also create strong magnetic fields that can warp the filament and grid structures of very high power valves. Some form of manual or automatic 'stepped' switch-on is highly desirable, temporarily inserting a suitable resistor in the primary of the mains transformer.

ELECTRONICS & THE ENVIRONMENT

MOST OF US like to think of our hobby as reasonably benign in respect of environmental pollution. Admittedly not everyone approves of the visual appearance of masts and towers - but then some of us still use trees to support our antennas. EMC of course is a problem, but is usually curable and seldom damages the environment. Health hazards from biological effects of RF radiation, other than known thermal effects, are still largely unproven, despite public agitation and many years of investigation. One needs to take note of the toxicity of cadmium, beryllium, mercury, etc, the need to provide good ventilation when using some cored-solder fluxes which can induce asthmatic problems, the possible effects of strong RF on heart pacers, etc. However, before we seem to be unduly smug, it is worth remembering that the production of semiconductors involves extremely dangerous toxic waste. A few years ago Silicon Valley was described as the most polluted area on Earth - though the position is said to have been improved since.

I was reminded of the continued concerns by an article 'The Environment' by Tekla S Perry in the 'Technology 2000' round-up in *IEEE Spectrum,* (January 2000, pp81-85) with its introduction "Research into making today's increasingly pervasive electronic products more environmentally safe is being spurred by concerns at both the global level - environmental contamination that will last for generations - and the personal level - the health of an individual." This illuminating survey covers such questions as reducing the high lead content in printed-circuit boards; achieving more energy efficiency to fight global warming; the continuing health concerns raised on the use of cellular phones; the effects of low-frequency (50 and 60Hz) electromagnetic fields, which seemed to go into remission, only to resurge; and the elimination of the use of chlorofluorocarbons (CFCs) a family of chemicals that damages the ozone layer.

Printed circuit boards manufactured in their millions contain components which have lead-based surface finishes and are attached with lead solder paste and lead-based wave solder. The electronics industry uses and discards a huge amount of lead annually (some 7700 metric tons for solder applications). Although this is less than the lead used for car batteries, most lead batteries are recycled, seldom the case with the lead in PCBs. When taken out of service, most PCBs in personal computers go into waste dumps, along with leaded circuit boards in obsolete video games, portable tape players, broken VCRs, etc. "Lead, like cadmium and mercury, is toxic. In humans it affects the nervous system, blood circulation and kidneys. Placed in landfills or incinerated, it can leach into the groundwater, where it can get into the food chain. In recent years lead has been legislated out of, or restricted, in most uses in the USA and in many developed countries. No longer is lead found in paint, pipe solder or in petrol in many areas, but its use in electronics manufacture has not yet been restricted."

The growing mountains of computer junk is seen as a key environmental concern. In Europe, the European Commission has recently circulated the third draft of a directive on 'Waste Electrical and Electronic Equipment', which addresses the use of cadmium, mercury and some other toxic metals, along with lead. It currently schedules a phasing-out of the use of all these substances, exempting batteries and PCBs, by 1 January 2004, although this draft may be modified in an anticipated fourth draft.

Tekla Perry shows that some major companies, including Sony and Matsushita, are planning to eliminate lead solder from domestic products this year. Similarly, some firms in the USA are attempting to clean-up the large quantities of polluted water resulting from electronics manufacture. Possible alternatives to lead solder include tin, copper and silver in various combinations. It seems likely that tin/copper will be used for wave soldering, with tin/silver/copper used for solder paste. These alloys have higher melting temperatures than the current tin/lead solders, 220°C. Tin/silver/copper melts at about 240°C and tin/copper at a rather higher temperature.

IEEE Spectrum notes that efforts are being made to promote the use of energy-efficient products, including computers and peripherals, fluorescent light bulbs, with TV set-top boxes and telephone equipment soon to be targeted. But some of these energy-saving projects may be countered by the increased use of computers resulting from the popularity of the Internet.

Possible health hazards resulting from the proximity to the user's brain of cell phones (800 to 2500MHz) continue to be investigated, with results beginning to be reported from industry sponsored research, although not often proving reproducible, and in some cases contradictory. But clearly this is a topic that has still a long way to run. As James C Lin, professor of bioengineering and electrical engineering at the University of Illinois puts it: "Given the results published so far, I personally feel that the implications of cellular telephone effects are not horrendous. But cellular telephones are a recent phenomenon. For the first time in history, we are putting a microwave source right next to the head of millions and millions of people. So we need to get a consistent and dependable set of answers, and that will take time."

Unfortunately the public does not always distinguish between the closeness of the hand-held cell phone and the far more distant tower-mounted cellular base station antennas, and this can be readily translated into opposition to any clearly identifiable amateur transmitting antennas.

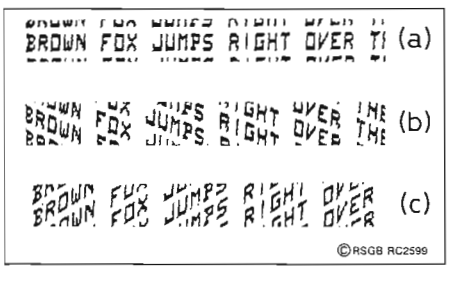

Fig 3: Appearance of Hellschreiber transmissions on a mechanical machine. (a) Transmitter and receiver running at approximately the same speed. (b) Receiver running slow. (c) Receiver running fast. (Source: G5XB's 1981 article)

RESURGENCE OF HELLSCHREIBER?

THE FIRST PRINTING radio-telegraph machine that I ever saw in action was in 1942-43 at Hanslope Park. This was a mechanical Hellschreiber, a system developed in 1929 by Rudolf Hell and which in the thirties came into use for press, diplomatic and military traffic. In WW2 a transportable Feldfernschreiber was used in conjunction with a conventional HF field transmitter for German military traffic. Transmissions were relatively broadband and could be readily identified by their characteristic throbbing sound (regarded as an unpleasant form of QRM by those struggling to receive weak Morse signals on or near the same frequency!). After the war, a few Hellschreibers remained in use, mainly in China, and a few amateurs acquired mechanical Feldfernschreiber or Hellschreiber machines and used them on the 3.5 MHz band - notably several Dutch amateurs and, in the UK, the late Stan Cook, G5XB, who had monitored German Hellschreiber traffic for Bletchley Park at Beaconsfield (later transferred to the BBC). G5XB wrote-up the mechanical Hellschreiber system in detail in *Radio Communication,* April 1981, pp 320-323, from which **Fig 3** is taken. After Stan went Silent Key, Bob ('Noz') King, G3ASE, acquired his Hellschreiber and continues to restore and experiment with it. [Incidentally, G3ASE (QTHR), is organizing another reunion for former RSS Voluntary Interceptors / SCU3 Operators, etc, or their friends or relatives, or anyone seriously interested in the wartime RSS and Box 25, at Bletchley Park on Sunday, May 14].

It might have been thought that in this day and age, this 70-year-old system - which is little faster than manual Morse and in which

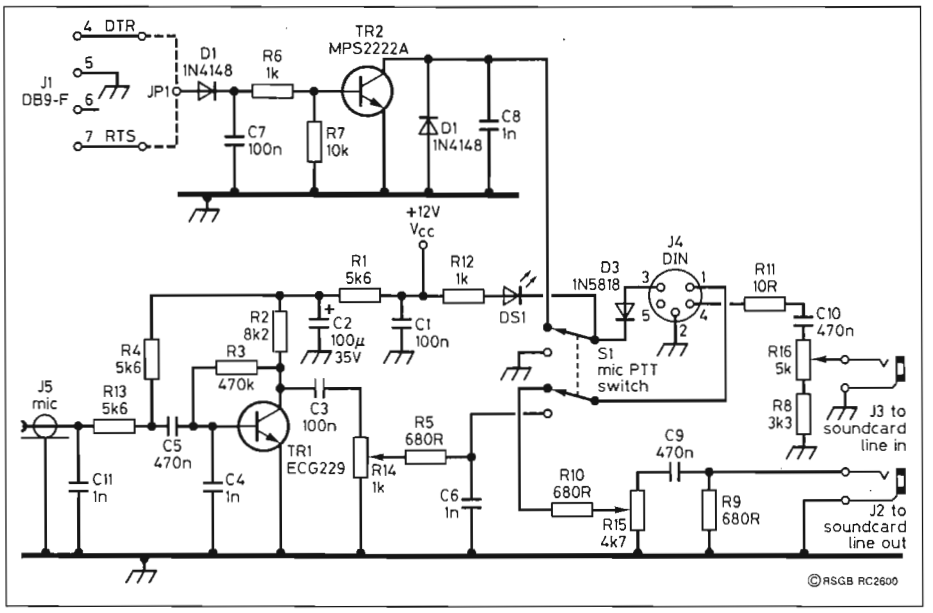

Fig 4: EB3NG's versatile PTTSound interface, providing adjustable levels between transceiver/computer and facilitating changes between speech and data systems including Hellschreiber. Full details in *QST*, November 1999.

the *shapes* of the letters are transmitted as a crude 'picture' created by a train of 'mark' and 'space' impulses synthesized in the receiver into a mosaic of black and white elements on a grid of closely-spaced parallel lines and displayed like a dot-matrix printer - would have been relegated to history. But this wideband system is remarkably immune to the effects of circuit noise and interference; and, to some extent, multipath; and does not have to be accurately synchronised. In recent years Hellschreiber has been given a new lease of life as an electronic, software-controlled computer/VDU system with improved 'keying' characteristics and is now attracting attention world wide. A useful review of the current situation is given by Murray Greenman, ZL1BPU, in 'Let's *See* you in Hellschreiber!' (*QST*, January 2000, pp52-54). It also featured in 'The 'New' HF Digital Modes', by Steve Meltz, N2QLQ (*QST*, April 1999, pp50-51), who drew attention to the increasing use not only of Feld-Hell but also Multi-tone Hell (MT-Hell) in which combinations of 7 to 16 tones are sent concurrently, allowing higher throughput, vertical characters, and the ability to use different fonts, underlining, bold, and italics. MT-Hell was devised in 1937 but not implemented until the coming of electronic systems.

Feld-Hell is still the most common mode, but MT-Hell seems set to catch up. The new breed of PC-equipped radio amateurs have revived and enhanced this interesting mode! ZL1BPU even suggests: "You do not need to understand how it works to enjoy this mode. Simply install the software, connect up your rig (probably the same cables you use for PSK31 and SSTV), set the signal levels and away you go!" This is not a sentiment I would endorse - I feel amateurs should at least have an inkling of the systems and technology they use, and I suspect that ZL1BPU feels the same.

ZL1BPU writes: "Of course there are plenty of new techniques to be explored (PSK31 is a current example); but old technology should also be understood and appreciated - and improved upon. After all, Morse is still in widespread use, and it dates from 1838! Hellschreiber has some important features and we have recently added Digital Signal Processing (DSP) to elevate it to a high-performance DX mode. It is not quite as sensitive as PSK31, but is much easier to tune, is tolerant of drift, and resistant to most interference except zero-beat carriers.

"The first DOS PC software for Feld-Hell, written by LA0BX, is still widely used. Recently it has been recognised that DSP could transform Hellschreiber into a highly sensitive mode and I proposed the term *Fuzzy Modes* to describe modes that are not really digital, nor completely analog, but provide important advantages of both by being human-readable. The first important improvement was to use a grey-scale display, rather than strictly black-and-white for reception. This significantly improves weak-signal readability. N1OWU and G3PLX used the Motorola DSP56002EVM evaluation module for DSP signal processing, while software for PC soundcards by G3PPT and IZ8BLY performs DSP inside the PC."

Peter Martinez, G3PLX, also improved the 1937 seven-tone MT-Hell and uses 16 tones with an FFT receiver - a system now called Concurrent Multi-Tone Hell or C/MT-Hell. This is less sensitive than Feld-Hell, but remarkably immune to all kinds of interference. It is narrow band (200Hz) and free of keying sidebands, since the keying is at column rate rather than dot rate. There is also another new multi-tone system, Sequential Multi-Tone Hell (S/MT-Hell), which can be transmitted with a Class-C PA (whereas the other electronic modes require a linear SSB transmitter). A difficulty with S/MT-Hell is that keying sidebands tend to become visible within the character matrix.

The latest 'designer' Hell mode is IZ8BLY's Duplo-Hell, closely related to Feld-Hell, but two columns of dots are transmitted at the same time, using two different tones. It has the same typing speed as Feld-Hell, achieved by sending the dots for twice as long. It provides enhanced noise rejection and multi-path effects are reduced by a factor of two. The bandwidth is a little wider than for Feld-Hell, but ZL1BPU considers Duplo-Hell is great for low-band DX.

Ronald Bee, G3SZS, and David Williams, G3CCO etc are successfully using the IZ8BLY software, which can be found as freeware on IZ8BLY's website: http://ninopo.freeweb.org

A versatile interface between transceiver and a computer sound card to work for RTTY, PSK31, SSTV, Hellschreiber and many other modes is described by Salvador Esteban, EB3NG (*QST*, November 1999, pp60-61 and another version in the Spanish Edition of *CQ Radio Amateur*, August 1998): **Fig 4**. 'PTTSound' is a simple interface that allows you to set the audio levels to and from the computer sound card independently. It not only includes the serial port keying interface, but also a convenient microphone input and push-to-talk switch to facilitate switching between voice and digital (or image) modes. It is hoped that the circuit diagram will provide sufficient information, but for full details on construction and alignment etc refer if necessary to the November 1999 *QST*.