting stations throughout Australia was increasing. The year saw an additional station in Adelaide, 5KA commencing transmissions.

The single control multi tube sets indicated the introduction of many novel mechanical systems. The mechanical drives of Gilfillan, R.C.A. and King receivers in particular showed great ingenuity in construction. Great care was taken to ensure slap-free movement and accurate balance. Locally built receivers showed the same degree of ingenuity as their overseas counterparts. The Eagle receivers manufactured by the 5CL Radio and Electrical Co. had counterweights on the ganged tuning condenser drive shaft. They also used a cam wheel on a pivoted arm to vary coil coupling and another cam to enable the phone jack to serve as the battery on/off switch.

The quality of components showed considerable improvement resulting in better performance. Many patterns of cone speakers were on show and receiver circuits showed a tendency towards resistance — capacitance coupling in place of transformers in the audio stages. The cone speakers created a lot of interest, being shown in three types. The first had a rigid edge with single or double cone made of heavy cold pressed medium hard, long fibre paper. The second had a free edge with single or double cone made of heavy cold pressed hard long fibre paper or parchmentised paper and the third type had a rigid edge with single or double pleated disc (Lumiere type) of parchmentised paper or varnished fabric.

Some 32 stands were occupied in this exhibition, ten more than in the previous year. Some of the exhibitors displayed the same receiver models and components they showed in the Town Hall the previous year but many sets and components had not been seen before and created considerable interest.

Messrs. Behrens, Thiem and Mr. H.L. Austin of Norwood combined to mount a display of receivers manufactured by the Radio Corporation of America, together with locally made units by Behrens, Thiem's workshop and Mr. Austin. The RCA receivers had single tuning control dials of the drum-type with a clutch mechanism which enabled the operator to work the two dials in unison thus simplifying operation. The RCA models on show included an eight tube superheterodyne type with a speaker in a matched cabinet. A seven tube superheterodyne set made by Mr. Austin was unusual in that it used a crystal detector. Many keen listeners considered that a crystal detector gave higher quality of reproduction than a tube type detector. The receiver made in the Behrens, Thiem's workshop was a six tube tuned radio frequency receiver with three stages of resistance capacitance coupled audio amplification. In addition to receivers, the stand included samples of Perflex coils, Farrand and RCA cone speakers, and Tungar batteries.

The A.G. Healing & Co. stand displayed receivers and speakers made by the Atwater Kent Company in U.S.A. This company introduced a line of high quality do-it-yourself bread board components and then concentrated on a line of receivers of beautiful appearance and high quality workmanship and performance. The Model 20 was Atwater Kent's answer to Hazeltine's popular neutrodyne circuit patents by the use of "losser" resistances in series with the grids of radio frequency stage tubes. An example of the way in which the company was able to assemble a receiver in a small space was shown by the One Control Six Model on display. The receiver was placed in a metal case of small proportions and the controls consisted of a filament rheostat only and a single dial for tuning. A range of the attractive speakers made by the company was also on display.

The locally made Eagle range of receivers made by the 5CL Radio and Electrical Co. was well patronised. Improvements had been made to earlier models to upgrade performance and appearance. Circuits used were tuned radio frequency and neutrodyne types. A feature of the construction was a cast aluminium framework on which a bakelite baseboard was mounted. Coils were mounted in aluminium cans for screening purposes. This was one of the first locally built receivers to adopt this method. Additional screening was provided by silvered mirrors. The glass front panel gave a pleasing effect and the De Luxe model with its beautifully finished cabinet was the subject of many favourable comments.

The exhibit arranged by Oliver J. Nilsen and Co. of King William Street, contained several items of interest. The Orthosonic receiver manufactured by the Federal Radio Coporation was the centre piece of the stand. The set was a seven tube tuned radio frequency receiver with four stages of radio frequency amplification. It was fitted with a self-contained loop antenna and loudspeaker and during a demonstration several Interstate stations were received at good volume. The model was very popular and during 1925-26 ten versions of the Orthosonic were produced. The company also had a display of many of the lines of headphones in stock. They had one of the largest ranges in Adelaide including Pico, Elka, Scientific, Manhattan, Murdock, Siemens, Brandes, Federal, Trimms, Sterling, Baldwin, Henderson, Cable, Ensynophone, Revo and B.T.H.

The Andrews Radio Store displayed two receivers made by the De Forest Radio Co. as well as a range of tubes also made by de Forest. The attractive leatherette cabinet receivers showed remarkable sensitivity and high quality during demonstration. A five tube tuned radio frequency and a five tube reflex tuned radio frequency models were demonstrated. These two receivers were included in a range of eleven produced during 1925. An Elipticone loudspeaker created much interest. Many listeners who owned one of these speakers were of the opinion that they were a distinct improvement in loudspeaker design.

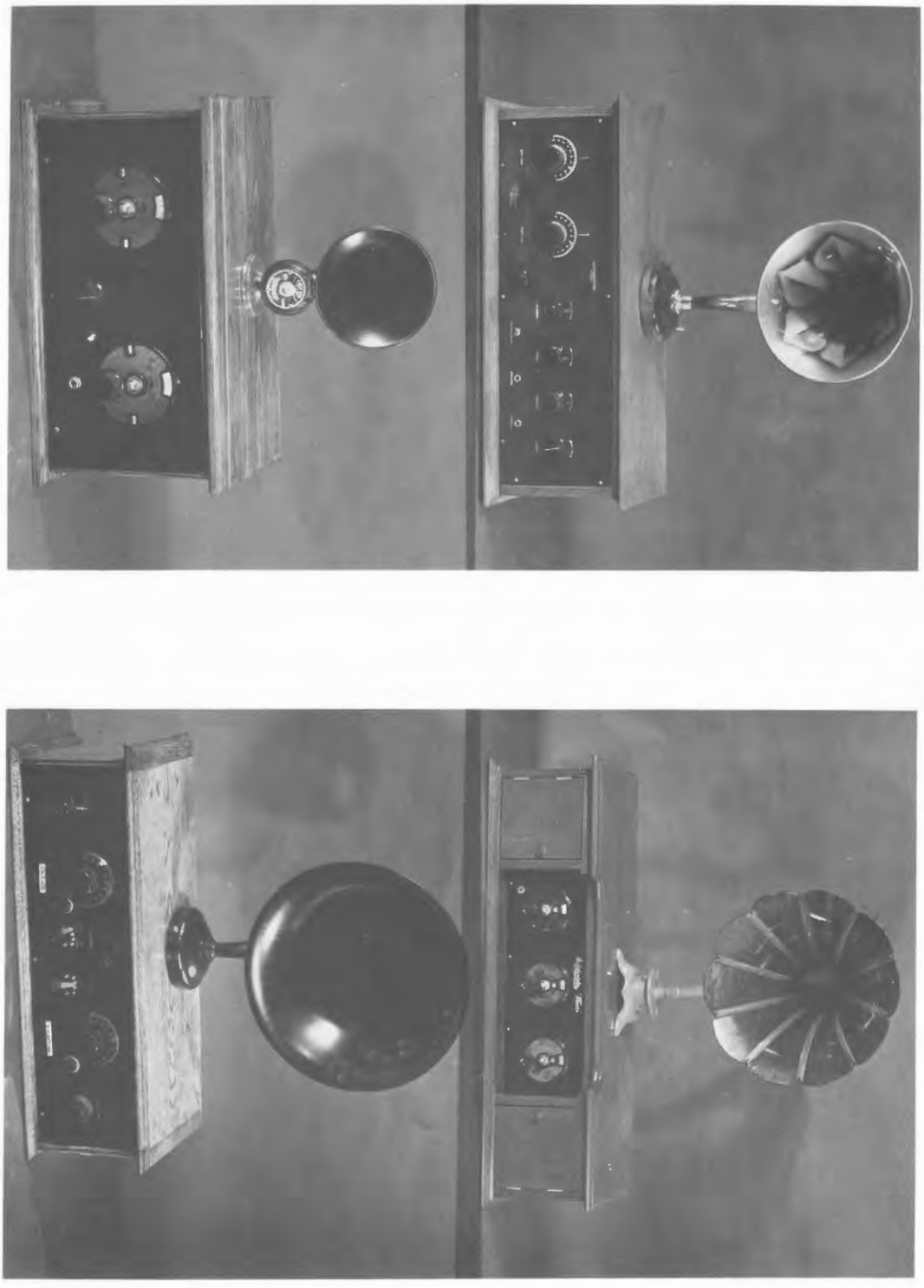
James Marshall & Co. were one of the local companies exhibiting for the first time. Their main exhibit was a Kellogg Console receiver made by the Kellogg Switchboard and Supply Co. The receiver, one of the Wavemaster series was a five tube tuned radio frequency unit with two controls and built-in loudspeaker. A table model using the same circuit was also on display and both performed well during demonstration. The stand also contained a Marshall five receiver in a floor type cabinet. Only one control was necessary to properly tune the receiver. An attractively illuminated dial complemented the set.

A range of Gecophone receivers was shown on the British General Electric Company's stand together with a selection of Osram tubes. The four tube Gecophone employed a high frequency tube, detector and two low frequency tubes with a reactance coupled to the plate of the high frequency tube. The five tube cabinet model normally covered the band 300 to 500 metres but was provided with alternative coils for other wavelengths. It was in a polished mahogany cabinet with high grade finish. The audio frequency stages employed resistance — capacitance coupling. The six tube supersonic heterodyne receiver was supplied with a frame antenna and was designed for headphone operation. The eight tube model was similar but had two additional stages of audio amplification for loudspeaker working. A switch allowed one of the tubes to be cut out when receiving local stations.

An extensive range of King receivers exhibited by A.W. Dobbie & Co. attracted a lot of attention. A shielded console model was a local point of interest. It contained a loop antenna operated from the front panel. The construction of the coupling device for controlling the operation of the tuning condensers from the one point was well engineered. The King Buffalo Inc. which marketed the receivers was originally called King Quality Products and in 1926 changed its name to King Hinners Radio Co. and shortly after changed again to King Buffalo Inc. Their first neutrodyne kit set was produced in 1925, and in 1926 they produced eight models including five tube neutrodynes and six tube tuned radio frequency sets. Sets available in Adelaide included the King-Hinners neutrodyne in table type, table type plus loudspeaker built-in and an elaborate console model each one a masterpiece of the cabinet makers art. The King Five broadcast receiver models were available in the same format but in the tuned radio frequency circuit. They sold in great numbers in knock down kit form.

Other stands were occupied by Edison, Swan Electric Co.; Messrs Allans Ltd; The Sport Radio Broadcasting Co.; United Distributors; Aeolian Company; Harris, Scarfe Ltd.; Louis Coen Wireless; Philips Lamps (Aust.) Ltd.; Newton, McLaren Ltd.; The Adelaide Radio Co.; H.E.A. McCarthy & Co.; New Systems Telephone Pty. Ltd. and Messrs Duncan and Fraser.

It is of interest that the 32 stands were insufficient to cater for many other well known distributors and manufacturers in Adelaide at the time. Other traders who made significant contributions in the period up to 1927 included A.M. Rodda of 117 Currie Street distributor of Rodaphone receivers; Millswood Auto and Radio Co. Ltd. of 109 King William Street and 113 Gawler Place manufacturers of a four tube De Luxe receiver; South Australian Radio Co. 33 King William St agents for Burndept and Polar radio equipment and components; H.C. MacKenzie, 13 Twin Street agent for Federal radio equipment; Messrs Varcoe & Co., 57 Gawler Place makers of home kit sets; Unbehaun and Johnstone 9 Rundle Street agents for Western Electric equipment and kit set manufacturers; Corbett, Dernham and Co., 19 Twin Street manufacturers of Tunafone receivers; Charles Atkins & Co. Ltd. agents for FADA receivers, Manhattan and Turney equipment; MacKenzie and Maddern, 102 Grenfell St distributors of a wide range of receivers and components; Radio Imports Ltd., Hindley Street distributors of De Forest equipment; Roy Hill & Co Ltd. agents for Peto and Radford Radio batteries; C.M. Lowe Commercial Road Port Adelaide receiver manufacturer; F.G. Koerner & Co.



Battery Operated Receivers Made in Adelaide 1924-28.
[*Courtesy Telecommunications Museum*].

275 Rundle St., distributor of imported and Arcoflex receivers; D. Green and Sons, 119 Parade Norwood and Rundle Street, component and receiver agents; Mather and Payne, Henley Beach Road, Torrensville suppliers of masts and antennas; S and E Electrical, 86 Flinders Street agents for Siemens equipment and components; Sampsons, 158 Rundle Street accessory distributors; Randell Electrical and Radio Stores, 225 Unley Road, Unley radio parts distributors; Southern Traders Ltd. 115 Unley Road, Unley, retailers of wide range of components; Frank S. Nelson, 192 Prospect Road accessory retailer; R.E. Jackman North Terrace distributors of Cutler Hammer, Freshman, Frost, Howard Remler and United radio equipment; Craven & Co. Rundle St radio accessories and receivers; Rodda, Stevens Ltd., 95 Waymouth Street makers of Quality Four receivers and A.C. Silby Woolnough Terrace, Execter, manufacturer of receivers.

Most of these small firms eventually disappeared from the scene, being succeeded by larger firms such as Ernsmiths and its manufacturing subsidiary the National Radio Corporation Ltd. Ernsmiths celebrated its 53rd birthday in 1977 and began distributing its popular range of Scharnberg Strauss receivers from the early 1930's until 1976. Prewar, the sets were made by the National Radio Corporation Ltd but after the war when Ernsmiths was no longer associated with the N.R.C., Ernsmiths set up its own production facilities. Technical staff with the National Radio Corporation Ltd included Kev. Wadham, Ralph Baker, John Allan, Al Smythe, Doug Strangway, Len Wurfel, Lyn McKay and Jack Forby.

THE GOLDEN JUBILEE OF BROADCASTING DISPLAY

In November 1973 the Post Office in cooperation with organisations associated with broadcasting in the State and various individuals arranged a display in the Postal Hall of the Adelaide GPO to mark the Golden Jubilee of broadcasting in Australia. The display coincided with the 50th anniversary of establishment of regular public broadcasting in Australia when the Sydney station 2SB (later 2BL) officially commenced transmission on 23rd November 1924. The Post Office issued a commemorative stamp for the occasion.

The display was open to the public from 19th to 23rd November and declared open by His Excellency the Governor of South Australia Sir Mark Oliphant K.B.E. at 10.00 a.m. on the 19th. In inviting His Excellency to open the display Mr. A.H. Kaye, Director of Posts and Telegraphs in South Australia and Northern Territory said:-

"Your Excellency, distinguished guests, ladies and gentlemen.

Welcome to this display which we have set up to mark the Golden Jubilee of regular public broadcasting in Australia, and, particularly, a welcome to you, Your Excellency, for your presence and for accepting my invitation to officially open the display.

Over the fifty years, the Australian broadcasting systems have undergone many changes in management, control, programme arrangements, technical advances, and so on, with, probably, the major change being the addition of the visual element to sound broadcasting, with the introduction of television in 1956.

I won't comment on programme aspects of which I have very little knowledge except as generally satisfied, but also sometimes a dissatisfied, viewer and listener, but speaking as one who has served much of his adult life as a radio engineer in the Australian Post Office, I should like to make the point that we have been in the broadcasting business since the very beginning. The part played by the Australian Post Office has changed from time to time. In the very early days, the technical facilities of the National Service were provided by the Post Office which also arranged programmes under contract. Later, all technical services were provided for the production and transmission of the programmes of the Australian Broadcasting Commission, which later took over the studio technical services.

Presently the Australian Post Office provides and operates, for the ABC programmes, the national sound broadcasting and television transmitting stations (and in some cases it also operates commercial television transmitting stations), most programme channels from studios to transmitting stations including Interstate channels, and we have a variety of other services such as seeking out causes of interference to reception.

Perhaps I should make a special mention of the overseas services transmitted by Radio Australia stations located in Victoria, Western Australia and Northern Territory.

Because the Australian Post Office has had this continuing though changing role in broadcasting in Australia, we in the South Australia/Northern Territory Administration of the Post Office thought it appropriate to mount this display. It has three sections — a collection of literature
— items of technical equipment
— a world wide collection of
postage stamps with the theme of broadcasting.
And I should add that a commemorative stamp will be on issue from Wednesday of this week.

Many organisations and individuals, too numerous for me to mention here, have contributed to this display and I acknowledge with thanks these contributions, and also acknowledge with thanks members of my own Post Office team who have designed and set up the display.

I think ladies and gentlemen, that you and others who visit the display during the week will find it interesting, and it will probably result in some nostalgia for many of us.

I have much pleasure in inviting you, Sir Mark to declare the display open."

In his address Sir Mark said

"About the year 1920 I was working as a 'cadet' in the Department of Physics at the University of Adelaide. At that time, the Department was located in the original building of the University, and Professor Kerr Grant had installed a wireless aerial stretched between the highest point on that building and the spire above the Elder Conservatorium. There was nothing to hear save telegraphy and the time signal, and our receivers were crystals of galena with a 'whisker' of fine wire contacting a sensitive spot which was not easily located.

Great was the excitement in the laboratory when two De Forest 'Audion' triodes were received, for, by good fortune, an American ship was in Port Adelaide fitted with equipment with which it broadcast recorded music. We squabbled over who should listen through the headphones, and marvelled to hear words and music. There were no loud-speakers for some time after that. Indeed, in England in 1928 I assembled my first radio set from a kit of parts from G.E.C., and for the first time heard music from a reed-driven cone speaker which hung, like a picture, from a nail in the wall.

It is of interest that during the early days of the Second World War, when we were developing microwave radar in England, Dr. Sayers used a crystal detector in a receiver for the first signals reflected from aircraft and ships, and this became the standard mixer.

Older citizens who visit this exhibition will experience the same nostalgia as do I, not only because of the fine display of equipment, but also because of the most interesting photographs and papers relating to the development of broadcasting in Australia. The international collection of appropriate postage stamps will fascinate the collector, and the ordinary man alike.

It is not easy to remember that there was no radio broadcasting in Australia before 23rd November 1923. In the intervening fifty years till now radio came of age, both technically and as an art. It brought pleasure and information to all, not least to the elderly and infirm. It became an important ingredient of politics, at election time

because it conveyed the policy speeches of contestants to the widest possible audience, and at other times because the proceedings of the Federal Parliament were broadcast. One very significant fruit of broadcasting was the symphony orchestras built up by the A.B.C. in the capital cities, orchestras which have delighted music lovers, and brought to Australia the greatest of musicians from all over the world.

Television broadcasting, which began in England and the United States in the late 1930's did not reach Australia till the late 1950's, by which time it was technically of very high quality. Shortly, we shall have television in colour. I must admit that I have not yet made up my mind whether T.V. is good or bad, as a social phenomenon. The television set has been called the "idiot box", for it replaces reading, emphasizes spectator sport at the expense of participation and, most of the time, caters for the lowest common denominator among the population. It could be the most powerful force for good, promoting education and enlightenment as, indeed, do a small proportion of programmes. Instead, it spreads the cult of violence, and it abounds with the so and so's show, which rapidly deteriorates into what is, for me, pandering to the lowest possible tastes in entertainment. Thank goodness for the switch on the T.V. set! That still allows some to refine their taste in broadcasting!

I have spoken for long enough. It is my pleasant duty to open, formally, this remarkable exhibition arranged by the Post Office. I hasten to add that while the Post Office is responsible for the communications side of broadcasting, where its technical performance is very high, it is not responsible for the programmes broadcast!"

The display looked back on 50 years of broadcasting and beyond to the origins of wireless and to pioneers associated with its development. It differed from the earlier exhibitions in that there were no trade exhibits, it had an extensive collection of historical records and a history of broadcasting throughout the world was portrayed through postage stamps. Equipment items included early broadcast transmitter components as well as receivers and accessories. Organisations and individuals who contributed equipment, components and historical records included the Australian Broadcasting Commission, Australian Broadcasting Control Board, Australian Post Office, Overseas Telecommunications Commission, State Library, University of Adelaide, 5AD — Advertiser Newspaper Ltd., 5DN — Hume Broadcaster's Pty. Ltd., 5KA — 5KA Broadcasters Pty. Ltd., 5AU — 5AU Broadcasters Pty. Ltd., 5MU — Murray Bridge Broadcasting Company, 5PI — Midland Broadcasting Services Pty. Ltd., 5RM — River Murray Broadcasters Pty. Ltd., 5SE — South Eastern Broadcasting Co. Ltd., News Pty. Ltd., Staff of the APO, Newton, McLaren Ltd., Bruce's Radio Service, Messrs. James Glennon, J.W. Ross, J. Trembath, W.S. Walker, K.A. MacDonald, R.D. Blackwell, A. Matthews, J.J. Hume and E.J. Hume. Design of the Display was under the control of Mr. John Payne assisted by Miss Maxine Besanko both of the Post Office Publicity Group.

Included in the historical records were circuits of the original 5PI Port Pirie transmitter the first country broadcasting station in the State, an early 5DN circuit and an original blueprint of the circuit of the 5000 watt 5CL transmitter installed at Brooklyn Park in 1925. Photographs of early and recent transmitter and studio installations of all Commercial and National broadcasting stations were also shown. Of particular note was a photo copy of the Adelaide Observer dated 25th September 1897 reporting a demonstration of wireless telegraphy during a public lecture at the University of Adelaide by Professor (later Sir William) Bragg. Another newspaper copy reported the first successful experiments in the practical application of wireless carried out by Professor Bragg and Sir Charles Todd on 10th May 1899 with the transmitter at the Observatory and receiver located some 200 metres away. A licence issued to Mr. R.A. Bruce on 27th September 1923 for the purpose of erecting an experimental wireless station and for operating a crystal receiving set attracted much attention.

A wide range of equipment and components was on display. They were grouped into receivers, loudspeakers, headphones, recorders, crystals and coherers, microphones, test instruments and transmitting tubes. Because of space limitations only a few of each group were shown but those that were shown were in use in South Australia during various periods.

Receivers included a six tube Igranic set, a Philips three tube a.c. set, an AWA tube battery receiver, a Fellophone Super Three receiver, a Fada five tube neutrodyne receiver, a 5CL Eagle receiver, a four tube Telefunken set, a Fisk Radiola portable, a Radiola Standard six, a King neutrodyne six tube set, a four tube portable of unknown make constructed in 1927, Atwater Kent 110 volt a.c. receiver, Burndept receiver, Crosley Pup single tube receiver, 1931 Car Radio, AWA four tube miniature portable, a modern National portable, miniature six transistor set from Russia, BBC Crystal set, crystal set by Oliver J. Nilsen, tapered coil crystal set and a single slide arm crystal set.

The Crosley Pup single tube receiver brought back memories to many visitors. It was produced in 1925 by Powel Crosley in United States for a low cost market. It was the first cheap, practical regenerative receiver on the U.S. market and was soon snapped up by South Australia distributors it operated with a WD12 tube, 22.5 volt B battery and 1.5 volt dry cell.

Loudspeakers included Sterling XR351, BTH Type C2, Amplion Dragon, Kellogg, Atwater Kent Type F4A, Tomtit, Sterling Dunkie, Amplion Dragon Fly, Utah folded horn papier mache unit, Ultra horn, Brown horn, a Philips plastic frame speaker and Amplion Junior De Luxe. The Amplion Dragon and Junior De Luxe models received a lot of attention. These models were specially finished and provided with a wooden trumpet of unique design in which oak or mahogany panels were united by a series of metal ribs giving a particularly attractive appearance.

The headphone section was very popular. As well as the original pair of Sterling headphones used at 5DN in 1924 there were Baldwin aluminium diaphragm phones, Baldwin mica diagphram phones, Sterling Lilliput, and Brandes Matched Tone types. There was a tremendous demand for Baldwin phones in the 1920's. They were much more sensitive than any other phones available at the time. Nathaniel Baldwin, a Mormon in Salt Lake City, discovered a new method of moving the diaphragm. He used a driving rod.

A Presto disc recorder originally used by 5AD and a Pyrox wire recorder also used by 5AD were displayed. The disc recorder was complete with turntable, drive mechanism, cutting head and a container of uncut discs. The same type of recorder was used at the ABC studios before being superseded by the tape recorder.

The range of crystal holders and coherers included synthetic crystals, galena, carborundum, chalcopyrite, a Perikon crystal to crystal detector and two nickel filing coherers. Samples of artificial crystals included Mighty Atom, Neutron, CAV and Silvertex. A Clapp — Eastman Ferron crystal detector, an Edison Bell twin crystal detector and a Silverton vertical crystal detector complemented the display. The Clapp-Eastman detector was mounted on a Marble base and made about 1914. Ferron was the trade name for silicon crystal mounted in a nickle plated cup. The twin detector consisted of two dust and damp proof glass tubes each containing a crystal and fitted with ball and socket adjustment with a special spring slider. By means of a switch the operator could quickly change from one crystal to the other to obtain the best results. The lower half of the tubes were opal to facilitate the setting of the crystal. The coherers were used by experimenters up until about 1912 and consisted of nickel and iron filings resting across a spaced V shaped conductor, the whole being enclosed in a glass tube. A striker operating on the principle of a trembler bell was associated with the coherer. Its purpose was to tap the tube of filings to ensure they were decohered following reception of a signal.

The microphones on show were all used for experimental or commercial broadcasting. A 77DX ribbon microphone, W.E. Altec microphone, "Cricket Ball" microphone and a carbon granule microphone in spring suspension, popularly known as the 3LO microphone, were on show.

Test instruments gave an example of models widely used in 1925-26 period. A voltmeter known as the pocket type with reading 0 to 10 volts was shown. Another voltmeter with plug-in terminals for reading voltages of both 'A' and 'B' batteries created interest. A second 'A' and 'B' battery unit used a switch on the back for changing scale. A panel mounting voltmeter of the Bowyer-Lowe type was specially made for use in sets employing dull emitter tubes. A Jewell No. 107 Universal tube checker was shown with a tube under test. In operation, the tube to be tested was placed in the tube checker and an extension plug placed in the socket from which the tube had been removed.

In addition to a range of low power transmitting tubes used by experimenters in the early 1920's, some early water cooled tubes used in broadcast transmitters were examined with interest by the visitors. Tubes from the first water cooled transmitters at 5RM, 5CK and 5CL were shown against the modern air cooled types used with the modern 50000 watt transmitters at 5CL and 5AN.

Another item of interest was a hook-up showing a complete home installation typical of the mid 1920 period. The receiver was a 5CL Eagle receiver with glass front panel and mirror back made in Adelaide by the 5CL Radio and Electrical Company, Liberal Club Building North Terrace. The antenna was a frame type with sides about 60 cm long. The frame antenna was suitable for receiving on wavelengths from 300 metres upwards. For shorter wavelengths it was supplied with 10 turns instead of the normal 20. A variable condenser of maximum capacitance .0003 mfd connected across the frame was suitable for tuning to broadcasting wavelengths of 300 to 500 metres; for longer wavelengths a condenser of correspondingly larger capacity was used or additional inductance connected in series with the frame antenna.

The batteries displayed with the set were three 45 volt Ever-Ready Superdyne types for high tension, a CAV Accumulator and an Ever-Ready 'C' Battery. The Superdyne types were introduced some years after the 1925 Ever Ready 'Wireless' types but none of these could be located at the time of the display.

The loudspeaker associated with the set was a magnificent papier mache Kellogg Symphony Reproducer employing magnetic diaphragm control which prevented excessive vibration of the diaphragm so ensuring high quality reproduction.

The display closed at 10.00 p.m. on 23rd November.

Most of the equipment at the display is now in the Telecommunications Museum established by Telecom Australia. The Museum was first located in the Engineering Building, 42 Franklin Street, Adelaide in the 1960's but in 1976 part of the display was transferred to Electra House 131 King William Street. The whole of Electra House will be eventually set aside for the display of equipment, records and documents associated with telecommunications, particularly as it relates to South Australia. The Museum is under the Chairmanship of Ken Work assisted by a Committee which in 1977 included Bernie Woodrow, Milton Gooley, Tony Thomas and the Author with very active support for expansion of facilities being given by the State Manager of Telecom, Murray Coleman. Peter McEntee joined the Committee in 1977 on the retirement of Bernie Woodrow.

The initial displays in Electra House comprised selections of early telegraph and telephone apparatus and documents but in April 1978 a display of vintage radio equipment was added.

SECTION 9

TIME AND PLACE

Time Signals and Longitude Determination

TIME SIGNALS

A ship's navigation is conducted by the process of regular periodic calculations of latitude and longitude. For latitude the master depends upon his solar observations. Longitude he usually calculates by determining through the ships chronometers at what hour the sun crosses the meridian. The accuracy of this method depends plainly upon the correctness of his timekeeper and it is wireless time signals which alone enable this correctness to be rigidly maintained at sea as on land.

By 1912 regular transmissions of time signals and weather information had become international practice. VIA in Adelaide started time signal transmissions in 1913.

In 1875 a time ball tower was erected at Semaphore and this enabled mariners at anchorage at Semaphore and parts of Port Adelaide to obtain correct time daily at 1 p.m. except on Sundays and Public Holidays. The 1.5m diameter ball was hoisted to the mast head at a few minutes before 1 p.m. and at exactly 1 p.m. it was released electrically following the operation of a telegraph key at the Observatory. The ball was placed at the top of the tower erected at the signal station near the beach and was 28 metres above sea level when raised. A plaque placed on the tower has the following inscription:

> "This time ball tower was erected in 1875 to enable ships at the anchorage and the inner harbour to rate their chronometers. The black ball was hoisted to the mast head at 12.57 p.m. daily and dropped at 1 p.m. by electric release from the Adelaide Observatory.
>
> With the advent of wireless time signals the service was discontinued in 1932.
>
> The structure has been preserved by the South Australian Harbour Board to preserve a link with the past and as a tribute to sea transport which played such a prominent part in the founding and development of the State".

At other ports throughout the State when a master wished to correct his chronometer he proceeded to the local Post Office where he was put in direct communication with the Observatory from where the time signals were transmitted. For busy ports this was a most inconvenient arrangement and it was a great day when Port Pirie was provided with its own time ball tower. The Port Pirie installation was the first in South Australia to utilise wireless in its operation.

Following receipt of permission from the Commonwealth Government to proceed with the establishment of a receiving station near the Port Pirie wharf, apparatus was installed in the time ball cabin located near the flagstaff at the Harbour Master's residence. One end of the copper antenna wire was attached to the top of the flagstaff but electrically separated from it by an insulator. The other end of the wire was fixed to the top of the time ball hut and insulated. A single feeder lead was taken down from the wire near its termination point on the hut and connected directly to the receiving apparatus. The top end of the antenna was some 20 metres above ground level and enabled strong signals to be received from VIA in Adelaide.

The receiving apparatus was constructed by Mr. J.J. McLaughlan, Superintendent of the Harbours Board Dockyard and installed by him on 11th April 1918. Mr. McLaughlan was a well known experimenter with his station XVE. The apparatus was very sensitive and gave complete satisfaction to the staff operating it from the outset.

The service was officially put into service on the 12th April and only on two days during the first six months was reception unsatisfactory. That was when alterations were being made at VIA and low power was being radiated. On those occasions recourse was made to the use of a land line from the Observatory.

One major problem experienced was the difficulty in hearing the time signals in the headphones due to the very loud noise near the time ball cabin. Noise from passing locomotives, steam winches, horse drawn carts etc., was of considerable magnitude but the problem was solved by providing double walls in the cabin and packing the intervening space with seaweed.

On receipt of the signal indicating the exact time, a lever was manually operated allowing the time ball to drop. For some time the ball was under the control of Mr. Charles Durham and the exercise was carried out at 1 p.m. daily. Besides mariners, local clock makers also made good use of the service. One of those was Mr. Les Craigie who attended the location each day to check his watch and then ride back to the shop to set all clocks and watches to the correct time.

Although the time signals transmitted by coastal and broadcasting stations are satisfactory for most day-to-day purposes they do not reach many of the outback areas where survey parties may be in operation. Also, these transmissions do not meet certain specific needs of surveyors, navigators or scientific workers. On 21st September 1964 the Postmaster-General's Department introduced a continuous time signal service through transmitters located at Lyndhurst, Victoria using call sign VNG. The original purpose of the service was to provide accurate time signals for the Woomera rocket range area in the north of South Australia and for surveying activities.

The system transmits seconds markers by double sideband amplitude modulation of the carrier and consists of various length bursts of 100 Hz tone. The minute marker is 500 milliseconds of 1000 Hz and during the 15th, 30th, 45th and 60th minutes, a station identification announcement is given without interruption to the time signals.

Frequency changes are made throughout the 24 hour period in a pattern designed to allow for different propagation conditions between day and night, thus achieving wide coverage. Carrier power is 10kW for all frequencies which with the 1973-74 sunspot cycle were 4.5 MHz from 1945—0730 AEST, 7.5 MHz for 0845 — 0830 AEST and 12 MHz for 0745—1930 AEST.

It is interesting to note that prior to 1895, Adelaide mean time, that is the longitude of the Adelaide Observatory on West Terrace was adopted as the standard throughout the whole of South Australia viz 9 hours 14 minutes 20.3 seconds east of Greenwich. As from 1st February 1895 a new standard time came into effect as a result of an Act of Parliament viz 9 hours east of Greenwich (135th meridian of longitude). This change followed on the recommendation of several Government Astronomers embodied in the 1894 Postal Conference Report. The recommendation set the 120th meridian on 8 hours east of Greenwich for Western Australia, the 135th meridian or 9 hours east for South Australia and the 150th meridian or 10 hours east for Victoria, New South Wales, Queensland and Tasmania. However the South Australians were far from happy and found it to be inconvenient for working hours. On 1st May 1899 the standard time for South Australia was changed by amendment to the earlier Act, to be 9 hours 30 minutes east of Greenwich.

Longitude Determination

The first application of wireless in the determination of longitude took place in Europe in 1904 on an experimental basis. In 1913 tests were started in connection with the determination of the difference in longitude between Paris and Washington using time signals transmitted from the Eiffel Tower in Paris and an American station in Virginia. These Franco-American experiments extended over a period of two years and nine months. The difference in longitude was determined to an accuracy of 0.01 of a second.

Wireless time signals in Australia were first transmitted on a regular basis by the Melbourne Coastal Radio Station from 10th September 1913 relaying signals from the Melbourne Observatory. A similar service through Adelaide Radio was implemented shortly after when signals from the Adelaide Observatory were used.

The first use of wireless time signals for the determination of longitude in South Australia was implemented in July-August 1914 in fixing the longitude of Port Augusta and Bookaloo in connection with the survey of land adjoining the East-West railway. Signals from both Adelaide and Melbourne stations were received on portable field wireless equipment.

During August-November 1914 longitude determination at several base stations was carried out by Mr. G.F. Dodwell, the Government Astronomer in connection with the Musgrave Range Expedition using portable field equipment. Clock beats controlled by star observations at the Adelaide Observatory were transmitted each night through Adelaide Radio at 9 p.m. They were successfully received by the expedition using the equipment previously used in the Port Augusta work.

During the next few years many other determinations were made with the field set in connection with the State survey. These included stations at Nairne, Goolwa, Pt. MacDonnell and Mt. Ruskin. At Mt. Ruskin where for some unknown reason the Adelaide Radio signals could not be heard, transmissions from the Melbourne Radio were used. The determination of longitude by wireless was of great assistance to surveyors working remote from telegraph offices and soon formed part of a regular programme of the work by the Observatory for the Commissioner of Crown Lands and the Surveyor-General.

In 1917 improvements were made to the antenna installation at the Observatory to improve reception. The antenna in use at the time was fixed to the anemometer tower and the efficiency was affected by the proximity of buildings and meteorological equipment. The new antenna was designed by Mr. F.B. Cooke of the Sydney Observatory during his visit to Adelaide earlier in the year and comprised an umbrella type with four cage arms. The lower half of the supporting mast was the trunk of a Norfolk Island pine tree formerly in the Observatory garden. The tree had died as a result of the severe drought in 1914 and it was cut down because it became a hazard to nearby buildings during periods of high winds. The top part of the mast attached to the pine tree pole consisted of a light steel frame which had been used as a portable mast for the wireless equipment during the Musgrave Range Expedition. The height of the new antenna was 23 metres and the work was carried out by engineering staff of the Post Office. The efficiency of the installation in receiving Observatory time signals from Sydney and Melbourne was greatly improved.

The fixing of the 129th meridian boundary separating South Australia and Western Australia had been under discussion since 1903 but it was not until 1918 that the South Australian government agreed to participate in establishing the line of demarcation.

The Government Astronomer Mr. G.F. Dodwell who was also Secretary of the Longitude Committee of the Australian National Research Council recommended to the government of the day that the accuracy of the adopted values of Australian longitudes should first be checked and that radio be used for this purpose to give direct connection between England and Australia. The longitudes had in earlier years been established by signals transmitted over the submarine cable system.

The proposal was subsequently supported by the Directors of the other Australian Observatories and included (a) the redetermination of an Australian prime station by wireless signals transmitted from a high power station intermediate between England and Australia and capable of being heard simultaneously at Greenwich Observatory

and at the Australian station and (b) the redetermination of the longitudes of the other Australian Observatories and other reference points, and a determination of a point on the 129th meridian, by a similar operation connecting each of these with the Australian prime station.

It was decided that Sydney Observatory would be the Australian prime station for direct connection with Greenwich and tests were put in hand to ascertain which of the existing wireless stations would meet the required conditions. The high power wireless station at Lyons in France was received with sufficient clarity for accurate time determinations.

In May 1920 the Lyons station transmitted, by arrangement, a series of mean time signals and the first record of wireless time signals received direct from Europe was made in Australia at the Sydney Observatory. Unfortunately the Adelaide observatory had at the time only a short wave receiver principally used for field work and the 15000 metre wavelength of the Lyons transmitter was outside the tuning range of the receiver. Adelaide Radio had suitable facilities and received the signals satisfactorily. Adelaide Radio station therefore joined the Sydney Observatory in this momentous occasion. The signals consisted of 300 rhythmic beats gaining one beat in 50 mean time seconds and omitting every 60th. They were transmitted at 10 p.m. Greenwich time corresponding to 7.30 a.m. in Adelaide. The early morning conditions were favourable for reception and the signals were recorded as well defined dots admirably suitable for a determination of longitude with high precision.

During the year the Observatory acquired additional wireless equipment including a long wave tuner, two tubes, two pairs of Brown headphones and a two stage amplifier. This allowed facilities to be set up for the reception of the long wave transmissions from Lyons during June and July. In July signals were also received from the Annapolis station near Washington and although the level of atmospherics was very high the time signals could be distinctly heard. Signals from these stations were not of sufficient strength to allow automatic recording on paper tape, but Mr. E. Thrum of the Observatory staff developed a semi-automatic method which greatly assisted in reception of the signals.

The experiments carried out in Adelaide indicated the possibility of receiving the signals with field type equipment and so allowing determination of the 129th meridian in one step direct from Greenwich instead of by a second step using an Australian prime station. Decision was therefore taken to carry out a trial exercise at Deakin, a railway siding near the border. The party selected to carry out this experiment included Mr. Dodwell, Lieutenant V.D. Bowen of the Defence Department, C.A. Maddern of the Observatory and C.M. Hambidge and J. Crabb of the Survey Department. They left Adelaide on 13th November and arrived at Deakin the following day. Mr. H.B. Curlewis, Government Astronomer from Western Australia joined the party on the 17th.

By arrangement with the French authorities a series of test signals were transmitted from 17th to the 23rd November for five minutes each morning at 3.45 a.m. Central time. The beat signals from a special transmission clock were received at good strength at Deakin with the portable field apparatus and a preliminary direct value of longitude was obtained. The field equipment which was loaned by the Defence Department for the experiment consisted of a single tube auto-heterodyne receiver of the oscillaudion type. Some tubes were loaned by the Commonwealth Radio Department, some condensers and other apparatus loaned by Mr. J.S. Fitzmaurice, Post Office State Engineer and Professor Kerr Grant of the University loaned a sensitive galvanometer of the Eindhoven pattern. The antenna consisted of two wire 30 metres in length supported by two portable 15 metre high guyed masts.

Following the success of this experiment a meeting of the Longitude Committee held in February 1921 in Melbourne decided that an attempt should be made to determine directly by the long distance wireless signals, two points on the 129th meridian viz. Deakin in the south and Kimberley in the north.

The party on this occasion consisted of Messrs. Maddern and Dodwell of the Adelaide Observatory, Hambidge and Williams of the Survey Department, Hugh Duncan a volunteer assistant as well as Mr. Curlewis who again joined the party at Deakin. The wireless equipment earlier supplied by the Defence Department was used again but supplemented with an additional chain of amplification. The apparatus was set up in the railway station cabin and the Commonwealth Railway staff loaned a set of accumulators to operate the receiver.

General Ferrie, the Director of the French Radio Service arranged for a series of signals to be transmitted from Lyons at 20 hr 15 min Greenwich Civil Time which corresponded to 5 a.m. at the border and in addition he arranged for the Lafayette station near Bordeaux, the most powerful transmitting station in the world at the time to send out signals at 20 hr G.C.T. on a wavelength of 23,400 metres. The station had only just commenced the transmission of world time signals in accordance with the programme of the International Time Commission.

The American authorities also co-operated in this historic work. Admiral Hoogerwerff, the Director of the United States Observatory in Washington arranged for the high power Annapolis station to send a special series of signals at 19 hr. 55m G.C.T. These signals were transmitted each day from 21st April until 10th May 1921.

The party at Deakin successfully received the signals from Bordeaux 18 times, from Lyons 17 times and from Annapolis 11 times. The regular Annapolis transmissions at 3 hrs G.C.T. were also received 11 times. An intercomparison of the results was secured with the observatories at Greenwich (Lyons, Bordeaux and Annapolis signals) at Paris (Lyons and Bordeaux signals) at Washington (Annapolis signals) at Ottawa (Bordeaux and Annapolis signals) at Sydney (Lyons signals) at Adelaide (Lyons and Bordeaux signals) and at Perth (Lyons signals).

In addition to the reception of signals from Lyons, Bordeaux and Annapolis, the Deakin party also took night and morning signals from the Adelaide and Perth Radio Stations as an aid in checking the chronometer and getting local time. Star observations were taken by Mr. Curlewis with the Perth almucantar and by Mr. Dodwell with a portable transit instrument lent by the Sydney Lands Department and brought up to date in Adelaide. The position of the 129th meridian in accordance with the figures obtained was approximately 2.8 kilometres east of the observation point.

From Deakin the party proceeded to Kimberley to establish a northern point on the meridian and set up camp on 19th June near the reputed position of the boundary some 29 kilometres north east of Argyle Station. In re-establishing the trigonometric survey mark, the party named one of the mountains Mt. Ferrie and another Mt. Hoogerwerff after General Ferrie and Admiral Hoogerwerff who contributed so much towards making the determination possible by wireless signals.

Although signals from Adelaide Radio were received satisfactorily at Kimberley, reception from Lyons, Bordeaux and Annapolis were often very poor. Annapolis could not always be received during the morning periods and the Bordeaux signals were heard on only a few occasions. A longitude connection was obtained with Greenwich (Lyons and Bordeaux signals), Paris (Lyons and Bordeaux signals), Ottawa (Bordeaux signals), Adelaide (Lyons and Bordeaux signals) and Perth (Lyons and Bordeaux signals). The position of the meridian was found to be approximately 2.4 kilometres west of the observation point.

At both Deakin and Kimberley, the wireless signals were received by ear by the method of coincidence. Mr. Dodwell subsequently visited Greenwich and made a comparison between the method of reception of the wireless signals employed at the boundary and the automatic reception at Greenwich. The result of the comparison showed no difference between the ear reception by the method of coincidences and automatic reception at Greenwich (Lyons and Bordeaux signals) when the same part of the signal was taken in both cases and was referred to the same part of the clock beat.

The establishment of the points at Deakin and Kimberley allowed the border between South Australia and Western Australia to be accurately fixed. It is worthy of note that this was the first longitude determination to be made with the help of wireless time signals completely girdling the earth. The signals travelled some 16000 kilometres from Annapolis and 14400 kilometres from Lyons.

SECTION 10

HULLO WORLD!

— Space Age Communications, Research and Radiocommunications

SPACE AGE COMMUNICATIONS — CEDUNA EARTH STATION

The Overseas Telecommunications Commission's Earth Station at Ceduna was officially opened on 20th February 1970 by the Postmaster-General, The Honourable Alan S. Hulme M.P. at a formal dinner to mark the occasion at the Hotel Australia, Adelaide. In his address the Postmaster-General said:

"First I should like to extend to the Overseas Telecommunications Commission (Australia) through its Chairman, Sir Arthur Petfield, my appreciation of the courtesy that has been extended to me in being invited to perform the official opening of the Commission's fourth earth station for satellite communications.

In the period that I have been Postmaster-General — over six years — I have seen our international telecommunications networks develop in diversity, sophistication and size to a degree that would have been unbelievable if forecast even as recently as the 1940's.

After nearly a century of submarine cables over which telegraph traffic only could be handled and less than fifty years of somewhat less than satisfactory high frequency radio services, the past decade — the fabulous sixties — ushered in a completely new era in international communications. First came the submarine telephone cables to carry our voices under the sea for the first time from nation to nation.

Starting with the CANTAT systems between the North American continent and the United Kingdom, the next spectacular achievement was the successful laying of the COMPAC cable between Australia, New Zealand and Canada.

This great link — Australia to Canada via Fiji and Hawaii; Canada to Britain and Europe — brought for the first time in our history high quality speech facilities between all points along the route.

This Commonwealth network was then augmented by a similar cable between Australia and South-East Asia, terminating at Kuala Lumpur and with connections at Madang, North Borneo, Hong Kong and Singapore.

This was the SEACOM cable which connected to the COMPAC/CANTAT network via a broadband link within Australia.

This made the Commonwealth network a global one — the realisation of a dream by a number of dedicated people who, with the support of the Governments concerned, proved in the face of some early scepticism that it could be done.

But communications today do not stand still. Even while the submarine telephone cables were being planned and installed, science was looking in another direction — into the as yet untapped field of outer space.

I believe that when the history of the present century is written, two scientific dates will stand out. It was in 1942 that the first atomic stockpile took place and it was in 1957 that the first artificial satellite was launched.

These two events heralded the atomic age and the space age. For man's future they are equivalent to the discovery of fire and the invention of the wheel.

We might well stand today on the threshold of a communications revolution as fundamental as the one we are already experiencing.

I have in mind such refinements as the Laser Beam which already has found many exciting applications from flashing a light to the moon and measuring its reflection, to the drilling of a diamond, and eye surgery; the instant newspaper transmitted continuously by radio waves directly to the reader; and combined telephone and television instruments where one sees the person with whom one is speaking.

Certainly this decade will see many new applications in telecommunication practices. The computer, for instance, will become a dominating business and social influence. As the business community becomes more dependent on computers a tremendous upsurge in data traffic over telephone channels is predicted.

A growing range of facilities will be available to the telephone user. Push-buttons will replace rotary telephone dials and other new services will include automatic wake-up and reminder services; a "beep-beep" tone to alert a subscriber already engaged on a call that another caller is waiting; special instruments for people with speech or hearing disabilities.

Interstate conferences by dialling additional numbers to "add on" new persons to a call in progress will be practicable.

An interception service will automatically connect a calling subscriber to an operator, a telephone answering service or an announcement when the called person is absent or has changed his number. The service will also aid in the detection of nuisance callers by enabling the number of the telephone originating such calls to be instantly recorded simply by the called subscriber hanging-up briefly.

Looking further ahead, this interception service will provide an automatic redirection facility by which calls may be directed to another nominated telephone when the call party is absent from his own. Calls may thus "follow" a subscriber anywhere in the national telephone network.

By the late seventies an estimated 90% of Australian telephone subscribers who will be using S.T.D. will probably also be able to make international calls automatically.

Domestic satellites will offer prospects of increased communications for the sparsely settled areas of the continent.

While it is technically possible now to use internal satellites the cost is still beyond the limits that can be contemplated for normal civil communications.

We expect that the future costs of domestic satellite channels and of ground stations will drop as a result of continuing developments in this field. When domestic satellite costs can compete economically with other methods Australia will certainly use internal satellite communications to supplement the existing and proposed high capacity broadband networks.

Notwithstanding what I have just said, Australia has in fact already put a satellite to work for internal communications by using not an internal satellite but one of the INTELSAT series over the Pacific. To provide additional telephone channels between Perth and the Eastern States, a link has been devised using the coaxial cable between Perth and Carnarvon, satellite channels between the O.T.C. earth station at Carnarvon and the Pacific satellite, satellite channels back to the Moree earth station and internal channels between Moree and Sydney.

It is almost two years since it was my pleasant duty to officially open an O.T.C. earth station at Moree in New South Wales. This was history in making because the Moree station was the first to be brought into use in this country for commercial use.

O.T.C. already had a station at Carnarvon but it was used for services associated with the National Aeronautic and Space Administration space programme.

Since then however, another O.T.C. station has been provided at Carnarvon which means that, from tonight onwards, Australia has three operative earth stations for commercial telecommunications use.

I am sure you will agree that this is a praiseworthy effort on the part of this young country which, this year, is celebrating only the 200th anniversary of its becoming a British possession. Today, as a senior member of the British Commonwealth of Nations, Australia is one of the world's leaders in telecommunications.

This new station at Ceduna, which perhaps is more sophisticated than those that came before it, has the added interest that it is the first to provide a direct satellite link between this country and the United Kingdom.

Facing westward and operating through a satellite poised over the Indian Ocean, this station initially will work with the United Kingdom and Indonesia but in the near future will work with Europe, Africa, the Middle East and Asia.

The Indian Ocean satellite — one of the INTELSAT III series — has a total capacity of 1,200 two-way voice circuits, including facilities for on-demand television. It can and will, in fact, handle all classes of telecommunications traffic, including data transmissions.

I said earlier that communications do not stand still. This is emphasised by the fact that the new generation of INTELSAT satellites — to be known as the INTELSAT IV series and scheduled for launch during 1971 — will be capable of providing 6,000 two-way voice channels or 12 simultaneous T.V. relays.

You will agree with me that these developments — already achieved or planned — make it quite clear that the age of pioneering in space communications is past — and that the future appears to be quite unlimited.

The INTELSAT satellite programme is controlled by the International Telecommunications Satellite Consortium, the instrument of a group of over 90 Nations throughout the World. Australia is proud to have been a member of this Consortium since its inception and is proud also of the role it has played in the satellite development programme.

The concept of a global system has been established and succeeding satellites in the series will blanket the world in a communications coverage undreamed of only a few years ago.

We tend to become matter-of-fact about things today. Served as we are by the telephone, radio, television, jet aircraft and the other modern devices we take for granted, and sharing however vicariously in space flights and the projects that have put men on the moon, the launching of another communications satellite merits comparatively limited news coverage.

But to me a satellite launch still is an exciting achievement. I never cease to wonder at the fact that there is a satellite 22,300 miles up and here is a station on the earth's surface and, between the two flow the magic of person to person telephone calls and all the other accepted communications media including, of course, television relays — television brought to you in your homes with a clarity almost perfect in its detail.

Tonight you have seen this demonstrated.

Today, the rapid growth of world population, the emergence of new countries and markets, and an era of expanding international commerce, have all contributed to world wide telecommunications demands.

In this situation, the successful development of coaxial submarine cable systems together with the satellite programme — with their combined promise of capacity, dependability and quality, is a turning point in international telecommunications.

Communications have brought the world close together and have done more, I believe, to promote understanding between people than any other factor I could name.

With its opening tonight this station at Ceduna becomes a link not only in a global satellite network but also a most vital link in Australia's internal communications complex.

International communications received at Ceduna will be fed into a huge network of broadband coaxial cable and microwave radio systems reaching into all parts of the Continent. Similarly, outgoing communications via this station will converge here from this same network.

Ceduna today therefore becomes one of the most important communications transit centres in the Commonwealth.

Physically, Australia is one of the most isolated countries in the world. Because of this, efficient communication ties with the rest of the world are vitally important.

I believe that the Government, through the Overseas Telecommunications Commission (Australia) and the Australian Post Office, has met this need. It will continue to do so as this country develops further and its demands for telecommunications increase.

Finally, Sir Arthur, I should like to extend to everyone associated with the establishment of the Ceduna earth station my congratulations on a job well done.

The decision to build the station was, of course, taken at Government level but the implementation of this decision was a matter for the Overseas Telecommunications Commission (Australia), the Commonwealth Departments concerned, the various contractors and sub-contractors and, of course, the people who did the actual work on the project.

Tonight's telecast was a co-operative venture between the British Broadcasting Corporation, the Overseas Telecommunications Commission (Australia), the Australian Post Office, the Australian Broadcasting Commission and Australia's commercial television stations.

I might mention here that the Post Office was pleased to make all relay channels within Australia available free of charge.

My only task now, Mr. Chairman, is to declare the Ceduna earth station officially open and this I have pleasure in doing".

Other speakers at the ceremony were Sir Arthur Petfield, Chairman of the O.T.C., The Honourable Robin Millhouse, M.P. Attorney-General representing the Premier of South Australia and Mr. C. Vahtrick, Acting General Manager of the O.T.C.

Guests at the Hotel Australia and at the station site saw Australia's first live colour telecast from Britain. Simultaneously viewers all over Australia saw the telecast on their home sets in black and white. In all, thousands of kilometres of Australian Post Office landline and microwave radio relays, three O.T.C. earth stations and two communications satellites were involved in bringing this historic telecast to Australian viewers.

The programme, from the British Broadcasting Corporation in London was transmitted to the Indian Ocean Satellite by the British Post Office earth station at Goonhilly Downs in southern England. After being received from the satellite at Ceduna the programme was sent via broadband microwave radio link to Adelaide then to Melbourne, Sydney and Brisbane with feeds going to country television stations. A split of the programme was sent from Sydney to the O.T.C. Moree earth station in New South Wales which transmitted it to the Pacific Intelsat satellite. This was received by the O.T.C. earth station at Carnarvon in Western Australia and relayed to Perth. By the time it reached Perth the signal would have travelled about 160,000 km in about 600 milliseconds.

The 15 minute programme arranged by the Australian Broadcasting Commission and the British Broadcasting Corporation, included live news segments from countries throughout Europe. The format of the programme was arranged to demonstrate the flexibility of satellite communications and how, by co-ordinating satellite facilities with existing land-bound communication systems, Australia could be instantly in touch with most of the world "live" — via satellite. The colour receivers used were designed and built in the Research Laboratory of Philips at Hendon in Adelaide where black and white sets had been produced since 1956.

The earth station at the time of commissioning provided communications through the Intelsat III satellite located over the Indian Ocean and was capable of handling all types of telecommunications traffic including telegraph, telex, telephone, television (both colour and black and white) and data. Initially it provided communications with Britain and Indonesia but later services were introduced between Australia and other countries in Europe, Africa, the Middle East and Asia.

The Ceduna station which cost $4 million to construct became the fourth earth station in Australia for satellite communications. It placed Australia among the world leaders in earth station ownership. The other stations at the time were at Moree, and two at Carnarvon. The first Carnarvon station completed in 1966 was installed to provide communications with the United States via an Intelsat satellite over the Pacific Ocean for the Carnarvon NASA tracking station. In 1969 it was re-equipped to perform the task of controlling the positions and operations of the Intelsat III satellites over the Pacific and Indian Oceans. The second Carnarvon station which is almost identical with the Ceduna station went into operation carrying NASA traffic late in 1969. The Moree installation officially opened in 1968, initially carried commercial and social telecommunications traffic between Australia and the United States, Hawaii, Japan and Hong Kong via the Intelsat III satellite. The Ceduna station is O.T.C.'s first to face westwards towards the Indian Ocean satellite.

With access to both the Indian and Pacific Ocean satellites — through Ceduna and Moree — Australia obtained capability to communicate directly via satellite to any country in the world with an earth station using one of these satellites.

Each of the Intelsat III satellites the first of which was launched in December 1968 was designed to have a capacity of 1200 two way voice circuits and one on-demand television channel. This meant they could simultaneously handle up to 1200 telephone calls — or their equivalent in telegraph, telex or data services — and one television programme. The next generation of Intelsat satellites — Intelsat IV series the first launching of which took place in January 1971 — were designed to handle up to 6000 two way telephone circuits or 12 simultaneous television broadcasts. Both Moree and Ceduna are capable of expansion to meet greater traffic requirements through these satellites. The Ceduna station has a maximum capacity of 1650 two way speech circuits or up to four simultaneous colour television circuits. On opening, the Ceduna station was allocated a total of 132 circuits through Intelsat III but only 17 were provided initially — 15 to Great Britain and 2 to Indonesia. In 1974 circuits were in operation to earth stations in Great Britain, France, Germany, Italy, Spain, Greece, Malaysia, East Africa, Indonesia and India. During the visit of the Shah of Iran in September 1974, a temporary circuit was established with Iran.

The station transmits a maximum effective radiated power of 12.6 megawatts through its 30 metre diameter Cassegrain type parabolic dish antenna. The antenna which weighs some 300 tonnes has been manufactured to very fine tolerance and is capable of being positioned within an accuracy of 1/100 of a degree. It is electrically driven by equipment housed in the concrete antenna pedestal. The aluminium sheeting surface of the dish has been manufactured to an accuracy tolerance of 0.7 mm. It can

operate in winds up to 112 km/h and is designed to survive winds of up to 160 km/h. The antenna system has a transmit gain at 6 GHz of 60 dB and a receive gain at 4 GHz of 55 dB.

Signals are first emitted from the feed horn at the centre of the antenna and beamed towards the hyperbolic sub reflector which is a tripod in the centre of the dish. This reflects the signals into the main dish which bounces them on their way to the satellite circling the earth at about 11,200 kilometres per hour in a geostationary equatorial orbit some 35,700 kilometres out in space. By the time the signal transmitted by the station has reached the satellite it has reduced to a level of about 10^{-10}watts.

The satellite which revolves in space so that its outer coating of photoelectric cells are exposed to the sun evenly, receives this weak signal through its specially shaped antenna. The satellite amplifies the signal and re-transmits it on a different frequency band for reception by other earth stations. The journey from the earth station to satellite to earth station — a round trip of over 71,000 kilometres takes 300 milliseconds. The signals transmitted by the satellite and which are received by the Ceduna earth station are infinitesimally weaker than in the reverse direction. The level is about 10^{-19}watts. As a comparison this signal is at least 250 million times weaker than the signals picked up by a normal domestic broadcast receiver.

Special equipment is provided to amplify the weak signals received from the satellite to ensure noise is kept to a minimum. After reception the signals are first boosted through a cryogenic amplifier which uses liquid helium with an associated compressor and pump unit. The amplifier functions in a vacuum at a temperature of -256^{o} centigrade. A failure of the cryogenic system would cause the amplifier to heat up rapidly to ambient temperature and as it can take up to 24 hours to cool down again to the desired temperature, the amplifiers are operated in pairs each with its own cooling system so that failure of one does not cause an outage of the receiver. On emerging from the low temperature amplifier the signals are passed through a chain of amplifiers to raise the signal to a level where it can be fed over the normal 2 GHz national broadband microwave radio link system which terminates at the station.

Ceduna which is some 800 km from Adelaide on the Eyre Highway was chosen as the site for the earth station because it was within the coverage area of the satellite over the Indian Ocean yet it was relatively close — as far as telecommunications are concerned — to the main traffic generating areas in the Eastern States. It was also on the route of the Australian Post Office broadband microwave radio system linking Adelaide with Perth. The site chosen is 40 km out of the town on a granite rise which is one of the few locations in the area capable of supporting the enormous load imposed on the foundations by the antenna system.

An important impact on the township with the construction of the station was the introduction of some 13 new families to the area. Fourteen new houses were built by the South Australian Housing Trust for the Commission. The number of houses has since been increased to 17.

The staff at the station on commissioning included Mr. H.F. Cranfield, Station Manager and Messrs. J.W.K. Adams, D.J. Anderson, R.L. Beckett, D.B. Reich, J.F. Bothwell, F.C. Grasby, A.A. Gribble, E. Hempstead, R.P. Murray, R.S. Mackinnon, R. Ringe, F.T. Sullivan. In 1976 the Manager was Mr. A. Houseman.

RESEARCH — WEAPONS RESEARCH ESTABLISHMENT

For reasons of security, space and interest this short account of the Weapons Research Establishment in South Australia during the mid 1970's is necessarily incomplete. It is therefore not indicative of the whole subject — coverage, aims or achievements of the W.R.E.

History

Soon after the end of World War II, the latter stages of which saw the use of rocket propelled weapons, the United Kingdom embarked on a large programme of research and development in the field of guided weapons, and to implement this programme required a large unpopulated area where a suitably instrumented guided weapons testing range could be established. Following extensive investigations, it was found that such an area existed in Central Australia and in 1946 the United Kingdom Government approached Australia with proposals to set up a guided weapons testing range in that area. Discussions between the two Governments led to a decision to establish in Australia facilities for research and development on guided weapons including a testing range with all necessary instrumentation and assessment facilities.

This agreement, the Joint United Kingdom/Australia Project, commonly referred to as the Joint Project, had as its object to "set up and operate, as a joint United Kingdom/Australia undertaking an experimental range and supporting establishment for the testing and development of guided weapons, pilotless aircraft and air launched equipment, including radio and radar control and counter measures, and such other agreed projects as can be carried out making use of facilities then in existence or planned." Australia was to be responsible for the range and associated facilities, developmental facilities and production capacity (in Government factories, private enterprise, etc.).

At Salisbury there existed a very large former war-time munitions factory which could be used as a headquarters and supporting laboratories and in 1947 the Long Range Weapons Establishment began operations at Salisbury with the object of building a Range, starting from Woomera and extending some 2,000 km to the north-west over practically uninhabited country.

Scientific staff were engaged for the Establishment, and from this, grew the concept of an Australian Defence Scientific Service consisting of personnel of the Long Range Weapons Establishment, the Munitions Supply Laboratories (renamed the Defence Standards Laboratories) and the Division of Aeronautics of the C.S.I.R. which was transferred to the Department of Supply and renamed the Aeronautical Research Laboratories.

In 1949, it was decided to supplement the L.R.W.E. laboratories at Salisbury with others to provide a broader background for the work on guided weapons and to cover other aspects of defence science. Some activities of the Aeuronautical Research Laboratories were transferred to Salisbury to create the High Speed Aerodynamics Laboratory. A Propulsion Research Laboratory for research on rocket motors used in guided weapons, and an Electronics Research Laboratory were also established.

As these various laboratories have developed and the requirements for trials at the Woomera Ranges have become more specific, the organisation has, from time to time, been modified to provide improvements in the administration and direction of work. In 1955 all the establishments and laboratories at Salisbury were amalgamated into one organisation, called the Weapons Research Establishment.

In 1969 the Establishment underwent some reorganisation consequent on a reduction in the programme of testing of United Kingdom weapons at Woomera. Some of the staff who were previously engaged wholly under the Joint Project were redeployed towards the Research and Development requirements of the Australian Defence Forces, so adding strength, particularly in the fields of electronics and operational analysis, to Australia's defence research and development capability.

The United States of America, during its preparations for the 1957/58 International Geophysical Year, requested and was granted approval from the Australian Government to install satellite tracking facilities at Woomera. Subsequently the two Governments agreed to establishing a comprehensive network of tracking stations in Australia to support the United States space programmes. Stations were established at

Woomera, Muchea and Carnarvon in Western Australia, Cooby Creek in Queensland, and Tidbinbilla, Orroral Valley and Honeysuckle Creek near Canberra in the Australian Capital Territory. Muchea, used for the Mercury Manned Space Project was closed following completion of the project and the activities of this station were transferred to the Carnarvon station for subsequent projects. Under the agreement, the United States provided tracking and other equipment, while the stations were built, operated and maintained by Australian staff. Until 20th January, 1969, the operation of these stations was the responsibility of the Weapons Research Establishment; in most cases the Station Director and some assistants were W.R.E. officers while the station operational staffs were provided by contracting firms. This task was later passed to the Central Office of the Department of Manufacturing Industry in Canberra.

Salisbury Research Laboratories and Headquarters

The Establishment at Salisbury occupies approximately 1200 buildings and covers an area of some 1,150 hectares. In the initial stages of the operations of the Establishment, communication by air with Woomera was conducted from the war-time R.A.A.F. Station at Mallala, some 40 km north of Salisbury, but as the need arose for larger and faster aircraft, it was decided to construct Edinburgh Airfield adjacent to the Establishment for air support for trials and the air-lifting of freight and passengers to Woomera. (This latter function has for sometime now been carried out by civil charter). The Airfield was operated on behalf of the Establishment by the Royal Australian Air Force, which also maintained and flew the aircraft required for trials and other activities. In recent years the need for this facility has decreased, and Edinburgh has now been transferred to the full jurisdiction of the R.A.A.F. Edinburgh, as well as being the Headquarters of R.A.A.F. in South Australia, is now a fully operational R.A.A.F. base. Under agreement with Department of Defence, aircraft associated with Joint Project trials are still stationed, maintained and operated from this base by the R.A.A.F.

W.R.E. has established extensive workshops at Salisbury, and since 1953, has had its own Apprentice Training School. In 1974 the Apprentice Training School had 26 instructors under a Principal, and apprentices were being trained in ten trades. The facilities of the school included 14 fully equipped training workshops, seven classrooms, two drawing rooms, staff room, dining rooms and indoor and outdoor recreation centres.

In recent year apprentices from the school have been encouraged to exhibit examples of their workmanship at the Royal Adelaide Show. In their first four years of participation members of the school won 266 prizes comprising 90 first, 87 second, 70 third and 19 fourth prizes as well as a number of honourable mentions.

Woomera

The Trials Ranges operated by the Establishment are based on Woomera, a town built exclusively for this purpose, in virgin country 8 km from Pimba on the Trans-Australian Railway and some 500 km north-west of Adelaide. In 1975 it was a compact town of about 5000 inhabitants administered by the Establishment as a domestic base for the Range and other operational areas spread over some hundreds of kilometres. The country is semi-desert with a mean annual rainfall in the vicinity of 175mm, but despite this, sheep are grazed on the pastoral leases within the proclaimed area and a high-grade wool is produced.

The town is an example of modern town planning in which traffic avenues skirt the residential streets. All normal services such as water, electricity and sewerage are provided.

A number of independent Ranges have been used at Woomera from time to time for special purposes, but the principal missile Range is based at Koolymilka, approximately 40 km to the north-west of the town. It includes a number of launching

aprons spread over a large frontage allowing work to proceed on several projects simultaneously. An elaborate network of instrumentation which falls broadly into optical and electronic categories covers the trials area.

Electronic instrumentation systems include multi-channel telemetry systems to record internal behaviour of vehicles and missiles in flight, tracking systems using pulse and doppler radar techniques and a Missile Tracking System in which an airborne beacon is tracked by a ground system of auto follow antennas.

Both the optical and electronic instrumentation systems are subject to continual research and development so that they can be up-graded to meet requirements as more sophisticated weapons are developed and tested.

In order to meet the requirements of targets for guided weapon trials, a high speed pilotless jet aircraft has been developed. This aircraft named Jindivik, an aboriginal word meaning "the hunted one", designed and built in Australia by the Government Aircraft Factory, is controlled by radio signals from the ground and in its latest version is capable of climbing to a height in excess of 20,000 metres and operating close to the speed of sound. It takes off from a recoverable tricycle trolley from which it is released automatically when flying speed is reached, and is landed on a retractable skid. A variety of special weapon-assessment equipment, including cameras which film the approach of a missile can be fitted. Other devices can be fitted to simulate aircraft of much larger size.

Apart from its military programme, the Establishment has a long and continuous interest in upper atmosphere and near space research work, resulting from the availability of Woomera for the firing of rockets. A number of rockets such as Long Tom, HAM, HAD, HAT, HAEC and Aero High have been designed and built by the Establishment. The latter generations of these rockets are being fired from Woomera in a steady programme, to obtain further knowledge of the earth's atmosphere in the region above the height covered by meteorological balloons and below that covered by satellites.

A larger and more ambitious programme of upper atmosphere research has been based on the British designed Skylark rocket. Skylark can carry sizeable payloads to a height of 300 km, and since the inception of this programme hundreds have been fired from Woomera. Management of the experimental programme as at 1974 was vested in the Space Research Management Unit of the United Kingdom Science Research Council and the experiments forming the payload were designed by various British research institutions. In addition, experiments designed by Weapons Research Establishment and some Australian Universities have been carried in this rocket.

The Sparta programme, a joint U.K./U.S.A./Australian project to study physical phenomena of bodies re-entering the earth's atmosphere, made use of multi-stage rockets with the American Redstone booster as the first stage. Whilst this programme was in progress, the U.S. Department of Defence agreed to make one of these vehicles available to Australia for the purpose of launching a satellite. The objectives were to extend the range of scientific data relating to the upper atmosphere, assist the U.S.A. in obtaining physical data of relevance to its research programme, develop techniques pertinent to launching trials in the ELDO and British satellite programmes and demonstrate an Australian capability for developing a satellite using advanced technology and existing low cost launch facilities at Woomera.

As the firing of this vehicle had to take place immediately at the completion of the Sparta programme, a period of less than twelve months was available in which to design and build the satellite (known as WRESAT) as well as the experiments which it was to carry. Work was commenced in the Salisbury Laboratories, and at the Adelaide University, and was completed in time to enable a successful launching to take place on Wednesday, 29th November 1967. The satellite remained in orbit for 42 days and during that time completed 642 orbits. Scientific information was transmitted for 5

Antenna for Space Research at Weapons Research Establishment WOOMERA.

days in which time 73 orbits were completed. This information was collected on magnetic tape by the global tracking network of the National Aeronautics and Space Administration of the U.S.A. and other observers throughout the world and was passed to W.R.E. for analysis. The measurements were conveyed to ground stations by radio-telemetry transmitting on 136.350MHz. Additionally, the telemetry sender conveyed certain satellite house-keeping information such as state of the batteries. Other equipment carried was a C-Band radar beacon to provide initial trajectory information for safety tracking and subsequent data analysis purposes.

The designing, building, testing and launching of a satellite and its experiments in the space of some eleven months, and its success at the first attempt are achievements believed to be unequalled in any of the other countries engaged in space research.

Organisation

The W.R.E. organisation under the control of the Director, W.R.E., is made up of four technical wings each under a Deputy Director, and a fifth under the Chief Administrative Officer provides general support and administrative services. The four technical wings are the Weapons Research and Development Wing, the Applied Physics Wing, the Engineering Wing and the Trials Wing.

The Wing mainly concerned with research and development in radio, electronics, radar and lasers is the Applied Physics Wing. It is assisted by extensive laboratories and test facilities covering all portions of the electro-magnetic spectrum. It consists of three Divisions:

(a) **Systems Analysis Division**

The Systems Analysis Division carries out analytical studies of various kinds for the Australian Armed Services, using the techniques of mathematical modelling. Because electronics enters into almost every field of warfare, few studies are complete without consideration of electronic countermeasures. The Division therefore studies the technology of electronic warfare, both as a necessary environment for the analytical work, and as an activity in its own right. This Division also undertakes experimental investigations and theoretical studies of the propagation of radio and sound waves through the lower atmosphere, and of radio waves through the ionosphere. It operates the Establishment's IBM 7090 computer and provides a consultative service on programming and data reduction methods for users of this computer.

(b) **Electronics Division**

The Electronics Division develops and evaluates radio, telemetry, radar, and other electronic and computing systems for Service use. It conducts research and development in such new techniques as are required. In addition, it undertakes investigations of operational problems in the application of such systems in the Armed Services, and provides a consulting service.

The Division maintains and calibrates a large part of the Establishment's portable electronic test and measuring equipment, and for this purpose maintains a standardising laboratory. It operates a microwave anechoic chamber, an extensive antenna test field, a seismic test facility, and a number of specialist laboratories, carrying out research and development at frequencies up to 70GHz.

(c) **Optics and Surveillance Division**

The Optics and Surveillance Division develops and evaluates infrared and visual systems for the Services, including conventional and coherent (laser) light, and carries out associated research and development of new techniques. It thus extends the work of the Electronics Division to higher orders of frequency in

the electromagnetic spectrum. The Division also investigates surveillance problems and devices. Special facilities available for this work include a low-illumination test tunnel, extensive optical manufacturing and test facilities including frequency response, testing equipment, an advanced optical thin-film laboratory, a laser test range, and equipment for eye-movement measurement.

In support of the materials aspect of optical and laser research, a small crystal-growing facility in provided.

Research is also carried out on the behaviour of electrons and ions at low gas pressures, and on the physics of semi-conductor materials.

Radio Projects

Security classifications which normally apply to much defence research and development work unfortunately preclude the release of information on the full range of the Establishment's interesting radio projects but a general appreciation of its wide scope will be evident from the following examples detailed in selected Annual Reports:-

(1) **Radio Wave Propagation**

The use of high frequency (h.f.) radio waves for point-to-point communications is expected to decline as satellites and cables take over the high density traffic on world-wide circuits. However, h.f. radio will continue to be used for many years for low cost installations, for short distance and mobile circuits, for some shipping and aircraft communications and particularly in cases of national emergency. A research programme at W.R.E. on radio wave propagation via the ionosphere, while directed towards achieving an understanding of anomalous propagation and the effects of ionosphere perturbations in low latitude regions, has important applications to the improvement of h.f. communication prediction systems and to direction finding. Two aspects are worth mention:

(a) **Oblique ionospheric sounding network**

Ionospheric sounding equipments operating at St. Kilda near Adelaide, Townsville and Yamagawa (Japan) are programmed and synchronized to regularly record propagation data, over the frequency range 4 to 64MHz for the various circuits. It is expected that a sounder at Okinawa, now belonging to the Japanese Radio Research Laboratories, will rejoin the network in the near future. The propagation data is published and forwarded to world data centres. It is also important for the validation of h.f. propagation prediction programmes and useful in studies of the accuracy of different prediction programmes. Recent results show that current programmes still do not predict the unusually high frequencies which can propagate over transequatorial circuits during equinoctial months.

(b) **Travelling ionospheric disturbances.**

High frequency propagation predictions would be improved with a better statistical description of the variability of the ionosphere. For example, radio waves propagated via the ionosphere can exhibit marked variations in amplitude, doppler shift and direction of arrival as a result of tilts in the reflecting layers of the ionosphere. Some of these tilts are often associated with wave-like motions that have come to be called travelling ionospheric disturbances. These disturbances exist over a wide range of scale sizes (horizontal wavelengths varying from tens of kilometres to a thousand kilometres or so) and they travel at a variety of speeds ranging from one kilometre to tens of kilometres per minute. They also exhibit preferred directions of travel, which vary seasonally. Their effect upon radio waves propagating along a given communication path is critically dependent on the direction of travel of the disturbance with respect to that path.

The characteristics of these disturbances are being monitored by means of several h.f. sounding devices. A vertical swept-frequency ionosonde, operated routinely at 15 minute intervals is used to provide data on the diurnal and seasonal variations in local electron density. A spaced transmitter network has been established which comprises three fixed-frequency transmitters forming approximately a right angle triangle of side length 30 kilometres; a horizontal element interferometer is co-located with one of the transmitters and measures, by a phase front technique, the apparent direction of arrival of return waves from each of the three transmitters. These measurements enable the diurnal and seasonal variations in travelling-ionospheric-disturbance speed and direction to be studied and they also permit investigation of the spatial correlation of the travelling-disturbances, observed at ionospheric points some tens of kilometres apart. Interpretation of the radio wave propagation experiments is considerably facilitated by the use of simulation techniques, which allow the travelling disturbance and its effect upon radio wave paths to be investigated by computer.

(2) **A V.H.F. Direction-Finder for use on Small Surface Craft**

A direction finding system originally developed during 1969 and used very successfully during 1970 and 1971 in the recovery of free-floating buoys in various sea conditions and at distances approaching the radio horizon, has been adapted for use in conjunction with distress beacons fitted to life-rafts as a homing aid for search and rescue work. An experimental system, operating at the distress frequency of 243MHz, demonstrated useful performance when exercised on an R.A.N. patrol boat in April, 1972. The system uses a two-position azimuth scan by the receiving antenna beam, the cross-over point of which defines the pointing direction. The beam scanning, which is at a 1,000Hz rate, causes the received signal to be amplitude modulated. The amplitude and phase of the modulation indicates magnitude and direction of the azimuth error. In operational use, the antenna cross-over point is lined up with the bow to stern axis of the motor launch, thus making the target bearing indicator zero coincide with the launch heading. The bearing indicator is a centre-zero meter which shows whether the transmitter beacon is on the port or starboard side of the motor launch and indicates the angular offset. Typically the system has a bearing accuracy of one degree at a range of 13 km with a 1 watt transmitter, and a calm sea. The maximum useable range is approximately 28 km depending on sea state.

The equipment is intended for installation in a motor launch with the minimum amount of disturbance, and is consequently required to be completely self contained and portable.

(3) **Ultra High Frequency Radar Facility**

A high-power pulsed coherent u.h.f. radar facility has been developed for the experimental investigation of advanced radar signal processing techniques and for propagation studies.

The radar features a transmitter capable of transmitting pulses of peak power 1 megawatt and duration 0.2 microseconds to 0.1 milliseconds, with an average power of 5 kilowatts. The final power amplifier of the transmitter uses a super power beam tetrode tube (RCA-4616) consisting of 40 separate unit tetrode elements situated around a central water-cooled plate. The r.f. circuitry for this tube includes a pressurized coaxial plate-cathode cavity, and an unpressurized grid-cathode input cavity, both resonant in the three-quarter wave mode. Motor tuning of each of these cavities can be carried out remotely from the control console. A 10 metre parabolic antenna with crossed dipole feed is mounted between

two 16 metre high towers with a fixed azimuth. The elevation of the antenna can be set between 0-8 degrees. The coaxial feed-lines, splitting hybrid and the antenna feed are pressurized with sulphur hexafluoride gas to minimize the arc-over problems.

The radar receiver features a low-noise (2 dB) preamplifier, followed by a balanced mixer and a number of i.f. amplifiers with various bandwidths. Envelopes and phase detectors are provided permitting the measurement of both amplitude and relative phase of the returned signals. The recording facilities include:

* a wideband video tape recorder suitably modified for radar signal recording;
* two high-speed 35 mm film cameras capable of photographing the radar returns on pulse-to-pulse basis;
* a six-channel pen recorder for recording various radar parameters.

In addition, the radar facility includes a precision automatic calibration system capable of determining the level of returned signals with high accuracy ($\pm$ 1 dB). The calibration signals can be fed into the radar antenna from a distant tower during the transmission.

(4) **Radio Altimeter**

During 1970 a novel radio altimeter was under development. Conventional radio altimeters work by measuring the transit time of a pulsed high-frequency signal or by using a frequency modulated transmitter and measuring the frequency difference between the transmitted and received signals. The signal generation and processing equipment required for such techniques is relatively expensive, and an altimeter of this sort can form an appreciable proportion of the cost of a small missile or target aircraft.

In the new development, a very short pulse of energy is radiated, reflected and received without using a carrier frequency or any modulation process. The energy is spread over a very wide frequency band, so that at any discrete frequency it is small enough not to interfere with other radio systems. Special circuits are incorporated to eliminate the effects of interference from such external sources on the altimeter performance. The greater bandwidth also allows better accuracy and height resolution than is found in conventional altimeters.

(5) **Laser Rangefinder**

A man-portable laser rangefinder or optical radar has been developed for use in field branch artillery, to check the concept operationally. Operating at 1.06 micron in the near infra-red, the laser transmitter consists of a neodymium-doped calcium tungstate rod as the active medium mounted in an optical cavity which is Q-switched to generate the necessary high intensity short duration laser pulse. The output pulse from the laser is collimated with a lens to achieve a narrow beam width. The receiver combines a Cassegrain optical system with a silicon PIN detector placed in the focal plane and is mounted and aligned coaxially with the laser transmitter. A 6X sighting telescope is used to lay the instrument on a target and range is found by determining the round trip time of the laser pulse to and from a non co-operative target; the known velocity of propagation of the laser pulse is then used to calculate the range. This is achieved through the use of modern high-speed electronic counters and the range in metres is displayed digitally on a light-emitting diode display which is projected optically into the field of view of the laying telescope. This form of display has the advantage of allowing the operator to retain his view of the target whilst reading the range. The successful development of the man-portable laser rangefinder and its accompaying measuring head with angle readout has provided the Army with a rapid means of determining the spatial location of a target with a high degree of

accuracy. Further, and because of its accuracy, the laser rangefinder can also be used to provide crude survey during mobile operations. Its use by a forward observer from a surveyed observation post has greatly increased the probability of achieving effective fire with the first round.

(6) **Single Station Location**

The problem of locating high frequency (h.f.) transmitters has been important for many years. The use of direction finding systems in connection with the navigation of sea and air craft, and by member nations of the International Telecommunications Union (I.T.U.) and the military, for surveillance of the radio spectrum, is well known. Direction finding has also been used for the study of the propagation of radio waves.

Single-station location is a new h.f. location technique, first demonstrated in W.R.E., on which work has been proceeding for some years. It has many advantages over conventional methods of h.f. direction finding, particularly at short to medium distances. Areas of research related to single-station location techniques may be broadly identified as being connected with three-dimensional direction measurement, mode resolution, ionospheric measurements (both local and remote) including tilts and travelling disturbances, and propagation models including three-dimensional ray-tracing with magnetic field. Automatic data collection and processing is also involved.

RADIOCOMMUNICATIONS

The first public radiocommunication systems were installed to provide service between Kangaroo Island and the mainland. Kangaroo Island had been linked by a submarine cable installed between Kingscote and Normanville in 1875 to provide telegraph communications and by another cable, between Cape Jervis and Cuttlefish Bay in 1929, which provided telephone circuits. About 1932 an experimental radio system was installed with terminals at the Kangaroo Island Post Office and the Adelaide GPO. It was a continuous wave telegraphy system with the transmitter operating in the lower part of the HF band. The transmitter output power was about 25 watts and fed an inverted 'L' antenna. The system was operational until 1938 and was used as a standby system for the cable telegraph circuit.

In February 1943 a speech system was installed between Kingscote and Mt. Lofty, the site of the present National Television Service transmitter. It was the first full-time public frequency modulation link installed in Australia. The equipment had been designed in USA for Army tank use and orginally destined for Batavia. At the outbreak of the war it was directed to Australia. The equipment was a single channel system transmitting on a frequency of 39.1 MHz and receiving on a frequency of 42.18 MHz. The transmitter output power was about 10 watts. Separate curtain type antennas were used for transmitting and receiving. Speech inversion equipment was installed to provide a measure of secrecy.

By 1948 traffic indicated that extra circuits would be required in the near future. Late in 1949 the 40 MHz radio system was rendered unusable for lengthy periods by radio interference from overseas transmitters. By May 1950 two new radio telephone systems had been installed and were carrying traffic. The 40 MHz radio equipment was, however, retained as a standby system for emergency use and remained functional until its removal around 1957. The new radio equipment operated in the 160 MHz band.

The equipment was manufactured by Electronic Industries Ltd (EIL). The units were single channel systems with a transmitter output power of 10 watts. Separate corner reflector antennas were used for both receiving and transmitting. Speech inversion techniques were employed to provide circuit privacy. With the installation of the two 160 MHz radio-telephone systems, Kangaroo Island then had three voice channels for communication with the mainland.

Radiocommunications Control Centre and Terminal Mt Bonython.

In 1954 the existing facilities were progressively replaced by the installation of new multi-channel radio-telephone bearer equipment. By 1958 the submarine cable was no longer in use and the single channel 40 MHz and 160 MHz radio-telephone bearer systems had been removed. The two new radio-telephone bearer systems each had a capacity for five channels (1 + 4), so that by the end of 1957 Kangaroo Island had eight voice channels for general communication with the mainland. The radio-telephone bearer equipment was manufactured by the Postmaster General's Department in Adelaide and operated in the 160 MHz band. Initial transmitter output power was 50 watts, and this was later increased to 100 watts. Corner reflector antennas were used.

In 1959 the Departmentally built radio bearer systems were replaced with commercially developed units TCA type 1666B which had become available. At this time, Mt. Bonython was being developed as the major radio terminal station for radio communications systems to Adelaide, and in keeping with this plan, became the associated repeater terminal for the new Adelaide to Kingscote radio-telephone system.

In 1961, 900 MHz 12-channel capacity radio bearer equipment was installed at Kingscote and Mt. Bonython for evaluation. The equipment type 723-SU-1A was manufactured by the Standard Telephones & Cables company (STC). The transmitter output was 10 watts and 5m dish antennas were used. In 1964 diversity equipment was added. This equipment remained in service until the end of 1974 when it was replaced by a multi hop system via Chandlers Hill and Delamere. The new system provided 60 channels between Adelaide and Delamere and 24 channels to Kingscote.

The first Outback Subscribers Radio Telephone Service in South Australia was brought into use in November 1948 at the Andamooka opal fields. It worked into the Australian Post Office base station at Broken Hill.

The service operated in the high frequency band and the equipment was manufactured by Electronic Industries Ltd. The transceiver had switching facilities to enable selection of a suitable frequency depending on the time of day. Amplitude modulation mode was employed with a transmitter output of 25 watts. Power was provided by rechargeable batteries with vibrators being used for high tension voltages. Three centre fed dipoles slung between three 23m Metters towers were used as antennas. The service operated on a schedule basis between the hours 8.30 am—9.30 am; 3.30 pm—4.30 pm and 6 pm—6.15 pm. In emergencies the Broken Hill base which operated continuously could be contacted if propagation conditions were favourable. On 19th April 1967 the facilities were replaced by a 470 MHz 6 channel system to Woomera with a repeater station at Todd Ridge.

The service was extended to Radium Hill on 20th December 1950 and The Bunkers barytes mine east of Blinman in April 1957. The Radium Hill installation employed EIL equipment and at the Bunkers, Philips TCA 1650 equipment was installed. The Radium Hill service closed down on 3rd December 1953 when wire line carrier circuits were provided to Adelaide. The Bunkers service was closed when the mining operations ceased at the site.

Single channel and wideband systems have over the years been installed between several other centres. These have included 160 MHz band links Whyalla to Iron Baron, Whyalla to Crystal Brook and Mt. Hope to Elliston and 900 MHz band links Mt. Bonython to Tailem Bend and Mt. Lofty to Yorketown. The original Whyalla to Crystal Brook equipment installed on 22nd august 1947 was similar to the frequency modulation system with curtain type antennas installed between Mt. Lofty and Kangaroo Island in 1943. It was replaced by a 160 MHz link in 1950.

A public mobile radiotelephone subscribers service was commissioned in Adelaide on 24th March 1952. An STC 250 watt base transmitter operating in a frequency modulation mode in the 156-174 MHz band was installed in Commonwealth Building near the G.P.O. The transmitting antenna was mounted on a 23m Metters tower

erected on the roof of the building. The receiving antenna was fitted to the top of the wooden flagstaff on the G.P.O. clock tower but because of severe radio interference it was subsequently moved to Mt. Lofty. At the same time an additional receiver was provided at Panchito Park (now Nunyara) with a voting system for automataic selection of the best signal.

The first microwave broadband telephony system was commissioned in November 1966. It had capacity for 960 telephone channels, operated in the 4 GHz band and linked a terminal in the MLC Building in Adelaide to Balaklava via Mt. Bonython. In 1964 the system which was of Siemens manufacture was extended to Port Pirie and in the following year Pt. Augusta was connected into the system. The first Interstate system Adelaide-Melbourne, was commissioned in 1966 with the installation of a 6 GHz G.E.C. system from Mt. Bonython. Adelaide was linked with Perth with the commissioning of the East-West system via Eucla in 1970.

Television stations are linked by an extensive network of broadband microwave radio relay systems. The first systems were installed between Adelaide television studios and transmitters at Mt. Lofty in 1959-60. The network now includes systems to Broken Hill, Woomera, Ceduna, The Bluff, Mt. Burr and Loxton.

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