

**THE INSTALLATION OF
31 RADAR STATION, DARWIN, 1942
AN INVESTIGATION**

By Colin MacKinnon

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with

A Postscript and Additional Material by

Ed Simmonds

Edited with Foreword by Warren Mann

Radar Returns

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THE INSTALLATION OF No 31 RADAR STATION AT DARWIN IN FEBRUARY 1942.

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FOREWORD

The bombing of Darwin on Thursday 19 February 1942 has long been the subject of controversy among military historians. Australia had been at war with Japan for about ten weeks. From its very beginning, the Japanese forces had demonstrated their intention to prosecute the war with aggressive vigour and had made significant advances in what many military and political authorities interpreted as a 'pincer' movement directed toward the invasion of mainland Australia. Darwin's geographical position marked it as a logical target for air, sea and possibly even land attack. Despite this, the town found itself on that day with little defence and no effective warning of the approach of a naval force comprising most of the ships from which Pearl Harbor had been attacked, dispatching even more aircraft than took part there in a devastating two-part attack on the military and civil infrastructure of the town and its surroundings causing more than 300 deaths.

At that time, the use of radar as a means of early warning of air attack was in its infancy. In November 1941, the Australian War Cabinet had given the RAAF responsibility for operations concerning the use of radar in the defence of Australia, and supported the CSIR in a program of research and development on equipment to that end. At the outset, with Japan and USA not yet involved, the RAAF had seen its immediate task as supporting Britain in its struggle with Germany and Italy.

W/Cdr A G Pither, a signals officer who had had some radar training in Britain, had been appointed to take charge of radar operations, and one of his earliest tasks was to set up a program for training the technical personnel. No 1 Radio School, was established at Richmond Air Base, NSW, and the RAF was asked to provide an officer and four NCOs as instructional staff as well as also some basic equipment. Arrangements for the basic training of officers and mechanics were made with Sydney University and Melbourne Technical College (now RMIT University) respectively.

A CSIR project to modify Army Shore Defence radar equipment to give early warning of air attack had not actually started when the war with Japan broke out. Dr J H Piddington, the scientist in charge of it, and his team began a frenzied development effort that, in less than six days, produced an experimental unit which was tested, successfully, at Dover Heights in Sydney. Pither, impressed, placed an order for three 'pilot' units for delivery to the RAAF by the end of January 1942. The first unit was to be for experimentation, with the second to be installed at Darwin and the third at Rabaul.

The equipment for Darwin was delivered to the RAAF on 4 February. Two officers who were still on course at Richmond were selected to take charge of its installation, supported by four mechanics and eight operators who were also finishing their courses; none of them had even seen equipment of that type before. The radar set was to be air freighted, with the aerial having to be cut into smaller pieces to fit through the door of the DC2 aircraft. The first load arrived on 9 February, but the final load, with another technical officer, did not get there until 21 February.

Because of installation, tuning and calibration problems, and, it must be said, a lack of understanding and support by the RAAF hierarchy in Darwin, the equipment was not operational until 22 March. Some historians of the Darwin bombing have blamed the RAAF for not having the unit operating before the first bombing and others have presented conflicting stories of what happened; none was accurate. Colin MacKinnon investigated and documented the circumstances and presented his findings in June 1993. Unfortunately, his paper seems not to have been widely circulated and so, with the approval of his widow, it is now included in the archive for the benefit of future researchers.

Colin MacKinnon was born only a few months before the Darwin raids. As an engineer and amateur radio buff, he became deeply interested in the wartime development and use of radar and, in the 1980s and 90s, working with Ed Simmonds and others, made a significant contribution to the gathering of its history from the primary sources that were still available though diminishing rapidly. Sadly, Colin died in 2004 after a long illness, aged 63.

INTRODUCTION.

On 19th February 1942, Darwin suffered the first two of a number of Japanese air attacks, and that tragedy and the surrounding events have been analysed by a number of commentators. At the time of the first raid the RAAF had an Air Warning (AW) radar set in Darwin, but it was not operational. A Royal Commission examined the circumstances of the raids but there have always remained several unresolved questions in the many accounts.

- There are diametrically opposed reports of the radar installation: on the one hand the RAAF says the set was still being installed, whilst several publications insist that the set was already installed.
- The set did not become operational till a month after the first raid and there are conflicting reasons for that delay. The scientists claim that the RAAF personnel were incapable of getting it into operation.
- There are claims that the RAAF did not have the instruction manual for the radar set.
- The CSIR Radiophysics Laboratory (RPL) claimed to have started to build an air warning radar well before events proved there was a need. This has been disputed by other commentators.

This study seeks to find answers and put to rest a controversy that has raged for 50 years and more. Extensive use is made of all known previous commentary and references, which are given in detail. The resulting document is much longer, perhaps, than the conclusions justify, but the reader can now consult all the accounts in the one place and follow the logic applied.

A serious analysis is only possible because in 1991 and 1992 several eyewitness accounts were published from RAAF personnel who worked at the radar site before and on 19th February 1942 and these shed new light on events. Contact with these participants has allowed full investigation of the circumstances.

In the following analysis the references are presented in chronological order so that the reader can follow the pattern of comments, except that the RAAF eyewitness accounts which were written in 1991-93 have been placed in the context of the 1942 events they described.

Each Reference is numbered, then quotations {in italics} from that reference are identified by the number, plus a letter, and are subsequently referred to by author and. reference number/letter. The page number in the referenced publication is also shown. Any explanatory comments interpolated by the author within referenced quotes are shown in square brackets: []; further comments by the editor are enclosed thus: { }.

REFERENCE 1: *Radar Yarns*, Edited by Ed Simmonds and Norm Smith, 1991. ISBN 0 646 03827 3, Published by E W & E Simmonds.

Ed Simmonds and Norm Smith both served in the RAAF during WW2 as sergeant radar mechanics and between them had wide experience in the installation and operation of Australian and overseas radars. Feeling that existing books inadequately covered the RAAF's radar efforts in WWII, they started collecting material in 1988, producing *Radar Yarns* in 1991. This book contains a brief history of RAAF ground radar and a collection of anecdotes from surviving radar personnel, including several who helped install the radar station at Darwin.

1A - p.9 *These early stations used ShD aerials with the first AW transmitters and receivers. This aerial was a heavy steel structure and S/Ldr John Norrie reports a crop of blisters resulting from using a hacksaw to break one down into components small enough to fit through the door of a DC2.*

The ShD radar had been developed by the Radiophysics Laboratory in 1940-41 for the Australian Army as a Shore-Defence (or ship-detection) set.

The Dakota DC2 and DC3 have only one small passenger door. Although the aerial could be dismantled into three subsections, these were still too large to fit through the door of a DC2/DC3. Consequently it had to be disassembled into components and even sawn into smaller parts, and then reassembled and welded back together on site at Darwin.

For technical details of the ShD and AW radar equipment see Appendix 1.

1B - p.21 *Mechanics and operators [for 3IRS] came straight from No.1 Radio School and took different routes to get to Darwin. The former were all 'direct entries' being radio buffs and amateur operators while the latter were re-mustered from {aircrew} W/T operators.*

These mechanics were drawn from the radio industry and had just completed a short but intensive electronics course, so they were amongst the best-trained radar technicians in Australia even though they had had no instruction on the AW equipment. (W/T = Wireless Telegraphy or Morse Code)

1C - p.21 John Scott, Radar Mechanic at Darwin:

The technical crew left for Darwin by train from Sydney on 3 February 1942. We arrived in Brisbane on the next day and stayed the night. Then I received a signal indicating that I was to return to help with the loading of the equipment and to accompany it to Darwin. The others in the party, P/O Hannam, Bill Couper, Bill Welstead and Errol Suttor {also P/O Bruce Glassop} left for Darwin, flying Qantas.

Having loaded the equipment in a DC3 piloted by P/O Campbell, we headed for Darwin staying overnight at Charleville. The next day we took off for Darwin . . . and we arrived on 9 February. Then I met up with the other mechanics who were digging trenches.

The flight time from Sydney to Charleville by DC2 or DC3 was approximately 4 hours. The time from Charleville to Darwin was about 9 hours, and close to the safe fuel limit for that duration. We can deduce that the aircraft left Sydney sometime on 8/2/42. Other sources confirm that the AW radar was completed on 4/2/42 and handed over to the RAAF on 5/2/42. It then had to be transported to Richmond Air Base, broken down to fit in the DC2, and loaded according to weight and bulk, and that task appears to have taken 2½ to 3 days. The overall weight of the AW complete was around 12,000 lbs (6,000 kg.), whereas the payload of a DC2 is 5,000 lbs. (2,500 kg.), so either 3 aircraft were needed, or, as seems likely from later evidence, one DC2 made three round trips to Darwin. Once the DC2 arrived at the RAAF Air Base outside Darwin the equipment had to be unloaded and transported to the site, so it is unlikely that the reassembly started before 10/2/42 and maybe as late as 11/2/42.

As the mechanics were “digging trenches”, one might assume that the installation was at that stage waiting for the radar equipment. However it has been suggested by those who knew P/O Hannam that, seeking personal prestige, he may have taken responsibility to do the installation with only the help of P/O Glassop.

1D - p.21 Lew Collier, Radar Operator at Darwin:

Eight of us, all operators, were posted one afternoon to Darwin. We left Richmond without having been fed. It was a panic situation and we were hurriedly moved to Central Railway Station to catch the Melbourne Express which, incidentally, they held for us so great was the urgency ... At Ascot Vale ... we were tropically kitted and had a mass dental treatment ... rushed to Spencer St. Railway Station guarded by SP's. All very hush-hush. We made Darwin in seven or eight days which could have been a record for the overland trip at that time. At the Personnel Depot, ... we were quizzed about our mustering by the CO who was an F/O... He told us to 'stand by' which meant we did some spine bashing in the shade watching other airmen dig slit trenches etc. Some three or four days later we were collected by P/O Hannam and went to Dripstone Caves.

The doover hut was built by the Allied Works Council, otherwise known as the Civil Construction Corps (CCC), and an army hut was given to us for our quarters. Some difficulty was encountered when they were installing the array which, from memory, weighed about half a ton. No one helped with lifting gear. In fact no-one wanted to know us. The array had been assembled at the time of the first raid and was lying on the ground near the doover.

After the first raid most of the civvies shot through leaving the CCC yard unguarded. Some of the boys went over and 'liberated' a long wooden pole and a pulley or two. They rigged up the pole and hitched a rope to the truck and lifted the array. When it was almost in place either the rope or the pole snapped and dropped the array which did not do the dipoles or the doover hut much good.

For about seven days after the first raid we were forgotten men. No toilet facilities, no food rations, no cooking facilities with the only water supply being what we collected from a natural rock basin in Dripstone Caves. As operators we did not contribute greatly to the installation of 3IRS, being mainly relegated to navvying. As we had all spent some time on Flying W/T Operator training we felt that we could have been more helpful but the mechanics were very conscious of their expertise.

Collier gives a positive indication that the array was assembled, and lying on the ground, but NOT installed on 19/2/42. He also mentioned the lack of help from the civilian workers or the Darwin RAAF base and the abortive efforts of the radar people to install the array by themselves. Having made a record overland trip, the party was kept at the Personnel Depot for several days because the CO was unfamiliar with the mustering of RDF Operator, and sought higher authority before allowing them to proceed. So much for urgency in the face of bureaucracy!

1E - p.23 John Scott, Radar Mechanic at Darwin:

The first problem was how to get the array into position. It was a prototype and built like a battleship. We tried every trick we knew and it was only after the incident when the rope broke that Harry Hannam, our first CO, decided to get help which came in the form of the US Services sending out a mobile crane and lifting it into position.

The second problem was power - yes power. It would appear the power supply had been completely overlooked. Our CO again contacted the Americans and within a day or so a power unit was delivered. It was a small unit that could be lifted by hand the type used for home lighting. It was supposed to operate the gear including the variable load of a ¾HP drive motor. It was like trying to start a car engine with a torch battery - impossible. Once again Harry Hannam found the solution in the form of an old two-cylinder Kelly and Lewis engine driving an alternator, mounted on the back of a truck. We learned that it had been used as a lighting plant on a property in the district. It proved to be suitable and was nursed along by the radar mechanics for a few weeks until a Southern Cross diesel and a fitter arrived.

Now for the third problem, the most difficult of all. The array was now up, the power supply adequate and all we had to do was get the equipment operating. It was a matter of positioning the dipoles, cutting the coaxial cable to the correct lengths, and matching up the complete system to give the maximum output with

a desirable lobe pattern and a high sensitivity on the receiver side. The instrument used for this purpose was an Impedance Measuring Set, termed by most as a 'buggery bar'. We tried everything we knew to get satisfactory results without success. The longer we worked on the calculations the more the buggery bar looked like a trombone. It is to be remembered this was a prototype and only the experts from Radiophysics had previously achieved the delicate procedure of matching the array. P/O Hannam sent for assistance through the RAAF to Radiophysics. Dr J Piddington who led the team for the AW arrived in Darwin and after a couple of days the gear was working satisfactorily. The first enemy aircraft were located at a distance of 80 miles on 22 March 1942. The crew on watch at the time were Bill Welstead, mechanic, Fred Findlay and Kevin Wass, operators with Fred Findlay on the cathode-ray tube at the time.

The array was not a prototype, it was based on the standard ShD aerial, built to withstand coastal gales and weighing over 900 kg. Later LW/AW designs were substantially lighter and made to dismantle so as to fit into a transport aircraft.

Scott confirms the evidence of Collier, that the array had not been installed by 19/2/42 and that the RAAF had trouble trying to lift it, and he also gives the solution to how the aerial was finally installed. In his book, *Adventures in Radar*, Porter (Ref.5) shows an illustration (Plate 14) of jury-rigged poles improvised on site and used as lifting devices to raise the turning gear and aerial of the AW Transportable system at 38RS on Bathurst Island.

The power supply requirements would have been known to the RAAF, so it would appear that someone forgot to arrange a suitable unit. Power units were in short supply for most of the war but Darwin should have had No 1 priority.

It is important to note that the scientists of Radiophysics were the only people who had experience in matching the ShD and AW arrays and that the Darwin aerial had been completely dismantled for transport. The technicians who went to Darwin had never seen or had any experience with the aerial matching arrangements for this new AW radar set.

Various reports give the first enemy intercept by the AW as either 22/3/42 or 23/2/42, but the 22nd is correct.

An interesting aspect of this account is that on two occasions the CO, Hannam, contacted and received prompt assistance from the American forces. That reflects very badly on the level, of cooperation given to the radar crew by their own Area staff.

The radar set, the aerial and the building, hut or tent housing it were collectively known as the 'doover'. The Impedance Measuring Set' (IMS) was colloquially and universally called the 'buggery bar', allegedly because Wing Commander Pither exploded at a meeting with RPL scientists and said "It is useless, you can't get within buggery of the required result."

REFERENCE 2: *More Radar Yarns*. Edited by Ed Simmonds, 1992 ISBN 0 646 11358 5. Published by E.W. & E. Simmonds.

Following the success of *Radar Yarns*, and with new information coming to hand, Ed Simmonds updated the history and collated additional anecdotes from other radar personnel and published them in *More Radar Yarns*.

2A - p.39 *Harry Duggan is probably the only man who should be known to every officer and mechanic who served in ground radar during WWII.*

p.41 *On 19 January 1942, Harry was made an acting sergeant and sent on detachment to 3STT at Ultimo. During the day he worked with the scientists at RPL and assisted in building one of the experimental prototypes of the AW transmitter and receiver.*

After a week or so the equipment [AW radar] was sent to the Army site called Hill 60 at Port Kembla, NSW. There were three other RAAF types working with the RPL people on the installation of the gear and were divided into groups. Harry worked with Harry Minnett from RPL on the matching and phasing of the antenna.

2B - p.42 Harry Duggan, Radar mechanic at Port Kembla:

Harry Minnett was the boffin who did the antenna work... He used the 'buggery bar' and told me to make the adjustments up on the array, he would say things like "move the shorting bar 2 inches and the tapping point one and three quarters". Then he wrote all his readings and results in a book. If anything went wrong he went back in reverse over every step we made until he was satisfied.

2C - p.42 *Test flights were then arranged by Radar School to establish the vertical polar diagram of the unit... From Harry Duggan's statements it is felt that Port Kembla was on the air between 10 and 15 Feb.*

This reference is to the first AW set which was sent to Port Kembla, just south of Wollongong, and it had the benefit of several RPL scientists to get it operational. It illustrates the procedure involved in matching the aerial, and importantly, the normal procedure of mapping the aerial pattern to calibrate it, ie to account for variations in aerial performance. An aircraft was flown around the station at known heights and distances whilst readings were noted off the radar screen. Then a calibration chart was drawn up 'showing the variation between the readings and true height and distance. To be effective, the Darwin radar also had to be calibrated, a, time-consuming task which is not mentioned in other commentaries.

Alexander (Ref.4C) says this AW for Port Kembla was completed on 23/1/42. If it became operational between 10/2/42 and 15/2/42, the time taken for installation, even including help from RPL, was not less than 18 days, and possibly as long as 23 days.

2F - p.141 Fred Hull, Radar Technical Officer at Darwin:

On 20 February 1942, the day after the first raid on Darwin, I was taken off No.2 Radio Officers' Course and posted to 3IRS at Darwin. I was instructed: to pack my belongings and be ready to proceed with the last load of the RDF equipment for the station. Early next morning on reporting to a hangar where a DC3 was ready to take off, I was surprised to find the pilot, F/O Max Campbell, who was to take me to Darwin. Max and I had worked together at the Royal Flying Doctor Service at Port Hedland.

When some distance from Darwin you could see smoke still rising from the city. We eventually landed and found transport to Dripstone Caves where we met Harry Hannam and Bruce Glassop who were anxiously awaiting the equipment to complete the installation. At this stage there were some civilians still working on the site and imagine my surprise to find the foreman was Val Maddigan from Port Hedland.

After reporting to Harry Hannam and getting settled in I was informed by Harry that he and Bruce Glassop had everything in hand and there was not enough room in the doover for any more. It seemed to me that he resented me having been sent.

As a result I never got to know what really was the problem but from what I heard they were having trouble with phasing the array and low power output. Dr Piddington was contacted and apparently decided to come up and sort out the problem. I believe that when he arrived. he found that the coaxial cable was not the correct type and a signal was sent to get the correct one. I also believe that when the new runs of the correct cable had been run, and the set tuned, 3IRS worked satisfactorily.

Hull confirms that Hannam and Glassop were in Darwin earlier, and he was the third, accompanying the last load of equipment. Some reports state there were only two officers. It can be assumed from Hull's report that the aerial was now up and a power unit had been obtained. The reference to no room in the doover suggests that the last of the electronics was being connected and, perhaps, ancillary gear such as telephones and radio.

The comments about wrong cable are plausible. Coaxial cable was a relatively new product in Australia, especially useful for radar aerials, and in very short supply (see RPL technical reports RP 56/1, *Stocks of Telcothene Cable - 5/12/40*, RP 56/2, *Stocks of Telcothene Cable - 7/5/41*). RPL had requisitioned almost all available stocks of several grades and types and had tested them to determine their suitability as feeders for aerials (see RP 23/1-5 *Constants for Telcothene Cables*).

REFERENCE 3: Correspondence with Fred Hull, John Scott and Errol Suttor, February 1993, giving eyewitness accounts of 1942.

Prompted by the anecdotes in Simmonds Ref.1C, 1E, and 2D, the author wrote to surviving Darwin radar personnel enclosing extracts of certain claims about the radar installation, and posed a number of questions about the events of 1942. Hull and Scott have been quoted above in Simmonds and Errol Suttor is the only other surviving mechanic of the original four from 31RS. He was later an instructor at Radar School. The questions, with the answers provided by each person, follow; I use **Q** for Question, **H.** for Hull, **S.** for Scott and **Su.** for Suttor.

Ref.3A Answers to author's questionnaire from Hull, Scott and Suttor:

H. *I am surprised at the statements made by Dr Piddington even if the happenings were 50 years ago. I stand by what I said in my letter to Ed Simmonds last year, a copy of which is enclosed. This is an item in More Radar Yarns page 141 [see Simmonds (Ref.2F)]. I will cover this more fully after answering your questions.*

Q1. What was the building constructed for the AW? If not the standard concrete building, what, and how was the array supported on top? Is it possible to sketch the layout of the hut and position of the array?

H. *Cannot say for sure but presume it was the standard concrete structure.*

S. *The building was constructed of angle iron supporting corrugated iron sheathing. The array was not supported. at the top of the building. It was free turning through the roof of the hut. Errol [Suttor] has supplied a layout of the equipment.*

Su. *Building was part of a standard steel corrugated iron building on a concrete slab. The motor housing was a frame constructed of angle iron and I think about a metre square and maybe slightly higher. I do not remember much about the motor gear but we must have had a gearbox as there was a drive chain from the motor ... A hole had been left in the roof for the mounting and drive shaft for the array. I am not sure about this. I have an idea that it [the support for the array] was constructed of angle iron but it may have been tubular. It would have to have been rugged to support the array. Sometime after the first raid we received a cover for this hole. The array would have been mounted immediately above the turning gear.*

Q2. How many DC2 loads were shipped? I believe three - correct?

H. *I am not sure but I think it was three loads. I accompanied the last load.*

S. *I was always under the impression that the aircraft was a DC3. I was aware of only one load of 'gear' being flown to Darwin. The load was only the array and racks.. There. was no power supply, bods or other equipment, the pilot, W/Op. and myself.*

Su. *I believe the plane was a DC3 on loan from Australian National Airlines. It was a passenger plane with all the seats removed. The plane was. fully loaded and as far as I can remember was the largest load to arrive by aircraft. Maybe some other equipment may have arrived later by aircraft but I have no knowledge of this.*

Q3. Was the array completely dismantled into angle-iron pieces, or what size were the bits? What about the reflector mesh? The door of a DC2 is only about 4 feet x 2 feet 6 inches in opening so how did all the stuff fit through?

H. *I was not involved in the loading of any equipment. See my letter to Ed attached. [Simmonds (Ref.2F)]*

S. *The array was completely broken down and parts tied together. I can well remember the main [heavy] drive shaft because I was worried that it might shift during the flight. This aircraft was used to lift cargo, it had been stripped of all interior fittings and perhaps the door had been enlarged. When the equipment was loaded at Richmond a block and tackle type of lifting arrangement was used. The reflector mesh was probably in panels and rolled.*

Su. *The array may have been broken down into small parcels as the frame was angle iron and the elements galvanised tubing. The reflectors may have been panels.*

Q4. What difficulties were encountered getting the turning mechanism and big gear into a DC2, then into position on the hut?

H. *Not involved in the loading of any equipment.*

S. *As far as I can recall the turning mechanism had been dismantled to the smallest components and stacked in the cabin. For the next part of your question please refer to Ed's Radar Yarns, page 23. [Simmonds & Smith (Ref.1E)]*

Su. *I remember assisting in assembling the array on the ground next to the building but I cannot remember details.*

Q5. How long did it take to fly from Sydney to Darwin, one day or two?

H. *One day, left Richmond first light and arrived late afternoon.*

S. *It took us 2 days to complete the trip from Richmond to Darwin.*

Su. *On 3/2/42 John Scott, Bill Wellstead and myself left Richmond for Brisbane to fly to Darwin the next day. John stayed at my place overnight and next morning received a phone call to return to Richmond by train. Bill and I flew to Darwin on 4/2/42 staying overnight at Cloncurry arriving at Darwin during the afternoon of 5/2/42. Harry Hannam was also on this flight. Bill and I spent our time hanging around RAAF Station, unknown and unwanted. To keep us busy Bill and I dug a trench. John arrived about 9/2/42 with a plane full of equipment.*

Q6. When did Dr Piddington arrive? It would have been after the last DC2 shipment (21/2/42) and prior to 14/3/42, but when?

H. *Dr Piddington would have arrived at least seven days after 21/2/42.*

S. *I cannot remember the date of arrival of Dr Piddington.*

Su. *I remember Dr Piddington arriving but not the date. Maybe he had other persons with him but I do not remember them.*

Q7 What were relationships like with Dr Piddington and Bruce Cooper when they were there?

H. *I had very little to do with them therefore I could not pass an honest opinion.*

S. *I do not know the answer to this question but I hope they discussed matters between themselves in more detail than with us. We were at a disadvantage filling sand bags some distance away.*

Su. [No comment]

Q8. Why was there no power supply sent with the set?

H. *Was not involved in dispatch of any equipment.*

S. *If you ever find out I would dearly love to know.*

Su. *It must have been an oversight in not supplying an alternator. Somehow we obtained a portable generator but it wasn't really satisfactory as the starting current of the array turning motor was too much. Shortly after this we obtained an alternator powered by a two-cylinder Kelly & Lewis petrol motor. This was mounted in a cabin built on a Bedford truck. We had trouble due to {a faulty} rocker arm and often we had to run the engine on one cylinder with the spark plug of the faulty cylinder removed. Eventually we received two diesel-driven alternators along with operators.*

Q9. Did you have the instruction manual, or did it come later?

H. *Never saw any manuals until I took over as CO.*

S. *We had a blueprint of the construction of the array. Apart from this I do not remember seeing an instruction manual on the equipment. It was very hush-hush.*

Su. [No comment]

Q10. Do you recall what was wrong with the coaxial cable? One story says more cable was shipped up to replace the wrong stuff. Is that so?

H. *See my letter to Ed. Yes, as far as I can recall, when Dr. Piddington checked he found the coax cable was the wrong type, they sent for the correct coax cable which arrived in a few days time.*

S. *I was never aware of any problem with the coaxial cable. The trouble as I remember was in the matching.*

Su. *The four mechanics did not play any part in the testing. We along with the eight operators spent all our spare time filling sand bags and building the sand-bag wall around the building. Both John and I are sure everything was shipshape except for the phasing and matching of the array which appeared to be beyond the skill of Harry and Bruce.*

The following extracts from reports, including excerpts from an interview with Dr Piddington in 1976 and another in 1980, were included with the questionnaire and the respondents' responses follow:

“RAAF technicians who had installed the radar at Dripstone Caves a few miles north of Darwin, days before the raid, were still fiddling with the set when the first waves of Japanese bombers roared in. The RAAF experts, hurriedly trained at Richmond (NSW), had no manuals to guide them and were unable to grasp the intricacies of operating the set. Piddington’s team - the men who could work the radar - were in Sydney, unaware that the set was in Darwin. And behind a veil of secrecy RAAF chiefs had made no effort to fly the scientists there to get the set functioning.” (Crouch (Ref.11))

H. *I arrived in Darwin late afternoon on 21/2/24 [should be 21/2/42], the second day after the first raid, with, the last load of equipment for No 31RD. This I believe was essential equipment to complete the installation. I cannot remember exactly what the equipment was but I do know Harry Hannam was waiting for the last load to complete the station. Perhaps John Scott or Bruce Glassop [now deceased] may remember. I always thought it was receiving equipment. However, they could not have had the station operating on 19/2/42 as Dr Piddington suggested if some equipment had not arrived.*

S. *As a matter of fact the mechanics and operators were toiling with the assembly of the array as the first raid was experienced. P/O Hannam was in hospital and P/O Glassop was at the main airfield. May I say we were working under extremely adverse conditions (two ACI's). At this stage it was not a matter of operating the set but of erecting the array. I know that Harry Hannam in desperation sought assistance from RPL through the RAAF. I really believe that the RAAF commanders were apathetic about this new type of equipment.*

Su. *Prior to the first raid I think all equipment had been installed and the array assembled ready for installation. John remembers us trying to raise the array with block and tackle and a truck but I don't. I remember the arrival of a Yank with a truck-mounted crane.*

“Piddington believes if he and Mr. Bruce Cooper had been there to work the radar on February 19 it could have given Darwin a vital margin of warning - the set had a range of 100 miles.” (Crouch (Ref.11))

H. *Possibly, but all of the equipment was not there, as stated above.*

Su. *During the first raid Jap fighters flew over the site at a few hundred feet but did not strafe. My rough diary mentions that on 21/2/42 the array was half in position.*

“The young officers chosen failed to get the set functioning properly. And, the RAAF base commanders at Darwin were, apathetic about the 'contraption. Nobody thought to send for Piddington and his ‘boffins’ who, absorbed in further radar work in Sydney, weren't even aware the radar was in Darwin ... Belatedly, Piddington and Cooper were rushed to Darwin and they got the set going.” (Crouch (Ref.11))

H. When the third load arrived Hannam was not able to get the station operating satisfactorily, owing to low power into the antenna and other minor problems. They decided to send for Dr Piddington who arrived with an assistant a few days later. I believe they found the main problem for low power output was the wrong type of coaxial cable among other minor items. Maybe in endeavouring to find the reason for low power output, our personnel got their equipment a little untidy.

S. When Piddington arrived in Darwin the array was in place, the units connected, the whole thing was operating other than the matching procedure. Piddington arranged for an aircraft to calibrate the set.

H. And yet, Piddington stated that "it only took us a week to get it going"?

“On 19th February, a fortnight after it arrived in Darwin, Pither's Air Force technicians could not get the set working. It should have been there earlier and it should have been operating earlier. It only took us a week to get it going'.” (Moran (Ref.16C))

H. If all the equipment and the correct coaxial [cable] had arrived before 19/2/42 no doubt Pither's Air Force technicians would have had No.31RD operating and picked the Japs up 100 miles out as mentioned in Para. 2. Now, who sent the wrong coax - was it Piddington's ‘boffins’? If so they must be the responsible party for not having the station working earlier.

Su. From my diary I see that we had a raid (the fifth) on Thur. 19/3/42 which was not picked up by 31 but the raid on Sun. 22/3/42 was picked up at 80 plus miles. This seems to suggest that Dr Piddington was still at 31RS at this time.

“We found the set a hopeless mess when we literally flew to the rescue. It took us a week to get it going because they'd made such a mess of it. Once we two Laboratory officers had succeeded, we were no longer silly backroom boys but popular.' Piddington.” (Moran (Ref.16C)).

H. As I had not been involved in any of No.31RD's installation I have no idea what happened during this period. On arrival at Dripstone caves I was informed by the CO (Harry Hannam) that there was not enough space for any more in the operating room and that I was to supervise the digging of slit trenches and generally improve the living conditions of the camp.

[In addition, an RAAF officer, possibly Scherger, reported to the Air Chief Marshall that the radar was definitely installed prior to 19/2/42, but was not ready for operation. See Moran (Ref.16) and Schedvin (Ref.17F)]

H. Please read my letter to Ed. Simmonds enclosed. As far as I can recall all statements are reasonably correct. I have been thinking hard about our arrival in Darwin on 21st February 1942. We arrived late afternoon 21/2/42 and stayed overnight at OHQ, reported the following morning; my paybook shows I reported on 22/2/42 PZ 828 (whatever that means) apparently I was picked up with the equipment and taken to 31RS on the same morning. Should you require documentary proof you can have my paybook or perhaps a photocopy. This now definitely puts down the time that I delivered the equipment as 22/2/42. I have no further comments as to the installation of No.31RD. [Hull uses the designation No 31RD instead of the more common No 31RS or 31RDF when referring to a radar station.]

S. The statement about "a hopeless mess" and Scherger's statement that "the radar was definitely installed" was a whole heap of crap. I must. say at this stage that: Harry Hannam and Bruce Glassop were rather guarded with the activities of the matching of the array. We were not altogether taken into their confidence. Perhaps they were protecting their status and ego - after all they were commissioned officers and we were ACI's (I think that is the lowest rank possible). In spite of this they had our complete. respect.

Both Scott and Suttor rose through the ranks, Scott to be a Flying Officer, and Suttor to Warrant Officer.

These responses show clearly that the radar set was NOT installed on 19/2/42 and that the last of the equipment did not arrive at Dripstone till 22/2/42. The timing of Hull's trip with the "last load" is consistent with 3 aircraft loads of equipment. The fact that the pilot, P/O Campbell, did the first and last trip to Darwin leads one to think that only one DC2 may have been used with the same crew making 3 round trips. The RAAF only had 9 DC2's at this time, all in great demand.

Ref.3B What follows is the full text of original letter from Fred Hull to Ed Simmonds and quoted (with minor editing) in Simmonds (Ref.2F), with additional comments added in answer to author's questionnaire.

On 20th February 1942, the day after the first raid on Darwin, I was taken off No.2 Radio Officers' Course and posted to No.31 RDF, Darwin. I was instructed to pack my belongings and be ready to proceed with the last load of No.31 RDF equipment. Early next morning, on reporting to a hangar where a DC3 was ready to take off, I was surprised to find the pilot F/O Max Campbell was to take me to Darwin. Max and I had worked together at the Royal Flying Doctor Service, Port Hedland.

When some distance from Darwin you could see smoke still rising from the city. We eventually landed and found transport to Dripstone with the equipment, where we met Harry Hannam and Bruce Glassop who were anxiously awaiting the equipment to complete the installation. At this stage there were some civilians still working on the site and imagine my surprise to find the foreman was Val Maddigan from Port Hedland. On one day three of us from Port Hedland were involved with No.31 RDF!

After reporting to Harry Hannam and getting settled in I was informed by Harry that he and Bruce Glassop had everything in hand and there was not enough room in the doover for any more! It seemed to me that he resented I had been sent. I then decided to hop in with the boys and dig some slit trenches etc. and generally improve the living conditions of the camp. I cannot remember if he treated the mechanics in a similar manner. As a result I never got to know what really was the problem but from what I heard they were having trouble with phasing the array and low power output. Dr Piddington was contacted and apparently decided to come up and sort out the problem. I believe that when he arrived he found that the coaxial cable was not the correct type and a signal was sent to get the correct one. I also believe that when the new runs of the correct cable had been run, and the set tuned, 31RS worked satisfactorily.

Dr Piddington was at 31RS about a week. I never got to examine the equipment room of 31RS during this period and cannot comment on Dr Piddington's claims. I would think that things must have been a bit untidy with all of the trouble Harry was having. With due respects to him I think Dr Piddington was a bit hard in his criticism.

Several people have commented that Harry Hannam had what could most politely be described as a 'difficult personality'. This trait may have affected the impressions gained by Dr. Piddington during his time at 31RS and could have strained relationships.

REFERENCE 4: *History of the Development of the Australian LW/AW equipment.* T B Alexander, RP 207/3, 11/1/45. CSIR.

Bruce Alexander was employed in the RPL from 1941 to 1945 as a Research Officer. He went to Singapore and Penang to advise the British Army on the design and construction of huts for the proposed ShD radar stations for those areas. He was closely involved throughout the entire radar effort and designed the AW MkIII radar transmitter.

In the foreword to this Restricted RPL document he says: "Every attempt has been made to check the accuracy of the dates of the various stages of development as quoted. Most instructions, however, were verbal, very few decisions being recorded, due to extreme urgency in the initial stages of development. This has made the task of checking dates extremely difficult but the available information has been carefully sifted and it is believed that the following account is factually and chronologically correct."

4A - p.3 *On the 17th September, 1941, the Radiophysics Laboratory undertook to investigate the possibility of local manufacture of an air-warning set, having a range of about 100 miles. The initial scheme proposed was one using an ShD-type receiver cubicle but with a simplified time base. The transmitter was to be similar to the British GL or CHL type. Very little effort was directed towards this project in view of the commitments on the ShD and GL sets.*

The key words here are "undertook to investigate the possibility" - it was a brief paper exercise, no manufacture was attempted.

The ShD radar that RPL had designed for the Australian Army coastal defence had a range of only 30 miles, whereas the English GL (Army gun laying) or CHL (RAF chain home low) transmitter was much larger and more powerful, giving a range of 100 miles, suitable for air warning. At this time RPL had 2 CHL sets in store, but delivery of more, or components and valves for any local copy, was uncertain.

4B - p.3 *On the 8th October, 1941 a further investigation was carried out on the possibility of using two NT99 valves with spark modulation for the transmitter cubicle. This was done in an effort to avoid the delay involved in building CHL and GL transmitters. However, as no valves were available in Australia, further work was not carried out and development was postponed pending their arrival.*

Again, this was an exercise on paper. Later, Alexander was responsible for the design and manufacture of a radar transmitter using two NT99 valves and a spark modulator, called the AW MkIII. The first sets were produced in July 1943, but were not ready for field trials till late 1944.

The NT99 was a scaled-up version of the VT90 valve used in the Australian ShD, AW and ASV radars. It had been developed in England and enabled the UK to build smaller but more powerful radar sets. Availability of NT99's for Australia was most tenuous until mid-1943.

4C - p.5 *The first equipment [AW] complete with 100% or more spares components was completed on the 23rd January, 1942. The second and third equipments were completed and handed over to the RAAF on 31st January, 1942 and 4th February, 1942.*

Alexander gives specific dates for completion of each of the first three production AW sets. The first set was installed at Port Kembla, the second {sent by ship} to Port Moresby, and the third was air freighted to Darwin.

REFERENCE 5. *Adventures in Radar*. Flight Lieutenant F.H. Porter, 4th Ed. 1992, Privately published (With Foreword by Wing Commander A.G. Pither, dated 17/5/46.)

Hal Porter was one of the trainee officers in the first radiophysics course held at Sydney University from September 1941 to February 1942. Suitable candidates from the university science and engineering faculties were given a concentrated course of training under Professor V A Bailey and became known as 'Bailey Boys'. Porter served in senior postings in radar throughout the war and was still a serving officer when he wrote this semi-technical and anecdotal history of RAAF radar.

5A - p.23 *Meanwhile two AW ground stations were rushed north, one to Darwin and the other to New Guinea. Bruce Glassop, Harold Hannam, Fred Hull, these three very old hands took Darwin's station and Bill Scarff took Moresby's.*

Partly due to a strike and lack of interest by the services, the Darwin station was not ready to detect the large Japanese air armada which devastated the town and killed so many Australians and Americans on 19th February, 1942.

Porter calls the three officers "very old hands". They were drawn from the prewar electronics/radio industry and were in their late 20's to early 30's, a little older, and with more practical experience than later recruits, some of whom were often only 19 or 20 years old. {Actually, Rex Wadsley took the AW to Port Moresby and Scarff was later to take over the COL unit (37RS) at Milne Bay. }

This reference to a strike is the only one in the AW saga. The unions around Australia were very strike-prone during the war but, as the equipment came by air, it would have been handled by RAAF labour. I have not seen any reference to a strike by the Darwin Dept of Works which could have delayed completion of the building. The fact that it was built or at least almost completed between Pither's visit on 28/1/42 and when the first radar shipment arrived on 9/2/42 indicates a very prompt construction. On the other hand Pither read the manuscript and should have noticed any error in the record of what would have been a dramatic event for the RAAF. Without corroboration I have to discount mention of a strike as not significant to events.

The comment about "lack of interest by the services" is a recurring theme, (and perhaps Porter would not dare to write "by very senior RAAF officers) and lack of help from the RAAF Base at Darwin does appear to have been a reason for the delay in installation. Accounts from RAAF people involved recorded by Simmonds & Smith (Ref. 1E) indicate that some time was lost before help was obtained from US forces to complete the radar installation.

REFERENCE 6: *An Account of the Development and Use of Radar In the RAAF.* Wing Commander A.G. Pither, December 1946. Unpublished manuscript.

Wing Commander Pither was the RAAF representative sent to England in 1940 to learn about radar. He directed the RAAF radar effort until August 1943 when he was sent 'on exchange duty' to the UK, returning to resume control as Director of Radar in January 1945. Pither is regarded as the 'father of RAAF radar' and his report is an exhaustive analysis of the technical and organisational development and deployment of radar and makes numerous references to official files and minutes of meetings to back his statements.

6A - p.11 *The matter [of a use for imported air warning equipment, two CHL and one MB2 units, held at RPL] received some consideration at the 14th meeting of the RAB on 29/8/41 but as the government appreciation still provided only for defence against sporadic raids, no definite action was possible, although some consideration was given to the production of a long-range warning set by RPL who were eventually asked to produce two of these sets.*

The RAB was the Radiophysics Advisory Board, comprising very senior military officers and CSIR advisers who guided the RPL in its work and priorities.

RPL suggested that the MB2 transmitter and receiver which they held in store could be used at Darwin as an air warning radar, by attaching sets of dipoles to a tower planned to be built for the Army's ShD radar, which itself was well behind schedule. The long-range-warning set mentioned by Pither is that detailed by Alexander (Ref.4A).

6B - p.12 *It was not until October 1941 that the matter [of air warning] was given serious consideration and at this time War Cabinet in Agendum 421 decided that a long-range warning system was necessary ... [and] recommended the installation of warning stations at 32 places around the Australian and New Guinea coast (file 202/28/22, enclosure 4A).*

These recommendations were accepted in Defence Committee minute 159/41 on 7th November 1941 (enc. 22B) and thus, on the eve of the outbreak of war with Japan, the RAAF was presented with a colossal RDF program ... The RAAF was faced with the necessity of providing 64 early warning stations (two for each site) and 6 GCI stations ...

Note that there was no request for any equipment from RPL. The order for all equipment was placed with the UK. The RPL investigation in October of a design using NT99 valves (Alexander (Ref.4B)), appears to have been at its own volition and futile anyway given the lack of valves.

6C - p.14 *For the air warning programme, staggering in its size, there was no equipment available nor any prospect of securing equipment from overseas within a reasonable time. Urgent action was taken by the government and in January 1942 the Prime Minister ... cabled the UK Government asking for the immediate supply of radar equipment to meet the requirements of the Defence Committee Agendum. This equipment included, 32 CHL, 6,GCI and 54 AI.*

By late December 1941, RPL had adapted an ShD radar as an air-warning radar. This may have influenced the request for half the original UK order to be supplied urgently, the rest, hopefully, to come from RPL.

6D - p.15 *The first equipment [AW] was actually installed at Kiama in January and while this was under way I visited Darwin to select a suitable site there, Dripstone eventually being chosen.*

Pither has the wrong site in Kiama. The first AW radar was installed at an Army observation post at Hill 60, Port Kembla, and operated by RAAF and Army personnel. A little later another AW was sited at Kiama, south of Port Kembla, and the RAAF personnel then moved there. Pither, however, was sure of the date of his visit to Darwin, 28 January, and had noted the person he met from Dept of Works, Mr. Stoddard. {see Lockwood, (Ref.10C)}

6E - p.15 *Arrangement had been made to fly the radar station to Darwin, the station to comprise an ShD aerial system and the new AW radar. This move commenced on the 5th February, the personnel, P/O's Hannam, Glassop and Hull being taken straight from radar school for the purpose. The move was completed in February but the station was still being erected when the first air raid was made on Darwin on 19th February.*

Pither is in no doubt that it required more than one aircraft load and that the AW was still being erected on 19/2/42.

6F - p.15 *It [the AW meant for Rabaul, now overrun by the Japanese] was flown to Moresby* shortly afterwards and became operational in March. Shortly prior to this, early in January, the first CHL station had been erected from equipment held by RPL, at Shepherd's Hill, Newcastle, by P/O's Choate, Hannam and Glassop. The station was operating on 10th January and was thus the first air-warning station to be operational in Australia.*

6G - p.39 *Radar personnel appearing in the area got amounts of assistance from the different staff officers varying from obstruction to cooperation.*

The first example occurred at Darwin where, although I had visited the area, selected a site and made verbal arrangements with the area staff, the assistance provided for the radar personnel under P/O Hannam when they arrived was meagre.

On his visit Pither had arranged with the Dept. of Works to build a special radar building and arranged with the RAAF to assist in the installation, and it is inconceivable that he would not have made sure that the Area Commander was fully aware of what was going on. It was, after all, the highest priority project for the RAAF.

* {In fact, the late formerly F/Sgt Bill Harnath, a radar mechanic with the installation party, reported that the equipment including the aerial was shipped to Port Moresby on "one of the Burns Philp boats carrying mostly RAAF supplies" arriving towards the end of February (see Simmonds, *More Radar Yarns*, p 101)}

REFERENCE 7: *One Single Weapon*. M. Barnard, 1945-46. Unpublished manuscript.

Marjorie Barnard worked in the RPL library from 1942 to 1945. She took the opportunity to interview many of the RPL officers and wrote a manuscript tentatively titled *One Single Weapon*, although Mellor refers to it as *Radar*. Unfortunately her book reads more like a Biggles novel, full of melodrama, with few names and vague references with just a hint of the facts. It contains a number of errors and paints an altogether too favourable picture of events from the RPL point of view. If one knows the background and the people involved it is possible to pick up the threads of the history and to deduce who influenced a particular theme in her writing. For the historian it is suspect. However, I have included some of her references here where I could corroborate the facts, and because others have made frequent use of her manuscript.

7A - p.189 *It was decided at last to put up the air warning station [MB2] using the towers of the proposed ShD station. There was controversy between the services as to which should bear the expense. The air warning question was discussed by the Radiophysics Board at its September and October meetings. At the end of 1941 the ShD towers were not erected and there was no air warning cover at Darwin.*

As the official files give little hint of a controversy over which service was to pay the costs, the comment appears to be an opinion from someone at RPL who was aware of the services' feelings on the subject.

The decision to install the MB2 was rescinded in September when the Army claimed the MB2 had limitations and was unsuitable. For comment on reasons why the MB2 was not installed see Moran (Ref.16D).

The ShD equipment and tower construction program was well behind schedule, with blame being sheeted home to RPL, which was accused of trying to do everything and control everything.

7B - p.196 *RAAF personnel were being trained in RPL on the new AW equipment. An AW set was installed at Port Kembla and on 31st January one was despatched to Darwin by air. On 3rd February another set went to Port Moresby.*

The RAAF personnel say they helped build and install those first sets from RPL. There was no time for formal training, it was on-the-job experience.

7C - p.199 *The first prototype AW set was sent to Darwin - the set at Dover Heights was experimental, an original. It was loaded into a transport plane, no easy job, and a few parts were bent or jarred in transit. Unfortunately no scientific nursemaid accompanied it and the RAAF radar personnel in Darwin had, of course, no experience with this new and intricate equipment. They could not get it to work. They were still trying when the first big raid came on the 19th February.*

Barnard contradicts herself in Ref.7B and 7C. The first set went to Port Kembla, the second was sent to Port Moresby, and the third to Darwin after handing over on 4/2/42. The Port Moresby set was the last to come into operation because of the longer total time taken to transport it there. See Alexander (Ref.4C).

Barnard makes the first reference to "a few parts were bent or jarred in transit". The RAAF accounts do not mention that as a reason for the failure, so Barnard may be quoting from comments made by RPL staff who later visited Darwin and saw the set.

This is also the first reference to the RAAF "still trying" to get the set to work on the day of the raid whereas all previous references state that it was still being assembled. The recent eyewitness accounts, Ref.1, 2 and 3, are conclusive that the set was not even fully delivered till around 22/2/42. So how did Barnard reach the conclusion that the set WAS installed, but the RAAF had "no experience", "could not get it to work" by the time of the raid, and should have had a "scientific nursemaid"?

7D - p.200 *The raid brought an SOS to the Radiophysics Laboratory and a senior research man, the group leader of the AW research team, and an assistant flew north. They arrived to find the set in poor shape and Darwin in worse.*

Here we have a scenario where the set was in “poor shape”, yet previous reports indicate that the only thing wrong was that the coaxial cables did not tune properly Simmonds (Ref.1E and 2D) and Hull etc. (Ref.3). The unnamed RPL personnel were Dr Jack H. Piddington and Mr Brian Cooper.

7E - p.200 *The Radiophysics men spent a tense weekend repairing the set. On Sunday it was functioning and no sooner was it on the air than it picked up an approaching raid.*

Barnard does not specify which Sunday and allows only a weekend, giving the impression that the RPI, staff fixed the set over the weekend immediately following the first raid. In fact the set did not become operational until a month after the first raid, on 22/3/42 (Simmonds Ref.1E).

7F - p.200 Anonymous note in the margin of the manuscript near Ref.7E:
Thank God for the scientists. I presume no-one else present helped!

Someone has written this wry comment in the margin of Barnard's manuscript. Sally Atkinson, a long-time and very valuable secretary in the CSIRO Radiophysics Laboratory, informed Ed Simmonds, author of *Radar Yarns*, that the pencil notes in the margin were most likely to have been written by Sir Frederick White, Chief of CSIRO, when he read the script before deciding whether or not to publish it. I suspect it was meant to indicate how important the RPL was at the time and that the RAAF did not make a significant contribution in the final effort.

{The decision, presumably, was not to publish it, as the work exists only in manuscript form.}

REFERENCE 8: *Some Air-Warning Radar Used in Australia & the Islands* J H Piddington,
RPR 98, October-1949. CSIRO.

Dr Piddington was a Senior Research Officer with RPL and involved with the adaptation of the ShD radar to become the AW. He was the senior RPL officer sent to Darwin after the raid. This was an unrestricted report published by the CSIRO, giving a brief history of the early AW radar and a technical description of the later LW/AW radars.

8A - p.2 *All three sets [AW] were completed by 4th February 1942 and handed over to the RAAF for installation at Port Kembla, Darwin and Port Moresby.*

8B - p.3 *The AW set which had been flown to Darwin was damaged in transit and two Radiophysics Laboratory officers were sent to repair and adjust it. This was done by about 11am on Sunday, 23rd March {Sunday 22 March} just in time to detect and approaching raid at a distance of 85 miles.*

Here Piddington repeats the information that the set was damaged in transit, a proposition first mentioned by Barnard (Ref.7C). The similarities of theme between Barnard and Piddington in their accounts leads me to think she was influenced by his reports of events and used them as source material in her earlier work.

Piddington does not mention whether the set was installed or not at the time of the raid, but suggests something more than just having to adjust the set by saying that they had "to repair" it. That could have meant replacing the suspect coaxial cable.

REFERENCE 9: *Australia in the War of 1939-1945 Series V, Civil. The Role of Science and Industry*, D P Mellor, 1958.

Professor Mellor, then at Sydney University, wrote this chapter as part of the official history of Australia in WW2. It is overall a rosy picture of the accomplishments of the RPL and the CSIR. When Ed Simmonds interviewed a senior staff member of the Australian War Memorial in late 1988, he was informed that this volume was regarded as the, 'bible' on radar!

Mellor would have had access to RPL files, and appears to have interviewed senior RPL staff. However, the only reference identified by Mellor is on p.437 footnote 4, "Marjorie Barnard, *Radar*, an unpublished account". Mellor draws heavily on Barnard's work. Unfortunately he also repeats several errors from Barnard, for example:

Mellor Ref.9 - p.431 *Sets having a similar function in England had their transmitting and receiving aerials on separate towers 120 feet high. Pawsey, with the assistance of Minnett, invented a system whereby one tower and one aerial were used for both transmitting and receiving. This enabled a notable saving, since each tower cost about £50,000.*

Mellor faithfully repeats Barnard's errors:

Barnard Ref.7 - p.172 *In England such sets [similar to the Australian ShD] were being built with two 120' towers, one for transmitting and one for receiving, both costing about £50,000. In the Australian model one tower was used for both.*

Yet the total expenditure of RPL in 1942 was only £51,887! (See Evans Ref.13, Annexure 11, p 3.) In fact, the cost of the tall towers built in Australia in 1943 for the imported ACO radars was only £5,000 each (PMG quotation of price in RPL files).

Barnard, and therefore Mellor, was incorrect in comparing the Australian ShD with the UK radar which did use two tall towers and fixed aerials. That was the MB or Mobile Base set. The ShD bears more resemblance to the UK CHL radar, both having a single rotating aerial array, on a single tower. The UK CHL was in service well before RPL "invented" a system to use one aerial. In most cases the CHL in England and the ShD in Australia were mounted on low towers or on the roof of a building. However, the two ShD sets intended for Darwin were to be on 230 feet towers, and three on Rottnest Island plus one at Newcastle were to be on 180 feet towers, because the local coastline was too low.

Continuing with Mellor's references:

9A - p.432 *There were arguments as to which service should bear the expense of the installations [of air-warning radar at Darwin] and, when war broke out with Japan, Darwin still had no radar defence worth the name.*

Mellor has picked up the, theme on arguments over costs first mentioned by Barnard ref.7A. {The arguments appear to have been about the cost of the towers, to which were to be fixed separate dipole systems for the Army ShD equipment and the RAAF AW unit. }

9B - p.435 *The first three sets [AW], with a full supply of spare parts, completed by 4th February 1942, were made to a better general design and finish than the prototype.*

9C - p.435 *The set sent to Darwin was accompanied by technicians of the RAAF, who, although they were without manuals to guide them, felt confident of their ability to operate it. When an attempt was made they failed even to get the set on the air. While they were still trying to get it working the Japanese made their first raid on the town.*

Mellor continues the inference from Barnard that the radar was installed but the RAAF could not get it to work at the time of the first raid.

It is significant that Mellor says the RAAF was "without manuals to guide them", because there exists an RPL *Preliminary Manual* for the AW radar entitled 'PD17, Air Warning Set J.2X' which is dated 4/2/42 and consists of 14 pages. However, there is some doubt as to whether that date is correct (see Question 5, p41). The *Preliminary Manual* has a footnote: "Note: This information has been prepared in a hurried way and is of a preliminary nature only, to enable the equipment to be put into service. A more complete report is being prepared covering the installation." The *Final Manual* from RPL, 'PD17/1, Air Warning Set J.23', expanded to 27 pages, is dated 1/4/42. The instructions for *Adjustment of 36 Element Array for AW* in the preliminary technical manual consists of three pages and one diagram.

A lack of manuals is not mentioned in previous reports, so where did Mellor get the information that the RAAF did not have them?

9D - p.436 *An urgent call issued to the Radiophysics Laboratory brought Piddington, the group leader of the air warning project, and an assistant, Mr. Cooper, post haste to Darwin. After some tense days, the air-warning set was got going on 22nd March 1942. the radar had not long been on the air when at 11.30am the screen showed an aircraft or group of aircraft 84 miles east of Darwin.*

The first indication of the date of operation (22/3/42) was in the report from Piddington (Ref.8B).

REFERENCE 10: *Australia's Pearl Harbour Darwin 1942*. Douglas Lockwood, 1966. Published by Cassell. (Reprint, 1992, published by Penguin. ISBN 0 14 016820 6)

Douglas Lockwood was a newspaper war correspondent in Darwin at the time of the raids. He later wrote a number of books and followed a career in newspapers. In this book he devotes a page and a half to the radar in Darwin, and mentions both Pither and Piddington, but does not list his references.

10A - p.146 *the first operational radar set in Australia was being installed on a cliff at Dripstone Caves, a few miles north of Darwin, on February 19. It faced the Timor Sea and was capable of picking up enemy craft one hundred miles away. but the antenna had not yet been erected.*

Lockwood appears to be referring to details in Pither (Ref.6).

10B - p.146 *Dr. F.W.G. White, chairman of the Radiophysics Advisory Board, and Dr. J.H. Piddington improved the reception until aeroplanes could be detected 100 miles away.*

Under exceptional weather conditions stations could pick up signals 135 miles away, but the generally accepted range quoted in other RPL and RAAF reports and manuals was 70-75 miles, not 100 miles.

10C - p.146 *On January 28, 1942, Wing Commander (now Group Captain) A G Pither, Director of Radar (then RDF) at RAAF Headquarters, went to Darwin to select a site and acquire a building to house the equipment. He remembers that the Area Commandant, Air Commodore D E L Wilson, was sceptical as to the efficiency of radar and Pither's ability to get a building.*

P.147 *"Get one if you can but the Public Works chief is uncooperative", he warned Pither. On the contrary, Pither found that the officer-in-charge, E W Stoddart, was most helpful; he promised a building of the type and size specified would be erected at Dripstone Caves by early February, when Pither expected to return with his magic boxes and his men. Stoddart was as good as his word.*

There is no reference to any conversation between Pither and Wilson in Pither Ref.6, nor is there any reference to promises from Stoddart (Pither spells it Stoddard), but there may have been some later private communication between Pither and Lockwood in which these sentiments were expressed. However, it may just be Lockwood's writing style, to personalise the events based on the dry report by Pither Ref.6. Pither did not return to Darwin when the equipment and men were despatched.

10D - p.147 *The RAAF had established its own radar school at Richmond, NSW, and the first students were about to graduate. Pither selected three young Pilot Officers, Harry Hannam, Bruce Glassop and Frederick Hull. On February 5 the first flight arrived in Darwin with Glassop, Hannam and the set.*

No doubt the three officers would have appreciated being called "young". As previously mentioned, they were in their late 20's to early 30's, being drawn from the radio industry, and older than later graduates who came straight from University.

Lockwood is wrong with the arrival date of the first flight, and incorrect in believing it was "the [complete] set", but does understand that there was more than one flight. He has taken note of Pither (Ref.6E).

10E - p.147 *Pither recalls with surprise and perhaps a little bitterness that the new 'boffin boys' were greeted by Darwin base officers with a lack of interest that amounted to apathy.*

Pither (Ref.6G) is more circumspect in his appraisal of the reception given.

10F - p.147 *When the equipment had been installed there was further trouble. 'We could not get any signals or pick up our own planes within half a mile,' Pither says.*

After the bombing one of the designers, Dr Piddington, was sent from Sydney to help. The fault was found and a few days later the set came alive with symbols that represented aeroplanes.

Although perhaps Lockwood has embellished the prose a little (journalist's licence?) he accepts Pither's account of events, ie that the set was not installed prior to the first raid.

REFERENCE 11:Article headlined *Tragic Irony of the First Air-raid that Flattened Darwin*, Wallace Crouch, Daily Telegraph 14/2/67, p 26.

The article is almost a full page; it reports an interview with Dr J H Piddington and includes a photo of Dr Piddington. Crouch references *Australia's Pearl Harbour* (Lockwood Ref.10). As the article is long and includes other events at Darwin, I have only included excerpts from Dr Piddington's interview.

11A *When 118 Japanese aircraft caught Darwin completely off guard on February 19, 1942,... there was an air-warning radar unit in the city but it wasn't working. It is a bitter memory for Dr John H Piddington, a top Australian scientist and developer of Australia's first radar. The air-warning unit, Australia's first was developed by a team of 'backroom boffins' led by Piddington, a civilian. RAAF technicians who installed the radar at Dripstone Caves a few miles north of Darwin, days before the raid were still fiddling with the set when the first waves of Japanese bombers roared in. The RAAF experts, hurriedly trained at Richmond (NSW), had no manuals to guide them and were unable to grasp the intricacies of operating the set. Piddington's team - the men who could work the radar - were in Sydney, unaware that the set was in Darwin. And under a veil of secrecy RAAF chiefs made no effort to fly the scientists there to get the set functioning.*

His reference to "RAAF chiefs" who "made no effort" must include Pither, who was directly responsible for all RAAF radar.

As the 25th anniversary next Sunday of Darwin's first and disasterous [sic] air-raid approaches, it brings with it to Piddington the thought that if he had been in the city on the day its people might have had adequate warning ... Within days of the first raid Piddington and a fellow scientist, Mr Bruce Cooper, were rushed to Darwin, got the radar working ...

FIASCO

Dr Piddington a quietly spoken, trim figured man of 56, is now principal Research Officer of the CSIRO's Radiophysics Division of Sydney University and one of Australia's leaders in space research... [Crouch next gives examples of the events during the raid from Australia's Pearl Harbour] ... However, Piddington believes if he and Mr Bruce Cooper had been there to work the radar on February 19 it could have given Darwin a vital margin of warning the set had a range of 100 miles ... [next follows some biographical notes on Piddington] ... In 1937 he did radar research for the British Air Ministry, using an early television transmitter borrowed from Alexandra Palace in London ... Dr Piddington says: "Many. of the, top military brass were relying on Britain to supply us with radar once it had been properly developed there. But the group of us scientists were determined to make our own long-range plans - we had the men and the knowhow."

EFFECTIVE

The Navy and the Air Force were fairly indifferent to the potentialities of radar - they regarded it as a new fangled contraption still in the realm of fantasy. The Army, however, was most interested specially Colonel, later Major-General, J S Whitelaw, then in command of the coastal defences along East Australia . . . [next came details of the army radar set and its use] ... News of the Pearl Harbour attack galvanised Piddington's team into action. They - and by then the RAAF bosses - realised that the immediate threat to Darwin and New Guinea was air attack and Australia didn't have a single Air-Warning radar. "On the night of December 7, 1941, myself, Cooper and 12 others set to work. By the following Saturday night we had developed a prototype set - a bit rough and ready, but with a 100-mile range under good weather conditions, and transportable in a Dakota aircraft. It weighed about 1000 lb. against the first 40-ton ones the Americans had come up with.

A minor point, but in other reports the AW is stated to have been started on the morning of the 7th and taken 5½ days; here it took 6 days starting at night. {The time difference will have meant that the news would not have been received here until the morning of Monday 8 December.}

The AW radar set that was developed at this time was not very transportable at all, the requirement for easy air transport came somewhat later. It is particularly relevant that Piddington states that the set only "weighed about 1000 lb." (500 kg). The electronics alone weighed about twice that, 1000 kg, and the aerial and rotator another 1800 kg. Other essential equipment brought the total weight to around 6000 kg. Piddington would have been well aware of the true, considerable, bulk and weight. (See Appendix 1 for details of weights.)

Pither formed a unit, No.31 Radar Station, to man the radar, but the young officers chosen failed to get the set functioning properly. And the RAAF base commanders at Darwin were apathetic about the 'contraption'. Nobody thought to send for Piddington and his 'boffins' who, absorbed in further radar work in Sydney, weren't even aware the radar was in Darwin... Belatedly, Piddington and Cooper were rushed to Darwin and they got the set going ... Dr Piddington saw out the rest of the war supervising the installations of radar sets at strategic spots throughout Australia and the Pacific Islands.

LESSONS

No decorations or awards came his way, and he slipped back to his peacetime job of helping advance the secrets of space., He says: "Perhaps we had to suffer the indignity of a debacle like Darwin to shake us out of our apathy and learn a few lessons." Dr Piddington has received a gilt-edged invitation card to be in Darwin next Sunday where Air-Commodore Pither is to unveil a monument at the site of the radar station. But for reasons of his own he won't be there,...

Piddington does indeed seem to have bitter memories and we are left to speculate on his reasons for not going to the Darwin commemoration.

As Lockwood (Ref.10) said, the radar had not been installed; Crouch must have relied on Piddington for claims that the technicians were "still fiddling", had no manuals, could not grasp the intricacies, and made no effort to fly the scientists to Darwin.

It is notable that Piddington has moved away from his own report in 1949, in which he said only that the set was damaged in transit (Piddington Ref.8B). Now he says the set WAS installed, and lays the blame for failure to get it operational with the RAAF but, as he did not arrive in Darwin till well after the 19th, he was not an eyewitness.

REFERENCE 12: G.A. Pither, in 'Letters to the Editor', *Daily Telegraph* 18/2/67 p.2.

Pither made a quick response to Grouch's interview with Piddington and it was published as a small item in the *Letters* section four days after the original article.

12A In Darwin to unveil on Sunday a memorial to RAAF wartime radar, I read with the greatest interest Wallace Crouch's article on the first air radar in Darwin on February 19, 1942. It is most unfortunate that the article has minor errors which detract from its worth, and I would like to correct them.

The article says that Dr Piddington believed that if he had, been in Darwin at the time of the first raid his newly installed radar unit could have provided adequate warning, but 'RAAF experts hurriedly trained', were unable to grasp its intricacies. The fact is that the last Dakota-load of radar equipment, including the all-important aerial, arrived in Darwin two days AFTER the bombing.

About a week later the radar was complete, but its performance was poor and Dr. Piddington was immediately called to Darwin to get it working. While he was getting there the RAAF technicians located the fault - a defective aerial feeder cable - and had the station working fairly well by the time he arrived. Nevertheless, they were extremely grateful to have the designer on hand to extract the last ounce of performance from it.

From that time onwards the radar was an all-important part of the defence of Darwin, and as others were installed the RAAF organisation, together with the fighter aircraft of the US Air Force and the RAAF, achieved the defeat of the Japanese raids on Darwin.

As the one who had the responsibility for the radar defence of Australia in those days, and who had constant contact with Dr Piddington and his team, I have the greatest admiration for the job they did. As he says, they worked night and day to produce the first air warning radar ever used in Australia. It was a completely Australian effort.

The operational use of the radar in the hands of many hundreds of RAAF men and women was also a completely Australian effort and there can be few better examples of Australians using their own resources in the interest of Australian defence.

On Sunday, the 25th anniversary of the first bombing raid on Australian soil, I will unveil a memorial on the site of the original radar. Dr Piddington and many other veterans of those days have been invited, but unfortunately very few can afford the time or the money to make the trip. Nevertheless, a great many citizens of Darwin have accepted the invitation, and we will establish the first monument on Australian soil to the defence of Darwin.

A.G. Pither (Air-Commodore), Riversdale Court, Hawthorn, Melbourne, Victoria.

Pither was obviously sufficiently moved to write a very quick response considering the time that it would have taken to receive a copy of the Tuesday *Daily Telegraph* in Darwin and get a reply back in time for the Saturday edition.

Note that Pither says the RAAF had already found the problem, "a defective aerial feeder cable" and had the station working "fairly well" before Piddington arrived. One would think that he would have to be sure of his facts before making such a rebuttal of the previous assertions by Piddington.

Moran (Ref.16J, to follow) has taken Pither to mean that the aerial was in the last load, but careful reading can give what I believe was the intended meaning that the complete set had to include an aerial, which Piddington has clearly neglected to consider when quoting weights (Crouch Ref.11C), ie it was the radar equipment *in toto* which included the aerial, not necessarily the last Dakota-load. See Pither (Ref.6E) wherein he distinguishes between the 'aerial system' and the 'radar' set itself and indicates both are required to make up the full radar station. Other evidence, (Simmonds Ref.1 and 2 and Ref.3) indicates that the aerial and the rotator were in the first delivery and that makes sense as they required more time to install.

REFERENCE 13: *History of the Radiophysics Advisory Board, 1939-45.* W F Evans, 1970. CSIRO.

Evans, a CSIRO employee, was commissioned to write this history for the CSIRO. He used a large number of official RPL and Government files but gives special credit to the following sources:

- a) M Barnard's unpublished story of Australian Radar. [usually known as *One Single Weapon*]
- b) Mellor *The Role of Science and Industry*
- c) Minutes of the RAB taken by the secretary, Mr. G Cook.

13A - p.88 Annexure 29 [in Evans] is a press article from the Sydney Telegraph of 14th February, 1967, by Wallace Crouch, based on a recent interview with Piddington.

Unfortunately the Darwin set, although installed by the time of the first Darwin Japanese raid, could not be brought into operation by the operators available. Piddington and an assistant were rushed by air to Darwin, and the set was commissioned early in March.

Evans bases his account on the newspaper article by Crouch Ref.11, and makes no mention of the rebuttal from Pither in the *Telegraph* of 18/2/67 (see Pither (Ref.12)).

13B - p.91 Justice Lowe: *"I was informed, while at Darwin, that one radio location unit had been erected and was undergoing tests, and would shortly be in operation ..."*

The Royal Commissioner into events at Darwin, Mr. Justice Lowe, visited Darwin to take evidence 5/3/42 to 10/3/42. He appears to be referring to evidence given by Air Commodore Wilson, see Moran (Ref.16M).

13C - p.93 Chief of Air Staff: *"This locally built set had in fact been installed before the raid but was not ready for operation."*

Evans is actually quoting from a report TO the Chief of Air Staff after the Royal Commission, see Schedvin (Ref.17F). The facts, which should have been available to the writer (believed to be Scherger), do not support the above report, so it is a mystery why he would mislead the Chief of Air Staff. Is it possible that admitting the set had not been installed, due, at least partly, to a lack of assistance by the Area Commander, may have been an embarrassment? Or was he simply not in touch with the true situation?

13D - p.189 *Enemy raids on Darwin in February 1942, created a serious emergency. This had been partly anticipated by the Radiophysics Laboratory when steps were taken in September 1941, to put together an Australian-designed AW set. These were made more urgent after Pearl Harbour in December 1941.*

As has been pointed out previously, these, "steps" were no more than a paper study of a long-range air-warning set which bore no resemblance to the later AW design. (See Alexander Ref.4).

13E - p.189 *the first of these [AWs] was flown to Darwin prior to the first Japanese raid on 19th February 1942 (but was not actually operational until 20th March 1942).*

It was actually the third production set. Evans gives the first indication of exactly when the set came into service. It comes from the quote below:

13F - p.189 *The following was an extract from a report of a senior officer of the Laboratory who was in Darwin assisting in the adjustment of the equipment: "Tests on the AW set were carried out on the 20th and 21st March and in the early morning of 22nd. Most of the tests were done with small planes (Wirraway, Kittyhawk, and A.24).*

"Operation with enemy aircraft: At about 11.30 a.m. on the 22nd March, indication was obtained of a plane or group of planes at a distance of 84 miles East of Darwin ... Speed was estimated at about 160 m.p.h. and the height at between 12,000 and 14,000 feet ... About twenty minutes after the first warning Fighter Operations said our fighters had engaged the enemy."

The senior officer was obviously Piddington. It is interesting to note that he was "assisting in the adjustment", not installing or repairing the set.

REFERENCE 14: *Surprise and Enterprise, Fifty Years of Science in Australia.* F W G White & D. Kimpton, 1976. CSIRO.

This is a, large format promotional booklet explaining CSIRO work in many fields. One section is devoted to radar and was written by Professor Fred White who became head of the RPL in 1941. He wrote this section after he retired as Chief Executive Officer of the CSIRO (from 1949 to 1970).

14A - p.21 *Towards the end of 1941, it became obvious that air attack would be the real danger to Australia and a group of scientists under Jack Piddington worked at top pressure to improvise an air-warning system based on the ShD system but modified to provide the maximum possible range without using more power. Thanks to the background of ShD experience, the first experimental equipment was produced in only 5½ days late in 1941 ... One of the first production models was sent to Darwin in February 1942. RAAF technicians were installing it when the Japanese staged their devastating bombing raid on the morning of the 19th. Piddington and his team flew to Darwin and assisted in getting the set operating by the morning of the 22nd, just in time to detect another Japanese bombing force. It was intercepted and scattered 32 kilometres off the coast.*

This account by Piddington's former superior and printed in 1976, after Piddington's claims in 1967 that the set had been installed, is interesting because White accepts that the set was NOT installed and he does not agree with Piddington. He also does not make any claim that the RPL started work on an AW project in September, 1941.

REFERENCE 15. *Saga of Achievement*. E.R. Hall, 1978. ISBN 0 9595927 0 9. Bonall Publishing.

Group Captain 'Bon' Hall served in RAAF signals. He was a POW in Singapore from 1942 till 1945, and later became CO of the RAAF School of Radio. He retired in 1968 and wrote his book based on RAAF records and interviews with surviving radio and radar personnel.

Hall gives as references without specific credits:

a) Mellor: *Role of Science & Industry*

b) Pither: the late Air Commodore A.G. Pither CBE, who provided much of the information on radar.

15A - p.200 *Although the decision on the [Air Warning] stations had been taken in September, it was not until the night of 7th December, 1941, that 14 members of the Laboratory started to build the equipment.*

By claiming that it had started development of the AW in September the RPL left itself open to Hall's criticism that it wasted 3 months! Hall appears to base his criticism on evidence given by Dr Martyn at the Royal Commission, wherein he did claim that RPL had commenced work in September (see Schedvin Ref.17C). If that were the case then Hall would have been justified in his criticism for, as seen in Alexander (Ref.4A) and Pither (Ref.6A and 6B), there was no real work on such a set.

15B - p.200 *The first three sets were completed by 4th February, 1942, and it was planned that they should be installed at Darwin, Kiama, and Rabaul. In January Pither had gone to Darwin and on 29th January, 1942, he selected a site at Dripstone Caves for the Darwin station.*

(Pither (Ref.6D) gives 28/1/42 but the difference is not important.)

15C - p.200 *It [the AW meant for Rabaul] was flown to Port Moresby shortly after where it was installed and became operational in March.*

A new AW set and an ShD aerial system, the same as the Port Moresby station, was flown to Darwin in Dakota aircraft, the first of which left Sydney on 5th February, 1942. Pilot Officers H. Hannam, B.L. Glassop and F A Hull were selected to install the equipment. They had not long before completed their training at No 1 Radio School at Richmond. When he selected the Dripstone Caves site, Pither arranged with the Department of Works superintendent for a 30' by 18' standard hut to be erected on site. Hannam and Glassop accompanied the first load of RDF equipment to Darwin and found the building on site and partially finished. They immediately set to work to assist in the completion of the building and then started preparation of the installation.

The hut erected for the radar was of steel frame, clad with corrugated iron sides and roof and sitting on a concrete slab. It was a standard 'Comet'-brand prefabricated hut 24' by 24' in area. A steel frame support for the heavy aerial and rotator was constructed inside the hut, poking out through the roof.

15D - p.200 *With the general apathy which existed in Darwin area, Hannam, had the utmost difficulty in getting support and assistance from the RAAF station ... Hannam and Glassop had to undertake pick and shovel work in the preparation for the installation.*

The lack of assistance from their own RAAF base is a recurrent theme. It is doubtful that Hannam, as the officer in charge, actually did shovel work. The other officers and men relate stories of digging trenches etc.

15E - p.200 *On the morning of 19th February 1942, Darwin was subjected to a humiliating enemy raid. Hannam was in hospital, having contracted dengue fever. During a break in the raid, Glassop found Hannam in a slit trench near the hospital and, while others headed south, together they went out to Dripstone Caves to hasten the completion of the RDF installation.*

On 21st February - two days after the heavy raid on Darwin - the final load of RDF equipment arrived by Dakota accompanied by Pilot Officer Hull.

Hull (Ref.3) confirmed the 21st February as the arrival date, with his pay book (No. 51845) showing his posting commencement on 22/2/42.

15F - p.200 *When the RDF equipment was unpacked it was found to be damaged. Work on the installation continued and an urgent call was sent to RPL for assistance. Within days of the first raid, the leader of the AW project and a fellow scientist went to Darwin to work on the installation. . . . work on the RDF station continued and the equipment became operational on 22nd March.*

Damage to the equipment has been mentioned by Barnard Ref.7C then Piddington (Ref.8B), but not previously by the RAAF. It is quite possible that some damage did occur in transit, given the rushed and makeshift arrangements.

15G - p.201 *The Chief of Air Staff had asked that a British MB RDF station held by RPL be installed at Darwin, but no action was taken. In September a decision was made to erect at Darwin an RDF station which was to be developed by RPL, but work on building the set was not started until 7th December.*

Hall repeats his previous assertions, Ref.15A.

15H - p.201 *The final set had been hastily constructed and it had not been subjected to operational trials. All equipment for the RDF station had not arrived in Darwin until two days after the first raid on 19th February and there were no manuals to assist the RAAF team in the installation of the equipment. Despite the presence of two of the scientists who had developed the RDF set, the station did not become operational until 22nd March, 1942. The RDF station had only been working a short time when at 11.30am the screen showed an aircraft or group of aircraft 84 miles east of Darwin ... A subsequent RDF plot showed the aircraft to be at 12000 to 14000 ft. and travelling at a speed of about 160 miles per hour.*

Hall repeats Mellor's assertion that there were no manuals (Ref.9C), a claim made also by Piddington in Crouch (Ref.11A).

Although Hall's account is critical of the RPL, it certainly bears out the other and most recent evidence in Ref.3.

REFERENCE 16: *Radar Defence and the Darwin Disaster*, 1942. M Moran, 1981.

Michael Moran completed this thesis for his degree from Australian National University. He makes extensive reference to the Royal Commission of Justice Lowe and to taped interviews he made with Dr Piddington in 1980. Unfortunately, Moran did not keep a copy of the tape. Moran also uses Pither Ref.6, Lockwood Ref.10, and the articles published in the *Daily Telegraph*, Crouch Ref.11 and Pither Ref.12.

Please note that my copy of Pither Ref.6 is an original copy on foolscap and the page numbers differ from those quoted in Moran's work. I have therefore shown my page numbers in square brackets.

16A - p.iv *A third such set [AW] was in Darwin on the day of the attack. It could have provided significant forewarning but the Air Force personnel who had accompanied it to Darwin a fortnight before could not get it working.*

Moran has concluded in this preface that the set was installed and the RAAF could not get it operating.

16B - p.14 *When, after Pearl Harbour, the Laboratory hurriedly designed and built a lightweight air warning set, Pither did not seem to its designer to make as great use as he might of the Laboratory's help in getting the set assigned to him for Darwin operational. (Ref. Piddington, conversation with author, 27/4/1980.)*

16C - p.14 *In the event, on 19th February, a fortnight after it arrived in Darwin, Pither's Air Force technicians could not get the set working. 'It should have been there earlier and it should have been operating earlier', Piddington recalls: 'It only took us a week to get it going.' He and a colleague had found the set 'a hopeless mess' when they literally flew to the rescue: 'It took us a week to get it going because they'd made such a mess of it.' Once the two laboratory officers had succeeded, they were no longer 'silly backroom boys' but popular. (Ref. Piddington, *ibid.*)*

This is a sharp revision of Piddington's original stand where he only says the set was damaged, Piddington Ref.8B. Then in his interview with Crouch Ref.11A, he states the RAAF could not get it functioning properly. Now the set is a hopeless mess! He appears very critical of the RAAF, and one wonders on what evidence he can say that the set "should have been there earlier . . ." Undoubtedly, if the RAAF had been able to use more aircraft the complete set would have been in Darwin earlier, but we must assume that Pither did all he could with the facilities available.

Hall (Ref.15H) says "Despite the presence of two of the scientists who had developed the RDF set, the station did not become operational until 22nd March, 1942.", but Piddington, quoted here in Moran Ref.16C, says "It only took us a week to get it going." an obvious difference of opinion between the two writers!

It is difficult to reconcile Piddington's assessment that the set was "a hopeless mess" with the RAAF evidence that the problem was only with the lengths of coaxial cable, a very small item of the overall equipment. It is probable, as suggested by Hull (Ref.3), that the place was untidy but it seems unlikely that the RAAF technicians would attempt any unofficial modifications or alter anything without higher authority, to justify Piddington's claim that "they'd made such a mess of it."

16D - p.44 *On 17th September, White learnt officially that "General Sturdee feels that the equipment (MB2) has certain limitations and disadvantages and the cost is rather high, ..." (Ref. Army HQ to White, CZ/6S)*

However, the RPL had already proposed modifications to double the aerial size for the MB2 which would increase the range at low angles and make it more suitable for ship detection, therefore overcoming the "limitations and disadvantages" that the Army used as a reason to reject the set (see RPL File RP39/2 *Warning RDF Station at Darwin - Aerial Arrays 1/2/41*).

Barnard Ref.7A stated "There was controversy between the services as to which should bear the expense." This impression was probably gained from RPL observers. Although the Army rejection mentions cost as a

secondary reason, it does seem more likely that this was in fact the major reason for rejecting this set. Moran believes the rejection was for technical reasons, but he did not have access to the RPL report mentioned above (RP39/2). I believe that the Army did not want the MB2 installed on their tower at Darwin because it didn't want to pay for something that was more useful to the RAAF, and should have been paid for by them.

Professor White was head of the RPL by this time, having replaced Dr D F Martyn.

16E - p.48 *Independently of White's efforts in late 1941, some of the Laboratory staff began working on the idea of developing a lightweight air warning set by adapting parts of the ShD. This work, begun in September, was inspired by the poverty of British supplies, and transfigured by Pearl Harbour. Its leader, Piddington, read of the Japanese raid [on Pearl Harbor] while riding a bus to work, down in Pitt St. At ten that morning {8/12/41} he gathered a group in the Laboratory and, within the week, they built a set. It was light, portable, required no high towers and promised long range warning. (Ref. Piddington, *ibid.*)*

Yet Alexander Ref.4A, points out that very little effort was given to the September proposal which relied on the availability of supplies from the UK. The AW set that eventuated in December was a modified ShD radar and had little in common with the September proposal. The AW could hardly be called lightweight or portable at 6000 kg. Such a set did not develop until mid-1942, and then only at the request of Pither, who collaborated directly with the Railways Department, by-passing RPL (see Pither (Ref.6)).

There is nothing in the RPL technical files to indicate that any design or manufacturing work was done on a likely air warning set prior to December, 1941. However, Martyn in his evidence to the Royal Commission asserted that RPI, had commenced work in September (see Schedvin Ref.17C).

One must wonder why Martyn and Piddington were so keen to claim priority for the AW when clearly the RPL did not develop it until the rush job of December. Of course claiming priority of invention is a most important activity of academic recognition.

16F - p.50 *Pither went to Darwin on 28th January to prepare the way, selecting a site on a cliff near the town. (Ref. Lockwood, p.1467.)*

16G - p.50 *The set arrived one week later, ["one week later" is 4 February and clearly incorrect] accompanied by two Air Force officers. The Laboratory was not told at any time before the raid that the set was in Darwin, (Ref. Crouch Daily Telegraph 14/2/67) a fact which may reflect the lack of Air Force interest in the Laboratory's practical assistance which Piddington has mentioned. (Ref. Piddington, *ibid.*)*

It seems most unlikely that the RPL, which had been very closely involved with the planning to send the set to Darwin, would not know that it was being shipped by air urgently and could be expected at its destination within a few days of handing over.

16H - p.50 *What happened next is unclear, for some of the evidence is contrary. Twenty-five years later, Pither wrote in response to a suggestion that the set should have been operating on the day, "The fact is that the last Dakota-load of radar equipment, including the all-important aerial, arrived at Darwin two days AFTER the bombing. About a week later the radar was complete, but its performance was poor and Dr Piddington was immediately called to Darwin to get it working. While he was getting there the RAAF located the fault a defective aerial feeder cable and had the set working fairly well by the time he arrived. Nevertheless, they were extremely grateful to have the designer on hand to extract the last ounce of performance from it." (Ref. Pither, Daily Telegraph 18/2/67). [See Pither Ref.12A]*

It was more than a "suggestion" that Piddington made in his interview with the *Daily Telegraph* published on 14/2/67, Crouch (Ref.11), it was an accusation.

Pither was replying to the drubbing that Piddington had given in the paper four days previously and his explanation certainly fits the other evidence found. Note that Pither struck a conciliatory tone in his reply, giving credit to Piddington - was he trying to heal a rift between the two? (See Pither Ref.12A).

16J - p.51 *Yet Piddington recalls that he found the set “a hopeless mess”, that “it took us a week to get it going because they'd made such a mess of it” (Ref. Piddington, conversation with author, 27/4/80). If it was the case that “the station was still being erected” on 19 February, the failure lies not only in the delay of the aerial, the cause of which is unknown, but also in the events which took place in the fortnight between the arrival of the set and the day of the raid (Mellor. P.436.)*

Moran has preferred to accept Piddington's version which doesn't accord with other evidence on several points. In questioning the delay it seems Moran did not consider the logistics of shipping the equipment to Darwin, and he did not have the evidence of eyewitnesses now given in Simmonds Ref.1 and 2, nor Ref.3.

16K - P.52 *(Blake) “I got information first because they wanted location and they specified certain things that were necessary, and they came to me and asked whether we would find them, and I told them. I took Captain (Scherger) along and showed him. I showed them some machine-gun posts dug in and they said it would take too long and they would have to take a chance.” (Ref. Maj. Gen. D V J Blake, [Army], highest ranking officer in Darwin, evidence to Lowe Royal Commission, 5/3/42.)*

It is hard to know what Blake is referring to. The reference to machine-gun posts has no relevance to the site needs of the radar. What would "take too long and they would have to take a chance"? The radar set needed a building on a cliff-top site, not some use of machine gun posts. Why was Scherger involved? Pither had already arranged a contract for a building with the Dept of Works on 28/1/42 and it was all in hand. I suspect Blake was in mind of some totally different project, or just confused. Moran himself finds elsewhere that Blake "was quite in the dark" (see Moran Ref.16 p.51).

16L - p.52 *According to Blake this approach took place “about a week” before the raid. If so, he may provide a clue to the operational failure, for his evidence then suggests the cliff site was chosen not when Pither went to Darwin on 28 January, nor when the set arrived on or about 5 February, but 'about a week' before the raid, or 12 February.*

Moran is clearly mistaken for thinking the site was selected only on 12/2/42, because a substantial building was required before the set could be installed, and we know from other evidence that it was there, built between 28/1/42 and 9/2/42, as arranged by Pither. Moran repeats his error of assuming the complete set was in Darwin by about 5/2/42.

16M - p.52 *The evidence of the Air Force Area Commander, Air Commodore D E L Wilson, provides some reason for believing that this was the case. he was asked, [L is Lowe, W is Wilson]*

L When you assumed control of this area, did you consider a radio location set was necessary?

W Yes, I knew the Air Board policy that Darwin was going to have an aero-location set and an officer came here. A set was allocated to Darwin. It is now being tested.

L Did you take any steps to accelerate the forwarding of such a device?

W None other than that the officer who came here was told that my need was urgent, and the equipment was to be sent up by air. They are big rectangular pieces of metal weighing quite a lot, and they are very solid.

L When did he visit here?

W In between my visit to the Air Board and my visit to Java - prior to the 15th.

L When did the machine arrive for assembly?

W After the raid. In fact, the whole of the machinery only as recently as two or three days ago. We had a fair amount of trouble about the power. The matter had been in the mind of the Air Board long before the raid took place, but it rested on the work being obtained from the Laboratory in Sydney.

Wilson's evidence is a bit vague but he did at least comprehend that the set was not complete till after the raid and that there was a problem with a power supply. However, his "two or three days ago" puts the last arrival at around 1 or 2 March, but we know it was 22 February.

It is strange that these two very senior officers, Blake and Wilson, did not know with any certainty where they had been, or when, or who they had been speaking to. The matter of this top priority secret new device must surely have made an impression and been noted in a diary or such. It seems odd that in the military services where even the simplest request generates a mass of paperwork, that the Royal Commissioner did not just call for loading sheets or flight plans for aircraft, or pay slips or travel authorities for personnel which would give precise dates and actions.

16N - p.53 *But Wilson had visited the Air Board in Melbourne, 'at the beginning of February' - or shortly after Pither arrived in Darwin - and spent 'about three days in Melbourne and unfortunately, about four days travelling time'. He had arrived back in Darwin 'approximately a week' before he left for Java on 15th February. If these dates are correct it is hard to place Wilson's return before 7 February, or two days after the set had, according to Pither, been flown to Darwin. (Ref. Lockwood p.147; cf. Pither, op.cit.p.15)*

Moran has interpreted the words of Lockwood (Ref.10D), who was incorrect when he drew from Pither (Ref.6E). Pither actually wrote "This move commenced on the 5th February . . ." and "The move was completed in February but the station was still being erected when the first air raid was made on Darwin on 19th February." [my emphasis]

16O - p.54 *Furthermore, 'the officer' - presumably Pither - visited Wilson between 7 and 15 February which roughly supports Blake's timing. It is curious, however, that Blake should recall being visited by Scherger rather than Pither - a recollection which better fits a scenario in which Pither had returned to Melbourne and the two junior officers whom he thought inexperienced were up in Darwin. (Ref. Pither p.39. Moreover, Wilson's evidence is misleading or mistaken on a number of counts. He thought 'the whole of the machinery' had arrived about 2 or 3 March, which was plainly wrong. He was told the set was too cumbersome to fly up by air, which was curious since - if his dates were correct - it had already been flown up, bar the aerial, and in any case weighed only about 1000 pounds. He may have confused the aerial with 'the machinery'.*

Unfortunately having questioned Blake's suspect or confused statements, Moran prefers a hypothesis based on his story, not the alternative simple version of Pither. There is no reason to disbelieve that it was Scherger who visited Blake and it is more likely that "the [anonymous] officer" who visited Wilson between 7 and 15 February was P/O Hannam, attempting to obtain help with installation of the set, in which case the evidence of Blake and Wilson fits more easily with the events. A lowly Pilot Officer would not be remembered by an Air Commodore whereas, if it had been Wing Commander Pither, Wilson would most likely have recalled the name.

Moran's problem with Wilson regarding the impossibility of shipping the apparatus by air is answered by accepting a meaning of "I was told that it was [previously] thought impossible to get the apparatus sent up by air [but that has now been achieved]." The RAAF had managed to dismantle the large aerial into pieces small enough for air transport.

Moran is misled in thinking the weight of the set was only 1000 pounds, as given by Crouch (Ref.11A).

16P - p.54 *But in another place, Pither, who did not give evidence before the commission, recalled meeting Wilson and selecting a site when he visited Darwin at the end of January. (Ref. Lockwood, p.1/4/67) [Lockwood Ref.10] In any case there was a delay of about one and one half weeks, partly due to the inexperience of the two officers who replaced Pither in Darwin. They were, Pither believed, handicapped by lack of assistance from Air Force personnel in Darwin, a lack they might have overcome had they "known their way around" (Ref. Pither p.39). Interestingly, the officers found the Area-based Air Force cooperative whereas Pither had found the Area Commander "skeptical".*

[Wilson was sceptical (Pither, in Lockwood), but the officers found the station less helpful than Wilson's people (in Pither)].

This is an erroneous conclusion which does not accord with the references quoted. Wilson was the RAAF Area Commander, in control of all RAAF personnel around Darwin, therefore the station people were Wilson's people. See Lockwood (Ref.10C and 10E) and Pither (Ref.6E). The recollections of Pither, reported by Lockwood (Ref.10) as quotations and used by Moran, do not appear in Pither's written work, Pither (Ref.6).

16Q - p.54 *Piddington recalls that when he and a colleague visited Darwin in Wilson's time, 'they more or less ignored us'. (Piddington, conversation with author)*

Darwin was in crisis at that time, there had been a mass exodus of civil and military personnel and those that remained were somewhat preoccupied with fighting a war, so it is perhaps understandable that Dr. Piddington was not given the attention and recognition he desired. Hannam was not noted for social graces so may have just expected Piddington to get on with the job in hand, rather than be feted by a genial host.

Given the new evidence of Simmonds Ref.1 and 2 and of Ref.3, the technical data on the AW radar set (Appendix 1), and the different interpretation of dates and events now possible, perhaps Moran would reassess the conclusion he reached in his preface (Ref.16A).

REFERENCE 17: *Shaping Science and Industry*. C B Schedvin, 1987. Allen & Unwin.

{Professor} Boris Schedvin wrote this book as *A History of Australia's Council for Scientific and Industrial Research, 1920-49*. He {is an economic historian who} is listed as a specialist on the history of the Australian economy in the 20th century, and perhaps unfamiliarity with electronics might explain the technical errors in his chapter on radar.

Schedvin had access to official CSIRO, RPL and Government files, and also makes frequent reference to the works of: Pither, Barnard, Mellor, Evans, Hall, and Moran. He also had access to the taped interview of Piddington with Moran.

17A - p.261 *White took the initiative by asking whether additional AW [apart from the two CHL and one MB2] would be required for other parts of Australia, and by offering the prospect of developing a model with higher power and a much greater range (160 to 225 km). (Author's note No.30 - CSA, series 297, Minutes RAB 14, 29/8/41)*

17B - p.262 *Meanwhile, the laboratory began a series of experimental modifications to the ShD in an attempt to convert ship warning to air warning. The work was begun in September in anticipation of a decision by the Chiefs of Staff on AW requirements." (Author's note No.32 A common complaint by the RAAF was that the laboratory failed to initiate work on the AW until after Pearl Harbour, some three months after the decision to establish the stations. The facts are, as reported in the main text, that the laboratory made a start in September, thus anticipating official approval by the Joint Planning Committee. The project was delayed by Piddington's absence ... (Cf. E R Hall, p.200 and A.G. Pither)).*

17C - p.262 *In addition to an increase in power, the main modification was to the aerial to permit sky scanning. Some delay was caused by the absence abroad of Jack Piddington, leader of the ShD project. Work began in earnest soon after Piddington's return. Legend has it that the first Australian AW set was improvised in 5 1/2 hectic days in December 1941, but this tends to underplay the importance of the preliminary research. (Author's note No.33 - Martyn in his evidence before the Lowe RC insists that work on what was to become AW MK I (Aust) commenced in September 1941. CRS A816, item 37/30/293, M556.)*

Unfortunately Schedvin has misinterpreted the facts, as should be clear by now. See Alexander (Ref.4) and Pither (Ref.6).

When the Chiefs of Staff did make a decision to order Air Warning radar they ordered it from UK, not RPL. See Pither Ref.(6B).

The RPL did not make any experimental modifications to the ShD aerial until after 7/12/41, as part of the AW development, and it was not to "permit sky scanning". The ShD aerial was quite suitable for sky scanning, but the transmitter was not powerful enough to give long range on aircraft. RPL proposed in September to use the more powerful CHL transmitter, but none was available; then in October proposed to build a new powerful transmitter, using valves that weren't available!

17D - p.262 *The sequence of events leading to the first Darwin raid on 19 February has been subject to some dispute. Those in the RAAF close to Squadron Leader A G Pither, who was responsible for installation of the Darwin AW station, claim that the set for Darwin did not appear until two days after the first raid on the 19th. (Author's note No.34 - as reflected in Hall) [Hall Ref.15] The obvious inference is that no blame should be attached to the RAAF for the absence of air warning on the 19th.*

Radiophysicists claim that the complete set arrived in the second week of February, probably around the 10th or 11th. Experts from the laboratory did not accompany the set to advise on installation and operation because Pither was confident that RAAF staff could handle the job. They were not competent, however, to assemble complex electronic equipment, and were not able to get the set working in the admittedly short period before the first raid. (Author's note No.35 as reflected in Mellor) [Mellor Ref.9].

Indeed, when Piddington, assisted by B F C Cooper, arrived in Darwin several weeks after the first raid they found the set in a hopeless mess. (Author's note No.36 - recorded interview between J H Piddington and Michael Moran, 27/4/1980. Tape made available by Moran.) [Moran ref.16]

17E - p.263 *The evidence, while not conclusive, supports the Radiophysics version. In testimony before Mr. Justice Lowe ... an RAAF officer and future Air Marshal, Frederick Scherger, indicated that the set arrived in the second week of February. (Author's note No.37 - RS, A816, item 37/30/293, D216, evidence of Group Capt. F R W Scherger.)*

17F - p.263 *An official comment on Lowe's first report prepared for the Air Chief Marshal was unequivocal:*

This locally made (AW Mk I) set had, in fact, been installed before the raid but was not ready for operation. The system is now (April 1942) functioning with considerable success.

(Author's note No.38 - CPP, 194546 Vol IV, Commission of Inquiry Concerning the Circumstances Connected with the Attack made by Japanese Aircraft at Darwin on 19th February, 1942, p.1039.)

There is no hint in the RAAF commentary of late or incomplete arrival.

These statements by Schedvin are quite unfair. Wilson, in his evidence to the Royal Commission did state that some of the equipment did not arrive till after the raid. (See Moran Ref.16M). Scherger was correct in stating that "the set" had arrived in the second week of February but neglected to mention that the rest of the equipment arrived after the raid.

17G - p.264 Piddington and Cooper were summoned to Darwin; Piddington was the only person who fully understood the workings of the set. It was working within a week, and commenced operations on 22 March. Almost immediately a formation of aircraft was detected 135 km east of the town approaching at 260 km and hour and flying at 12000 to 14000 feet. The enemy was engaged, and one aircraft shot down.

No previous commentator has claimed an aircraft was shot down, and official records indicate only that this raid was disrupted due to the radar warning given.

Schedvin is altogether too favourably disposed to the RPL (CSIRO) version of events, but after all, it was the CSIRO that had commissioned him to write its history.

REFERENCE 18: Dr J H Piddington, correspondence 22/2/1993, in answer to a letter from author asking for clarification of his claims.

18A In reply to your letter re ShD and AW, you will find the answers in Australia in the War 1939-45 Civil The Role of Science and Industry. by D P Mellor, Canberra, Aust. War Memorial. [Mellor Ref.9]

I did not have a tape of talks with Michael Moran. When Brian Cooper and I arrived in Darwin it was obvious that Hannam and his team had been playing around with the set for some time. However they had so little training in electronics that I doubt they could ever make it work – in particular the aerial tuning.

The whole debacle was the fault of George Pither who wanted all the credit for himself.

After Darwin the RAAF asked us (CSIR) to go to Hammond Island (Thursday group) where the AW was soon to save a whole squadron of US B17's on Cape York, and then to cause the loss of a flight of Zeros at Lae.

Yours sincerely, Jack Piddington.

Strangely, Brian Cooper has no recollection whatsoever of his time in Darwin, although he does remember other events of that period.

Piddington is in no doubt where the fault lay for the debacle at Darwin!

The claim that Pither wanted the credit for the installation at Darwin does not seem likely. Pither was already in charge of RAAF radar. He had ordered a number of radars from UK and arranged installation of one existing UK set at Newcastle in January 1942. There seems little reason or need for Pither to claim credit for radar installations. The set at Darwin was just one in the overall program, and it was the inconvenient Japanese raid that catapulted it into unfortunate prominence.

CONCLUSIONS.

The conclusions are almost an anticlimax after the revelations of the new evidence available and the detailed study now possible. Some answers are now clear but other questions remain unanswered and may never be resolved. The reasoning applied and answers to a number of questions posed during this research follow.

Question 1 - Was the AW radar installed at Darwin on 19/2/1942?

The evidence now available supports overwhelmingly the fact that the AW radar was NOT installed at Darwin on 19/2/42. Where, then, did that oft-repeated assertion to the contrary come from? An analysis of all the references cited by various commentators makes interesting reading and is summarised below:

REF. No.	AUTHOR	FOR	REFERENCES FOR INSTALLED OR NOT:	
			NO	YES
Ref.1D	Simmonds	RAAF	Collier	
Ref.1E	Simmonds	RAAF	Scott	
Ref.2D	Simmonds	RAAF	Hull	
Ref.3	Suttor	RAAF	Suttor	
Ref.4	Alexander	RPL	(made no comment)	
Ref.5	Porter	RAAF	from Pither?	
Ref.6	Pither	RAAF	Pither	
Ref.7	Barnard	RPL		from Piddington?
Ref.8	Piddington	RPL		Piddington
Ref.9	Mellor	RPL		Piddington
Ref.10	Lockwood	-	Pither	
Ref.11	Piddington	RPL		Piddington
Ref.12	Pither	RAAF	Pither	
Ref.13	Evans	RPL		Piddington
Ref. 14	White	RPL	White	
Ref.15	Hall	RAAF	Pither	
Ref.16	Moran	-	Wilson	
Ref.17	Schedvin	RPL		Piddington
Ref.18	Piddington	RPL		Piddington

So, on the one hand, we have surviving eye-witnesses Collier, Scott, Hull and Suttor who state categorically that the AW set had not been installed at the time of the first raid, plus Pither and Porter who were closely involved and in a position to know the true situation. Wilson, in his evidence to the Royal Commission believed the set had not been installed, and White, the most senior man in the CSIRO, also accepts that it was not installed, giving a total of 8 people all prepared to say the AW was NOT installed on 19/2/42.

On the other hand all the assertions made by various commentators that the set WAS installed and that the RAAF personnel could not get it to operate can be traced back to statements made by just one man, Dr J H Piddington - yet he was not even in Darwin till several weeks later. His own knowledge of the logistics and questioning of the personnel on site would have revealed the several air shipments, the difficulties with

erecting the aerial, the lack of a power unit, and the fact that the last delivery made on 22/2/42. Why then would this one person claim it had been installed but the RAAF technicians were incompetent to get it operational? Why would he escalate his claims in his very critical interview with Crouch in 1976 and to Moran in 1980 to further castigate the RAAF?

The mild comments made by Piddington in his early report (Piddington Ref.8) when compared to the later critical newspaper interview (Crouch Ref.11) and then his comments made to Moran (Ref.16) when taken with the newspaper response from Pither Ref.12, lead one to speculate on the atmosphere which developed between the parties and the motives of Piddington. Perhaps the wording in Crouch Ref.11A gives a clue, with statements such as:

"a bitter memory for Piddington"

"No decorations or rewards came his way"

"for reasons of his own he won't be there [to see Pither unveil a monument in Darwin]"

The recent letter from Piddington (Ref.18) makes his attitude very clear:

“The whole debacle was the fault of George Pither who wanted all the credit for himself.”

Piddington seems to have been resentful for not receiving enough recognition and particularly bitter towards Pither, who eventually advanced in the RAAF, retired as an Air Commodore and received a CBE. Ed Simmonds has another view on Wing Commander Pither which has as yet not been finally written. In essence he believes that Pither was not a glory seeker and only wanted to get on with the job in hand. In addition Ed believes that Pither did not receive the recognition he deserved during the war. {See *3IRS, Dripstone Caves*, p 54} He appears to have been a gruff man who was not prone to relaxing and admits himself that he virtually created radar as a private empire. It would appear that this antagonised the RAAF hierarchy because he was not promoted during the war. Promotion was postwar {though the CBE (Military Division) was awarded in the RAAF Postwar Honours List on 2 January 1956}.

It is now known that relationships between the RPL, the military services and the Government and private manufacturers were at times very strained. Dr. Martyn, the head of RPL and a close friend of Piddington, was transferred from RPL after being declared *persona non grata* by the PMG, although other reasons were also considered to justify his removal (see Schedvin Ref.17 p.256). Pither (Ref.6) criticises the RPL, using reports from the Army to illustrate the level of dissatisfaction felt by all. Perhaps these criticisms are one reason for Piddington's ill feelings.

Question 2 - Why wasn't the radar set installed before 19/2/42, though handed over to the RAAF on 5/2/42?

There are three reasons:

- a. The complete radar set was large and heavy and had not been designed for rapid transport by road, rail or air. It had to be dismantled and cut down to fit in the available aircraft, then re-assembled on site. Contrary to what Piddington has promulgated, and has been accepted by other writers, the weight and bulk of the complete set posed a major transport problem and therefore caused inevitable delays.
- b. It took three trips by DC2 to transport the entire set to Darwin, taking a total of around 16 days. From the dates given it appears that it took an average of 5 days to make the round trip from Sydney to Darwin each time, including loading and unloading. That places the earliest possible arrival of the final (third) load in Darwin around 21/2/42 which accords with Hull's claim of its (and his) arrival on 21 February.
- c. The RAAF base in Darwin did not provide assistance before the raid and it was the US Forces, after the raid, which were instrumental in getting the radar installed at all! Despite the highest priority and the backing of the most senior officer in the RAAF, let alone the Government's belated urgency, it appears the Darwin RAAF officers treated the situation casually. Their attitude and then the disgraceful events after the first bombing do little to enhance the reputation of these high ranking RAAF officers in Darwin (see Lockwood (Ref.10) *Australia's Pearl Harbour*).

Question 3 - What was wrong with the set after assembly?

It is obvious that the trouble was in the aerial tuning, but it is not clear whether it was due to:

- a. faulty coaxial cable - or the wrong type supplied;
- b. inexperience of the technicians;
- c. lack of the manual;

or a combination of all three circumstances.

It does seem that there was something wrong with the cable. The claim made by Pither Ref.12, that one cable was faulty and was replaced prior to Piddington's arrival, could well be correct. The time taken to find the fault may have been extended by inexperience, and lack of the manual would have made it especially difficult.

An interesting scenario is suggested by Hull Ref.3. If the RAAF had managed to install the station a few days earlier, or the Japanese raid had been a few days later, the station would still not have been operational because the coaxial cable was the wrong grade or faulty. The blame would then have fallen squarely and heavily on RPL, which had supplied the cable.

Question 4 - Why did the radar not become operational till 22/3/1942?

The last of the equipment was delivered on (or about) 22/2/42 and Piddington arrived at the end of February or early in March, yet it took another 2 to 3 weeks for the station to become operational. The aerial tuning problem had to be solved, and this may have involved waiting for correct or extra coaxial cable to be shipped from RPL in Sydney. Then the important calibration procedure had to be carried out by flying an aircraft around the radar installation a number of times. No commentator has taken account of this time-consuming task (made very dangerous by the possibility of further Japanese air attacks!). The time taken to get the station on air compares favourably with the 18 to 23 days taken for the Port Kembla installation, yet Piddington and others have ignored the inevitable time delay for calibrating the aerial when making their claims that the station should have been in operation earlier.

Question 5 - Did the RAAF have a manual for the AW during installation?

The possibilities are:

- a. the manual was not produced till much later than the 4/2/42 date indicates;
- b. the manual was available but not passed on to the RAAF;
- c. the manual was passed on to the RAAF but not sent to Darwin.

Piddington and Hall, from opposing camps, both say there was no manual at Darwin, whilst technicians on the spot do not recall seeing it, yet the preliminary AW manual is dated 4/2/42. Had RPL supplied a manual Piddington would surely have disclaimed RPL responsibility and blamed the RAAF for its disappearance, so it seems certain that, as claimed, the Darwin station did not have a manual because it had not yet been produced. If so, the reason the manual is dated 4/2/42 is open to conjecture, although other RPL technical documents also show discrepancies in dates of publication. The manual was written by Brian Cooper and the aerial tuning details were written by Harry Minnett, both involved in the installation of the first AW station at Port Kembla from mid-January to mid-February. If they wrote the instructions following their practical experience of the Port Kembla installation, there is a good chance they were not typed up until some time after 19/2/42, despite being dated 4/2/42, but the true circumstances will probably never be determined.

Question 6 - Why didn't Pither or the radar officers on site give evidence at the Royal Commission?

Their evidence would certainly have clarified the events but would also have been a damning indictment of the RAAF Commander and his staff in Darwin. One is left to speculate as to whether the high-ranking RAAF officers decided not to involve the lower ranks, and so minimise personal embarrassment and career damage. No mention is made in the Royal Commission evidence that it was actually the US Army Air Force which got the aerial erected and supplied the power unit.

As it was, the actions of RAAF personnel after the bombings left much to be desired and drew scathing criticism from the Royal Commissioner, but the high ranking officers escaped with their reputations only bruised. They claimed that confusion amongst low-ranked officers led to the 'evacuation' drama. However, it would have been hard to find a similar scapegoat for the obvious lack of assistance provided to the radar crew, given the secrecy of radar and the direct responsibility held by the senior officers.

Question 7 - Did the RPL start manufacture of an Air Warning radar in September 1941 as claimed?

The claim that the RPL had commenced development, in September 1941, of what was to be called the AW radar set, does not stand up to scrutiny on a number of counts.

The claim was first made by Martyn, the chief of the RPL, in his evidence to the Royal Commission in 1942 (see Schedvin Ref.17A, 17B, 171C) and is repeated by Piddington in Moran (Ref.16E). However, Alexander (Ref.4A, 4B) and Pither (Ref.6A, 6B, 6C) show that no such development was undertaken. The author's search of RPL technical files did not reveal any work which could be construed as a development leading to the AW, prior to December 1941. The paper study that was undertaken in September was of a theoretical design that was nothing like the December AW.

Given that there seems to be an overwhelming need in academic circles to claim first priority for any development or breakthrough, perhaps Martyn and Piddington felt the need to stretch the limits of fact to make the earliest possible claim. That then left the RPL open to the criticism of Hall (Ref.15A, 15G) that the RPL had done nothing constructive for three months.

Interestingly, claims by the same two scientists that they had prior knowledge of radar and had even built a radar set before the UK revelations in 1939 expose similar problems of credibility (unpublished paper *Radar Knowledge in Australia Prior to 1940: Fact or Fiction?* MacKinnon, 1993.)

It is obvious from a close study of the AW design and the RPL Technical files that the AW was actually the outcome of the fortuitous existence in December 1941 of the ShD radar set - itself a modification of the UK ASV MKII radar - and parts lying around in the Laboratory from a failed GL (Gun-Laying) radar project, and the ease with which they could be adapted to meet a need that had not been taken seriously before Pearl Harbor, ie not before {8/12/1941 (EST)}. It is interesting (or worrying) to speculate on the outcome for Australia and the RAAF if the GL radar design, a failure for its intended purpose, had not been available and so suitable for adaptation to the ShD, to create the AW.

It is hoped that this long and exhaustive analysis will set the record straight for future researchers and commentators. At least those on the RAAF radar side can rest a little easier knowing that they were not responsible for the delay in warning Darwin (in fact coast watchers on Thursday Island gave a 30 minutes warning by radio but it was ignored by the RAAF officers on duty.)

APPENDIX 1

Technical Details of the AW Radar Equipment.

REFERENCE: *The Early History of Australia's Radar.* C. MacKinnon, *Electronics Australia.*
(3 part series, January - March, 1991)

Background

In 1939 England confided the secrets of radar to Commonwealth countries, and as a consequence Australia set up the Radiophysics Laboratory (RPL) to carry out further radar development. The RPL received samples of the English ASV MKI and ASV MKII radar (Air to Surface Vessel) but RPL projects to improve it and to develop a GL (gun-laying) radar failed. However, the ASV design was used as the basis for the Army ShD (Shore Defence or Ship Detection) radar. The ASV transmitter, using two VT90 triodes was used, along with the ASV receiver, with extra circuitry to provide two cathode ray tube displays, one for range and one for bearing or azimuth, with a complex time-base circuit to provide more accurate readings. The ShD equipment was fitted into four 19 inch rack-type PMG cabinets. The ShD aerial was a large phased array connected in three sections so that the aerial beam could be switched for greater bearing accuracy. Initially the aerial was rotated by a hydraulic motor but later production used an electric motor with a gear and chain drive.

Around the same time as the ShD was being developed, work proceeded on a GL radar which used two 833 valves, but the project was eventually cancelled. Although the RPL ASV project failed, HMV Pty. Ltd. began manufacture of a copy of the UK ASV MKII in 1941, to outfit the RAAF.

Development of the AW

The ShD was designed for a range of only 30 miles, (the range of the coastal artillery). When the urgent need arose for an Air-Warning radar with a range of 100 miles or so, the RPL adapted the ShD transmitter by increasing the length of each transmitted pulse (for more power), but then had to decrease the number of pulses per second to keep within component power limits, and to allow time for the pulses to return from a more distant target. To achieve longer pulses the ShD transmitter was modulated (driven) by the inclusion of that cancelled GL transmitter unit, which luckily was capable of withstanding the higher energy levels.

The bandwidth of the ShD receiver was made much narrower, which improved the ratio of signal to noise, ie it improves the ability to pick out faint signals from the noise. The receiver was taken from the HMV ASV production lines and retuned. In fact the first three AW sets had pre-production ASV receivers from HMV bolted to a piece of plywood and slid into the PMG rack. Later versions had a proper front panel.

The AW was designed to have only one display, for range, so the electronics were simplified and only two of the PMG racks were used. The transmitter weighed about 550 kg and the receiver about 450 kg.

AW Electronics Equipment

The first three AW sets were assembled at the RPL in the grounds of Sydney University and could have been transported to Richmond Air Base, along with spares etc, on one truck.

Aerial

As its name suggests the ShD (Shore Defence) radar was located on the coastline and consequently the aerial was designed to withstand fierce storms. The AW used the same large and heavy aerial and RPL adapted it by eliminating a three-section switching arrangement and coupled the three aerial sections together using coaxial cable and tuned feeder lines to match the impedance of the aerial to the transmitter. The aerial weighed around 1200 kg and was approximately 6m. by 5m. by 1m. When assembled. It was constructed of angle-iron frames, bolted and welded together and covered with sheets of 25mm by 25mm steel wire mesh as a reflector. For road transport the aerial could be dismantled into 3 sections each 2m. by 5m. by 1m.

Rotator

The first ShD rotators used a hydraulic pump and oil motor controlled by servo valves. It was a heavy and complex device but luckily the NSW Railways had just completed a prototype of an alternative electric motor rotator, and this was pressed into service for the AW.

This rotator consisted of a 3/4 HP electric motor driving a reduction gear box which turned a chain gear. A chain turned a very large driven gear attached to the aerial centre axis. The rotator mechanism was housed in an angle-iron frame, underneath and supporting the aerial array, and was about 2m. by 2m. by 2m. in dimensions and weighed about 600 kg.

Both the aerial and rotator were manufactured by the NSW Government Railways at the Eveleigh workshop at Redfern. It is likely that they were transported to Richmond assembled and then had to be dismantled into components to fit into the aircraft. Some parts even had to be cut smaller with a hacksaw. Once on site it would have to be reassembled like a giant meccano set.

Spares and Test Equipment

The usual kit of spares and test gear weighed around 450 kg. (References: RPL Research files, in particular PD1 through PD17.)

Building

The ShD and a number of AW sets were installed in a reinforced concrete 2 or 3-room building, with the aerial and rotator mounted on a flat roof. However, in view of the urgency, the building at Darwin consisted of a 'Comet' brand prefabricated hut made of steel frames with corrugated-iron cladding, similar to farm sheds popular in the N.T. It was 24' by 24' (8m. by 8m.) and bolted to a concrete slab floor. A separate frame was constructed and fitted internally to support the aerial and rotator. Sometime after the installation a cover was provided to seal around the hole in the roof!

Airfreight to Darwin

The all-up weight of the complete AW with a set of spares and ancillary wireless equipment and work tools was about 6000 kg. In February 1942 the RAAF transport aircraft was the Dakota DC2 with a payload capacity of around 2500 kg, so it is apparent that 3 aircraft would be needed, or if only one was allocated, then it would require three trips. Two respondents think the aircraft was a DC3 chartered from Australian National Airways. The RAAF had leased 4 DC3s from ANA but had returned them by June 1940. It then purchased 10 DC2 aircraft ex-Eastern Airlines for coastal patrol and transport duties. It is possible that the RAAF did use one of ANA's DC3's but the differences between the DC2 and DC3 would not have made any significant difference to the logistics of getting the AW set to Darwin.

The door of a DC2 or DC3 is only about 1.5m. by 0.7m., meant for passenger access, and the DC2 cabin is only 1.7m. wide (the DC3 cabin is 2.33m. wide). The difficulty in loading the aerial parts and even the electronics cabinets now becomes obvious.

The RAAF. obtained a number of Dakota C47, transport, versions of the DC3 with two large doors, in 1943 and this eased the loading of large items considerably.

One eyewitness report says it took two days to fly to Darwin, because the aircraft did not leave till midday. Another flight took only one day, beginning at first light. That long trip was possible because it was summer, with long daylight hours. DC3 pilots contacted by the author consider one day from Sydney to Darwin would be a real strain on aircraft and crew and that two days would be a more reasonable expectation.

(Reference: *Dakota, Hercules and Caribou in Australian Service*, S. Wilson, 1990.

Aerospace Publications, ISBN 0 9587978 5 4).

APPENDIX 2:**Instructions for matching coaxial cable lengths for AW radar set.**

There have been technical problems with the reproduction of this appendix; when these have been overcome, it will be re-inserted

APPENDIX 3

Tragic Irony of the First Air-raid that Flattened Darwin.

Wallace Crouch.

(Full text of the article in Daily Telegraph, Tuesday 14/2/1967, p.26)

When 118 Japanese aircraft caught Darwin completely off guard on February 19, 1942, killing 243 people there was an air-warning radar unit in the city but it wasn't working.

It is a bitter memory for Dr John H Piddington, a top Australian scientist and developer of Australia's first radar. The air-warning unit, Australia's first was developed by a team of 'backroom boffins' led by Piddington, a civilian.

RAAF technicians who had installed the radar at Dripstone Caves a few miles north of Darwin, days before the raid were still fiddling with the set when the first waves of Japanese bombers roared in.

The RAAF experts, hurriedly trained at Richmond (NSW) had no manuals to guide them and were unable to grasp the intricacies of operating the set.

Piddington's team - the men who could work the radar - were in Sydney, unaware that the set was in Darwin.

And behind a veil of secrecy RAAF chiefs made no effort to fly the scientists there to get the set functioning.

As the 25th anniversary next Sunday of Darwin's first and disasterous [sic] air-raid approaches, it brings with it to Piddington the thought that if he had been in the city on the day its people might have had adequate warning.

Within days of the first raid Piddington and a fellow scientist, Mr Bruce Cooper, were rushed to Darwin, got the radar working, and in subsequent raids on Darwin, the effectiveness of the set resulted in Allied fighters having adequate warning to intercept the Japanese raiders far out to sea.

FIASCO

Dr Piddington, a quietly spoken, trim figured man of 56, is now principal Research Officer of the CSIRO's Radiophysics Division of Sydney University and one of Australia's leaders in space research.

His disclosures about the wartime fiasco at Darwin add to the unhappy picture of events there on February 19, 1942 that Darwin journalist Douglas Lockwood described in a recently published book, *Australia's Pearl Harbour*.

Lockwood labelled it "Darwin's Day of Shame", when the savage Japanese attack produced a reaction of chaos and panic, culminating in drunken soldiers looting houses and shops, and attempted 'dictatorship' by military police and mass desertion by Australian servicemen.

Even without its radar working, Darwin got a 30-minute warning of the impending raid - flashed from coast-watchers on Bathurst Island - but due to the messages being delayed Darwin's sirens wailed simultaneously with the first bombs falling on the wharves and ships.

However, Piddington believes if he and Mr Bruce Cooper had been there to work the radar on February 19 it could have given Darwin a vital margin of warning - the set had a range of 100 miles.

Dr. Piddington's association with radar research goes back to his pre-war student days.

Born in Wagga, where his father was a wool-classer, he went to Sydney High School, then Sydney University where he was a brilliant student with an exceptional capacity for maths.

He got his B.Sc. with 1st class honours, his BE, and finished with the University Medal for Engineering.

A travelling fellowship took him to Cambridge University, where he got his Doctorate of Philosophy. There he studied physics at the Cavendish Laboratory under Sir Edward Appleton, Nobel prize winner for physics in 1947.

The great Lord Rutherford was still head of the Laboratory in Piddington's time there.

Piddington became absorbed in the comparatively new science of radio physics, using radio waves as his tools of trade. Inevitably, he became involved in the then hush-hush development of radar.

In 1937 he did radar research for the British Air Ministry, using an early television transmitter borrowed from Alexandra Palace in London.

Back in Australia in 1938, he joined the Radio Research Board, under the Chairmanship of Sir John Madsen, chief executive officer of the Council for Scientific and Industrial Research (forerunner of the CSIRO).

Dr Piddington says: "Many of the top military brass were relying on Britain to supply us with radar once it had been developed there.

"But the group of us scientists were determined to make our own long-range plans we had the men and the knowhow."

EFFECTIVE

The Navy and the Air Force were fairly indifferent to the potentialities of radar - they regarded it as a new-fangled contraption still in the realm of fantasy.

The Army, however, was most interested - specially Colonel, later Major-General, J.S. Whitelaw, then in command of the coastal defences along East Australia.'

In great secrecy, Piddington and his colleagues built Australia's first radar unit – a cumbersome but effective set fitted with valves specially flown out from the U.K.

"In those days we needed a radar valve with an output of about 10 kilowatts - equivalent to what a broadcast station used.

"We got one which flashed a radio signal for ten-millionth of a second, then shut down for 25th of a second, then flashed again.

"Today's radar sets burn a megawatt - a thousand kilowatts."

The team's first radar set was installed in a concrete block house at Dover Heights and linked for fire control with the batteries of 9.2" artillery guns lining the coast north and south of Sydney.

"It worked well. On practice shoots we could follow on the radar screen the bleep of the shell in flight, then the splash in the sea. It had a 15 mile range," says Dr Piddington.

Piddington's success with the sea-ground radar resulted in the British Army rushing him to Malaya, Burma and Hong Kong to install similar shore battery sets there.

But when the Japanese stormed over these places these were the guns which were pointing the wrong way.

News of the Pearl Harbour attack galvanised Piddington's team into action.

They - and by then the RAAF bosses - realised that the immediate threat to Australia and New Guinea was air attack and Australia didn't have a single Air-Warning radar.

"On the night of December 7, 1941, myself, Cooper and 12 others set to work. By the following Saturday night we had developed a prototype set - a bit rough and ready, but with a 100 mile range under good weather conditions, and transportable in a Dakota aircraft.

"It weighed about 1000 lb. against the first 40-ton ones the Americans had come up with.

“The set was put together so hastily that normal safety covers were left off and high tension wires carrying 10,000 volts were a hazard to the scientists.

In tests over Sydney, the cumbersome radar set detected planes 60 miles from the city - but they were Allied, not Japanese.

A local electronics firm was given a crash order to build three sets to be despatched as fast as possible - under the orders of the Chief of Air Staff, Air Commodore [sic] Sir Charles Burnett - to Darwin, Port Moresby, and Port Kembla.

REELED

On February 5, 1942, the first set off the assembly line was flown to a site at Darwin chosen by Wing Commander (Air Commodore, recently retired) A.G. Pither, who was the new Director of Radar at RAAF Headquarters.

“Pither formed a unit, No 31 Radar Station, to man the radar, but the young officers chosen failed to get the set functioning properly. And the RAAF base commanders at Darwin were apathetic about the 'contraption'.

Nobody thought to send for Piddington and his ‘boffins’ who, absorbed in further radar work in Sydney, weren't even aware the radar was in Darwin.

Then came the morning of February 19 and Darwin, with a radar the Air Force couldn't work and only a handful of outdated planes to defend it, reeled under the fury of the Japanese attack.

Belatedly, Piddington and Cooper were rushed to Darwin and they got the set going. On March 22 when the Japanese launched their next biggest attack the radar at Darwin proved itself a tremendous weapon.

It's detection of the Japanese planes allowed the squadron of American P40 Kittyhawks, which had arrived at Darwin a week before, to intercept and disperse the enemy 20 miles out to sea.

Although the Japanese made many more attacks on Darwin, the radar-directed planes took the sting out of them.

Dr Piddington saw out the rest of the war supervising the installations of radar sets at strategic spots throughout Australia and the Pacific Islands.

LESSONS

No decorations or awards came his way, and he slipped back to his peacetime job of helping advance the secrets of space.

He says: “Perhaps we had to suffer the indignity of a debacle like Darwin to shake us out of our apathy and learn a few lessons.”

Dr. Piddington, has received a gilt-edged invitation card to be in Darwin next Sunday where Air-Commodore Pither is to unveil a monument at the site of the radar station.

But for reasons of his own he won't be there ...

POSTSCRIPT

A Few Comments from Ed Simmonds (June 1993)

My instruction on the 'buggery bar', from memory, was a one-hour lecture plus a demonstration to the class lasting maybe a couple of hours in total for the 12 of us - that was in July 1942. But it was the only instrument we had at the time and therefore better than nothing.

In comparison with other radar sets of the time, the output of the AW transmitter was only a 'piddling' 10kW; in consequence, it was of paramount importance that the array be properly matched and phased to get the maximum power up the stick. Any mismatch caused hot spots within the coaxial cable and so accelerated possible failures in what was really a primitive product.

Unfortunately very few people could use the BB with either confidence or efficiency. Many are the reports that men slaved over the BB operating it like a trombone without positive results. On Bathurst Island (38RS) they gave up and did the matching by calculation using the Smith Chart. At Merauke, Fred Hull and his boys, fortuitously ham operators, went back to their experience in the amateur field to achieve an acceptable solution.

There was a marked improvement in output etc when the coaxial cables were scrapped and replaced by open-wire feeders in the AW-type aerials.

One of the sad things from a researcher's point of view is that the CO's of the early radar stations were neither required nor were they asked to complete the A50 Unit History Sheets. And, whilst it is of little consequence to the story of 31RS, it was not officially formed, according to RAAF records, until 1 June 1942.

On the question of CSIR's relationship with others, *Clear Across Australia*, a history of telecommunications by Ann Moyal: Nelson, 1989, page 167 states, at the end of two-thirds of a page of criticism:

The contribution of the PMG Research Laboratories, however, has never been given full due. CSIR was quick to claim public credit for Australian radar work although the major part of the undertaking that brought radar into operation was the engineering task performed by the small, creative and persistently determined PMG Research Laboratories team.

It will never be known whether or when RPL was asked to go to Darwin. The number of their experts with experience on AW was probably only three or four. It is known now that three of them were down at Port Kembla in early February with Harry Duggan - what else did the RAAF have in mind? We know that Harry Minnett went to Tomaree (20RS); in April 1942. Piddington and Cooper went to Hammond Island (36RS) and Port Moresby (29RS) after returning from Darwin.

The Kiwis were well ahead of us in many fields and they did ensure that the boffins went with the installation party. The Brits also did it in some cases.

An inventory of available radar staff as at 12/1/42 is rather interesting:

Officers	RPL	1	
	PMG	1	
	On stations waiting	2	(Shepherd's Hill?)
	Waiting	1	
	On course	25*	
	Total	30	

Mechanics (Ground)	RPL	6 (Air)
	PMG	6 (Air)
	Stations	12 (Ground)
Rathmines		3 (Ground)
On course 5A		12 (Air)*
2G		17 (Ground)*
Total		56

* Available at the end of February 1942

Operators NIL

Trainee Radio Mechanics	Course 1 - end of March†	25
	Course 2 - end of April†	38
	Course 3 - end of May †	45
	Course 4 - end of June†	56
	Course 5 - end of July†	58
	Total by end of July 1942†	222

† Still requiring two months training in radar, either Air or Ground, at No 1 Radio School, Richmond NSW.

Note: the actual numbers available from these five courses were lower because of drop-backs and failures.

Officers: Course No 1 at Sydney Uni (Bailey Boys): 38 available from March 1942- plus two months at Richmond (either Air or Ground).

In my first talk to Brian Cooper, on the phone when he did not know who I was, he could not remember anything about Dripstone Caves. Later in a letter dated 22/2/92 he was still a little vague:

At Darwin we were put up at the RAAF base in quarters that had been well ventilated by Jap bombs. My memory is fading but I think we would have arrived two days before the recorded date of the radar detection of the raid of March 22nd. So that would have been Friday 20 March. The next day we were at Dripstone sizing up the problems with the RAAF crew. At this distance I can't remember exact nature of things that were wrong with the set when we arrived but I think it was pretty close to working and a bit of designer know-how was needed to fix the remaining problems.. There were recriminations later about the delay in getting the set going but the crew were on a learning curve and I don't think all the answers were in the notebooks

We weren't back in Sydney long before we were asked to go to Hammond Island and Port Moresby to look over the AW installations there.

Brian also told Walter Fielder-Gill: "I sympathise with them as they probably had a very rudimentary handbook - virtually nothing but a few circuit diagrams to go on."

Some final comments (June 1993):

The first raid on Darwin was an horrendous blow to the nation's image and ego and everyone was looking for reasons and scapegoats. In my opinion, whether 31RS was on air or not would not have made any difference to the outcome because no one took any notice of Father McGrath's adequate warning from Bathurst Island.

I have heard it said that the services at Darwin adopted the public service attitude of not making a decision (in this case, sounding the alarm) for fear of making a mistake and being made to wear its consequences – an attitude that still seems to exist in the public service today!

It is possible that 31RS could have had an effect on the raids between 19/2/42 and 22/3/42. However, No 5 Fighter Sector was not formed until 25 February 1942 so, if 31RS had been on the air, it could only have reported to the same inefficient Operations Room that stuffed everything up on the day of the first raid. The crux is that the RAAF people there had to make a decision of whether the aircraft were theirs or ours, and got it wrong.

On this basis, whether 31RS was on the air or not becomes an academic exercise and only needs clarification for historic reasons, which Colin is now doing.

My conjecture is that Piddington's apparent change in attitude between 1946 and 1967 may have arisen from the fact that he may have read Pither's report in the interim and taken umbrage to the criticism RPL got from Pither on several fronts.

On 22 March 1992, RAAF radar veterans celebrated with a reunion at Bendigo the 50th Anniversary of the first radar station becoming operational in a combat area. There were no recriminations mentioned then as to who did, or not do, what or to whom. The CS1R people still living had been invited to attend; Piddington declined on the grounds of poor health or eyesight, but Alexander, Cooper and Minnett came along and enjoyed themselves.

December 2008.

Dr Piddington died in 1997; in an obituary for him, Harry Minnett revealed that RPL knew that 31RS was not complete at the time of the first raid. This suggested to me that Dr Piddington ran a 'tight ship' - no one was permitted to make public opinions or facts contrary to his statements.

The following article, which is my own summation of 31RS, Dripstone Caves, was written after 2000 and published in July 2006. In its slightly edited form, I believe it to be accurate.

Ed Simmonds

31RS – DRIPSTONE CAVES

Having read many documents relating to the early days at 31RS I now believe that not all published words on Australian radar history are factually correct. One has to remember that in times of crisis the human psyche looks for a scapegoat. Everyone tries to protect his or her back. Cover-ups are common. This assessment of the position relating to the first raid on Darwin has been based on primary sources, meaning those people who were part of the scene at the time.

Here are the events leading up to the first operational success of RAAF radar at Dripstone Caves on 22 March 1942 as supported by official documentation and the eye-witness reports of people involved.

In September 1941, RPL was authorised to design a long-range air warning set. However, apathy in 'high places' including the War Cabinet, together with a shortage of suitable valves, probably hampered their efforts because nothing happened until early December 1941. In the meantime, a War Cabinet decision of 7 November had given the RAAF responsibility for setting up and operating an air-warning system.

Then, on Sunday 7 December 1941 (Monday 8 December, Australian Eastern Standard Time), Japan attacked Pearl Harbor. Dr J A Piddington, who was in charge of the ShD project at RPL, was galvanised into action and, with a team of a dozen or so of his staff, started to modify the ShD set for air warning. On the evening of 13 December, "a very 'haywire' experimental air-warning set" was installed at Dover Heights, using a 36-element ShD array already in use there. It detected aircraft at distances that established its feasibility and was operated by the Army in the defence of Sydney for many months.

On the following day, W/Cdr A G Pither inspected the installation. At that stage, No. 1 Radio School was the only unit that Pither had under his command. He sought funds to purchase, through the school, three prototype sets to be built by RPL; the number of sets was guided by the availability of valves and later he increased the order to six. He ordered that the British CD/CHL set which had already been delivered to No 1 Radio School should be installed at Shepherds Hill near Newcastle and this became the first RAAF operational air warning radar on 10 January, 1942.

At that time, Pither was convinced that no Australian-made equivalent of the COL-type equipment would be any more than a stopgap⁵. He was shown to be spectacularly wrong when the LW/AW proved itself in the field.

On 24 Jan 1942 RPL reported that the first unit was finished but it is not clear whether this included the AW aerial. It was sent to Kiama for installation there. On 28 Jan, Pither went to Darwin to select a site. He also arranged with Mr Stoddart of the Allied Works Council for the construction of a suitable building; this was promised for early February.

Two officers, P/Os Harry Hannam and Bruce Glassop, fresh from the first ground radar course for officers, and three mechanics, AC1s Bill Couper, Bill Wellstead and Errol Suttor, directly from the second ground radar mechanics' course, left for Darwin on 3 Feb by rail to Brisbane thence by Qantas, arriving on 7 Feb.

The second RPL unit was handed over to the RAAF on 4 Feb and was taken to Richmond for shipment to Darwin. AC1 John Scott, another mechanic from the same course, was detailed to help with loading and to accompany the equipment on the flight to Darwin, arriving on 9 Feb.

P/O John Norrie and mechanics, Bill Harnath (from the same No 2G course) and Errol Suttor all reported that the aerial had to be cut up to smaller pieces so that it could be loaded through the doorway of a Douglas DC2 aircraft. RPL had overlooked the fact that the ShD aerial had not been designed for air transport. Its size and weight were such that three aircraft loads were needed. The first load arrived on 9 February and the last, accompanied by P/O Fred Hull, reached Darwin on 21 February. Hull, however, though technically competent, was excluded by Hannam from the installation operations

Re-assembly of the unit began at Dripstone, probably on 10 February, under the supervision of P/O Hannam. By 19 February, when the first Japanese air raid struck Darwin, the equipment was installed, but the aerial was still lying on the ground awaiting the final components which were coming the flight with P/O Hull.

The unit was woefully under-resourced. Great difficulty was experienced in lifting the aerial into position, for which purpose the RAAF had not provided any lifting gear. A pole, pulleys and rope were scrounged but the rope broke, damaging both the aerial and the building. An appeal to the US Air Force resulted in a mobile crane being sent to lift it into position. Similarly, no source of power had been supplied; appeal to the Americans resulted in a small power unit being provided. However, it proved inadequate and another was scrounged, in the wake of the first Japanese raid, which could be nursed along for a few weeks until two adequate diesel units and a fitter arrived.

Finally, there were great difficulties in matching and phasing the antenna array. With no manuals and no experience in using the impedance measuring set ('bugger bar'), the technical staff tried everything they could think of without success. Finally, P/O Hannam appealed, through the RAAF, to RPL and on 1 March or thereabouts Dr Piddington and Dr Brian Cooper arrived on site. They found that the wrong co-axial cable had been supplied and this took a few days to be replaced. Then they matched and phased the aerial and the unit was operational on 22 March 1942. The first enemy air raid was detected by 31RS on that day.

Dr Piddington Had expressed himself "bitter" because his 'innovation' [my choice of word] was not operational on 19 February. The following is a summary of Dr Brian Cooper's statement relating to the time when he accompanied Piddington to the site in March 1942: -

- RPL knew that the aerial had not been erected at the time of the first raid.
- It said that the RAAF mechanics were at RPL to assist in the construction of the prototypes, not to familiarise themselves with the AW as stated by Evans. This was confirmed by a statement from the late F/O Frank Bound who was one of the RAAF at RPL.
- It also stated that Mellor trivialised the efforts of the RAAF personnel in his work and went further to say that Dr Piddington was directing his 'ire' at the senior RAAF officers not the men. His major complaint was that W/Cdr Pither sent 'partly trained and inexperienced officers' to the remote and isolated site.
- The major effort of the RPL men was to match and phase the aerial using their IMS.

In one respect, RPL may have had a point. Though W/Cdr Pither had nothing but 'partly trained and inexperienced officers' to choose from, it may be that, with the benefit of hindsight, he did not select the best one available to install the unit. The then P/O Fred Hull, another recently commissioned officer at the time still completing his course at No 1 Radio School, Richmond, might have been a better choice as he had worked previously on high-frequency radio with the Royal Flying Doctor Service. He was chosen as the first to command the formally constituted 31RS, but was excluded from technical involvement with it during the period of problems of installation. Later, he was able to match and phase an aerial at Merauke without using the 'bugger bar'.

There were mistakes made by the RAAF. No power supply accompanied the set and no arrangements were made for lifting the heavy aerial. P/O Hannam, who was put in charge of the installation, had to find a power supply and a means to erect the aerial. The American Air Force helped him solve both problems. In addition, no instruction manuals for the AW or IMS had been supplied. The Darwin bureaucracy of the RAAF was not at all interested in this new-fangled thing and virtually ignored the station, RPL and Dr Piddington.

Despite Dr Piddington stating on several occasions that he would have been able to have the set on air on the 19th February the above timetable of events shows that he could have not been successful.

Since the 'top brass' took no notice of a radio message from Father McGrath, a missionary on Bathurst Island, that the Japanese were on the way to Darwin, can anyone be sure then that the same 'top brass' would have taken any notice of a similar report from 31RS had it been 'on air.'?

It is unfortunate that this event led to animosity between RPL and the RAAF but there were faults on both sides. In summary:

- RPL failed to appreciate the fact that the AW aerial and tower were not designed to be transported by air. It seems that Dr Piddington over-reacted.
- W/Cdr Pither may have selected the wrong officer to install 31RS but he had no officers who had trained on or even seen an AW or an IMS beforehand.
- The RAAF may have failed to take advantage of the offer by RPL to assist in the establishment of the station, but failure to do this had no effect on the outcome on 19 February 1942.
- None of the three RAAF mechanics who were attached to RPL and could have assisted in the manufacture of the prototypes were included as members of the installation party. The RAAF should perhaps have insisted that an appropriately knowledgeable person from RPL be involved actively in the installation.

• *Ed Simmonds*

(This is a slightly edited version of an article which appeared in *Radar Returns* Vol 11, No 1, July 2006, p6)

A Tribute to Colin MacKinnon 22/4/1941 - 5/10/2004

Colin MacKinnon, VK2DYM, developed an interest in radio as a youngster living in the country town of Orange, NSW. From modifying the family radio and learning the basics of electronics from *Radio and Hobbies* magazine, he earned pocket money by repairing neighbours' radio, bought war surplus equipment and became an inaugural member of the Orange Amateur Radio Club. When Colin was 15, his father died, and he assumed a good deal of responsibility for his four younger brothers and sisters.

With engineering studies, career, marriage and moving to Sydney, radio went on the back burner for a long time. He spent his time flying aircraft, racing cars, sky-diving and hang-gliding before rekindling an interest in radio. He took out an amateur radio licence, promptly upgrading it to the full call by sitting the Morse exam. He was later involved with the WIA broadcast team as a volunteer announcer and engineer. His interest in war surplus radio equipment led to his gathering and restoring a large collection. In particular, he had a great theoretical and practical interest in antenna performance.

Colin was intrigued with the history of Australian wireless and amateur radio, especially in WWII, and wrote many technical and historical articles for local and overseas journals. He assisted me with research into WW2 radar history, and was a marvellous support in the early days of our exercise as he researched the CSIR and CSIRO files for me. It would not have been possible to cover some of the aspects of our history without his assistance.

Ed Simmonds

NOTE

Complete versions of the following publications, to which reference has been made in this paper, are available separately in this Archive:

An Account of the Development and Use of Radar in the RAAF, Wing Commander A G Pither, December 1946 (Unpublished Manuscript)

Radar Yarns, Edited by Ed Simmonds & Norm Smith, 1991

More Radar Yarns, Edited by Ed Simmonds, 1992

(Both originally published by E W & E Simmonds)