

*The* **MOBILE G. C. I.'s**  
*of* **RAAF RADAR**

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*Edited by*  
**MORRIE FENTON**

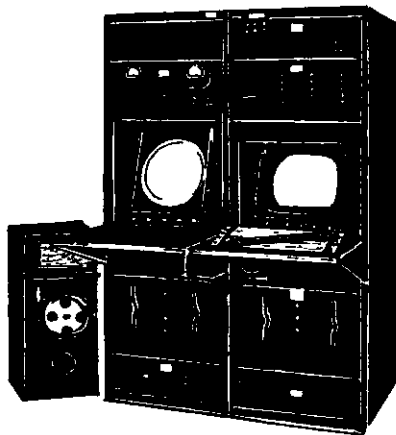


# *The* **MOBILE G. C. I.'s** *of* **RAAF RADAR**

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THE GROUND CONTROL

STATIONS ON WHEELS.



The Mk.V COL/GCI and aerial  
control.

*Edited by*  
**MORRIE FENTON**

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*Morrie Fenton*

THE MOBILE GCI's

of RAAF RADAR.

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Edited by

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(M.E.Fenton)

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Additional reading -

154 Radar, Truscott.

The Exmouth Radar

Story.

131 Radar Ash Island

(These three small histories tell the stories of  
three mobile GCI stations.)

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## PREFACE

It is difficult for me to realise that it is almost 10 years since a small group of ex-radar veterans began a 'hunting and gathering' exercise to collect stories and information before we all go to the Great Doover in the Sky. In 1987 very little had been published about RAAF Ground Radar - but now as the result of the enthusiasm of that group and the 400+ co-operative veterans the position has been largely corrected.

One of the original group, Morrie Fenton, has been the most prolific editor and diligent 'ferreter.' Here is his 11th booklet which covers a rather unique radar topic, namely the Mobile GCIs. They posed the biggest problem of sorting out 'which went where.' This does not detract from the other fixed GCI stations and the transportable Australian made LW/GCIs.

To be specific six GCI sets were part of W/Cdr Pither's order for equipment from England when the RAAF was given the responsibility for air warning only one month before Pearl Harbor. Pither designated the locations as being Sydney, Darwin, Port Moresby, Brisbane, Townsville and Perth-Fremantle but there was no clarification as to the number of mobiles required.

Despite all the work of the researchers there are still some mysteries or unexplained items such as a report that a GCI unit was moved to Parkes aerodrome. Confirmation of this has not yet been found in any official documents. At the risk of being repetitive it was essential for the group to contact as many veterans as possible because the files and reports which still exist have enormous holes in them. I do not believe that anyone could write a history of a secret operation such as radar based solely on official documents due to their deficiencies. Of course being able to add the flavour of memories into the article or book makes them more meaningful to us the ex-radar veterans.

In retrospect the GCI equipment was the forerunner of Ground Control Approach and present-day Air Traffic Control systems so we were really working in the forefront of technology. Certainly we were under a 'cloak of secrecy' during WWII but I cannot agree with A P Rowe's statement that 'the more secret a project, the less efficient it is likely to be.'

Congratulations Morrie and on behalf of the RAAF radar veterans can I express our sincere thanks not only for the written word but also the excellent sketches which have as big an impact as the text itself.

Ed Simmonds  
Banora Point  
August 1997

### EDITOR'S NOTE.

This small booklet is a genuine attempt to gather together stories, recollections and descriptions of the Australian mobile GCI's. I believe there were 6 units which were employed at 10 stations - 2 Crossleys and 4 Internationals. Doubtless there are other opinions, stories and even photos, and these would all be welcome, if made available at any time.

Some of the material has been seen before - but to have one record or collection in booklet form makes in effect the only historical account so far of these unique vehicles.

### ACKNOWLEDGEMENTS.

I gratefully acknowledge the help, advice and the stories which have been received.

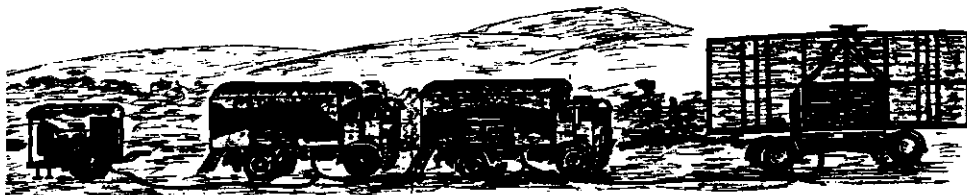
I thank.....Bob McDonnell  
Bryan Wardle  
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Jim Bettess

Finally I thank the Editors of 'Radar Yarns,'  
'More Radar Yarns,' and 'Echoes over the Pacific'  
for permission to use stories from their books.

Morrie Fenton.

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### THE ENGLISH MOBILE GCI.

During the Battle of Britain when the daylight raids commenced over England, it was found that the air warning stations equipped with the CH (Chain Home) sets, enabled the defending fighter planes to be 'vectored' by the Controllers at Fighter Sector to a visual contact with the enemy planes. But when these raids lessened, the enemy commenced intensive night bombing raids, and the number of successful interceptions dropped away, necessitating the introduction of a new method of directing interceptions. This new method, with GCI (Ground Control Interception) radar employed the new PPI tube alongside a Range/Height tube, and was operated from Mobile ground stations together with AI (Aircraft Interception) i.e. airborne radar and operator in the nightfighters. This new method increased the enemy losses from 1% to 7%.

The new system involved several essential operations from within the Receiver/Operations cabin of the mobile GCI station:

- \* The ability to quickly distinguish Friend from Foe. (IFF)
- \* Fast, direct R/T communication between the Controller in the GCI cabin and the nightfighters, which were equipped with AI.
- \* The ability of the mobile GCI station to quickly plot Grid References and to give accurate height estimates. The first, together with the relative positions of aircraft, could be quickly seen and read from the PPI tube, while the height and range could be estimated from the range tube.

An estimate of height was obtained by switching transmission between the upper and lower sections of the GCI aerial, so they were fed either in phase or anti-phase, so creating two overlapping lobes in the vertical plane. The ratio of the two signal strengths could then be assessed by the operator from the two blips appearing side by side on the screen; and from a calibrated chart in front of him, he could then quickly estimate the height of the aircraft. The Controller, standing behind the operators, could then 'vector' the interceptors into their most favourable position for an interception as he was in direct contact by Radio Telephone. (R/T) The operator on the AI in the aircraft took over as soon as contact was made.

Many of these new English GCI radar units were mobile, with transmitter and receiver installed in large CROSSLEY hard-top vans. The necessary generators were on trailers, and the portable aerials on stabilised 4 wheel trailers. These units could act as independent, mobile Fighter Sectors controlling interceptions within their range. The first of these units, operated by civilians, was set up in October 1940 and was operating two days later. By Christmas that year, six GCI's were operating - twelve by 6th. January 1941.

The new mobile method of controlling interceptions soon proved successful, and two of these units, although designed for English conditions, came to Australia in late 1942 with the Spitfire squadrons.

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### THE AUSTRALIAN MOBILE GCI's.

The outbreak of war in the Pacific saw a southward drive towards Australia, and in February 1942 came the first of the many air-strikes against Darwin and the other northern targets. These were countered by the then small Allied defensive forces which soon included the first of Australia's early warning radar stations - but towards the end of 1942, a great boost was received to the defence forces with the arrival of the well proven English fighter plane, the Spitfire. Three squadrons of the famous planes arrived and began working up - the RAF 54 Squadron and the Australian 452 and 457 Squadrons. And with the Spitfires came two mobile Crossley GCI radar set ups. The first of these units formed 134 Radar (then RDF) and comprised 3 Crossley vehicles - 2 housing the receiver and transmitter - the third being a general purpose vehicle for towing and the like - and from the station's early days, first at Richmond and Kogarah through to its last at Ash Island, it was efficiently staffed by WAAAF personnel.

From its permanent site near Newcastle, the unit filled two essential roles....firstly of covering Newcastle's giant steel and manufacturing centre, and also acting as a training centre for pilots being instructed in the duties of Controller or C.O. of radar stations, with practice interceptions being arranged from Williamtown air base.

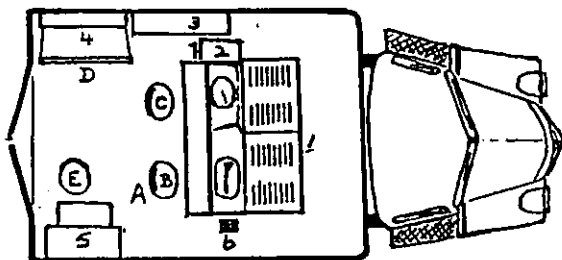
After some months, new GCI gear and generators arrived to be installed in huts on the same Ash Island site, and so in February 1943 the Crossleys moved on, firstly to Maroubra where 134 radar was set up to watch over the great liner-cum-troopship QUEEN MARY which had arrived with the men of the 7th. and 9th. Divisions. Two months later in April the Crossleys again moved, this time to Bunnerong Park to become the mobile Doover for 136 radar. The station, now with its mobiles, moved by ship, rail and road to Townsville where 136 radar set up on its permanent site at Alligator River. The final task for the vehicles can be traced in the early Diary entries for 151 radar which, after forming up about June/July 1943, moved north firstly with only one motor transport tender to Townsville (where the Crossleys of 136 were located) after which its transport establishment is listed as 5 heavy



tenders and 3 trailers. This must surely indicate that the Crossleys had now become the mobile Doover for 151 radar which was ready to move on to Merauke.

The second Crossley GCI unit was allotted to 132 radar which shipped out of Sydney to Darwin on the WANAKA and set up at Knuckeyes Lagoon. 132 maintained a high state of efficiency and played a key role in the aerial defence of Darwin. In April 1944, 132 radar came on air with new RWG gear and Caterpillar diesels. The Crossley units were taken over by 150 radar which then moved down the bitumen to set up and come on air at Adelaide River where it apparently tracked the last intruder aircraft to fly in over Darwin.

At 1 RIMU in Sydney with work starting in October 1943, Australia then built up four new GCI's on large American KB5 International chassis, and in these was installed similar English Mk V GCI sets, but improved with an electrically turned and controlled aerial unit. The power units for these new stations were two 4 cylinder Listers, each being mounted on its own four wheeled trailer. A further refinement was a small air-conditioning unit in the receiver cabin - an attempt to keep the operating area cooler (but seldom did). The receiver was mounted across the cabin with plenty of access room around the sides and rear. A plotting board and small switchboard occupied the corners immediately inside the lined cabin and completed the standard fittings - and the 'A' and 'B' channel key for the R/T. with its speaker and handset, were attached above the receiver.



1. Receiver.
2. Aerial Control.
3. Air cooling unit.
4. Plotting board.
5. Switchboard.
6. R/T phone and speaker.

A - Controller. B - Range/height operator. C - PPI Operator.  
D - Plotter. E - Switchboard operator and recorder.

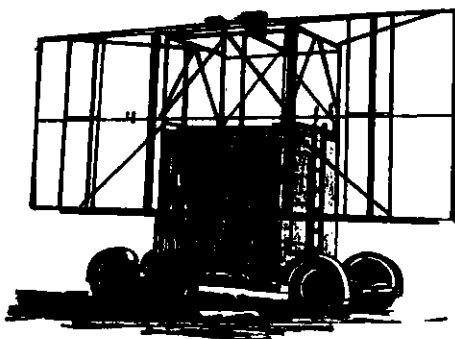
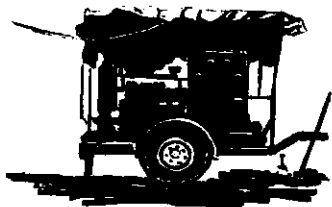
The four stations equipped with these International type Doovers were:-

152	Tadji N.G.
153	Finschafen N.G. and Momote Adm. Is.
154	Truscott NWA
155	Exmouth WA

Unlike the earlier Crossleys, these mobiles occupied their chosen sites and did not move until the stations closed.

These half dozen Mobile GCI's in Australia's WW 2 radar programme - the Crossleys and the Internationals, form an interesting, even slightly radical part of our radar history.

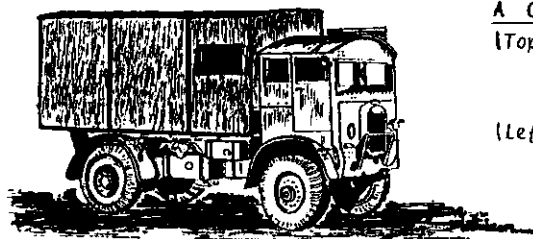
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A CROSSLEY 'DOOVER.'

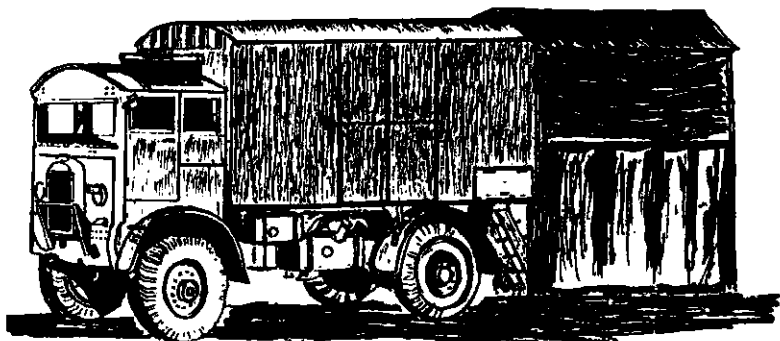
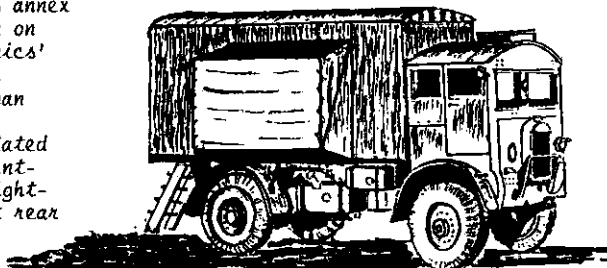
(Top) A 3 cylinder Lister generator on a 2 wheel trailer, with an older design portable aerial, probably hand turned.

(Left) Crossley tender, with unlined framed hard-top. One window in front panel.



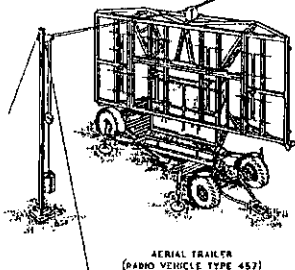
(Right) A Tx van - insulated hard-top. Canvas annex could be let down on one side. Mechanics' bench and storage across front of van

(Below) An Rx van - insulated hard-top - fan ventilated. Canvas light-trap and annex at rear over steps.

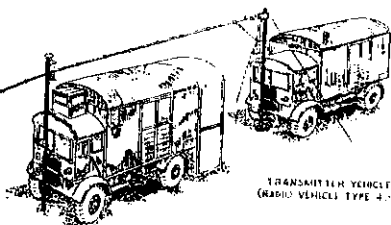


## THE MYSTERY OF THOSE CROSSLEYS!

MOBILE GCI MKIIX, GENERAL VIEW



AERIAL TRAILER  
(RADIO VEHICLE TYPE 457)



TRANSMITTER VEHICLE  
(RADIO VEHICLE TYPE 455)

RECEIVER AND OPERATIONS VEHICLE  
(RADIO VEHICLE TYPE 40W)



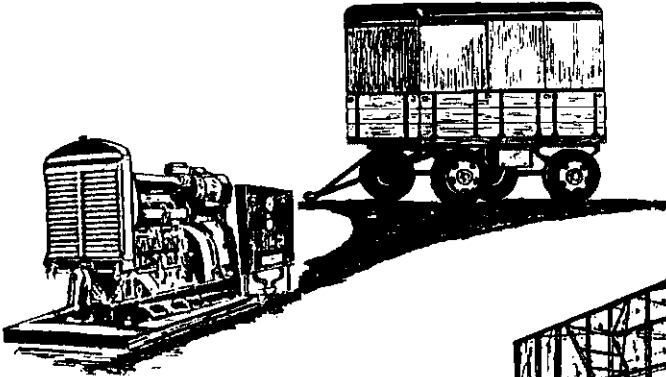
**EDITOR.** Very few photos of the 'Mobiles' have survived or surfaced - none at all of the Crossleys - so the booklet illustrations have depended on recollections, plus the sketches found in magazines other than a few photos of the Internationals. This page shows an English sketch of a mobile GCI and a sketch of a Crossley radio van. From these, and from the memories and descriptions offered 'with good intentions' by ex-personnel, the illustrations in this booklet have been produced.

Naturally (after 50 odd years) memories and opinions have varied and certainly the individual Doovers and vehicles also varied greatly through the war years, particularly the canvas light traps and annex ops rooms tacked on to the vehicles, just as the 'fixed' Doovers were constantly being changed and improved.

Strangely, a good idea of a Crossley van used in England has been obtained from a video, but the Australian version seems to have been somewhat different in appearance. Maybe the vans were 'built up' or altered at 1 RIMU or while on service. But most opinions seemed to favour 'hard-tops' with little ventilation. The Internationals presented few problems as I well remember the vehicles at 154 Truscott, and the photos helped a lot. So....the sketches have been presented, hopefully, to give at least a good idea of our GCI's on wheels, but at the same time pointing out that no two memories (or Doovers) were quite the same.

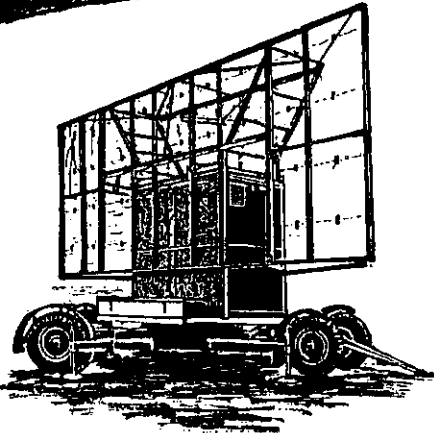
My thanks to all who have helped, or who have tried to help. Particularly to Gordon Mills who must be the record holder for these units - he was posted to five of them and must be the best authority!

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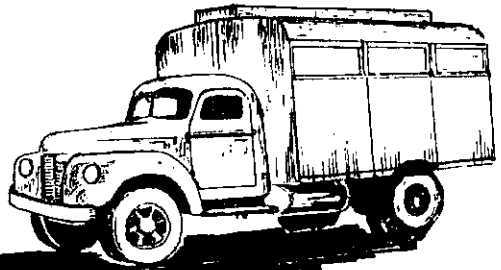
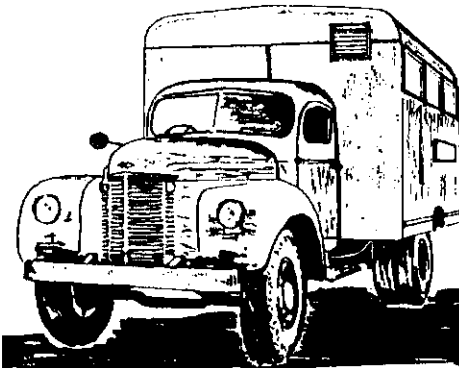
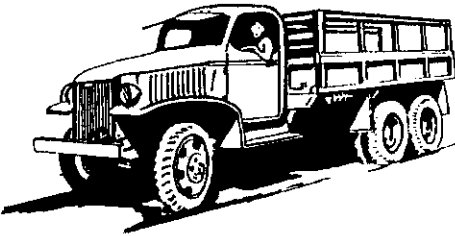
THE 'AUSTRALIAN' ASSEMBLED MOBILE  
GCT DOOVER.

(Above) The 4 cylinder Lister power unit was mounted on a 4 wheel trailer with opening sides



(Above) Later design portable and electrically operated aerial.

(Left) The GMC was popular as the station transport.



The principal Doover vehicles were INTERNATIONAL KB5 models - the Rx van (Left) was fully lined with a small air-cooler unit. The Tx van (Right) had clearstory space above the transmitter.

THE "MOBILES."

Type. GCI Mobile. Made in United Kingdom.

Ground Controlled Interception - Truck mounted, on CROSSLEY and INTERNATIONAL vehicles.

Type of Array: Broadside Array, upper 2 stacks, 4 bays lower stacks. 4 bays at mean height of 10 feet. Switched to be in phase or antiphase.

Frequency...Mc/s 209  
 Pulse Recurrence Frequency.....400  
 Pulse Width Microseconds..... 3  
 Pulse Power K/w..... 120 - 150  
 Display..... Range/height tube A type, and PPI.  
 Maximum normal range..... 80 miles

CROSSLEY - English built, 4 x 4, 3-4 ton, GS Q type, 2 and 3.  
 96 BHP. RAF chassis, used for various purpose bodies.

IHC (INTERNATIONALS)-KBS and KS5 3-4 tons, USA built, 1935 - 1945  
 RH drive, 4 speed gearbox to 2 speed rear axle.  
 Side valve engine 60 - 70 HP.

LISTER Diesels. English built. 3 and 4 cylinder separate cylinder heads, 20 and 25 KVA. Hand cranked, low compression starting, changed to high by hand wheel. Units on 2 and 4 wheel trailers. Governed to approx. 1500 RPM with direct coupling to alternators.

Units used in Mainland Australia and New Guinea by RAAF. The Receiver equipment in the Internationals was equipped with electrically operated array, and an air cooler in the cabin. The array was separately mounted on 4 wheel trailer. Early aerials were hand turned.

There were 2 CROSSLEY units and 4 INTERNATIONALS.

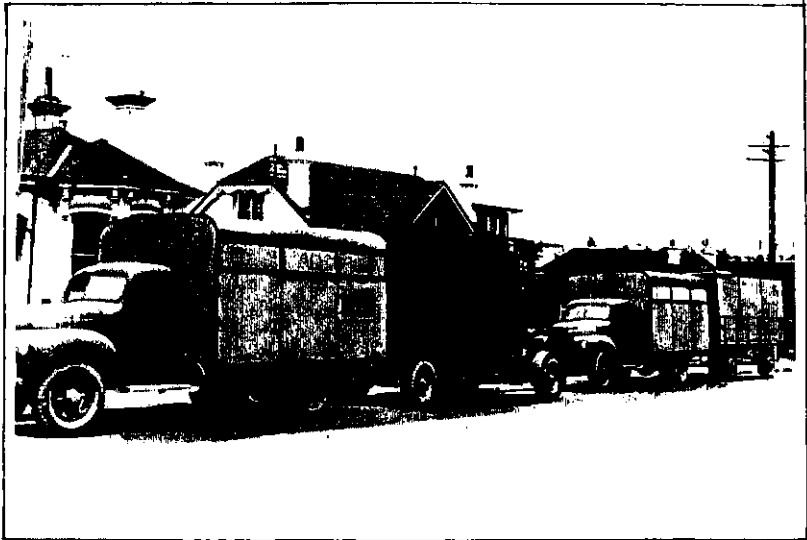
CROSSLEY units.

INTERNATIONAL units.

GCI unit

1	131 Ash Island NSW.	152	Tadji NG
2	132 Darwin NT	153	Finschafen NG
1	134 Maroubra NSW		Momote Adm Is.
1	136 Bunnerong Park NSW	154	Truscott WA
	Alligator River Q	155	Exmouth WA.
2	150 Adelaide River NT		
1	151 Merauke DNG		

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A MOBILE GROUND CONTROL INTERCEPTION (G.C.I.) STATION READY FOR THE ROAD.

The vehicles are the American K.B.5 Model Internationals (1935 - 1944) which were used for the four mobile stations, 152 - 153 - 154 - and 155. The trucks were fitted out at 1 RIMU, Sydney with lined cabins in which were installed the Mk.V G.C.I. equipment. This was powered by Lister diesel generators on four wheeled trailers. The aerial was also on a separate trailer, and could be folded down, or broken into frames for easy transport.

The leading vehicle is the Receiver van, in which the operating crew and control officer were stationed. The small hinged panels along the roof-line could be opened to admit light and air, but usually were closed when operating.

The small panel on the side of the van was to admit air to a small air-conditioning unit, and a fan to expel air was fitted to some of the vans.

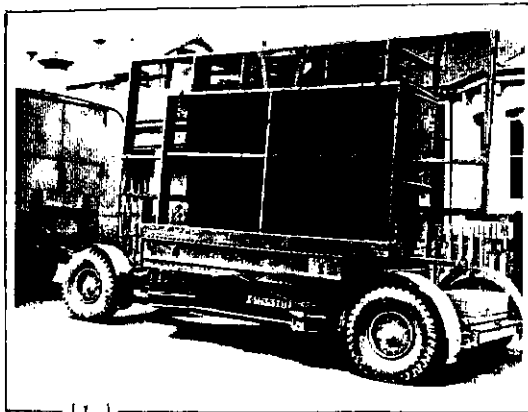
Double opening doors at the rear of the van also were closed when operating when the temperature was raised to an almost intolerable level with up to five men inside. However, a small canvas annex fixed over the doors improved conditions at other times.

The second vehicle is the Transmitter van where usually the duty mechanic worked, and a narrow bench was fitted in front of the console. Note the additional head room, or ventilator space above the equipment. The aerial trailer and one Lister generator trailer are also shown, and a second generator trailer was usually towed by the station tender.

The four photographs on the next page show how the aerial was assembled, from (top) ready for the road, to (bottom) ready to operate.

These photographs from George Day.

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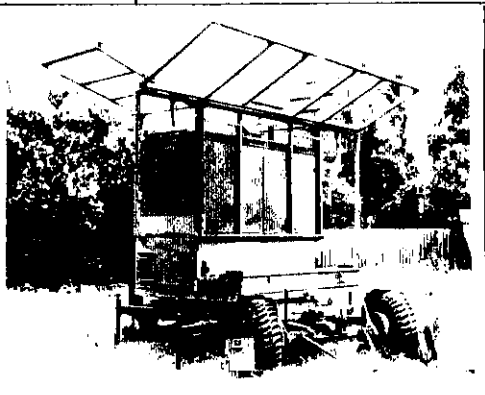


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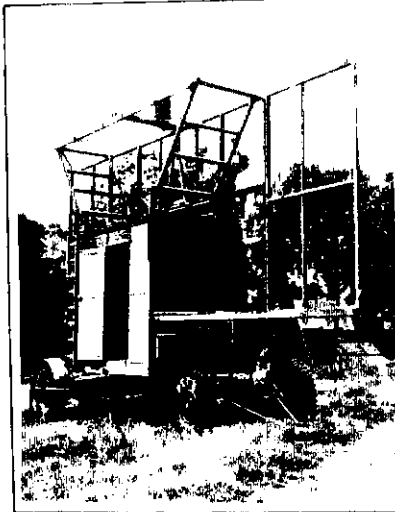
The mobile GCI aerial  
and trailer:-

From (1.) ready for the  
road;

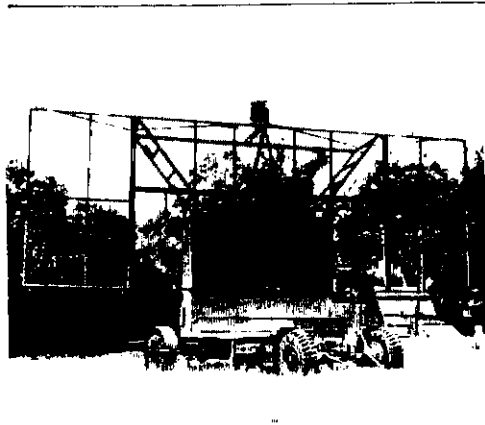
To (4.) ready to operate.



(2.)



(3.)



(4.)



GCI Team at 132... from left - G.McGarvie - J.Sands - R.Cruikshank -  
S/Ldr. Brand - J.Bryan - R.McDonnell.

#### A DAYTIME RAID ON DARWIN.

Bob McDonnell.

132 RDF - 20th. June 1943. F/Lt. Brand and his crew of Ops. were on standby on this day as there had been a recce over two days before - then on the 19th. came the warning of a large concentration of Jap planes on Timor - they always moved them south when preparing them for a raid. This was to keep them safe and away from any danger of a precautionary raid from Darwin based bombers.

F/Lt. Brand (later a Squadron Leader Controller) always was on standby when a raid was expected - also his preferred GCI team with R. Cruikshank on the PPI - J.Sands on Communications with 5FS - G.McGarvie on the Plotting Board - J.Bryan out on the Manual Aerial (a mighty lonely job at these times) and R. McDonnell on Range and Height. When operating, the PPI Op called the compass bearing from the station - the Range Op called the distance and height - the Plotter calculated the Grid Reference position which was relayed to FS and recorded. On the 132 Mobile Mk.V COL, the distance was considered accurate to about 3 miles, but height was fairly primitive. The echo was split, and the right hand echo was estimated as a proportion of the left - e.g. - R.10. L. 7½.....R.10. L.8. etc., then the Operator's chart gave an estimate of the height. The chart was the result of calibration flights with an aircraft radioing its height and the station recording the range, and the readings made the basis of the chart. Readings were considered accurate to about 2000 feet, but could be misleading whenever T.I. was present.

But the most misleading estimates could be made during a big raid when for instance, the Japs had bombers at say 26000 feet, fighter cover at 30000 feet directly above and slightly behind, and then more fighters at about 32000 feet. These all showed on the screen as one huge blip, virtually impossible to separate or accurately estimate.

So at about 9.30 a.m. on this day we were warned by 5 FS that 38 RS on Bathurst had given warning of a fairly large raid. 132 picked them up at about 100 miles, and by their slow speed we advised that they were climbing and to expect bombers with fighters slightly behind and about 4000 feet above.



Some 40 plus Spitfires were 'Scrambled' and Vectedored to intercept near Melville Island where we heard the 'Tally Ho' from the Wing leader who then took over, and eventually we lost them in the ground pulse about 5 or 6 miles away. There were about 21 bombers and the same number of fighters, so we heard afterwards.

F/Lt. Brand was passing information to the Wing leader, but the Japs kept their formation very tight. We heard heavy explosions as bombs were dropped - and we heard the regular 'Crump' of the heavy AA boys who put up a box barrage - and so with the Spits diving among the Japs - and the AA fire, it was fortunate there were no casualties among our own fighters that day.

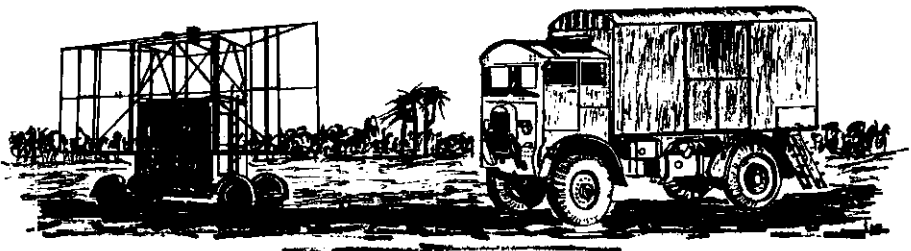
Then came a real surprise. Nine light bombers (I think they were Dinahs) came in at sea level, apparently lifted over 31 RS at Dripstone who apparently missed plotting them too - then screamed at low level over RAAF Darwin strafing as they went - then out and gone before anyone realised they had arrived..... meanwhile all our Spitfires were high up and still busy chasing the bigger game.

Subsequently I found out there were 21 heavy bombers, 9 light bombers, and 21 fighters. Some 14 of these were destroyed and several more damaged, while our losses were 2 fighters. The IFF on the Spitfires made easy the job of identifying them on the GCI, but there was interference on the radio between Fighter Sector, 132 and the Wing Leader which our RAF Wireless Mechanics blamed on the Japs - there was apparently some way they could tell.

It was always a great worry to us that the height reading we passed to the fighters might put them in a position where they could be 'jumped,' so we tried to play safe and put them high, for it was much easier to dive than climb with engines we now know were clapped out. It has come to light that Air Board in its wisdom sent NEW Spitfires to OTU Mildura for the trainee pilots - afterwards sending them on to Darwin. Talk about doing things back to front!

But a great advantage was the advance warning of a raid given by the Bathurst Island and Peron Island stations. They were always 'on the ball.'

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132 RADAR.....THE FUNNY AND THE TRAGIC.

Clive Sinclair.

I was somewhat amused on glancing through the 132 Record Book that on 4th. January 1945, the Maintenance Party from 105 FCU commenced a quarterly overhaul of the technical equipment. One night in 1943, Cpl. Merv. Everett, the mechanic on duty, and I overhauled just one of the units on the mobile GCI unit and we found 14 dry joints...and all still worked! To my knowledge no regular maintenance was ever done!

And in 1943, the original trailer units providing the power supply were replaced by Caterpillar Diesels and we were instructed how to start them. On September 1st. 1945 the record states, "Maintenance of Power Supply Diesel No. 3 is held up due to lack of pistons. These have been E.O.S. demand for six months!"

Well, so much for maintenance and lack of spare parts. On now to other things!

During an interception, the pilots were naturally highly excited and also very fearful as this little interlude will show:  
Heard on the R/T: *"There goes one yellow bastard: There goes another..... AND IT'S ONE OF OURS!!! Anyway, I've got this bugger dead to rights!!"*  
*"FOR CHRIST'S SAKE DON'T SHOOT JACK....IT'S ME!!!"*

Then there was the time two Spitfire pilots called up and wanted their IFF tested, and there was no Controller. So one of the operators on duty decided to have a go - not knowing anything about the proper procedure or the way things should be done.

1st. Pilot: "Wonder who the Controller is?"

2nd. Pilot: "He surely can't be a regular."

1st. Pilot: "I've never run into anything quite like this!"

2nd. Pilot: "Do you think he knows what he's doing?"

At this stage, S/Ldr. Mort.Brand the regular GCI Controller fronted up and everyone-I guess the two pilots also -breathed a sigh of relief.

Tragedy of course was always just around the corner and happened at the most unexpected times. One afternoon a Spit. was practising an interception with a Liberator. Everything seemed to go well...the blips merged on the screen...and then through came a frantic yell. After some time we were told the Spit. had collided with the Lib. It had knocked out one engine and then crashed, killing the pilot; the Liberator landed on RAAF Darwin and was safe.

Then we had an Officer and 9 OR's come up to work on a new station; they came from 3 M.I.S. On 23rd. November F/O C. Bell and LAC McCarthy were accidentally killed at Livingstone airstrip which was alongside the north-south road. They were standing by their vehicle watching Spitfires coming in to land when one veered off the runway and hit them both.

I think this may be sufficient. The doings that took place from time to time on radar stations could be extremely humorous and sometimes tragic. Like the time when I was at 308 at Milingimbi and I helped the mechanic overhaul the Ford 10. We worked all day, all night, then all the next day to about 8 p.m.

I thought I'd take a shower before turning in. I forgot the sandflies. We were supplied with special sand-fly nets for our protection. When I came from beneath the shower there must have been 50 billion sand-flies waiting for their meal. I never moved so fast in all my life to get under the net! Good luck with the book!

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151 RADAR STATION AT MERAUKE.

From "Echoes over the Pacific."

As the Merauke base developed so did the need for a GCI radar to deal effectively with expected attacks by enemy aircraft. F/Lt G.P. Phillips was directed to form 151 RS, a mobile GCI, at Richmond in June 1943. The English-made technical equipment was mounted on trucks and trailers prepared at No. 1 RIMU.

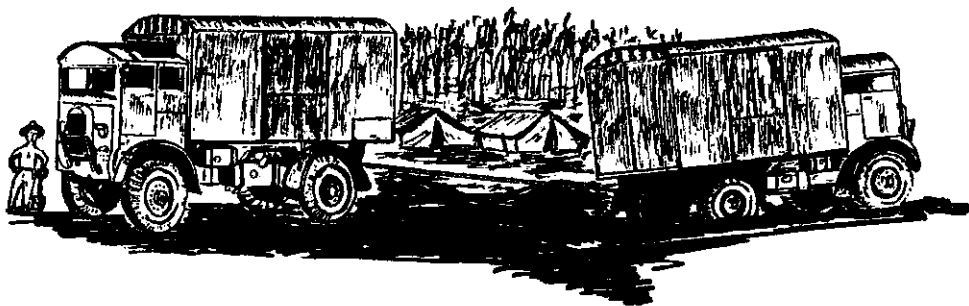
The station moved by train to Townsville. Personnel were given a training course in defence and the operational crew was strengthened by experienced operators and mechanics from 136 RS. Transit was by road to Cairns where the equipment was put aboard the SS BABINDA en route for Merauke. Personnel arrived in Cairns by rail and embarked on the SS ISLANDER on 21 December. Thursday Island was visited en route to Merauke where they arrived on 27th December.

Next day a suitable site was selected for the station on a flat grassy plain in order to fulfil the necessary 'siting conditions' for the operation of this height finding radar. The level nature of the ground in a high rainfall area meant the access tracks were soon churned into mud strips. Coconut poles were extensively used for corduroy construction or in pairs to provide wheel tracks.

F/O Bound arrived on 13 January 1944 to assist with the installation. He said that they had to build an earth platform in order to raise the gear above local flooding level. As PE's for tuning were non-existent an artificial one was contrived by suspending wire mesh between two coconut palms some distance away. On 22 March an AT5/AR8 communication system was set up for ground-to-air control of fighters. Three calibration flights were carried out and following that, height charts were prepared. Enemy activity was on the wane by this time and there was diminished need for a Controller. However, 151 RS was able to assume an early warning role while 40 RS went off air for a complete overhaul. LAC Neil Trainor said that when VHF communication was installed, it was decided to try working the Dutch aircraft from the radar. This idea was abandoned when it was found that no Australian spoke Dutch, and the heavily accented English of our Allies was barely recognizable.

Apart from the occasional reconnaissance aircraft, enemy air activity died away and there was no role for 151 RS to play:— so it was put on standby. Calibration flights and general maintenance became the norm.

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SOME NOTES ON 151 RS AT MERAUKE. (Neil Trainor) From 'Radar Varns.'

Early in 1945 when I became NCO in charge of 151 RS, the unit was on a 'care and maintenance' basis, and instructions were issued to run the gear for an hour a day. Within a week the humidity had played its part and it took over an hour to get a trace on the PPI tube. Soon afterwards we got instructions to move the gear.

This unit was a Mk. V GCI, truck and trailer mounted, with three 8 ton Crossley trucks. These were 4 wheel drive vehicles with double reduction worm differentials, so making them immensely powerful. Came the day for the move to the camp and station area.

The trucks had been standing, without running, for perhaps 18 months but gave remarkably little trouble. The nickel-iron batteries were filled with water and recharged. The engines were turned over by hand and then started readily. The worst part was pumping up the large tyres which had to be done with a hand pump because we had no compressor.

The unit was located on a short road which was separated from the main road by a large ditch bridged by two heavy timber planks, one of which had sagged lower than the other. Now the first truck to be backed out was not quite lined up with the planks. The tyres were a bit slack, being not fully inflated. The net result was that the tyres rolled leaving the rear end of the truck resting on its large differential. Despite all our efforts and ingenuity it refused to budge.

A large American 6x6 truck just happened to be passing so we enlisted its aid. With 20 men in the back to act as ballast, we hitched its winch on to the Crossley. All that happened was that the 6x6 gracefully pulled itself towards our truck. Then, as a final fling, our driver very precariously drove the second Crossley through the ditch and hitched onto the first truck. We were surprised that, with the worm differential in low ratio, it easily pulled out the first truck, giving rise to the theory that a Crossley could pull itself up a cliff if it could get a grip on the surface.

The rest of the move went smoothly with only a minor hiccough. Driving the lead truck, I had forgotten how high these trucks were and brought down our power lines. However, they were quickly repaired.

We used those Crossleys for many tasks including removing a six inch tree. In low gear it was not possible to feel if the tree was moving, but I found that the tree had dutifully followed the truck all the way.

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152 RS, Tadjj N.G., and 153 RS Momote, Adm. Is.

The first two mobile GCI's assembled in Australia on the American International truck chassis were 152 RS and 153 RS - and both stations were shipped out to New Guinea, although 152 RS first moved to Ash Island, and 153 RS afterwards moved on to the Admiralty Islands. Whether the vehicles proved unsuitable, or perhaps the need for their specialised use proved unnecessary - but while they undoubtedly provided useful service, neither station appears to have approached its full GCI potential on any one occasion:-

From 'Echoes over the Pacific' we learn:-

152 RS was a mobile GCI set up on trucks and trailers at No. 1 RIMU, Sydney. On arrival at Finschafen by SS DAVID F BARRY the personnel disembarked and the equipment went on to stage at Lae guarded by five personnel. Equipment and personnel arrived at Tadjj on 22nd. May aboard SS MARCUS DALY. On 25th. May 1944 the following report was written by F/O A.K. McKellar-Stewart:-

"Difficulty was experienced in unloading organisational and technical equipment as all carrying from ship to shore was done by barge. Much equipment was pillaged in transport despite efforts by personnel to prevent same. American servicemen unloading the equipment from the hold treated it extremely roughly, the consequence being that many cases were broken, the contents scattered and much equipment damaged by violence and rain. The radar equipment has not suffered badly as it is all in covered trucks which, although badly battered, afforded some measure of protection to the contents. Equipment, having been two months in tropical areas without protection, has deteriorated owing to damp and heat."

Despite that plaintive report, the radar was operating well by 7 July 1944. Credit must go to Cpl. D.G. Dove and his team of mechanics. Fighter Sector was well pleased with the station performance but due to lack of local knowledge, the radar had to be moved to higher ground when heavy seas threatened the aerial trailer.

....reporting to 111 MFCU were 152 RS, a GCI, and two LW/AW's, 340 RS and 348 RS.

153 RS, a mobile GCI, was brought to readiness and moved to Finschafen. There in January 1945 it joined another station which also seemed to be headed for nowhere. 350 RS was on an adjacent site also seeing the war out 'in limbo' - this unit had been in existence for 15 months and never ever became operational! A life of congenial co-existence was established. It was a case of 'static active' service suffered in tropical conditions and, hard to believe, aggravated by an acute shortage of water at that time.

NORCOM signal of 9 January ordered 153 RS to set up at Momote. An NCO with three guards and five radar operators formed an advance party which left on 1 February for Momote. It was not until 5 July that transport was available to Los Negros indicating the low priority for a GCI there.

The complete station including a GCI transmitter truck, two generator sets on trailers, a receiver/operations van, an office tender and a GMC cargo tender were transported to and set up at Momote. It was brought to operational status by 6 August and put on stand-by.

F/O W.W. Wellstead commented in his general report of 1 September 1945:-

"This station has not been called upon as yet, and with the cessation of hostilities there seems little possibility that the station will be required."

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154 RS TRUSCOTT, W.A. and 155 RS EXMOUTH, W.A.

154RS at Truscott and 155RS at Exmouth were 'twin' Mobile GCI's, for they formed at Richmond on the same day - 20th. December 1943 - and were equipped with similar vehicles and radar gear - Internationals with the English Mk. V GCI equipment, powered by large Lister diesel generators. Each had a motorised aerial mounted on a 4 wheel trailer.

The 154 vehicles were shipped to Darwin in June 1944 where the men who had meanwhile travelled overland via Melbourne and Adelaide helped to unload the equipment so that it could be tested at 44 Radar Wing at Coomalie. Then on again by the Liberty ship JOHN OWEN to West Bay, Truscott where shortly after being set up and brought on air, the station played an active and vital role in the interception of the last enemy plane to be shot down over Australia in WW 2. This was on July 20th., 1944.

The station remained 'on guard' at Truscott and as airstrip watchkeeper until the end of November 1945 when the mobile gear and the final crew of men returned to Darwin by RAAF ship.

155RS first came on duty in May 1944 at Ash Island, Newcastle where it was 'paired' with 131RS, no doubt as a performance test. Suddenly the order came to pack and make ready to move.

The men travelled by rail and several changes of gauge to Perth where they took delivery of their Internationals which meanwhile had been shipped over on the RIVER GLENEILG. The well known KOOLINDA then carried the men on to Onslow, then it was on to Exmouth to again meet their vehicles which by then had travelled overland and on some very rough roads which caused some damage to the delicate radar equipment.

The station was set up near the Vlaming Head lighthouse, where after several months of quiet service, the camp and equipment were all but destroyed in a fierce cyclone in February 1945 - which also destroyed their long range neighbour, 31RS.

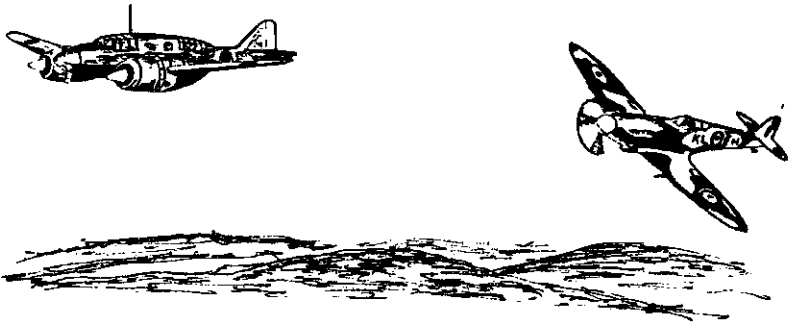
A programme of repairs and reconstruction was implemented, but the station was not called on to operate again, though 31RS was quickly replaced with an LW/AW.

The equipment of the two GCI stations could be described as 'state of the art' for the day, very accurate and technically sophisticated, and mobile so that the site could quickly be changed if necessary, with the task of directing and controlling fighter aircraft on standby at both Truscott and Exmouth.

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*An impression of the 154 line-up.*



**154 RADAR, TRUSCOTT. 'The last enemy plane destroyed  
over Australia.'**

Of the four International GCI's, only 154 Radar at Truscott had a positive brush with the enemy, and was largely responsible for the successful interception of a KI46 Dinah reconnaissance plane on 20th. July, 1944, shortly after the station had become operational at the new and secret airbase. The intruder aircraft was shot down by Spitfires from the RAF 54 Squadron - and the action was well reported:-

*The first warning of an intruder aircraft in the area was received from an early warning station at Cape Leveque, W.A. At the time, all the RAAF stations on Anjo Peninsula were recovering from a transition period. 58 OBU had just transferred operations from Drysdale to Truscott. 154 Radar was still working up to peak efficiency, and establishing its camp after having arrived from Darwin. 319 Radar was about ready to transfer from Drysdale to Truscott; and the radar eyes for the airstrip were the LW/AW stations on Sir Graham Moore Island and on Montalivet Island down the coast. The 154 GCI equipment was working and was operational, but the R/T link from the Receiver cabin to the Spitfires had not yet been established. So while the station could actually plot any planned interception, any instruction from the Controller in charge could only be communicated through the FCU R/T at the airstrip operations unit.*

*The Spitfires were 'Scrambled' at 8.50 a.m., and were back on the ground at 9.30 a.m. In that time, the three Spitfires of 54 Squadron, RAF, climbed to a height of 27000 feet, with one plane deployed over the Drysdale Mission area - the enemy reconnaissance plane was intercepted and shot down just north of Truscott, with the plane falling into Vansittart Bay; and the Spitfires were back on the ground.*

*The 154 Diary records... "Plots were passed to the Fighter Control Unit every 45 seconds, and filtered heights at regular intervals, and in so doing supplied the necessary information to the Controller, which enabled him to Vector the fighter to a position 1000 feet below and slightly behind the target, this enabling the Spitfire to attack from the blind spot. No attempt was made at controlling directly from the GCI as up to the date in question, a Controller had not been allotted, nor was the UHF R/T*

set up complete....."

Keith Backshall, the Sergeant Operator at the time, recalled the interception ....."The equipment we had was relatively new and had an effective range of only fifty miles. It was capable of giving a screen projection of the target and the interceptors, and could also calculate the height of the target to within 100 feet. The operation was handled by two radar operators with a pilot as flight Controller. The Controller was in radio contact with the fighter planes, and in fact it was he who scrambled the Spitfires and gave them flight details progressively to ensure them intercepting the Japanese plane before it reached the strip.

As far as I can remember, the Controller was F/Lt. Mailey, who was a son of the former Test cricketer, Arthur Mailey. We received a 'Tally Ho' from the Spitfires when the Dinah aircraft was slightly north of our base, and we went outside the vans to watch the dogfight. It was a very short-lived affair, and the Dinah was soon in flames and diving earthwards. It crashed in the ocean some miles north of our camp, and was in fact found by an Australian airman at low tide that day....

....the pilots of the Spitfires visited the Radar camp that day, and from memory I am sure they were British pilots who had been in Australia for only a short time...."

The Spitfires were in fact piloted by English pilots of 54 Squadron. An extract from the Squadron's history tells of the short action.....

..."F/Lt. Gossland, F/Lt. Meakin, and F/Sgt. Knapp formed the Squadron's detachment at Truscott. They were 'Scrambled' at 0850 hours by the Controller and F/Sgt. Knapp was 'Vectored' to Drysdale Mission. The two officers sighted the Dinah at 27000 feet, and as they approached the target from astern, they saw the aircraft dropping clusters of aerial fragmentation bombs which fortunately burst below and behind them. F/Lt. Gossland made his attack from the port stern, and his fire was seen to strike both engines, the port wing and the fuselage. The Dinah fell away in a steep dive, and F/Lt. Meakin followed.

He attacked and fired, and the starboard wing broke away. Flames burst from the Dinah, and it fell to crash into the sea about five miles north of the Truscott strip....."

A salvage crew later recovered the aircraft, and it was left in the bush inland from the West Bay Marine Section. Later From Japan came the information that the plane had belonged to the 70th. Independent Flying Squadron of the 7th. Flying Division. The aircraft had been based in Timor, and was described as a Type 100 Tactical Reconnaissance Type 2, 1940 Model KI 46 Dinah. More recently, the few remains of this aircraft, the last enemy plane to be shot down over the Australian mainland, have been identified and recovered, to be placed on exhibition in Perth at the Aviation Museum.

The 1944 interception took place over what was, and still is the loneliest and most remote part of Australia; and this short, sharp action which took place so soon after 154 Radar had arrived at Truscott is the station's principal claim to a place in Australia's war history.

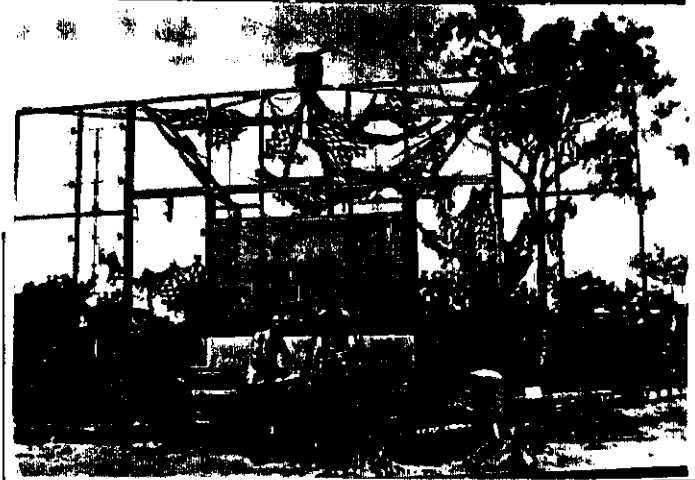
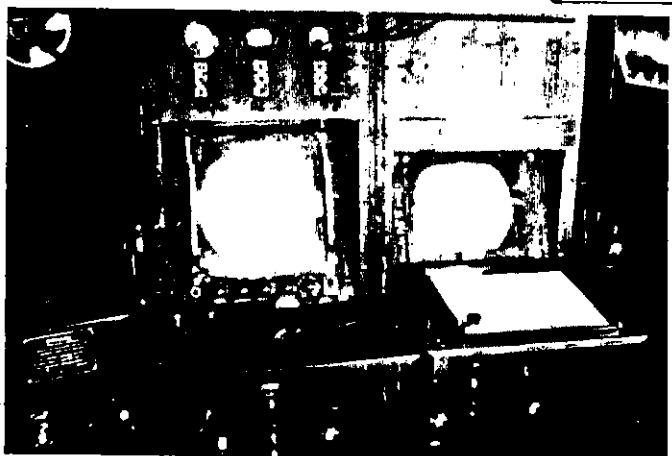
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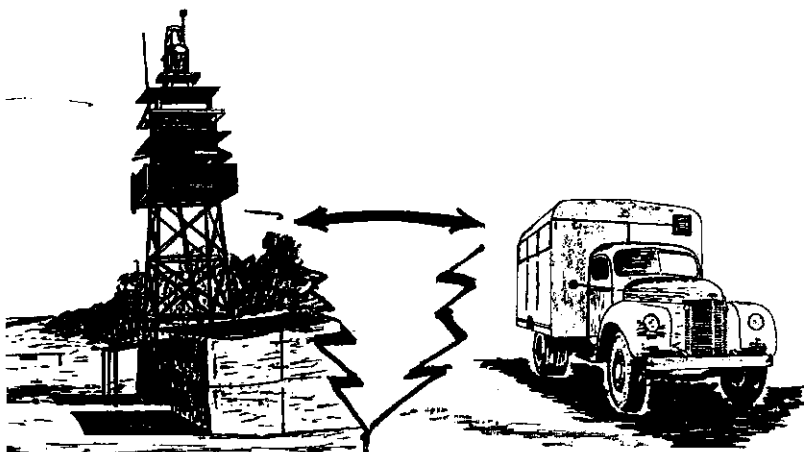
*Photo - K. Backshall.*

154 Radar at Truscott,  
 A mobile GCI set up  
 in International vans.  
 (Top) The camouflaged  
 Doover, with Rx and Tx  
 vans at left. Eric  
 O'Brien stands in front.  
 (Centre) the Receiver  
 and aerial control.  
 (Lower) The aerial,  
 with Frank Stubbs and  
 Jack Metcalfe.



Photos from

Stan Ledger.



"SWITCHING TO CHANNEL 'B'" .....

Despite being an integral - if somewhat independent part of the RAAF, the 140 plus radar stations saw little of service life as thousands of Air Force men and women knew it. Not for them the highly regimented life of the large air base...even less of the popular concept which seemed to always associate Air Force personnel with aircraft.

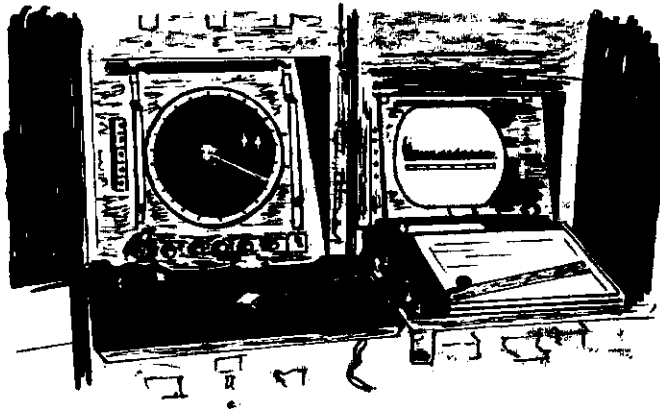
The more isolated radar stations were sometimes fortunate to have supplies and personnel brought in by the usually outmoded aircraft of a Communications Unit - sometimes by launch or other small marine craft if there was no suitable strip or landing place close by - but by and large any real association between radar personnel and aircraft was mainly coincidental - particularly so with the front-line aircraft of the forward areas - and to most radar crews, an aircraft simply meant a blip on the radar screens.

However, things were a bit different with GCI crews - and if the association with the actual aircraft was still somewhat remote, there was a close association with the pilots of the fighter planes by R/T, for as soon as the planes had cleared the airstrip, it was "Switching to Channel B," and the voice of the flight leader crackled through the loudspeaker in the GCI cabin seeking instructions from the controller as to course, speed and height. Then in turn the orders from the leader to the pilots of his flight could be heard, so that the voices on R/T could be linked to the blips appearing on the screens, or the plots on the board.

And whether in a practice interception (which were many and regular until late in the war) or in any real action, nothing could match the satisfaction of the Controller and his crew of operators than to hear the R/T crackle to life with....  
"Tally-ho....bandit 2 o'clock 1000 feet below!"

As a follow up to a successful interception, there was sometimes a much appreciated visit to the GCI station by the pilots involved, and it was apparent from the popularity of these visits that the pilots also appreciated seeing how the system worked, and so a greater understanding between pilot and ground station was developed. And it was also sometimes known that the Controller, usually a pilot himself, scored a flight himself just to keep in touch with the job of the pilot he was controlling.

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### ON THE TUBES !.

Each of Australia's many radar stations - AW - COL - ACO - LW/AW or whatever - demanded that its operators develop the skills and application to obtain the best results from the set - and although the skills necessary to operate GCI equipment were very much the same, there were two additional requirements - speed, and the ability to repond quickly to the requests and instructions of the controller. And in order to remain one of the team, it was necessary to attain an acceptable standard of efficiency, and to maintain that standard to the satisfaction of the Controller who was in charge of every interception, whether practice or for real.

Not for a moment can it be said that any group or team of operators was any more skilful than another. The ability to sight an aircraft blip at 150 miles which only showed as a slight thickening of the trace, or beat of an IFF signal, on the tube of an early warning set required the greatest skill and the greatest experience of all. But an equal and comparable degree of skill had to be exhibited by the GCI operator to satisfy the demands of the controller, otherwise it was...."On to the plotting board Joe....and you go on the tube George...and quick!"

The ability to call a grid reference from the PPI as the trace swept over a blip....the ability to stop - split the echo - estimate the ratio of the two and read the height, and all in seconds - the ability to keep track of 'friend' or 'target' - these were some of the skills which found favour or otherwise with the Controller, and which determined if one stayed in his team.

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155 RADAR, EXMOUTH, W.A. The cyclone of February 1945.

- (Diary entries)
- 1st. A cyclone warning was received.
  - 2nd. Cyclone struck at 1800 hours. All tents were in ribbons, canteen and store were blown down. Orderly Room tender turned over. At the strip the receiver truck, one diesel trailer and the aerial trailer were turned over, and the transmitter truck was blown off its blocks.
  - 3rd. Campsite a complete wreck. Personnel shifted to lighthouse quarters.

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(Lou Malempre.)

The day was very hot and sultry, with a pale green sky. There was not a breath of air. Near dusk it was really blowing. On ascending the track to the Radar it really started to blow...by the time we got to the Mess it was raging. Tents were blown over, the Orderly Room truck was blown over, and the Mess was disintegrating. I holed up in the concrete recess on top of the stoves while sheets of corrugated iron floated past at a great rate. We spent hours crouched in such shelter and I have never heard wind howling as it did. We could hear the sea roaring and I was concerned it would jump the sandhills and drown us. Thank God for Ningaloo Reef! Then came an eerie still...the eye of the cyclone was right over us...then the wind started howling again as the cyclone moved away. So we all huddled together again and all the debris came back tracking the other way. Some time after dawn the cyclone moved away and we took stock of things.

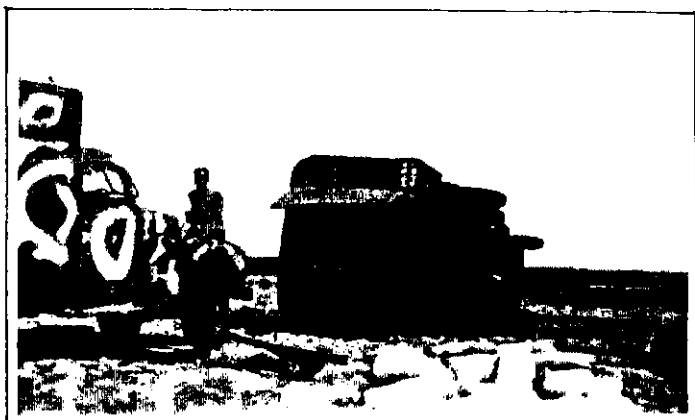
(Gordon Mills)

At 155RS, the Rx truck, the aerial trailer, one diesel trailer and the 3 ton Chev all rolled over. Our camp was demolished, also the Mess - but the small freezing room and the kitchen chimney remained intact. During tea at 6 o'clock, the full force of the cyclone struck. The Mess started falling apart, the roof blew off, and a tank began bashing its way through a side wall. Some fellows outside were blown away; some climbed up the chimney and some in the freezing room. We stayed like this until about midnight. The place was a complete shambles. By 2 a.m. all men were accounted for. A tidal wave went down the gulf then 40 miles inland. Three RAAF men from Potshot were drowned. There was plenty of sand in the lighthouse quarters and there were a few sheets of iron off the roof, but generally the building was O.K. All of our buildings were demolished.



(Above) The Orderly Room truck.

All photos from Gordon Mills.



(1.)



(2.)



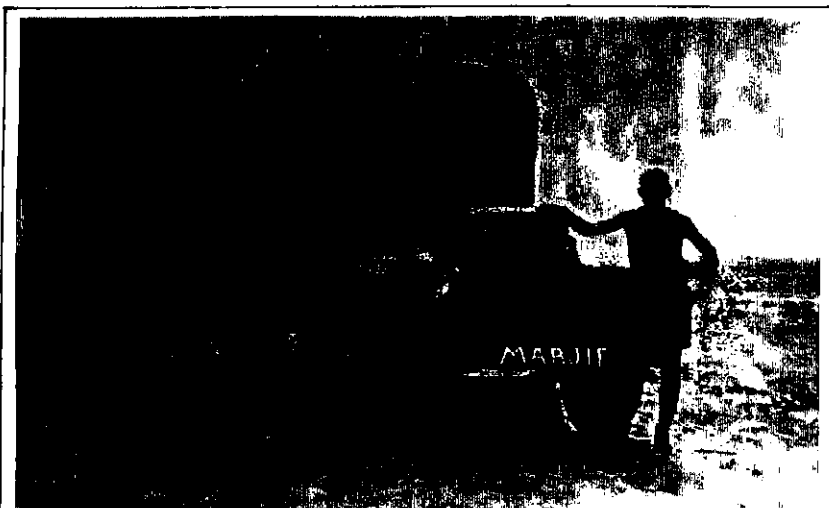
(3.)

AFTER THE  
CYCLONE!

155 Radar,  
Exmouth.

(1.) & (2.)  
The Rx van.

(3.)  
The wrecked  
Doover.



*The 155RS Internationals 'back on the road' with Jim Bettess.*

*Photo :Jim Bettess.*

#### ON THE ROAD WITH THE INTERNATIONALS.

Jim Bettess

After remustering to ground staff from air crew, I found myself at Geraldton W.A. after completing various courses as a Fitter Driver Motor Transport and Diesel Mechanic; so as a Diesel Maintenance Operator my title was FDMT DMO. It all sounded very important, but bringing it back to basics, I was a common old motor mechanic! So, one morning while working in the powerhouse at Geraldton, I was told I was posted to 155 Radar, and nobody seemed to know or care where that was! Days later when I arrived at Potshot Exmouth, I was met by a driver in a Dodge weapon-carrier who said "Hop in, we're heading for the Cape." He meant North West Cape, and so I finally knew where my home was going to be for the next few months. I think they had instructed that driver to scare Hell out of the new bloke (and he sure succeeded) by crossing the 17 dry creek-beds at breakneck speed which made a ride on the Big Dipper at Luna Park seem like a Sunday afternoon drive. He didn't say much, but did remark they had a 'bit of a blow' at the Cape. Twenty six miles later I found that 'bit of a blow' was going to keep me occupied for some time to come - a cyclone had hit 155 Radar, based mainly in KB5 International trucks, and the sight of a heap of overturned trucks is indescribable. The only recognizable sign of habitation was the cookhouse where the cook Sam offered me a steak, and I didn't know at the time that it was kangaroo.

Next stop was the lighthouse keepers' house where 155 had moved in with 31, the other radar unit, and I reported there for duty. I was looked over and quizzed by the other 25 ranks, and Flight Sgt. Ernie Holmes who was my immediate boss (and later good friend) showed me around - the workshop was completely unrecognizable as a building - it was just a heap of sand which, so I was informed, concealed a KB5 International truck with its motor dismantled! 155 Radar had mainly trucks, Inters which had only a few road miles on the clock - Perth to North West Cape. The truck in the workshop had not been properly run in and the heavy going from Perth had

nipped a bearing and a previous mechanic had pulled the motor down and was waiting for parts. At this time I was the only mechanic for both units. Flaherty, the other driver, and I shifted all the sand and set about restoration and finished up finding everything but 2 valve collets which were about the size of a split pea!! Next question? How did I improvise? I won't go into detail but I bet when that Inter was sold at Disposal, somebody would say "Fancy that!"

Late one night my boss roused me out of bed. There was a call from a Radio Directional Finder Unit 50 miles south. They wanted a mechanic to 'look at' a Ford 10 motor on a 7.5KVA alternator. The drill was for someone to drive while I slept in the back of the Dodge weapon carrier so I would be fresh when we arrived as the job was urgent. If you have tried to sleep on an outback track under these conditions - just forget it! Anyway, I had a look at the unit which had run out of water and it resembled a failed sponge cake - it was a melted heap well beyond repair. But under a canvas awning was a 25KVA alternator with a Ford V8 side valve motor also unserviceable. This proved the better option, and I was able to bring it back to life. We left next morning and they were happy, but not as happy as I was, for working without equipment and parts leaves a lot to be desired. Back at 155, I hoped my Lister diesels were still popping away; they were very simple, reliable and suitable for the job. Time passed, and we had all the Inters plus one Lend-Lease Chev ready to go when word came through that we would be leaving and more vehicles were required for the Convoy home. Again a trek into the unknown! We had instructions to proceed to a motor 'Pool' and pick up more trucks - namely - a mobile cookhouse and trailer and a service vehicle, and any other we considered necessary. The instruction was vague enough to get us 'lost in action' so to speak. We had no roads to follow, just a compass and a lot of landmarks, and just briefly, if our compass brought us face to face with a rocky outcrop we would have to detour of course - I leave the rest to your imagination - and more by luck than good judgement we found the 'pool' - about 25 acres of all sorts of military gear but no human life whatsoever. I looked hard for more Inters but there was not one to be found. ( I often wondered what happened to this dump after the war, and when I re-visited Nor'-West Cape in 1994 my memory wasn't good enough to attempt to find it.)

The trip back to camp was easier - we had acquired a Chev and trailer - I think they were called a Wiles cooker - and Chev Blitz and a Western Desert Ford Blitz which proved a disaster. After much organisation we set out for Perth but left behind the Dodge weapon carrier because 31 Radar needed it. We had the Inters, Chevs and a Ford for good measure with generator sets mounted on 25 pound gun carriages which was an added complication, for they had one side wheel which did not track - it ran quite a distance to one side which proved quite interesting.

The track to Perth was only well worn wheel marks which became confusing as sign posts had been removed in case of invasion we were told - I can assure you it would have been a very effective policy! The inevitable happened when the decision had to be made...left or right track at a fork. We took the most used track which led us 15 miles to a windmill - then the track circled the windmill and brought us back to the track we had come on. Of course we then couldn't pass each other and had we left the defined track we may still have been there. At this time the cook decided to make a meal break, so while we organised ourselves in this outback patch of dirt with more confusion than rush hour on North Terrace Adelaide, we were fed and calmed down. The convoy took to the track again with vehicles performing well, although the Ford Blitz driver reported suspected oil burning. We were set up with the cookhouse Chev, a Blitz with generator on a 25 pounder

trailer, a radar Inter, another Blitz and generator trailer, the Chev "Orderly Room," another radar Inter, the maintenance truck and trailer with our petrol, oil, spare tyres and tools, and then 'Tail End Charlie' (me in the radar International MARJIE).

Convoys are funny because the lead truck always wonders why the others can't keep up while the tail wonders why the front has to go so fast. The plan was for the food truck to go ahead to prepare the next meal, but as we had no communication, the system only worked if we had no breakdowns! The tyres, running off track, also punctured and held us up. The tyres were hard to get off the rims at first having been standing on salty ground at the Cape but became easier as we were changing them every few hours.

One morning we decided to send the food truck on to a place marked on our map as 'Winning Pool.' We all had visions of swimming in a pool at lunch-time, but we discovered nothing but a clump of trees and a salt pan which had not had water in it for years, hence no refreshing swim...but every fly in Western Australia was there to greet us. The flies forced us to move on with everything the cook had prepared a mile or so further to a spot where there was hot sand, spinifex, and a 'bearable' population of flies.

On the Ford Blitz, the oil filler came up into the cab and the driver had some beer bottles with long necks. He had it worked out that every nine miles on the run they would put in a bottle of oil....that Blitz truck used 28 gallons of oil on the trip.

The cook had trouble keeping the food cool so he used to spray water on the tins through the heat of the day which was great but it caused all the labels to come off, and then it was a lottery as to whether you got peas, beetroot, apple jelly or apple juice...sometimes bully or M and V.... looking back it provided us with our only entertainment although it wasn't funny at the time. But despite the problems, the journey down proved interesting after our stay at the Cape which had become pretty monotonous.

The original idea of truck/trailer; truck/aerial trailer etc was changed when we found out the best combinations for the various vehicles. Carnarvon was our first real point of contact with civilization. We had all dreamed of bananas, steaks, ice-creams and even women, but due to our noisy arrival after dark, we could not see where to acquire any bananas, the cafe was shut, so no steak or ice-cream, and all the Carnarvon mothers seem to have wisely kept their daughters busy at home!!

We eventually arrived at a Perth suburb, Bassendean I think, expecting something approaching a hero's welcome with red carpet and all, but no one even knew we were coming - we were told to pull to the side of the road and someone else would take care of the convoy. We did as told and guess what....two trucks promptly bogged in Perth's white sand.

Farewells were said with some sadness and we were taken to a Staging Camp to be despatched home for discharge. I have since seen not one man of the personnel of that convoy. What a shame! 50 years have passed since...but I believe I have written everything as it happened.

Finally...you might ask how did I overcome the valve collet problem I wrote about earlier? Well, I got the smallest ring spanner that was shaped in similar fashion, cut it into eight pieces, and after lots of experimenting, patience and cursing, I got enough pieces redesigned to do the job. If International ever saw it I don't think they would change their design... but it got us to Perth O.K.

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