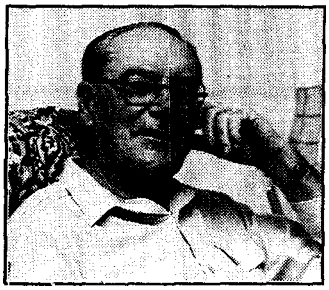

When I Think Back...

by Neville Williams

Aeronautical radio navigation beams from civil airliners to wartime bombers!

Researching historical articles is rather like turning over proverbial stones: you're never quite sure what you'll uncover! My recent articles on the pioneering flights of Sir Charles Kingsford-Smith proved no exception. Even before they appeared in print, I found myself with photostats of two supplementary historical articles which were sufficiently relevant to warrant mention by way of a follow up.

As readers may recall, the original subject was suggested to me by Aub Topp VK2AYT, librarian for the NSW Division of the Wireless Institute of Australia. Planning a series of Sunday morning WIA broadcasts, Aub had been researching the supportive role of amateur radio operators in providing wireless communication for the *Southern Cross*, particularly for the first trans-Pacific crossing in 1928.

Once having become involved in the subject, however, I ended up by recounting Smithy's overall career and developing the theme that — over and above their spontaneous contribution in 1928 — the amateur radio fraternity had also exposed the urgent need for an official aeronautical communications system.

Just as regional governments had done for shipping during the preceding decade, the authorities would clearly have to set up permanent radio networks to meet the needs of the airlines which would inevitably exploit the routes being pioneered by Smithy and other enterprising aviators.

In pursuing this theme, reference was made to historic IRE engineering papers presented in Sydney in 1938 — one whole decade later — which clearly indicated that, while Australians had been prominent in opening up the airways, we were lagging well behind Europe and the USA in terms of back-tip aeronautical radio communication and guidance facilities.

The validity of this latter observation was borne out by an article that Editor Jim Rowe subsequently came across in *Wireless Weekly* for June 7, 1935. Entitled 'Flying Blind on a Radio Beam', it had *been* written by none other than John Stannage — a man who was better qualified than most to comment on the situation.

John Stannage had been a crew member on the plane that found the *Southern Cross* when it was stranded in the desert near Wyndham — mainly because of inadequate radio facilities.

He had also been radio operator aboard the same plane in its historic crossing of the Atlantic in 1930 and, as an experienced marine radio operator, deserved much of the credit for guiding Smithy to a safe landing at Harbour Grace in Newfoundland.

He subsequently flew with Smithy across the USA to the west coast, to complete the world's *first* ever round-the-world flight.

Back in the USA in 1935, the year of Smithy's tragic death, Stannage had had the opportunity to take a close look at the mail/passenger service that had been set up by United Airlines in the Los Angeles — San Franciso area.

Relying heavily on available radio techniques for communications and guidance, UA were said to have earned a reputation for extraordinary efficiency.

Stannage knew only too well that it had been the lack of just such radio facilities that had led to the loss of the *Southern Cloud* in 1931, with all aboard — triggering the demise of Smithy and Ulm's Australian National Airways. (See panel).

Airliners in 1935

United had based its Pacific coast operation on the new American Boeing 247D transport, which Stannage described in the article as a `beautiful Ship'. As pictured in Fig.!, it bore a superficial resemblance to the Douglas DC2 and DC3/Dakota which became a familar sight in Australia from 1936 onwards.

A sleek all-metal, low-wing monoplane with a conventional tailwheel undercarriage, the 247D had occommodation for two pilots and 10 passengers — the same complement as for ANA's Fokker-based Avro 10's. However, with its clean lines and twin 575hp Wasp radial engines, the 247D had a normal cruising speed of 185mph — more than twice that of the older Fokker design.

According to Stannage, the glass-enclosed flight deck was well equipped, but still noisy enough to warrant the pilots wearing headphones for both on-board intercom and radio communication. The passenger cabin, however, was sufficiently well soundproofed to permit normal conversation.

Ian Debenham, curator for aviation at Sydney's Power House Museum, confirmed that, appearance notwithstanding, the Boeing 247D was considerably smaller than the Douglas DC2, which had lust appeared when John Stannage wrote his article, and which he referred to as 'huge'.

According to Ian Debenham, the success of the 247D had been such that they were in strong demand by other airlines.

Boeing put them off, however, on the grounds that their total production would be absorbed by United for the forseeable future. Boeing's rebuff presented a golden opportunity to Douglas, which came up with its DC2 — using a similar design philosophy, but larger and with a greater payload capacity.

In the 247D, the main wing spar intruded into the cabin floor space, complicating passenger seating and movement. In the DC2, the cabin was uncluttered, well insulated and roomy enough to accommodate at least twice as many passengers. In fact, the hugely successful DC3, developed from the DC2, could accommodate up to 33 passengers.

(In his book *Smithy — the True Story* referred to in earlier issues, Ward McNally notes that Smithy expressed a preference for the Douglas 'DC' series in 1935, when seeking the Australia/New Zealand mail contract. He claimed later that the British Government had let it be known that it would be inappropiate for the two colonial governments to endorse an American rather than a British plane for such a service).

On-board radio gear

Getting back to the 247D, Stannage says that he was granted free access to one of the planes on the ground, which gave him opportunity to study the nature and layout of the controls and 'the maze of instruments' which faced the pilots.

The plane was fitted with two main radio systems. One, based on a special medium-wave receiver, gave the pilot ready access to radio guidance, weather and flight information being provided at the time by the Aeronautical branch of the US Department of Commerce.

The relevant aerial was a wire 'V' running from the nose of the plane to a pillar atop the pilots' cabin and thence back to anchor horns atop either side, about midway along the fuselage. As such, the aerial was stable, with minimal drag and fairly safe from possibledamage.

In addition, the planes carried a two-channel shortwave receiver and transmitter, for independent communication with each other and with the company's own ground facilites.

A separate shortwave V-aerial ran from a splice under the nose cone to rear supports near each of the engine nacelles,

The radio equipment was housed in the nose of the fuselage, with a direct connection to the respective aerials. No tuning or adjustments were required of the pilots, all units being crystal-locked and operated by mode selector switches.

United had its main maintenance base at the Oakland Airport, Stannage was told, and each time one of the planes landed there after a long flight, a radio service engineer would open the cowling, release two clips and a supply plug and take the equipment to a service bench for a performance check. Every 200 hours it would be subjected to an extensive strip-and-check overhaul.

The radio equipment was powered by a motor-generator, running from the plane's central 12-volt battery supply — which floated across an engine-driven generator. An hydraulically operated shelf gave ground engineers ready access to the large battery for regular checks and made it an easy matter to substitute a replacement if necessary.

info and guidance

To John Stannage's delight, he was invited to occupy the second pilot's seat on a typical Los Angeles to San Francisco flight, during which he was able to experience 1935 technology in practical, everyday use.

The takeoff from UA's sealed runway, he said, was so smooth that it was literally impossible to tell exactly when the plane became airborne.

Chief pilot Sullivan took it to 1000 feet (305m), placed it on course and, pressing the intercom button behind the left side of his control wheel, invited Stannage through his headphones to take over. Stannage found the plane to be inherently stable, apart from a slight tendency to yaw, but so easy to control that his attention soon reverted to the radio facilities.

Flying at 5000 feet (1525m), they were well clear of the mountains below, which were themselves hidden beneath an endless sea of white cloud. But the plane was exactly on course for an intermediate stop at Bakersfield, as evidenced by an unbroken sequence of dashes in the phones from the beacon at their destination. UA had opted for aural rather then visual monitoring of the guidance beam, on the grounds that an off-course deviation would be more readily noticed.

At this stage, chief pilot Sullivan pressed the right hand buttom on his control wheel and reported in on the company system:

"Hello Bakersfield. Ship 27, ship two-seven reporting."

Back came the acknowledgment, without a trace of ignition or other interference, along with information about the amount of mail and freight to be picked up at Bakersfield and the number of passengers to alight and board. Then followed the weather information that he would need:

THE SOUTHERN CL OUD.

HOPE PRACTICALLY ABANDONED.

Did Liner Crash Into the Ocean?

Five days' desperate searching by air and land has failed to provide a clue to the whereabouts of the air liner Southern Cloud, which has been missing since Saturday afternoon.

All the territory in which it is considered possible that the liner could have descended has been thoroughly searched from the air.

Hope that the two pilots and six passengers are still alive has practically been abandoned.

The possibility that the liner crashed into the sea is being investigated.

Headlines like this one from the Sydney Morning Herald for Friday March 27, 1931 dealt a body blow to the fledgling Australian National Airways, whose planes Initiated a service without any radio backup whatever. Onboard two-way radio could at least have alerted the pilot of the Ill-fated Southern Cloud to treacherous storms ahead, or ground stations to the plane's position.

"Ceiling 8000 feet (2420m) rain squalls, barometer three oh oh four, temperature six eight, visibility one mile (1.6km) clouds breaking at Newman...", etc.

On receipt of the information, and after calculating that they would be nearing Newman and well clear of the mountains, Sullivan headed down through the dense cloud — guided by the beam and confident that, even without a break in the clouds, he could count on 800 feet of visibility above ground.

In fact, they were able to spiral down through a break above Newman and head for Bakersfield 'skimming along' at 200mph-odd at around 800 feet, which Stannage found quite fascinating. Sullivan took the opportunity to demonstrate the beam by veering to the left, to demonstrate how the dashes changed into a letter 'A' (dot-dash) and to an 'N' (dash-dot) when he veered right.

Assured of clear weather ahead, they proceeded without incident to Bakersfield. Then to Fresno, Mills Field at San Francisco and on to the UA base at Oakland Airport, covering 350 miles (560km) in an elapsed time of just under three hours. The regular scheduled non-stop flight over the same distance would have taken just over two hours.

Stannage added that, with Smithy in the Lockheed Altair, they had covered the distance in one hour and 35 minutes, just failing to break the then record by three minutes.

Summing up his reactions to the visit he said, and I quote:

I was rather amazed by the amount of confidence placed by the pilots in their directional radio gear. They tell me that the transcontinental pilots barge right into the bad stuff en route, without the slightest fear that they may be off their course.

These days, such situations are routine. Back in 1968 I was a passenger in a Air Lingus 707 that headed across the Atlantic from Shannon in Ireland, and deliberately took its place in a 'stack' adjacent to Kennedy Airport — flying through and into violent thunderheads.

This, the pilot explained, rather than be diverted with a plane load of passengers to "God knows where" in the middle of the night. Despite the darkness, the lightning, the wind and the driving rain, we landed smoothly at Kennedy — as did as many other planes stacked up over nearby La Guardia!

But Stannage's tribute was directed in early 1935 to systems that, by then, had been installed, tested and accepted across the USA.

Another three years were to pass before our radio engineers, in conference at Sydney University, were to be briefed on aeronautical guidance and communication facilities that were only then being installed in Australia.

Beams & bombers

Amongst the photostats made available to me by Aub Topp was a copy of an article from the UK magazine *Ham Radio* for June 1989, entitled 'The Battle of the Beams' and written by D.V. Pritchard G4GVO. It had apparently been reprinted by arrangement from *Practical Wireless* for January 1988. The article had little direct relevance to the Kingsford-Smith story but, along with the foregoing Stannage report, provided a distinctly different insight into the evolution of aeronautical guidance beams.

Pritchard makes the point that the German Lorenz beam system, along with other rival technologies, had been promoted throughout Europe during the 1930's, although with a rather different emphasis to elsewhere. In America, as in Australia, cities and airports were dispersed over a wide area, with the operational range of navigation and communication equipment emerging as a prime consideration.

In Europe, with its many cities and airports in relatively close proximity — and its often inclement weather — it was more important that navigation beams be able to guide planes during their approach procedure to a safe touch-down, under conditions of very limited visibility. The different emphasis was evident in the Erben/Lorenz presentation to the IRE in Sydney during 1938. (See last issue).

According to Pritchard, Dr.E. Kramer had commenced work on the basic Lorenz guidance system in 1932, based on carrier frequencies in the range 30 - 33.5MHz, tone modulated at 1150Hz. His concept was to radiate two overlapping guidance beams from the same MCW (modulated continuous wave) transmitter, one 'keyed' with a continuous sequence of Morse code dashes, the other with a suitably synchronised

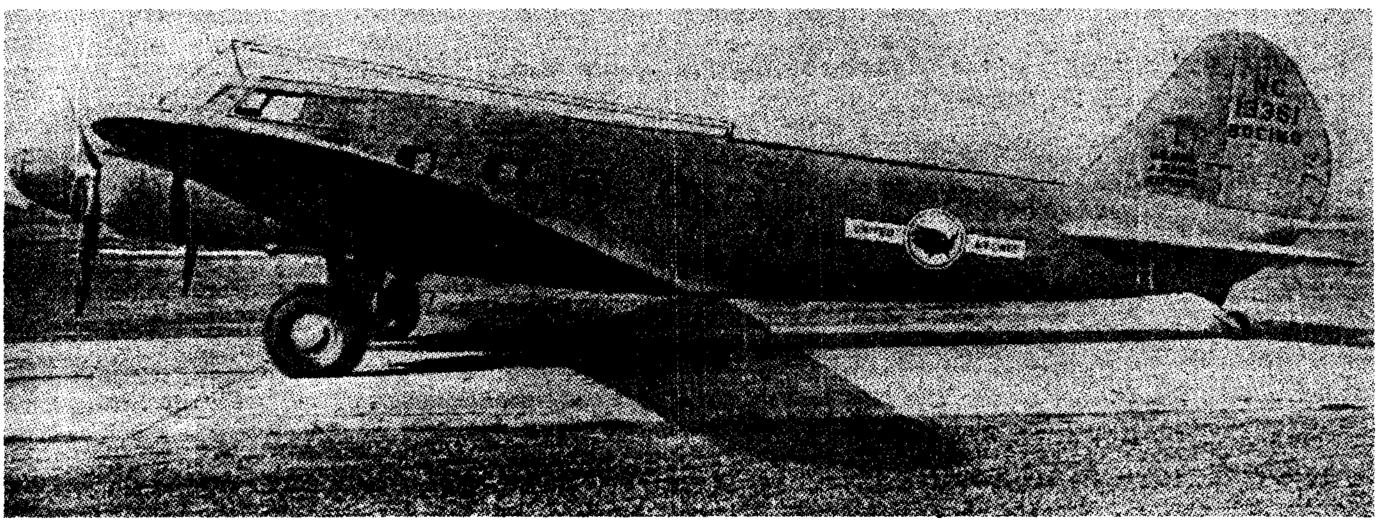

***Fig.1**: From Wireless Weekly June 7, 1935, a Boeing 247D with onboard radio communications and guidance facilities — which Stannage says had won for United Airlines a reputation for 'extraordinary efficiency'.*

train of dots. If an approaching aircraft encountered only dashes, the pilot would know that he was to the right of the optimum approach path. Dots only would indicate the reverse. In the central overlap or 'equi-signal' region, where the receiver sensed both beams, it would merge the two modulation components to produce a subjectively continuous 'on course' tone.

(An alternative approach, referred to in the Stannage story, involved using the Morse characters for 'A' and 'N', so timed that, when overlapped, the dots would be masked, leaving only a succession of dashes).

`Keying' separate lobes

To achieve the distinctive modulation of the respective beams, Kramer installed a vertical dipole at the far end of the runway, along with two separate parasitic elements — so placed that they could distort the dipole's normal field pattern into two overlapping lobes, displaced symmetrically to either side of the correct approach path.

Both parasitic elements, however, had a gap in the centre; each gap was bridged by relay contacts, such that they could only function as reflectors when the relevant contacts were closed. By energising the relays separately as appropriate, it was possible to arrange for the respective lobes to be activated, as if 'keyed' with dots or dashes, suitably synchronised.

(Since the right and left signals were both sourced from the one tone modulated carrier, possible problems of frequency or phase discrepancy were avoided).

By way of supplementary information, an 'S' (signal strength) meter offered the pilot a broad indication of his proximity to the source antenna. But a separate vertically-orientated approach beacon on 38MHz gave him a blip of distinctively different modulation, to indicate that he was 3000 metres from the start of the runway. A second approach beacon signified 300 metres to go.

As the Lorenz technology evolved during the 1930's, it was licensed to other countries and evaluated, from time to time, by the various major airlines and air defence forces. However, with the outbreak of war in 1939 its possible role had to be re-appraised, both as a domestic navigation aid and as yet another radio transmission that might conceivably serve to guide marauding aircraft to strategic targets.

Aware that this and other emerging technology could have a profound effect on the outcome of modem-day war, Britain moved to strengthen that aspect of the Military Intelligence Service (M16). What turned out to be a particularly fortuitous step, according to D.V. Pritchard, was the appointment in 1939 of a relatively young physicist, R.V. Jones, as Scientific Officer to M16.

Born in 1911, Jones had rounded off his formal education with an Open Exhibition in 1929 to Wadham College, Oxford. There he worked in the Clarendon Laboratory under Professor Lindmann, who later became Lord Cherwell and Scientfic Adviser to Winston Churchill.

Fortuitous hunch

In early 1940, Jones had a premonition that the Germans could be developing a radio navigation system to increase the effectiveness of their night bombing raids. Apart from the technical logic of such an idea, examination of documents from crashed German aircraft turned up the code name 'Knickebein' — meaning `crooked leg'.

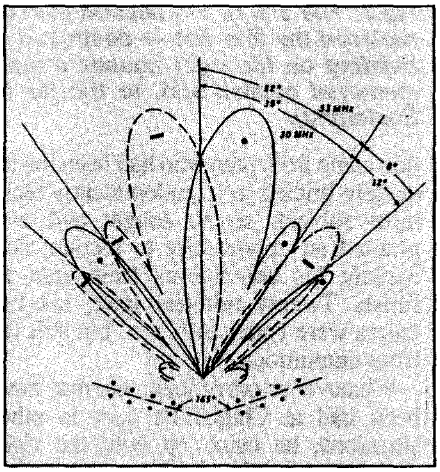

Fig.2: *Reprinted from Ham Radio for June 1989, this diagram shows the radiation pattern from a typical wartime Knickebein array. It extended the range by using twin phased arrays, suitably angled to concentrate the energy Into two slightly overlapping forward lobes.*

From its sense and context, M16 and Jones concluded that it might well signify a radio beam of some kind.

The speculation was heightened when two prisoners were overheard discussing 'X-gerat' (` secret apparatus'), being evidently something used in German aircraft and involving radio pulses. Could it relate in some way to Knickebein?

That such could indeed be the case was indicated by the navigator's notes from a downed Heinkel, which read:

Navigational aid: Radio beacons working to Beacon Plan A. Additionally from 0600hr Beacon Duhnen. Light Beacon after dark. Knickebein from 0600hr on 315 degrees.

Shortly *afterwards,* an ostensibly 'co-operative' prisoner made the mistake of `confiding' to the British what he wrongly assumed that they already knew: that Knickebein was a beam so narrow that two of them could pinpoint a target with an accuracy of less than a kilometre. It was related to 'X-gerat'.

Having by this time broken the German 'Enigma' code, M16 operators were able to identify further fragments of the jigsaw from other documents recovered from crashed enemy aircraft. One carried a German aircrew report of having received a beam a few miles south of Redford in Nottinghamshire, which had originated in Kleve — on the nearest German soil to England.

Other papers captured a few days later identified a second (or marker) beam being radiated from Bredstedt in Schleswig-Holstein. Jones' hunch had seemingly been authenticated, but it triggered time-wasting argument between the military buffs who were privy to what Jones was on about...

Technical conundrum

They were aware that the Lorenz system, as deployed in Europe, had a range of 10 miles at best (16km), with relatively broad lobes that were adequate as landing aids only because the focal point was co-sited with the home runway. It seemed unlikely that the Germans had been able to upgrade the concept sufficiently to sharpen the lobes to less than a kilometre wide at 300km or more from their point of origin. But who could be sure that they hadn't?

On the other hand, sharply defined beams might suggest transmissions at a centimetric wavelength — yet it was unlikely that available valves could deliver sufficient power in this portion of the spectrum. Yes, but German engineers had been quietly experimenting since around 1930, with radar techniques on 50cm; they might just have overcome the valve problem!

That aside, because of the quasi-optical nature of very high-frequency transmissions, others contended that the signals would not conform to the curvature of the earth anyway, but follow a straight path rising above the altitude limits of contemporary bombers.

It was left to an amateur, Rowley Scott-Farnie G5FI, then a signals officer in RAF Intelligence, to alert Jones to a report by T.L. Eckersley — Britain's foremost propagation expert. If Eckerley's calculations were correct, a 20cm wavelength beam originating in the Hartz mountains would indeed exhibit sufficient curvature to be detected by a plane flying over England at 20,000 feet (6,100m).

With Eckersley's article in hand, Jones was able to convince Professor Lindmann — Churchill's technical adviser — that guidance beams were at least technically feasible.

The big problem was that M16 had never been able to find anything in crashed German planes even vaguely resembling a centimetric wave receiver. The nearest thing was a seemingly ordinary E BL-1, a blind landing receiver that could as easily have come from a British plane.

Interrogation of German fliers yielded nothing new, but one was overheard to say in casual conversation that, no matter how hard the British looked for the equipment, they would never identify it. Jones interpreted this to mean that it was right there under their noses, and they simply hadn't recognised it.

Unwitting challenge

With this possibility in mind, Jones quizzed the technicians at Farnborough who had evaluated the German E BL-1 receiver. Was there anything unusual about it?

"No", they said, then adding as an afterthought, except that it was "many times more sensitive than they would ever need for blind landing". Could that hold the key to the situation? Was the E BL-1 fulfilling a double role?

As Rowley, G5FI commented to Jones, it was entirely feasible that the Germans had sought to disguise the beam system by operating it on accepted Lorenz frequencies (say) 30, 31.5 and 33.3MHz. This would check, what's more, with further recovered German flight documents, including mention of another Knickebein installation, this time at Stollberg.

Unfortunately, three Anson bombers fitted with standard Lorenz equipment and flown by Lorenz-trained pilots failed to discover any trace of alien guidance signals, over areas that were conceivably being targetted.

The impasse led to a top-level meeting between Churchill and a number of Service Chiefs, seeking to resolve the question as to whether the Knickebeins posed a tangible threat and/or whether the diversion of further time and trained personnel to their investigation was justified.

Jones, who had been invited to attend, quickly realised that much of the opposition came from men who had been inadequately briefed in a predominantly technical subject; so he sought and was granted an opportunity to recount and explain his convictions from start to finish. Twenty minutes later, his listeners were better informed but still far from unanimous.

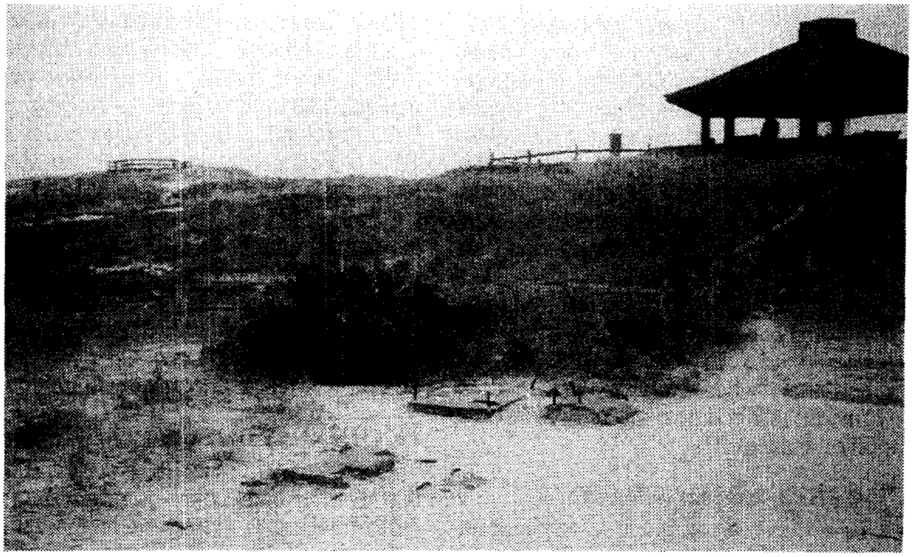

***Fig.3:** The site of the second Marconi transmitter near Harbour Grace, which replaced the first one — destroyed by a cyclone shortly after its erection. The building on the right houses a model of the installation. Adjacent to it is a memorial obelisk and, to the far left, a viewing platform. (Photo by 'Blue' Easterling).*

Whatever errors of judgment may have been laid at Churchill's door in other situations, he came up with the right decision on this occasion — tearing strips off the Air Ministry for their tardiness and obduracy and ordering them to get up there and 'find those beams once and for all'.

But, even so, Jones' troubles weren't over. Some still argued doggedly that beams or no beams, German pilots would continue to find their targets, just as RAF pilots were able to do over Germany. Ansons had consistently failed to find Knickerbein signals in the past — why should they be any more successful now?

They and their crews could be better employed on other assignments. Under pressure, even Eckersley was equivocal about his earlier pronouncement: yes, he *could* possibly have missed something in his maths!

Success at last

But the Ansons did go up, and one of them — fitted with a sensitive Hallicrafters receiver — did find a narrow alien beam, 400 - 500 yards (or metres) wide just south of Spalding, on 31.5MHz, with Lorenz dash/dot modulation.

They had flown along the equi-signal path, plotting it as they progressed, duly encountering an intercepting marker beam at a point near Beeston. The designated target was clearly Derby, the site of a Rolls-Royce factory producing engines for the RAF.

It was the kind of evidence that could not easily be ignored. With doubts abruptly dispelled, attention turned urgently to unravelling the technology and to possible counter-measures.

How had the Germans transformed a local, blind landing aid into a sharply defined, long-range beam? The answer: by the same basic techniques that amateurs had exploited during the same decade to extend their local 'rag-chews' across states, continents and oceans — by replacing unpretentious antennas with high gain beam arrays and upping the input power level for extra measure.

It turned out that, back in 1938, with war clearly in the offing, Dr Lohmann of Telefunken had discreetly devised a huge new array, conforming to the Lorenz frequency parameters.

Involving metal girders 30m high, spaced out over a distance of 90m, it was shaped like a shallow 'V', with an angle of 165°, and overlooked the runway, as did the original Lorenz antenna.

Mounted on a circular track, however, with a 50-watt transmitter at its centre, it could be rotated to project the beam in any desired direction. While able to double as a landing aid in conjunction with normal Lorenz receivers, it had another, more sinister potential role in view.

The actual antenna, supported by the

framework, comprised a total of 16 vertical dipoles and the same number of reflectors — eight of each per side — forming huge, twin, phased arrays, with lobes broadly similar to those illustrated in Fig.2.

Because of its supposedly 'broken necked' appearance, or 'geknickten' in German, it was given the codename of 'Knickebein' — which proved sufficiently transparent to attract Jones' attention.

Pritchard says that the precise details of Knickebein antennas, transmitters and receivers appear to have been lost, but Dr Lohmann's original array was followed by smaller and less conspicuous structures comprising half as many elements — four dipoles and reflectors in each leg — constructed of large diameter tubing to achieve a bandwidth covering the range 30 - 33MHz. The centre, equi-signal zone was +/-0.6° wide, as compared with +/-0.3°, but the range was much the same.

Ten such arrays had been set up by 1940. Lorenz/Knickebein receivers were also progressively installed in all German multi-engine combat aircraft.

Early model receivers were TRF types, which proved to be unduly susceptible to jamming.

In response, Dr W. Kloepler of Lorenz came up with a superhet alternative, switchable to 34 channels in the range 30 - 33.3MHz. Physically, it was a more or less direct replacement from the earlier model and carried the type number EBL-3H, presumably to support the masquerade as simply a new and improved landing aid.

British countermeasures

Once convinced that Knickebein posed a major threat, the development of countermeasures was accorded the highest priority under Wing-Commander E.B. Addison of No.80 Wing at Radlett and Dr.Robert Cockburn of the Telecommunications Research Establishment at Worth Matravers.

Manned receivers were placed in dizzy `crow's nests' atop selected Home RDF (radar) towers, to keep watch for the beams which some had argued would never be heard over Britain at less than 20,000 feet.

But they certainly were heard and, when they were switched on around dusk, reports from the towers were conelated to indicate their likely orientation. Ansons were then sent aloft to track and plot them accurately.

Meanwhile, medical diathermy equipment and industrial RF generators were requisitioned from available sources and `fiddled' to concentrate their noise output on the Knickebein frequencies. Installed in police stations, they were switched on and off at the discretion of No.80 Wing.

As a further measure, all available Lorenz equipment was modified and strategically located to operate as 'Meacons', or mock beacons, to confuse the pilots trying to follow the Knickebeins. Or, again, by placing a false marker short of the target area, German aircrews could hopefully be induced to drop their bombs in the countryside short of the target.

But the most effective countermeasure, according to Pritchard, was Cockburn's so-called 'Aspirins', which had been specially designed to cure the 'headache' presented by the Knickebeins.

Immensely powerful transmitters, they could flood the Knickebein route with false dashes, causing the pilots to fly 'in circles' searching for the companion dots. Or they might still hear dashes when they were actually in the equi-signal zone.

Contrary to some statements, the German Knickebein beams were never actually 'bent' by the British countermeasures — but the level of confusion was such that they may just as well have been!

After a few weeks of this, Luftwaffe aircrews realised that their beams had been completely neutralised. Ironically, however, it reportedly took several months before anyone had the courage to tell Luftwaffe chief Hermann Goering that his Knickebeins had become totally useless.

Had it been otherwise, according to the article, the system at its best would have been able to direct a bomber force to drop bombs every 17 metres across a designated target area! Who knows, asks Pritchard, how much more destructive the bombing might have been but for the perception and persistence of a young physicist who refused to be silenced by the 'experts'?

Mind you, how many residents in Britain's cities have even heard of Professor R.V. Jones — or his amateur friend G5FI?

Newfoundland in 1901

Rounding off the avionics theme, earlier mention of Newfoundland and Harbour Grace reminded me that, if radio guided the *Southern Cross to a* safe landing at Harbour Grace in 1930, it was only in 1901 that Marconi and Vyvyan, *using* crude brute-force spark equipment, had managed to launch the first-ever radio transmission across the Atlantic to that same remote spot.

The background to that historic transmission was detailed, you may recall, in a letter from W.A. ('Blue') Easterling featured in this column on pages 42-45 of the May 1991 issue.

That, in turn, reminded me that 'Blue' (Wal) Easterling had come across another photo that he had taken of the lonely, windblown site at Cape Cod, where they had erected a second antenna array to replace the one blown down a few days after it was erected.

If you do turn back to the story, as above, note that Walfleet should read Welfleet and the reference to arc supply volts should read 20,000=0 rather than 2000/200. In anybody's language, that's a lot of volts to be keying!

Thinking back over his own training in the spark era, Blue says that enormous RF voltages were developed on arc transmitter antennas, especially if the L/C ratio of the system was too high.

`Brushing' or corona effects would be evident across the insulators, or to any nearby metal object. All that remains now of Marconi's historic radio station are a few footings on the sandspit, that has been savagely eroded over the intervening years by recurrent Atlantic gales.

As I wrote the caption for Blue Easterling's picture, I called to mind Erben's preamble to his lecture to the IRE in 1938.

Although he was about to describe state-of-the-art navigational equipment for aircraft, he warned his listeners that it was the product of 'our two youngest technologies', both of which were still undergoing rapid development. How dramatic those developments have been — all within the lifespan of a single generation. (My own mother is only days away from her 99th birthday!)

In 1901, wireless telegraphy was still a primitive by-product of electrical engineering. Heavier-than-air flying machines were about to enter the manned glider stage. By 1931, more functional but still primitive wireless equipment was able to guide a practical aeroplane to a safe landing in Newfoundland.

Today, the world is being criss-crossed by hundreds of lavishly appointed jumbo jets and supersonic airliners. Space ships and satellites orbit the earth, all of them guided and/or controlled by modern high-tech radio.

I wonder whether Erben imagined, even in his wildest dreams, that people in his audience would live to see the day when satellite technology would be able to pinpoint the location of ships, aircraft, land vehicles and even individuals, within metres of any point on or above the earth?