radios. Trying to change the *standards* is not a good idea. Spurious-free dynamic range (SFDR) was defined in the early 1970s at Watkins Johnson Company (CEI Division) in concert with work done at the Rome Air Development Centre. This definition includes, but is not limited to, the MDS as *a signal 3dB higher than the noise floor*, rather than how DK4SX defines it. *QST* adopted these de facto SFDR standards a long time ago.

"One area not emphasised in the article is the *absolute necessity* today for manufacturers to use higher level and much higher intercept mixers in the first conversions of receivers, despite all claims of achievement in active commutating mixers. It is unacceptable in today's crowded HF environment to have class I or II mixers (+7 or +13dBm LO) in the first conversion of a receiver to reduce cost. HF is the toughest RF environment, and Europe is the test bed. . . ham radios with SFDRs upward of 105dB have generally been crushed by the European environment. . . Ham radio manufacturers have almost never used +27dBm passive class I mixers (triple balanced) in the first conversions. Why not? It is possible to build receivers with 120+ dB SFDR this way… "

In his reply, DK4SX refutes the idea that super-high-level MOSFET mixers [eg H-mode mixer - G3VA] are more costly than the ancient quad-FET mixer [if well-designed]. "In addition, using small relays to choose front-end bandpass filters is even cheaper than quality PIN diodes. . . Modern receivers show IP3 SFDRs of up to 105dB only because of [specified] reduction of IF and/or audio bandwidth. They still do not succeed in surpassing a 20-year-old Drake TR-7… I agree there would be a market for radios with ergonomic operation, ie, half as many knobs or sub-menus and superior RF performance. Hams take the 'cheapies' because they are there. I think with in-depth education, everybody would like to have top RF performance.

"There is a lot to do to make amateurs aware of the technical background of a well designed, modern radio's RF section and how best to evaluate the 'spec'. Just have a careful look at colourful 'data' sheets; even the difference in dynamic ranges is mostly unclear or intentionally concealed. . . One of the best receivers I know, the [professional] DASA/Telefunken E1800, with a guaranteed IP3 of +40dBm (typically +45dBm), has a first IF around 40MHz for IMD3 reasons. This receiver makes use of discrete quartz crystals to form a first [roofing] IF filter to avoid the IMD3 encountered with thin, VHF monolithic two-pole filters. So, why use such a high first IF [around 70MHz]? A first IF around 40MHz, with preselection, will grant a high IP3 and the possibility of narrow [roofing] bandwidths down to 3kHz. Compare the in-band behaviour of the KWM-380 (with only +15dBm IP3 and an 8-kHz filter in the first IF) to a modern radio. . . "

In a further comment, KW7CD agrees that most current radios were designed for the US where EMI is not as big a problem as in Europe. But on the 40MHz versus 70MHz first IF he remains convinced that the *image* [response] kills the 40MHz approach. "As you go up in the received frequency, say, towards 20MHz, these 40MHz IF radios will suffer interference from VHF/FM broadcast stations even with good front-end filtering. You must trust me on this, I speak from experience." [American high-power FM stations are more often sited in town centres than is the case in Europe - G3VA]

A letter from Peter Traneus Anderson, KC1HR, disputes DK4SX's suggestion that he needs no computer outputs from his ideal receiver. "I do need computer output, for RTTY, PSK31, SSTV and so on. I set up my homebrew receiver to have a control panel with few controls, as Graf recommends. Four knobs, three buttons and one numeric display. This design, using a DDS for its VFO, has permitted me to experiment with a wide range of tuning rates. . . on size, once 120dB RF ADCs appear [fully digitized receivers] you *will* carry your receiver in your pocket; the single-input low-pass anti-alias filter needs only a few large coils, and all other filters will be implemented digitally in the DDC chip." [But what size the control knobs and displays? - G3VA]

With the original *QEX* article, the Editor ran a sidebar: 'A better mousetrap'. "Although we don't often run this kind of article, we feel that the author's main point about dynamic range justifies the discussion. HF receivers operating in Europe suffer from extremely high levels of international broadcast interference. The cry for better strong-signal capability is echoed across the continent and in Great Britain. . . Receiver design involves conflicting goals. For example, the high-level mixer needed for dynamic-range extension requires more LO energy, which potentially means increased phase-noise and birdy difficulties. Multiple narrow bandpass filters in the first IF of an up-converting HF receiver seem to strain the trade-offs between performance, cost and reproducibility. Many experimenters have set their sights on digital direct conversion (DDC), since this architecture addresses most of the desires mentioned while avoiding many of the pitfalls. The number-crunching horsepower for DDC can be mustered even today, but ADCs with 119dB of dynamic range and sufficient conversion speed are still a way off. Until they appear, designers are hard-pressed to improve on the superhet. Practical matters in the design and operation of receivers mean that you are likely to agree with some of the author's points and disagree with others."

G8MOB, who shares my liking for the mid-20th Century large and heavy but serviceable valve receivers despite their limitations (his favourite receivers are still the Racal RA17L plus SSB adaptors and the later solid-state RA1772) was rather surprised to find DK4SX still recommending that a receiver noise figure of 15dB (just about achieved in the 1930-40s by the HRO) as adequate for most of the HF band. In fact this point has been made a number of times in *TT* for receivers used with a good, full-sized outdoor antenna, although 10dB is more appropriate for 28MHz or where a poor antenna is used. But it has to be admitted that for modern HF SSB or CW operation, particularly during CW contests where the other end is likely to be using a 300Hz filter, a separately tuned receiver is at a serious operational disadvantage to a modern transceiver because of the time required to ensure an accurate zero beat or at least one close enough to appear in his pass-band - at least that is my experience!

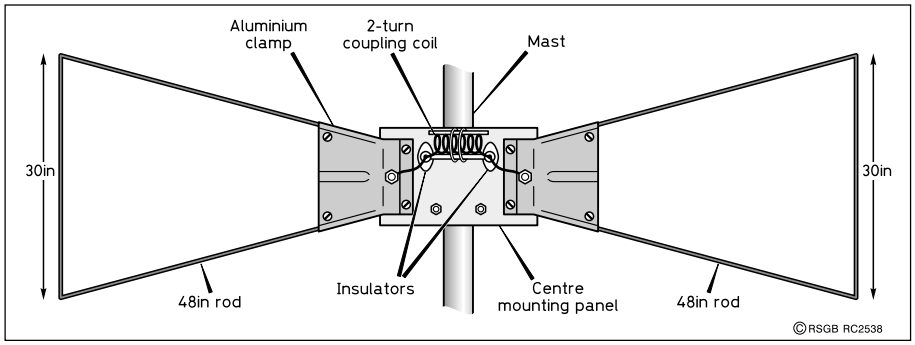

Fig 2: The 28MHz Wonder-Bar bow-tie antenna, as developed by K6OFM in 1956. Fashioned from a VHF biconical TV antenna, it provides good performance over the 28MHz band despite having an overall span of only 8ft (*QST*).

THE WONDER-BAR ANTENNA

RECENTLY, PETER Halpin, PE1MHO, sought my aid in tracing the original *QST* articles on the 28MHz Wonder-Bar antenna first described over 40 years ago by E T Bishop, K6OFM (*QST*, November 1956, but found sufficiently useful to merit further notes in February 1957, April 1981 and May 1981; and also in *CQ*, January 1961) as a recommended antenna for 50MHz. By adjustment of the elements and loading coil it should prove equally effective for 24 or 70MHz. With two or

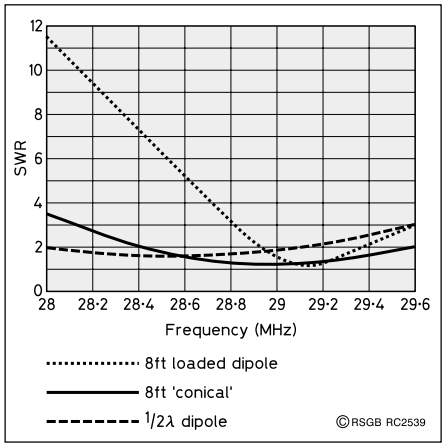

Fig 3: Comparison of SWR performance of the 28MHz Wonder-Bar (conical) antenna with (a) an 8ft dipole using 1in aluminium tubing; and (b) a full size half-wave 28MHz wire dipole.

three elements it can be used for two- or three-element beams, as noted in several of the *QST* items.

A 1956 editorial introduction states: "Using TV Biconicals on 10m - K6OFM describes the results he has had on 10m with a simple loaded dipole only 8ft long: **Fig 2**. SWR measurements indicate that fanning of the conductors brings considerable increase in bandwidth over a similar antenna with conventional elements."

As with all inductively loaded antennas there will be some small loss of radiation efficiency, but with this design this should be very little indeed. The spread (fanned) elements should ensure satisfactory operation over the entire 28MHz band. VHF biconical TV antennas are unlikely to be readily available in the UK, but, as K6OFM pointed out, many variations in construction are possible. "If a TV antenna of this type is not available, half-inch outer diameter lightweight aluminium tubing can be substituted, with four 48in and two 30in lengths needed. Also required will be two stand-off insulators, the loading coil which in the original comprised a B & W Miniductor No 3013 (12 turns No.16, 1in diameter, 3in long) and a few nuts and bolts. **Fig 3** gives the curves comparing SWR on a 52Ω coax line feeding the 28MHz Wonder-Bar antenna; an 8ft non-fanned dipole using 1in aluminium tubing, and a full size (16.5ft) half-wave 28MHz wire dipole.

The *CQ* 50MHz version is shown in **Fig 4.** The centre insulator is a 5in x 7in piece of plexiglass or similar insulating material. TV antenna elements or quarter inch copper tubing or rod may be used to construct the 'bowtie'. The centre loading coil consists of 10 turns of No.14 (AWG) bare wire, 1in diameter and spaced a quarter-inch between turns, with a 2 turn link of No.14 plastic covered wire around the centre. Adjust for minimum SWR by varying turn spacing.

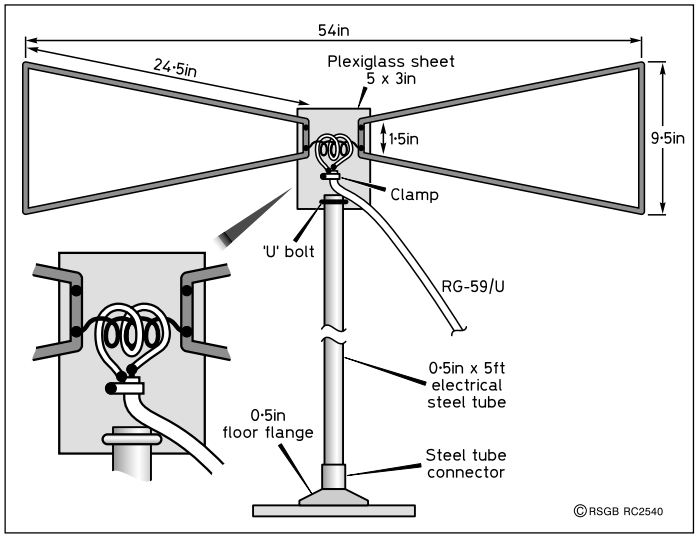

Fig 4: A 50MHz version of the Wonder-Bar antenna, as given in *CQ* in 1961. See text for constructional details.

BEAUMANOR & THE DOMINO INTERCEPTS

THE ILLUSTRATION showing Beaumanor Hall on page 10 of the December, 1999 *RadCom* reminded me that virtually nothing has ever been published in the amateur journals of the role played by the secret intercept stations concerned with the reception of the German occupation police (ORPO) traffic throughout the war (a source that became known as 'Domino') - an activity in which a number of amateurs played an important role. Although I was never personally concerned, details are now to be found in the Public Record Office at Kew (File HW3/155 'History of the German Police Section 1939-45') an account written as part of a secret history of GC&CS compiled at the end of the war. Additionally, the value of this work appeared in 1981 as an Appendix to Volume 2 of the official history of British Intelligence in the Second World War.

The PRO file shows that interest in German police W/T traffic increased after an initial 'break' into the hand-ciphers was made by Brigadier Tiltman at BP in the autumn of 1939, although the French [under Gustave Bertrand] and the Poles were already monitoring this traffic, which then amounted to some 80-100 messages per day. In the UK, sets were

An aerial view of Hanslope Park and the associated workshops and accommodation huts, but with the RSS/SCU intercept station off the right of the illustration.

allotted at the existing Metropolitan Police radio stations at Camberwell, South London, and Harpenden, Herts. These stations, under Harold Kenworthy, G6HX, had for some years been intercepting diplomatic and commercial traffic, with Harold Kenworthy working in close collaboration with Leslie Lambert, G2ST, the 'wireless expert' of GC&CS (aka 'A J Allenby' and 'A J Alan'), the polished star-story-teller of BBC Radio in the 1920s and 30s who fell terminally ill while at Bletchley Park and died in December 1941. G6HX (later awarded the OBE) was for a time seconded to GC&CS, although he stayed in Camberwell. He retired to Banstead, was a founder member of the Radio Amateurs Old Timers Club, and died in April 1960. Among a number of amateurs concerned with wartime intercept engineering at Camberwell was, I believe, Lyell Herdman, G6HD. In the early 1930s, G6HX and G2ST were jointly responsible for tracing by D/F the first identified Russian clandestine station in the London suburbs.

Hut 5 at BP was allotted for exploitation of Domino traffic. A French station at Metz was well suited to intercept the traffic from occupied Poland etc in the early months of the war, but when France was occupied in the summer of 1940 Bertrand and the Poles continued to intercept and decrypt some of the German police traffic from a secret base near Montpelier in Unoccupied France until November 1942, decrypting and passing some of this traffic to the UK via the Polish clandestine station at Stanmore.

In August 1940, some 12-16 receivers where allocated for intercepting Domino traffic at Beaumanor, which became the main Domino intercept station , although later additional sets were used at Kedleston Hall, Derbyshire, a large Georgian House in a deer park with a lake. The Germans became increasingly conscious that their ORPO traffic might be intercepted and increased both cipher and signals security - but to little avail, as indeed was the case with the parallel Abwehr traffic intercepted by RSS/SCU. Originally the German Po-