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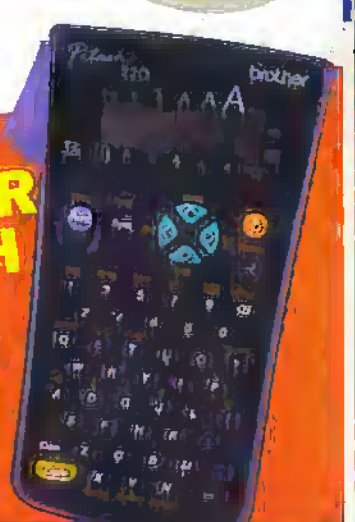

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THE MAPLIN MAGAZINE

ELECTRONICS and Beyond

June 1999 Vol. 18 No. 138

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Features

Regulars

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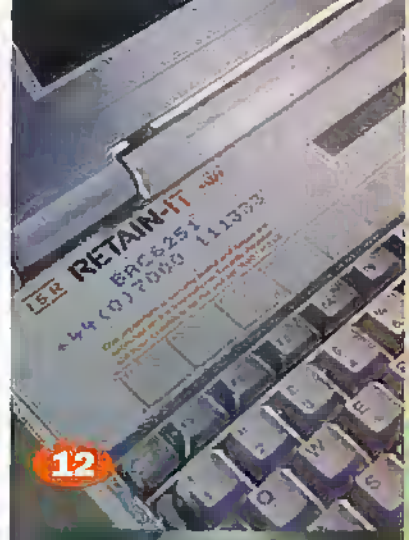

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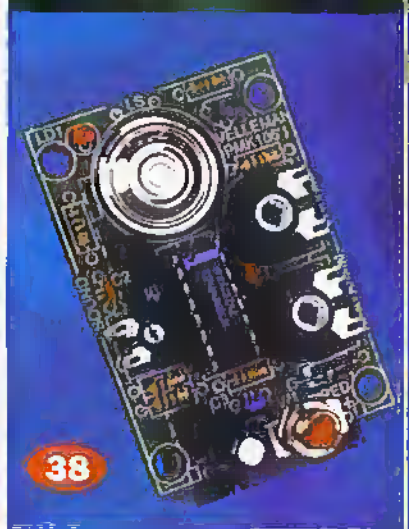

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ELECTRONICS and Beyond

We have received many letters and emails from readers questioning the inclusion of the Psycho-Kinetic Trainer and Movement Detector Project by David Aldous, and the Uri Geller column. Graham Marett has been one of the leading critics of their inclusion and we have published several of his letters in Air Your Views. Graham took up our challenge to write an alternative view and what has emerged is The Science of Scepticism, which we publish this month.

In a similar vein, Douglas Clarkson concludes his article Towards A Theory of Everything in which he delves into the universe, particle physics, and life! In his summary, he concludes that "the outcome of scientific research into matter has resulted in the expansion of the mind of the scientist, so that science has become more open, less predictable and consequently full of surprises."

Perhaps one of the greatest surprises of the next millennium may be antimatter space propulsion, for according to NASA scientists in five years time a millionth of a gram of antimatter could be enough to power a rocket into space. Chris Lavers divulges more about this and other forms of propulsion in his regulator feature Research News.

Britain's Best Magazine for the Electronics Enthusiast

NEWS REPORT

Almanac Says Over 364 Million PCs-in-Use

According to the Computer Industry Almanac, there were over 364 million PCs-in-use worldwide at year-end 1998 - up from 222 million in 1995 and 98 million in 1990. The UK had 18.5 million PCs-in-use or about 35.4% of the total at year-end 1998. The top 15 countries shown in the following table account for nearly 79% of the worldwide PCs-in-use at that time. These numbers include all PCs in businesses and homes.

Computer Industry Almanac projects that there will be over 500 million PCs-in-use worldwide at year-end 2000. The installed base of PC-like devices will grow to over 990 million by year-end 2005. The U.S. will grow to 222 million PC-like devices in 2005 or 22% of the world's total.

For further detail, check: <www.c-i-a.com>.

Contact: Computer Industry Almanac , Tel: +1 800 377 6810.

Country	No of PCs [millions]
US	129.0
Japan	32.80
Germany	21.10
UK	18.25
France	15.35
Canada	11.75
Italy	10.65
China	8.26
Australia	7.68
South Korea	6.65
Spain	5.71
Russia	5.63
Brazil	5.20
Netherlands	5.13
Mexico	4.60

Source: Computer Industry Almanac Inc.

Become a Film Producer With MGI Application

MGI Software has launched MGI VideoWave II, a major upgrade to its leading PC video-editing program. MGI VideoWave II is the first software designed for home and business use to offer support for both traditional 'analogue' equipment and new digital video technology (DV), and provides everything the user needs to become a desktop movie-making expert. The suggested price is £79.99 including VAT.

MGI VideoWave II turns a normal multimedia PC into a complete video production studio at an extremely affordable price, and enables users to work with their existing video camera as well as the new DV hardware available on the market. Due to increasing user demand, it is also the first product in its price range to offer support for MPEG-2, which provides broadcast video quality.

For further details, check: <www.mgisoft.com>.
Contact: MGI, Tel: (0171) 365 0034.

Small Businesses Get IBM Year 2000 PC Check

IBM is offering a comprehensive, cost-effective assessment to check the Year 2000 readiness status of business desktop hardware and software.

This new initiative is a result of an IBM survey which questioned a cross section of UK small businesses and found that the greatest barrier to Year 2000 readiness was the lack of available skills rather than a shortage of budget or time constraints.

The majority of survey respondents commented that contracts for freelance personnel specialising in Year 2000 are too expensive for the average UK small businesses.

The IBM PC health check offers an extensive service delivered by Year 2000 specialists for all business desktop hardware and software whether standalone PC's, servers or entire networks.

Businesses are provided with a report listing a business's PC make, model, serial number, Year 2000 readiness status, software packages, location; precise details of licensing reconciliation, and follow up recommendations to help businesses upgrade or replace hardware and software.

For further details, check: <www.ibm.com/year2000>.
Contact: IBM,
Tel: (0990) 426426.

3Com And Microsoft Develop Network Products

3Com and Microsoft have formed an alliance to jointly develop products that will connect personal computers within homes and enable consumers to save money by sharing modems, printers, scanners and other peripheral devices. The in-home networks would also make it easier to play multiple-player computer games.

For further details, check: <www.3com.com>.
Contact: 3Com,
Tel: (0118) 927 8200.

NEWS BYTES

Two is Better Than One

Researchers at IBM say two gates are better than one for controlling the flow of electrons through a transistor. The double-gate transistor solves the problem of electron leakage when the voltage to a transistor is shut off. Double-gate technology is expected to function down to channel lengths of 20 to 25nm.

The double gate system has additional benefits - it is inherently higher performing, thus boosting processor speed, and also is capable of modulating the threshold voltage of the transistor, thus reducing power requirements.

For further details, check: <www.ibm.com>.
Contact: IBM, Tel: (0990) 426426.

CD-Rewritable Fits In The Palm

Hewlett-Packard (HP) has announced the first rewritable drive specifically for portable computing: the HP CD-Writer Plus M820e, a new portable SCSI CD-RW drive which weighs less than half a kilo and fits in the palm of your hand. HP also announced three more new drives.

For further details, check: <www.hp.com/storage.cdwriter>.
Contact: Hewlett-Packard, Tel: (0990) 474747.

Sony and Madge Offer Next Generation Video

Sony and Madge have joined forces to provide complete solutions for video communication via local and wide area networks to the European market. The arrangement brings together two market leaders, offering Sony's video communication systems, together with Madge video network connectivity solutions, to provide a range of LAN/WAN video communication business applications.

For further details, check: <www.madge.com/vnetresource>.
Contact: Madge,
Tel: (01753) 661000.

Nortel Converges on Voice and Data

Nortel Networks is working with Hewlett-Packard, Microsoft and Intel on a new product that combines data and voice functions over the Internet. The Nortel collaboration targets a market that increasingly will dominate the future of communications according to the company.

For further details, check: <www.nortel.com>.
Contact: Nortel,
Tel: (01628) 432 000.

NEWS BYTES

Hayes Ships New Optima Card

Hayes has launched a new four-in-one combination PC Card that gives modem, GSM, ISDN and Ethernet LAN capability. The OPTIMA V.90 package includes the Hayes OPTIMA Global PC Card modem supporting the ITU V.90 standard, enabler software, an easy-to-use installation guide and PhoneTools communications software. The OPTIMA card gives analogue data at up to 56Kbps; fax at 14.4Kbps; 2 x 64Kbps ISDN; GSM data at 9600bps; and 10BaseT Ethernet LAN connectivity.

For further details, check: <www.hayes.com>.
Contact: Hayes, Tel: (01276) 704400.

Microsoft to Split

Microsoft is reorganising its operations into four major groups, focused on the needs of distinct customer groups rather than particular product lines and engineering efforts. The customer groups are: corporate chief information officers, knowledge workers, software programmers, and consumers. A report by Zona Research speculates that the move may be prompted by a desire to pre-empt any US government-ordered break-up.

For further details, check: <www.microsoft.com>.
Contact: Microsoft, Tel: (0345) 002000.

Psion Dacom Hails Cardbus

Psion Dacom has announced a new addition to its Gold Card NetGlobal range using the CardBus PC Card interface. Gold Card NetGlobal 56K + 10/100Mb CardBus offers simultaneous modem and Fast Ethernet operation. In keeping with Psion Dacom's policy on upgradeability, the new card has been developed for GSM and ISDN functions via a separate upgrade kit.

For further details, check: <www.psiondacom.com>.
Contact: Psion Dacom, Tel: (01908) 261686.

Microphones Detect Sounds on Mars

Microphone technology from a UK based company is enabling scientists to detect noises on Mars as part of NASA's Mars Surveyor mission. Sounds captured using Emkay's innovative low noise microphones are being relayed to earth via a satellite and analysed by NASA engineers and can also be downloaded from the Web.

For further details, check: <sprg.ssl.berkeley.edu/marsmic>.
Contact: Emkay, Tel: (01444) 235432.

World's Smallest Web Server Fits in a Shirt Pocket

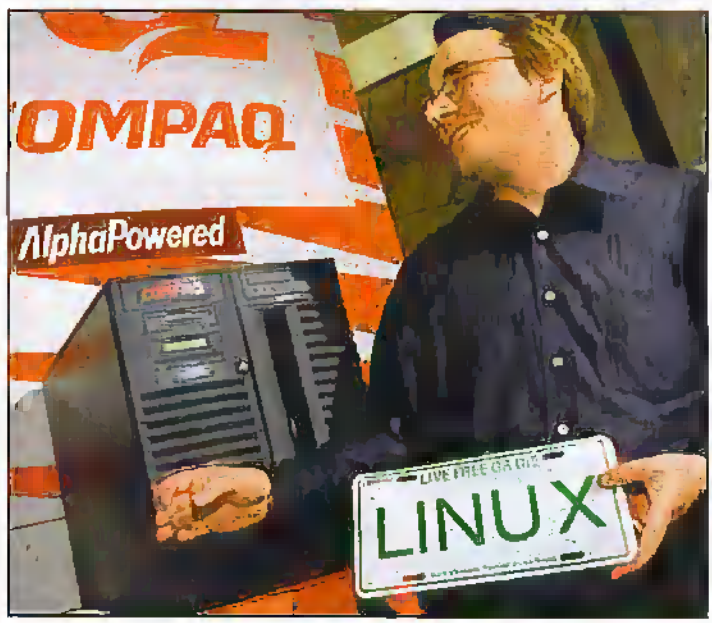
Matel is set to launch a series of Intel powered toys ready for next Christmas. The Intel Play X3 Microscope and Intel Play Me2Cam, will be available from Mattel in Autumn. The products have been jointly designed and developed by a team of engineers and toy designers from the two companies.

With the Intel Play X3 Microscope, children can magnify and display microscopic objects on their PC screens and then play with the images in creative ways. The microscope uses digital video imaging technology to let kids view, enlarge and save images of bugs, plants and other everyday objects.

The Intel Play Me2Cam creates a whole new system of play where children see themselves on the computer screen and use their own bodies to navigate in a virtual world. The Me2Cam system comes with a digital video camera and CD-ROM software.

Meanwhile Purple Moon, the US start-up that attempted to pioneer computer games aimed at girls, has closed its doors. The company cited overwhelming competition from major toymakers like Mattel and Hasbro, which were able to tie their computer game offerings to popular toys such as Barbie and My Little Pony.

For further details, check: <www.intel.com>.
Contact: Intel, Tel: (01793) 403000.



Linux Gets a GUI

Red Hat, one of the leading suppliers of the free operating system known as Linux has announced the development of a new user-friendly graphical user interface (GUI). Called Gnome, the interface was developed by a software effort led by the Mexican programmer Miquel de Icaza of the Universidad National Autonoma de Mexico, and is distributed with a word processor, spreadsheet, database, presentation manager, Web browser, and e-mail.

For further details, check: <www.redhat.com>.
Contact: Red Hat, Tel: +1 919 547 0012.

HP Selects ISI for Capshare 910 Information Appliance

Hewlett-Packard (HP) is using ISI's pSOSystem real-time operating system (RTOS) in the HP CapShare 910 information appliance.

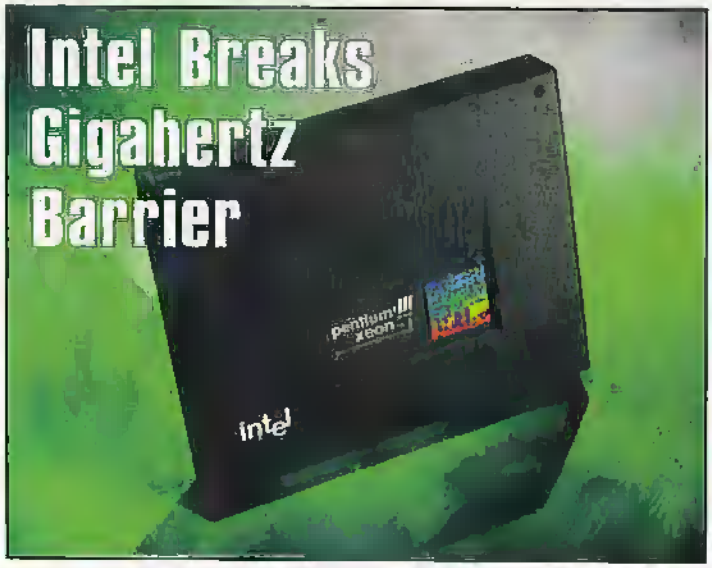
Designed for mobile computing, the HP CapShare 910 information appliance gives users the freedom to capture, store and share documents with virtually anyone from anywhere.

Using the 12.5 ounce appliance with a free-form swiping motion, users can capture up to 50 letter-size black and white pages. The HP CapShare 910 information appliance's page processing re-creates documents in as little as six seconds and shows a thumbnail of the image on the built-in liquid crystal display.

Once captured, the document can be sent directly to a printer or smart wireless handheld device via an infrared port, or to a PC via serial cable for e-mailing or faxing.

For further details, check: <www.isi.com>.
Contact: ISI, Tel: (01462) 687300.

Intel Breaks Gigahertz Barrier



Intel has broken the 1GHz speed barrier for a general-purpose microprocessor. This was the first time the gigahertz (one billion cycles per second) frequency has been achieved on a standard microprocessor. The technology demonstration, using a 0.25μm Pentium III processor, was shown to an audience of over 1,500 industry software and hardware developers attending the Intel Developer Forum in Palm Springs in March.

The demonstration consisted of a system running a CPU speed meter that registered greater than 1GHz clock speed, while simultaneously running a Microsoft PowerPoint application. The audience watched as the CPU meter moved steadily to and then beyond the 1GHz mark.

Only six years ago, the Intel Pentium microprocessor was running at less than 100MHz using 0.8μm process technology. That said the technology demonstration used special cooling techniques.

Intel expects to introduce processors this year using its new 0.18μm process technology, delivering higher frequencies than current Intel processors. The company expects production of commercial microprocessors operating at 1GHz frequency in the year 2000.

For further details, check: <www.intel.com>.

Contact: Intel, Tel: (01793) 403000.

WAP Interoperability Testing Ensures Compatibility

Ericsson and Unwired Planet have initiated interoperability testing between their WAP based products in order to make them compatible. According to a spokesperson for Ericsson this is an important step toward implementing the WAP interoperability and conformance requirements as they are formalised.

Ericsson's handsets will be compatible with the Unwired Planet UP.Link Server, and handsets containing the UP.Browser software will be compatible with Ericsson's WAP gateway.

For further details, check: <mobileinternet.ericsson.com>.

Contact: Ericsson, Tel: +46 70 560 0134.

EMC Moves Into Storage Networks

Data storage supplier EMC is moving into Enterprise Storage Networks. These switched high-speed networks of storage devices promise to make data more easily available from any system within an organisation by pooling its data among the networks rather than umbilically tying them specifically to a single user.

For further details, check: <www.emc.com>.

Contact: EMC, Tel: (01942) 275511.

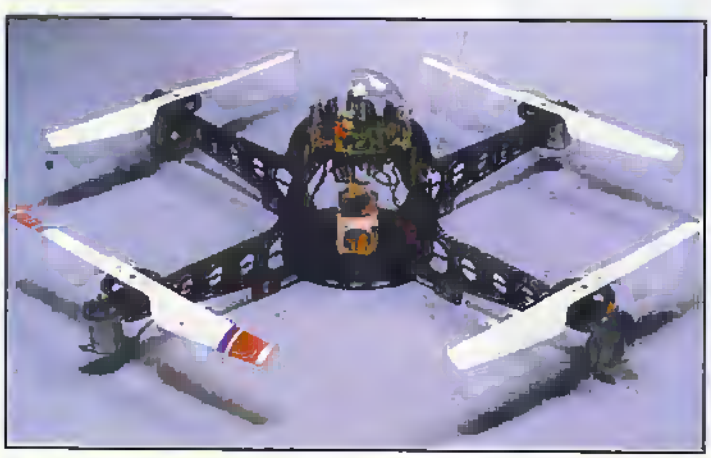
Canadian Flying Saucers Head to UK

A remote controlled flying saucer has been spotted in the UK. The unique four-bladed flying machine called the Dragonflyer is controlled by a four-channel transmitter and includes three on-board gyros for stabilisation.

The good news is that Canadian company Dragonfly Innovations has started selling innovative flying machines in the UK via the Web. The bad news is that the kits aren't cheap. The Dragonflyer for example will set you back around $425.

For further details, check: <www.rctoys.com>.

Contact: Dragonfly Innovations, Tel: +1 306 955 9907.



Year 2000 COMPLIANCE

Paul Williamson asks if business is just paying lip service to the problem?

Over the last year or so, no one can fail to have come across an article in the press concerning the Millennium Bug. An entire industry seems to have built up around solving the problem. Offers of seminars and talks abound, often hosted by some unlikely groups such as accountants and public relations consultants.

I was recently contacted by a local firm inviting me to a seminar on the subject of 'The Bug.' Apparently, as part of the package I would be given a floppy disk that would, they assure me, solve all my problems. Out of curiosity I attended a couple of seminars and was treated to several hours of attractive and colourful presentation slides where the speaker talked of 'time lines,' 'project space' and 'secondary infection.' Visually it was very impressive but, at the end of the day, not worth a hill of beans, with not one bit of practical or useful advice forthcoming.

When asked about the risks of PLCs in industrial applications, one speaker replied that most 'Public Limited Companies' already had a Year 2000 project well under way! Faced with such ignorance and misinformation is it any wonder that so many small to medium sized businesses have still done nothing about the very real problem of Year 2000 compliance?

Maybe one group of people who should be taking on this subject are those involved in computers and electronics. They, more than the PR men and accountants (apologies to my accountant in the unlikely event he is reading this) are likely to have the necessary background and training to understand the real problems.

A major difficulty is that many businesses believe they have addressed the problem. Many think that they simply have to obtain a floppy disk that checks to see if the BIOS of a computer is able to roll over to 2000 unaided and, if it is not, install a software patch. This is simply paying lip service to the problem, and deluding whoever has paid for such a disk that they will not be affected after 1999.

I know of one particular company that parted with good money for someone to visit their premises and spend the day installing TSRs on the PCs. The software was not looked at, nor was the operating system (they were using Windows 3.1), nor the telecommunications, nor any embedded systems.

Smaller Businesses Lagging Behind

As one would expect, the larger organisations have had Year 2000 compliance projects operating for some time. Indeed most of them are now at a stage of full compliance. It is the small to medium sized businesses that are lagging behind. So what kind of problems can these businesses actually expect to face after the roll over? Basically they break down into four main areas:

1. Computer Hardware
2. Networks
3. Embedded Systems
4. Application Software

Individual PCs

Individual personal computers are the easiest systems to identify, test and rectify. All that is required are the right software tools and procedures, and a little know-how. Having said that there are still a few pitfalls to be aware of. For example, use a write-protected disk when testing or updating either a BIOS or installing a TSR. Failure to do so introduces the possibility of infecting the utility disk with a virus at one site and then passing it on to other PCs. I have heard of a number of instances where this has actually happened.

In some cases, where a new BIOS is being installed, the PC will write a copy of the original BIOS back to the floppy disk, thus requiring the disk to be write-enabled. In such cases it is important to be certain that no virus was copied back to the disk during the process.

Another simple but important point is to clearly label a PC that has been tested and patched. There is nothing worse than undertaking this task only to hear that, a few weeks later, another party came to install or modify some settings and unwittingly overwrote the necessary start-up files by mistake. There are a few other potential problems when checking PCs but mostly it's straightforward.

Photo 1. Everything needs to be checked - even the alarm system.

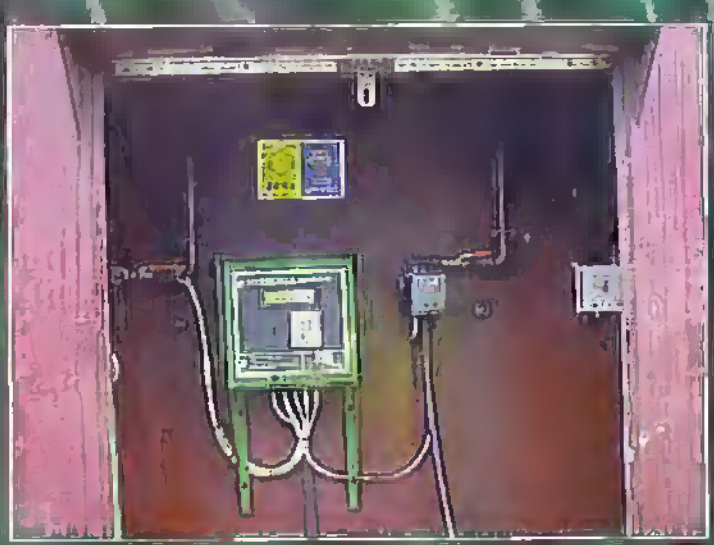
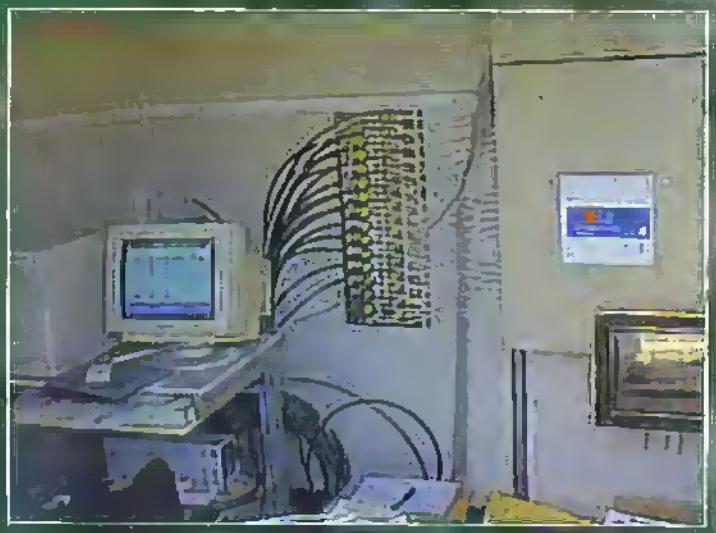


Photo 2. This fuel pump looks modern, but was not Year 2000 compliant

Photo 3. Software needs to be thoroughly checked.



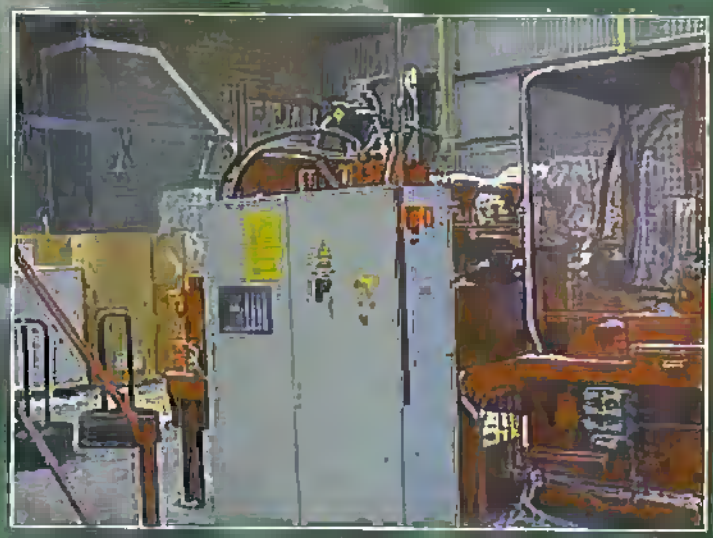


Photo 4. Critical equipment such as this industrial control system, should be at the top of the priority list.

Don't Forget The Networks

Networks are just as vulnerable to Year 2000 problems as individual PCs. Not only do file servers and individual clients have to be tested, but so does everything else that hangs off the network, such as fax and print servers, mail gateways etc.

One problem is that a network may well span locations and it only takes one mail-server that was missed out from the audit to throw a spanner in the works. As email gets sent through that insignificant looking and usually dusty box, it becomes date stamped incorrectly and risks going astray. There are various utilities available that will let you look across the network and see what's there, but it's a matter of knowing what to use and when to use it.

Routers, hubs and switchers are, for the most part, transparent to dates but software routers should be checked. As for the network operating system itself make sure it's compliant by checking with the developer. The term *Year 2000 Compliant with Minor Issues* is not good enough. There are patches and upgrades available for most network applications so make sure that your organisation has the correct one.

Embedded Systems

Embedded systems are a vital area in any Millennium Compliance project and one which must not be overlooked. The press is full of horror stories about alarm systems going off, fax machines refusing to work and video recorders packing up.

The reality is somewhat different. Of all the fax machines we have audited only a couple of older models will display the incorrect date i.e. 00/00/00. In those cases they will work perfectly well apart from the absence of a correct date on the header.

The same applies to the vast majority of alarm systems and heating controls etc. We have only audited video systems used in commercial and industrial applications, but if there is a problem it usually only requires the date to be reset and the situation is resolved. The exception to this are some makes of older security video surveillance equipment which use time lapse recorders. In a few instances a firmware upgrade is required from the manufacturer. These upgrades were initially free but recently some organisations are charging for the updates at anything up to £100 a time.

It's worth checking to see that the office franking machine will continue to frank after 1999. Whilst most are Year 2000 compliant, a good many older ones are not. Garages are an example of workplaces that may not have a desktop computer in the place but could well be affected at the rollover to 2000. The likes of tune-up and emissions testers etc. use embedded date chips, several types of which we know are not compliant and must be upgraded before year 2000.

Office telephone systems (PBX) are also a potential problem area. It really depends on the age of the system. Very often the PBX will have an embedded RTC which, if not compliant, can be updated quite easily. The PBX itself may continue to work even if not upgraded but, if external call logging or voicemail etc. is connected to it, they could possibly be affected. This was the case with one organisation which, after checking that their call logging system was non-compliant, found that they were faced with a £2000 bill for upgrading it. Rather they find out now than in a few months time!

The photographs shown are all of systems found to be non-compliant and which required an upgrade. They range from industrial monitoring equipment to fuel pumps with date and time printouts. The moral of the story is that, if a piece of equipment is important to the operation of the organisation, it should be checked. This applies doubly in the case of process control systems and safety critical equipment.

Software – The Final Frontier

Finally there is the software, which promises to be one of the more grey areas. Assuming that the hardware is fully Year 2000 compliant, how dates are dealt with depends firstly on what the operating system passes to the application; secondly, how the application stores and interprets that date and; finally how those dates are used in calculations by either macros or formulae. There are a few exceptions to this rule, including when an application obtains the date directly from the BIOS itself by-passing the O/S completely, but this is rare.

As I commented earlier, the term *Year 2000 Compliant with Minor Issues* is quite common, particularly amongst software developers. Unfortunately what may be a minor issue to one organisation may not be to another.

For example, anyone using Windows 3.1 (and there are still plenty of organisations that do) will have the year expressed by default as two digits, so 1st January 2000 will appear as 01-01-00. Lotus 123 versions 1 to 5 can handle dates in four-digit year format but, if it is passed 01-01-00 by the operating system it will assume the date is 1st January 1900. Lotus 123 is by no means the only application that handles dates in this way. For these versions of Lotus 123 to work correctly after 1999 the operating system must have its default year format changed from 2 to 4 digits, from within the Control Panel.

Then there are the macros and formulae used to calculate payments and payroll. How many small to medium sized businesses have been using these applications for years without giving them a second thought? There are many straightforward ways to remedy software problems, the only trouble is that an organisation has to know that it has the problem before it can remedy it. If the government figures are to be believed many aren't even bothering to look.

What makes the problems with software really worrying is that the effects may not be noticed straight away. Changes in the way software works are often subtle and, as any programmer will testify, bugs are not always immediately apparent. The average organisation is not going to meltdown after 1st January 2000, but if mistakes go unnoticed for long enough chances are it will cost them dearly.

While I certainly don't advocate stocking up on tinned food and candles, organisations must not simply pay lip service to the problem by getting someone in to "check" the PCs or, worse still, ignore the problem altogether. The fact is there is a very real issue and it has to be addressed in a timely and professional manner.

Paul Williamson info@lobking.co.uk

There's more to Year 2000 compliance than meets the eye

Don't underestimate the power of the millennium bug. Going from PC to PC with a diskette, is unlikely to make your business fully Y2K compliant.

There is no silver bullet or quick fix. What do you do first? How do you check networks, software and embedded systems? What will and won't work and what are the important do's and don'ts?

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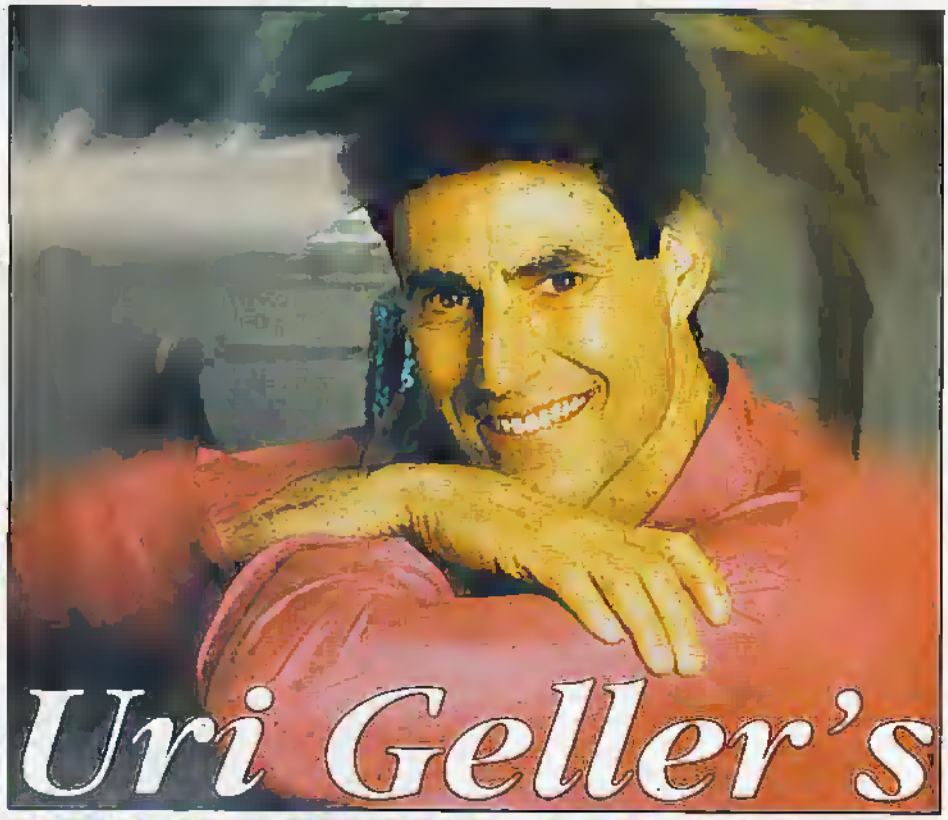


Uri Geller's EXTENDED REALITY

Voices From The Grave?

One summer evening in 1959, a Swedish painter and filmmaker named Friedrich Jürgenson decided to make a tape recording of some of the birds singing in the garden of his remote country home. He put his reel-to-reel tape recorder by an open window, waited for the birds to get going, and switched on. When he played his tape back after about five minutes, however, all he heard was some loud and unfamiliar noises. He checked the machine and nothing seemed to be wrong with it, so he tried again.

This time he heard the same buzzing and whistling, and some faint chirps from a nearby finch. Then, to his surprise, he heard a man's voice saying something (in Norwegian) about 'the voices of the night birds'. His first reaction was that his recorder had picked up a Norwegian radio station, which he knew to be possible - radio signals have even been picked up by electric ovens. Although he found it strange that the voice should mention night bird songs, which was just what he was trying to record, and then go off the air altogether.

Well, he thought, if it happened once it can happen again. So he left his recorder running every evening while he worked or read quietly. He had one of those machines in which a light indicator would show the strength of the signal that was being recorded. When nothing was being recorded, the light would go out altogether.

The light stayed off for a month of nightly recording sessions, then it suddenly came on at full strength, much to his surprise. He was even more surprised, when he played the tape back, to hear a voice clearly telling him "Friedrich, you are being watched". It did not say by whom. At least it could not have been a Norwegian, or a radio signal that had gone astray because the voice spoke in German and seemed to be speaking to him, rather than to the general listening public. Jürgenson was intrigued and decided to find out more.

He became even more intrigued one day when the phone rang in the middle of a recording session. It was his wife Monica, and when he played this tape back he clearly heard a man's voice saying "telephone Monica," a few moments before the phone rang. Over the next few days he heard all kinds of other voices, speaking in several languages - sometimes all at once. By 1967 he had recorded thousands of them and had enough to fill a book.

Word of his unusual activities got around and researchers began to beat a path to his door. One of them, a Latvian-born writer named Konstantin Raudive, soon found that he too could pluck voices out of mid-air and eventually compile an even longer book of their messages. *The Electronic Voice Phenomenon* (EVP) as it is now known, attracted the attentions of a few researchers in Britain and the USA, but it was in Germany that it really took off.

When the English translation of Raudive's book *(Breakthrough)* came out in 1971, his publisher brought him over to England and arranged to have him tested in the radio-frequency screened lab of Belling and Lee. Now, if anything gets into a tape recorder inside a Faraday cage, it can't be a stray radio signal. And something did get in - a brief but very clear voice addressing Raudive by his name. "Something happened which I can't explain in physical terms", said the technician in charge.

By the time Raudive died in 1974, 'Raudive voices', as they became known, were turning up all over the place, especially in Germany. In 1983 there was another breakthrough when two prominent EVP researchers, Fidelio Köberle and Hans-Otto König took part in an experiment in the RTL Luxembourg TV studio. König, a specialist in acoustics, originally became involved in EVP because he intended to debunk it - and found he couldn't after he was also addressed by name by an unknown voice. At least two other live sessions were held on RTL, in which two women who had lost a child heard what they reckoned were the voices of their son and daughter.

So, unlikely or unbelievable as it probably sounds to many readers of this magazine, the evidence for EVP is holding up fairly well. The only way to settle the matter, though, is to try it yourself. Several different set-ups have been used, using an ordinary tape recorder with a microphone (or even without one), linking a recorder to white noise radio, or using a diode circuit or a goniometer. Or you can do what the Belling and Lee team did and use a signal transmitter (unmodulated) to provide uniform-background noise.

All of these methods have worked, and there seems no reason to use any elaborate equipment. In fact, the operator seems to be more important than the apparatus, and the best results seem to come in when the operator has a real need for them or is taking a genuinely open-minded interest in the subject. You will probably record a good deal of noise and very little signal. Some of the noise may well be normal radio traffic that has got lost in the ionosphere and ended up on the wrong wavelength (the so-called Luxembourg effect).There should not be any doubt about the signals.

However, if you do get a good voice, beware of the trap that all the experts have warned about - thinking you hear something that hasn't been said. One researcher, whose English was not perfect, once played a number of voices to several different people and found that they often heard something entirely different in the same message. One of these, he thought, was the voice of Winston Churchill saying "Make believe, my dear, yes" which doesn't make any sense, at least to me. However, several English listeners agreed that what he was saying was a line from Land of Hope and Glory: "Make thee mightier yet".

So good luck with the voices out there and let me know if you get any really good results.

Uri Geller's novel Ella is published by Headline Feature at £5.99, and his Little Book Of MindPower by Robson Books at £2.50, and Jonathon Margolis' Uri Geller:Magician or Mystic? by Orion Books at £17.99.

Visit him at www.tcom.co.uk/hpnet/ and e-mail him at urigeller@compuserve.com

Diary Dates

Every possible effort has been made to ensure that information presented here is correct prior to publication. To avoid disappointment due to late changes or amendments, please contact event organisations to confirm details.

May 1999

6 May. Internet Seminar, Star, Birmingham. Tel: (01285) 884422.

11 to 12 May. Online Scotland '99, Scottish Exhibition & Conference Centre, Glasgow. Tel: (01224) 210122.

11 to 12 May. Digital Mapping Show '99, Novotel International Centre, London. Tel: (01883) 652661.

11 to 13 May. Control and Instrumentation '99, NEC, Birmingham. Tel: (0171) 620 3636.

17 to 19 May. Cable & Satellite Mediacast 1999, Earl's Court, London. Tel: (0181) 910 7931.

18 to 20 May. ISDN & ATM, Olympia Exhibition & Conference Centre. Tel: (01895) 454 545.

20 May. Technology Investor '99, Barbican Centre, London. Tel: (0171) 256 5364.

25 to 27 May. Internet World UK Spring 1999. Earl's Court, London. Tel: 0171 976 0405.

25 to 28 May. Ninth International Conference on Metering and Tariffs for Energy Supply International, IEE, Conference Centre, Birmingham. Tel: (0171) 240 1871.

26 to 27 May. Embedded Systems, Olympia, London. Tel: (0171) 681 1000.

June 1999

5 to 9 June. Application Development '99, Queen Elizabeth Conference Centre, London. Tel: (01306) 631331.

7 to 11 June. 16th International Teletraffic Congress, IEE, Edinburgh International Conference Centre. Tel: (0171) 240 1871.

8 June. Internet Seminar, Star, London. Tel: (01285) 884422.

8 to 10 June. Environmental Technology Show, NEC, Birmingham. Tel: (0181) 910 7732.

12 to 15 June. Seventh International Conference on Image Processing and its Applications, Manchester. Tel: (0171) 240 1871.

21 to 23 June. People in Control an International Conference on Human Interfaces in Control Rooms, Cockpits and Command Centres, IEE, University of Bath. Tel: (0171) 240 1871.

12 to 15 June. Seventh International Conference on Image Processing and its Applications, Manchester. Tel: (0171) 240 1871.

29 June to 1 July. Network Telecom, National Exhibition Centre, Birmingham. Tel: (0181) 742 2828.

30 June to 4 July. BBC Tomorrow's World Live, Earls Court, London. Tel: (0171) 402 2555.

July 1999

6 July. Internet Seminar, Star, Old Trafford, Manchester. Tel: (01285) 884422.

26 to 28 July. Third International Conference on Advanced A/D and D/A Conversion Techniques and their Applications, University of Strathclyde, Glasgow. Tel: (0171) 240 1871.

August 1999

10 Aug. Internet Seminar, Star, Edinburgh. Tel: (01285) 884422.

23 to 27 Aug. Eleventh International Symposium on High-Voltage Engineering, London. Tel: (0171) 240 1871.

September 1999

1 to 3 Sept. Ninth International Conference on Electrical Machines and Drives, Canterbury Christ Church College. Tel: (0171) 240 1871.

7 to 10 Sept. Ninth International Conference on Artificial Neural Networks, IEE Conference on Artificial Neural Networks, University of Edinburgh. Tel: (0171) 240 1871.

28 to 29 Sept. Business Computer Systems, G-MEX, Manchester. Tel: (07000) 464 336.

28 to 30 Sept. Document and Workflow Management '99, Olympia, London. Tel: (0171) 620 3636.

29 to 30 Sept. Softworld in Accounting & Finance - Autumn '99, National Exhibition Centre, Birmingham. Tel: (0181) 541 5040.

October 1999

6 to 8 Oct. Database Expo '99, National Exhibition Centre, Birmingham. Tel: (0171) 620 3636.

6 to 8 Oct. Information Management Events '99, National Exhibition Centre, Birmingham. Tel: (0171) 620 3636.

Please send details of events for inclusion in 'Diary Dates' to: News Editor, *Electronics and Beyond*, P.O. Box 777, Rayleigh, Essex SS6 8LU or e-mail to swaddington@cix.compulink.co.uk.

What's On?

Public Service Broadcasting is Sole Guarantee of Quality

BBC Chairman Sir Christopher Bland has called on broadcasters and politicians to make sure that public service broadcasting continues to flourish in the digital age. Only this way will British viewers continue to enjoy the range and quality of programmes produced by British programme-making at its best according to the BBC head.

Speaking to a gathering of TV executives at a Royal Television Society event in London, Sir Christopher Bland acknowledged that broadcasters were not the only guardians of democracy and culture; citing the role of literature, the theatre, art, music, science, philosophy, politics. But that did not diminish the importance of broadcasting in a modern society.

Sir Christopher warned that programmes and services of quality, distinction and innovation would be harder to achieve in a crowded broadcasting landscape. He said the broadcasting environment is becoming increasingly cluttered, both in terms of the quantity of programmes available and the differing delivery systems through which they may be seen or heard.

Quoting a recent survey, the BBC Chairman said the success of public service broadcasters around the world was related to the nature of their funding. The overall conclusion was that healthy public service broadcasters can greatly enrich broadcasting cultures, and the culture of their nations.

Sir Christopher said the study indicated that the distinctiveness of a market and the funding model of its public service broadcaster were clearly linked. It also indicated that the higher the advertising revenue as a proportion of total revenues, the less distinctive a public service broadcaster is likely to be although he cited Channel 4 as a clear and significant exception to this rule.

He also said that the licence fee provided the most stable of the available funding methods, and enabled public service broadcasters to invest in higher risk, more distinctive programmes and new services.

Sega Urges Developer Community to Think Big

"Go big, or go home," was Sega president Bernard Stolar's message to video game developers at his keynote address to the Game Developers Conference in San Jose, California in March. Stolar told an audience of more than 1,500 video game developers, reporters and industry luminaries that Sega, with its new Sega Dreamcast video game console, is out to change the way people think about video games.

"Sega Dreamcast is built for change," said Stolar, touting the advantages of developing video game software for Sega's evolutionary new Dreamcast console. Sega Dreamcast is the first video game console designed to evolve with changes in technology, allowing it to continuously expand and upgrade.

Another first is Sega Dreamcast's Internet capabilities, providing developers with the ability to create games with Internet options that can be upgraded using the Web, or live entirely on the Internet. Stolar announced during his speech that

Bernard Stolar and associate.

a 56k modem would be available for Sega Dreamcast when it launches this in the autumn in Europe and America. Sega Dreamcast has already sold nearly one million units in Japan since it was released in that country late last year.

Stolar promised game developers 360-degree support in their efforts. He said Sega will assign business and technical representatives to each developer and provide software tools, technical assistance and other support 24 hours a day to developers of Sega Dreamcast titles. Stolar claimed that more than 100 developers worldwide are now at work on Sega Dreamcast titles.

AOL Outlines Plans To Lead Europe Into Next Phase Of Internet Growth

AOL Europe will lead the drive to bring Europe online, announced president Andreas Schmidt at a press conference in March. A series of business and policy initiatives will position the company to build on its leadership and accelerate Europe's emergence as an Internet powerhouse.

Schmidt said the AOL's ultimate goal was to reach 10 million households in 2002 with its differentiated online services. It would be the leading online service in every market it serves and have the number one combined portal reach in Europe.

To achieve this, Schmidt laid out a multiple-brand strategy under which AOL and CompuServe will be supported by a unified, efficient infrastructure and a portal strategy aimed at driving additional advertising and e-commerce revenues.

In addition, Schmidt announced an extension of AOL's unlimited-access pricing policies in key markets, and reiterated AOL's determination to seek a regulatory environment that would benefit consumers and build the medium through free and fair competition. The goals were aggressive but achievable, said Schmidt, given the success of AOL Europe since its formation in late 1995.

Under the multiple-brand strategy announced by the company, AOL and CompuServe will remain separate brands but will be served by combined business support functions.

AOL will continue to serve the mass-market home user, while CompuServe will increasingly be focused on vertical business and professional audiences. AOL will invest aggressively in marketing behind the two brands to further build their respective market shares.

The company also announced a new portal strategy aimed at giving the company a significant additional share of the projected $2.77 billion in Internet advertising revenue in Europe by 2003. Paralleling the successful model of <www.aol.com> and <www.compuserve.com> in the US, planned AOL Centre and CompuServe centre portals will serve the distinct market segments established for the two brands.

The portals will run on a unified technical platform, based on Netscape technology, and will feature e-commerce, advanced search facilities, email and a strong focus on local market content. AOL and CompuServe's powerful communications tools, including Instant Messenger and NetMail, will also be integrated.

Schmidt announced that AOL's unlimited pricing plans will soon be available to even more members in Europe. The unlimited usage price model that has already been successfully implemented in France and the UK will soon be extended to Germany and to other markets the company enters.

Intel Forecasts Trillion Dollar Internet Industry By 2002

Intel last month outlined its vision of a billion Internet-connected PCs and millions of servers generating one trillion dollars of annual e-commerce revenues within the next few years.

In a joint keynote speech at the Intel Developer Forum, Paul Otellini, executive vice president and general manager, Intel Architecture Business Group, and Albert Yu, senior vice president and general manager, Intel Microprocessor Product Group, said that by the year 2002, it is estimated that annual e-commerce industry revenues will top one trillion dollars. They described how Intel is adjusting its product plans and designs to take advantage of this projected Internet-based commerce growth.

"The Internet is now the single most important growth driver in the computer industry," Otellini said. "The Internet is as important to Intel's future as silicon was in our past."

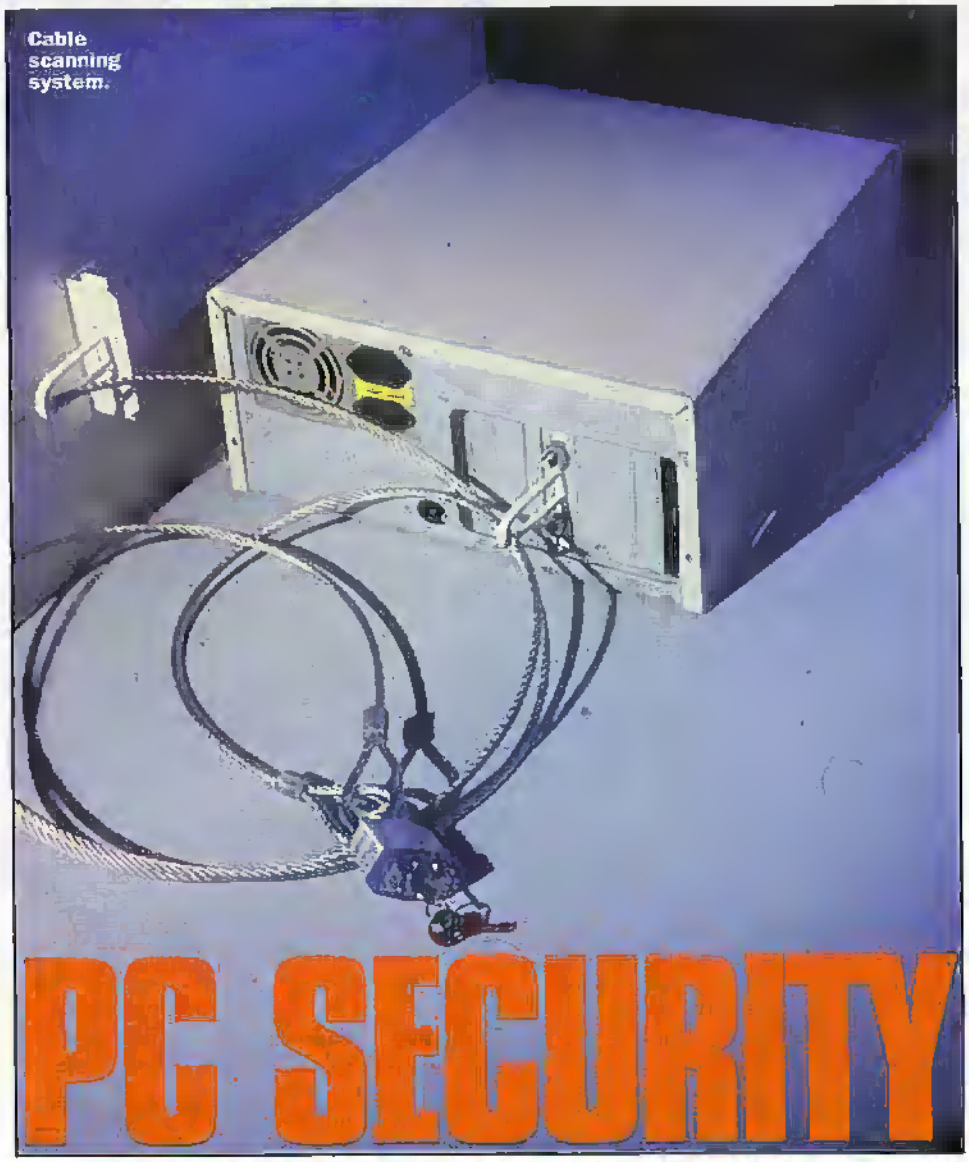
"The new Pentium III processor is the first Intel processor designed specifically to power a new Internet experience," said Yu. "The Pentium III processor incorporates new technologies such as Internet Streaming SIMD Extensions that help deliver crisper video, state-of-the-art 3D and more vivid sound on the Web. We now have the Internet in mind with every product we design."

In their keynote speech, Otellini and Yu described some of the primary new Internet-specific technologies and resulting performance benefits of the Pentium III processor. They demonstrated how the Pentium III processor utilises the new Internet Streaming SIMD Extensions, comprised of Memory Streaming Architecture, New Media Instructions and Concurrent SIMD-FP architecture, to enhance a PC user's computing experience.

For example, a Pentium III processor at 450MHz is 74% faster than a Pentium II processor at 450MHz on CPU-intensive 3D calculations, as shown by Ziff-Davis' 3DWinbench99, Lighting and Transformation Test. For further performance information, visit <www.intel.com/procs/perf>.

Otellini and Yu also described how Intel is helping to transform the Internet into a 3D, interactive environment by working with over 200 companies to deliver applications that will use the technology within the Pentium III processor to enhance today's PC Internet experience. They also outlined new specifics of the Pentium III processor's serial number feature, a technology designed to address the security needs of the Internet.

The Intel Developer Forum is a three-day intensive semi-annual forum providing hardware developers in-depth information on Intel technologies and initiatives. More information on the Intel Developer Forum can be found at developer.intel.com/design/idf. Updated information between Intel Developer Forums is available by subscribing to the Platform Solutions Newsletter at <developer.intel.com/solutions>.



Cable scanning system.

PC SECURITY

In part 1 Mike Bedford discusses how you can prevent the theft of your valuable PC.

Not many years ago, you could keep a computer at home, secure in the knowledge that it was very unlikely to get stolen. This is a far cry from the situation today as PCs have joined cash, jewellery, TVs, video recorders and HI FI systems as the most vulnerable items in case of burglary. Ironically, therefore, although many businesses have woken up to the threat of PC theft, many people with a PC at home still fail to take the matter seriously. Almost certainly your PC will be insured, together with all your other house contents, but I'd like to suggest that a PC needs rather more than this. If your house is broken into there will, inevitably, be some inconvenience as broken windows are replaced, the police and insurance companies contacted and, in the fullness of time, stolen goods are replaced. But let's face it, you can live without a TV or a video recorder for a few days, but what about your PC? Perhaps its loss is no more of a hassle than that of the TV if you only use your PC for playing games but if you use it in conjunction with your work or if you run a business from home then things are far more worrying. The consequences of being without your PC for a week or so could be very serious. But this isn't the end of the story. If you lose your TV, as soon as a replacement arrives then you're back in business. Not so with a PC. It could easily take you a day or so to re-install all your software, restore your data files from backup and configure the PC in the way you're used to. And this assumes, of course, that all your work was backed up. If, however, you back up just once a week – perhaps on a Friday – and your PC was stolen on a Thursday, then you'll also have a lot of work to re-do. All in all, therefore, it's far better to make sure your PC doesn't get stolen in the first place.

But it's not just theft which puts your PC at risk – together with the data which resides on them, PCs are at risk from a whole array of hazards. In this series we're going to investigate the four risks which are, perhaps, the ones which will be of most concern to users of PCs in the home. These four risks are theft, data loss, viruses, and damage due to spikes on mains cables and phone lines. This first article will concentrate specifically on the first of these threats – theft. And although the emphasis throughout this series will be on the home PC user, many of the principles also apply to PCs in small business premises.

Secure or Mark?

Products aimed at reducing the risk of PC theft are not in short supply. Just take a look through the advertisements in a computer magazine and you'll find all sorts of products including cable kits, enclosures, marking kits and internal PC alarms. The most common products come into one of two categories - those which secure your PC so that it's physically difficult to remove, and those which mark the equipment with some information which allows the owner to be traced. First of all, therefore, we need to tackle the question "which is best - secure or mark?".

Right at the outset I have to ask why it has to be a case of one or the other? Let's look at the potential drawbacks with employing just the one solution. As we'll see later, there's no such thing as a totally secure theft prevention system. So, depending on how determined the burglar is, how well equipped he is, and how much time he's prepared to spend in your house, even PCs which are bolted down can be removed. If, however, the burglar sees that the PC is prominently marked with your name and address, it could make the difference between trying to remove it and deciding it just isn't worth it. Even if the burglar isn't deterred and manages to remove the PC, the fact that it's marked with your details means that, in the event of its recovery by the police, it will be returned to you as the rightful owner. Depending on the rationale - and we'll look at the various marking schemes in a bit more detail later - it doesn't cost a fortune to mark your PC. Similarly - although there's a vast difference in the price and effectiveness of different systems - it is comparatively cheap to provide some degree of physical protection. So I come back to my initial assertion - don't just employ the one solution but consider a combination of securing and marking.

Securing Products

As I've already made reference to, no system will be 100% effective against theft. As you might imagine, the more you pay the more secure your equipment will become but the law of diminishing returns applies. So, for example, you might be able to prevent 30% of thefts by investing £20 on a physical protection system, perhaps this could be increased to 60% by spending £100 but to get up to 90% you might have to shell out £500. And beyond this you'd pay vastly inflated amounts for comparatively small incremental gains. So what level should you go for? That's impossible for me to say. All I can do is give some idea of the level of protection offered by the various systems and quote some prices. Beyond that you need to decide what degree of protection you require and how much you're prepared to pay for that protection.

The most popular type of physical protection kit, especially among home PC users, is the cable-based system. As we'll see however, this popularity has much more to do with price than with the level of protection afforded. This type of kit consists of thick steel cable, two or more steel anchor points, epoxy adhesive, and a padlock. Extra anchor points can be bought separately. Using the epoxy adhesive, anchor points are attached

Simple bolt-down locking case.

to the PC base unit, and optionally to the monitor and other peripherals such as the printer. One is also attached to something which immovable – perhaps the desk. The reasonably large surface area of the anchor points ensures good adhesion and strengths of up to 700 pounds are quoted. The anchor points have loops through which the cable is threaded. Having been threaded through each of the anchor points, the cable is secured using the padlock supplied. Kits vary in price from around £17 to £25 (see Maplin catalogue, Computer Section) depending on the adhesion strength achieved. Exactly how much of a deterrent this sort of system proves to be depends on how desperate the burglar is, how well equipped he is and how much damage he's prepared to do to the PC. In reality, it will only provide protection against a reasonably casual burglar but then many criminals who attack domestic premises do come into this category. A decent pair of bolt cutters will easily cut through the cable, a lump hammer would smash a desk and therefore release an anchor point attached to it, and my suspicion is that a lump hammer and cold chisel would remove an anchor point from a PC's casing albeit at the cost of damaging the case. And this raises an important point - a number of theft prevention measures are only effective if we assume that the burglar won't be prepared to damage the kit he's hoping to steal. It's not always reasonable to make this assumption, however. Some burglars only want equipment which they can pass on quickly. Fortunately, most burglars of domestic premises come into this category so a burglar could well pass up kit which he'd have to damage to remove. Remember, though, that PC cases are easily acquired – even legally they only cost about £20 each. So a new case might be a price worth paying for a PC you could sell on for £200. Not only this but some burglars, mainly those who target business premises, are not interested in PCs as working units at all. Instead, a PC is purely a source of valuable and often unraceable parts such as processors and memory modules. To this sort of criminal, a damaged case is no deterrent whatsoever.

Going up the range from these bargain basement cable systems we come to lock-down systems. These consist of two parts one of which attaches to the bottom of the PC's case using epoxy adhesive and the other of which is bolted to the desktop or, better still, the floor. Once the PC's case, together with its half of the lock-down kit, is brought into contact with the other half of the lock-down kit which is bolted to a fixed surface, the two halves lock together. The only authorised way of removing the PC, therefore, is by use of a key and unauthorised removal will be much more difficult than with a cable kit - especially if the PC is fastened to the floor as opposed to a desk. The much greater area of contact between a lock-down kit and the PC's case – compared to the anchor point of a cable kit – means that it is much harder to prize the PC free. Adhesive strengths of up to 4000 pounds are quoted by manufacturers so very serious damage to the case would result from any attempt to remove a PC by force. With many of these kits, however, it would be possible to remove the inside of the PC while leaving the outer case in place. Ironically, the cheaper cable solutions do provide protection against this, so long as you attach the anchor point to the rear of the PC's case rather than its side. Of course, if you use a lock-down kit to fix your PC to the floor, and if you locate it with the rear panel close to a wall, then it won't be possible to remove the inside of the PC without first unlocking it. Lock-down kits start at around £80 and, once again, are listed in the Maplin catalogue.

The last and most secure means of physically securing a PC is the steel enclosure. Now prices start at about £130 and rise to well over £200 but, probably more of a drawback to the home user, these units don't have a lot of aesthetic appeal. In other words, unless your PC happens to live in the workshop, you probably won't like the look of them. Steel enclosures come in two types, the first of which is often referred to as the entrapment and the second type the full enclosure. The entrapment is a stage on from the lock-down kit. It allows access to the front and rear panels of the PC but wraps around the case thereby making it much more difficult for a thief to remove the PC. So long as the entrapment is securely fixed to an immovable object, it's no longer a matter of trying to prize the PC off its fixing. Now it would be necessary to saw through the entrapment in order to release the PC. Needless to say, this will be effective against all but the most determined criminal. But it isn't the ultimate in physical security. If we draw the line short of a high security safe, the ultimate protection is afforded by the full enclosure. As you might have guessed, this is a full steel box with locking front panel which is bolted to the floor and inside


Bolt-down locking case with access to PC case.

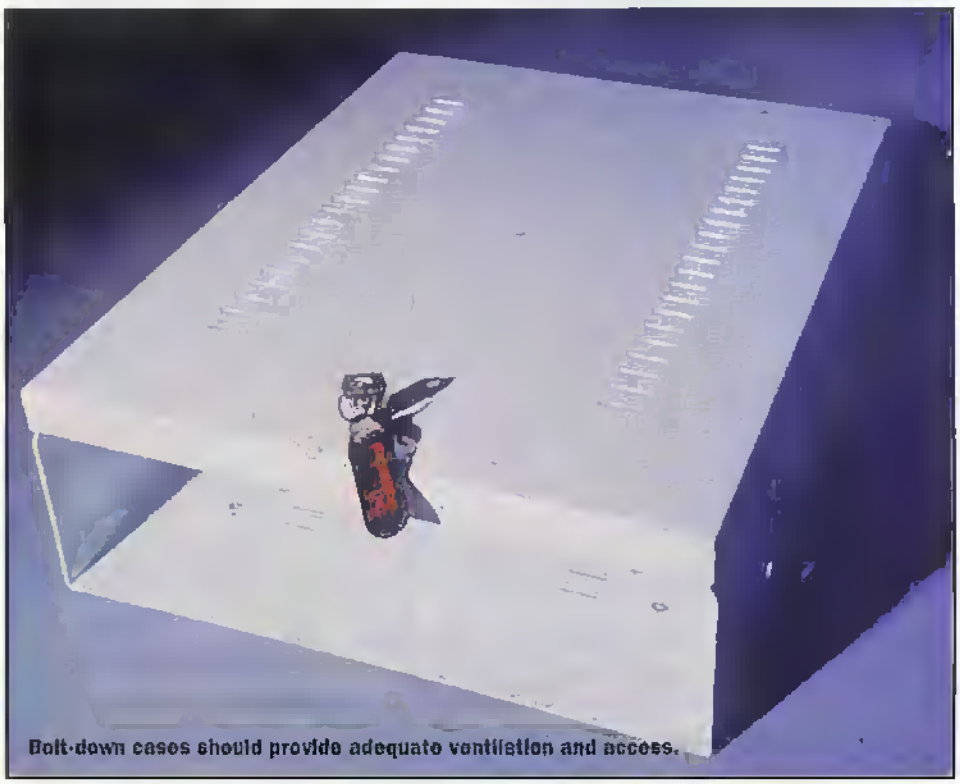
which your PC is locked away when it's not in use. The front of the enclosure is opened to allow the PC to be used and suitable ventilation allows the PC to be operated while inside the enclosure.

Marking Kit

Most marking kits are not sold exclusively for use with PCs but many suppliers of these kits now view computer users as one of their primary markets. The purpose of marking equipment is two-fold. First of all it makes the equipment a less attractive proposition to a thief. Clearly marked equipment will be more difficult to sell and its possession could lead to prosecution. And secondly, if the deterrent aspect of marking does not have the desired effect and your PC is stolen, the presence of some form of identification makes its return more likely. Marking kits are of two types, those which apply a visible mark and those which mark the equipment invisibly. Personally, I find the rationale of invisible marking somewhat questionable. If the marking can't be seen by the burglar then the deterrent aspect doesn't apply and the only advantage is that your stolen PC might just end up being returned to you. The only possible advantages are that invisible marking doesn't spoil the appearance of your PC and if the burglar doesn't realise that equipment is marked then he may be less careful about who he tries to sell it to and this could lead to prosecution. Correct me if I'm wrong but my guess is that you'd rather prevent the theft from happening than see the burglar behind bars. And if this is the case then go for visible marking. And on the issue of appearances, marking on the rear panel of the PC really isn't much of an eye sore. And if you really do like the idea of invisible marking, then why also go for deterrent of visible marking as an added extra?

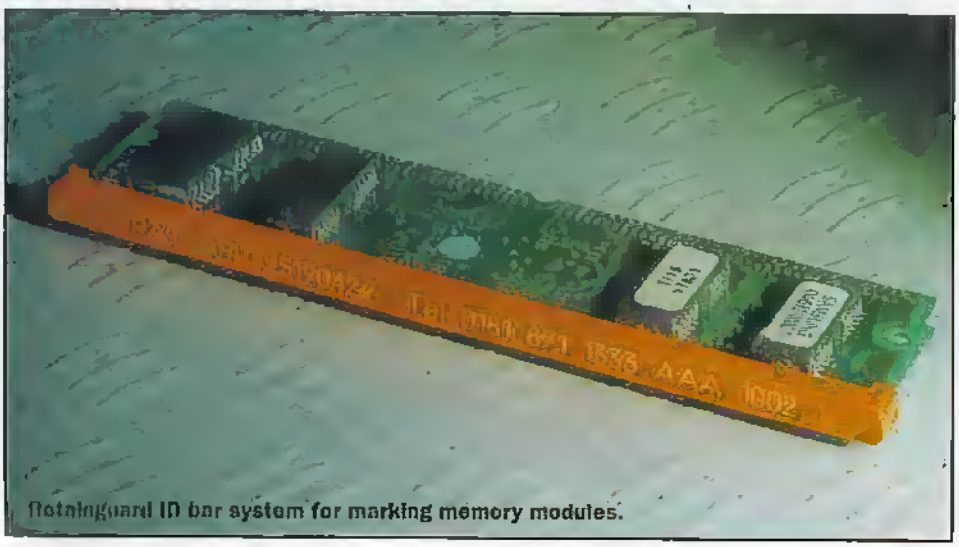
With visible marking kits there are two main techniques. The first is fairly obvious – you simply mark the PC with your name and postcode. One example of this sort of kit is Retainaguard's Basemark System which costs £21.34 for a kit with 12 stencils. Here, the user buys a number of pre-prepared stencils and a bottle of etching fluid which marks the equipment in a highly visible and indelible manner. You'd probably mark the rear panel of the PCs base unit, the rear of the monitor and the rear of your printer. And to make the point, you'd probably stick some of the supplied warning labels (which can be removed) at some more prominent position on the PC or nearby. These simply warn the thief that the premises are protected by the Retainaguard system. Securitrac Tags by Columbus Securitrac Ltd are slightly different. Here an anodised aluminium label which carries the identification is attached to the PC using epoxy adhesive. Clearly it's impossible to remove these labels without damaging the case or leaving a tell-tale mark. The disadvantage of marking equipment with your name and postcode is that it becomes less attractive not only to a thief but also to a potential buyer. If you intend to run your PC into the ground then this isn't a problem. However, if you might want to sell it in a couple of years time then this form of marking might reduce its resale value. This is one reason that a different form of visible marking system is popular. Typified by Retainaguard's ISR Link System which costs £38.40 for kit with 12 stencils, a unique identification number is etched onto your PC instead of your name and postcode. Retainaguard maintain a database – the contents of which are made available to the police – which records the registered owner of any marked kit. Obviously in the event of selling the equipment, the identification number on the kit stays the same but Retainaguard updated the database accordingly.

One other thing you may want to consider is marking some of the components inside your PC although it has to be admitted that the heyday of memory theft is now well past. A couple of years ago memory chips were reported to be more valuable than an equivalent weight of gold or of many illegal drugs. And at that time, rather than steal heavy PCs, a common option was for burglars to open up a PC on-site, remove and take the memory chips, and leave the rest of the PC behind. If you do decide to mark internal components then don't try to use some makeshift solution as you could easily end up destroying your motherboard, processor or memory. Retainiguard offer their ID-Bar system at £6 each for marking memory modules. These are plastic strips which carry a unique identification number and attach to the edge of the module using epoxy adhesive. Removing the strip without destroying the memory module is, reportedly, impossible. Bearing in mind the decline in chip theft, though, this is probably only an attractive proposition for PC users who have significantly more than the usual 32Mb or 64Mb of memory and therefore have some pretty expensive modules.



Bolt-down cases should provide adequate ventilation and access.

A simple but effective marking kit.



Datalinguard ID bar system for marking memory modules.

Alarms

A third type of PC protection device, albeit one which is encountered less commonly than either the physical protection or the marking systems is the PC-specific alarm. These are usually PC expansion cards which are fitted with a range of sensors such as photocells, mercury tilt switches, micro-switches and continuity circuits. The alarm sounds if the PC is moved, the case is opened or cables are unplugged and on-board battery backup ensures that the alarm will sound even if the PC is removed from the mains supply. And in the main – since it is assumed that a building will be protected by a burglar alarm during the night – these PC-specific alarms are intended primarily to prevent pilfering during the working day. And this, of course, applies much more to business premises than to homes. However, there is one possible reason you may wish to add this sort of alarm to your PC although I'd be inclined to suggest that this should be a secondary line of attack for people who want extra protection beyond that provided by physical security and marking systems. The reason that a home PC user may be inclined to adopt this solution is that most burglars will feel more than a little conspicuous if their getaway is accompanied by the sound of your PC's alarm screaming at 120dB. ComputerGuard by Bodyguard costs just less than £50. The Barracuda goes one stage further. In the event of the alarm triggering, not only is a siren sounded, the board also sprays indelible die inside the PC, thereby marking all the components as stolen.

Common Sense

In a sense, I feel something of a fraud getting paid to write this article, after all, most of what I've said is little more than common sense. Nevertheless, the obvious often does get overlooked. Furthermore, this tends to be an area in which many people stick their heads in the sand, thoroughly convinced that this is one problem which always affects someone else. As such, many people don't give a lot of thought to theft prevention. Perhaps, therefore, there's some justification in spelling out the obvious after all and, in that case, there are a few more common sense precautions which should be considered.

There was a time when burglaries occurred mainly in 'posh neighbourhoods' since houses elsewhere wouldn't have much worth stealing. Today, of course, burglars assume that just about any house has a TV and a video recorder so they're much less choosy – all houses are potential targets. But let's look at this from the burglar's viewpoint. There's an undoubted risk associated with entering someone's house uninvited so if you do decide to break in, it makes sense to maximise your possible gains. Whichever house you break into you're going to get a TV, a video recorder, a Hi Fi unit and perhaps some cash and jewellery. However, if you know that one house also contains a PC whereas another one doesn't, the house with the PC becomes the more attractive. The moral of this story is don't advertise the fact that you've got a PC. In other words, try to arrange things so that your PC isn't by a window and plainly visible from outside.

Exactly the same applies to laptops. Since a laptop is still considered by some to be a status symbol, the last thing many people want to do is to disguise it. Accordingly laptops are often carried around in special laptop carrying cases and even abandoned on the back seats of cars. Needless to say this is a big mistake. I spoke to one senior police officer specialising in computer theft who said that he always carried his laptop in a plastic supermarket carrier bag. It might not give you the same street cred as a fancy case which shouts "laptop PC user" but it vastly improves your chances of keeping hold of your laptop.

Finally on the subject of further common sense measures, don't consider the security of your PC and its peripherals in isolation. In talking to police officers about the problem of

Retain-It marking and registration system.

PC expansion card with alarm and sensors.

computer theft, a common recommendation was to consider PC-specific measures as part of an overall security regime. In other words, make sure your house is protected by five lever mortise locks, fit window locks, install an alarm and make sure you're not careless about locking doors and windows and setting the alarm.

Insurance

We introduced this article with the suggestion that insurance alone is insufficient to protect your PC and the valuable data which resides on it. What this doesn't mean, however, is that you shouldn't insure your PC, after all, none of the measures described here will guarantee that your PC doesn't get stolen. And for some people, a PC will not be adequately covered by a standard home contents policy.

If your PC is used exclusively for household, educational, and recreational purposes, then it's usually classified as a domestic appliance so your insurer will consider it as being in the same category as a TV or a video recorder. Another category of house contents is the 'valuable' and whereas this normally means antiques, jewellery, works of art and the like, a few insurance companies have been known to put PCs in this category. The relevance of this is that a list of valuables has to be given to your insurer. So do check that your insurance company doesn't consider PCs to be valuables. If it does and you haven't declared it then your PC won't be covered. It has also been reported that some insurance companies - conscious of the increasing risk they pose - will not insure home PCs at all but I haven't been able to confirm this.

If you run a business from home, then your PC will no longer be a domestic appliance (or a valuable). Even if you are employed and normally work from your employer's premises but occasionally use your home PC for work-related purposes this might also change the way your insurer views your PC. If in doubt check, because if your insurance company classifies your PC as a business tool, there are various approaches they may take. One possibility is that they'll just record the fact, but make no change to your premium - this is the situation with my current insurer, in fact this is one reason why I chose them. Alternatively, they may charge an additional premium in the region £10 to £25 per year. More extreme still they may decline to insure business-related equipment at all. A few companies are more forward looking, recognising the trend toward people working from home. These are the companies who don't accept that a PC used for business purposes poses a greater risk than a PC used for playing games and, in total contrast, believe that if the householder doesn't go out to work the house will be much more secure. These companies actually give a reduction in premium if you run a business from home but it has to be said that this sort of policy is still very much of a rarity.

Another insurance issue is cover for students using PCs in halls of residence. Some insurance companies will allow students' possessions in a hall of residence to be covered under their parents' house contents insurance but such companies are few and far between. In the main insurance companies consider equipment in halls of residence or 'digs' to be a bad risk and students frequently have considerable difficulty in taking out a separate policy. If you're in this situation and have problems it would be wise to talk to Endsleigh, the student insurance brokers who are represented in most university towns, and who have considerable experience in this area.

Sources

Cable kits and lock-down kits are available from Maplin – see the current catalogue. The following are sources of products which cannot be obtained from Maplin.

PC enclosures can be obtained from Secure PC (0171 610 6611) and Boxx Security (01494 558181).

The various marking products discussed are available from Retainaguard (0181 870 2224) and Columbus Securitrac Ltd (01865 865865). The Bodyguard Security Company (01908 218400) also do various property marking kits including kits for invisible marking.

The ComputaGuard alarm card is supplied by the Bodyguard Security Company (01908 218400) and the Barracuda by Secure PC (0171 610 6611).

COMMENT

by Keith Brindley

3Com's Palm division comes under this column's wide-ranging gaze this month. The Palm personal digital assistant (pda) family represents the best-selling pda device ever. Full stop. While it wasn't the first pda to hit the market, and it certainly isn't the most powerful, it did capture the imagination, and in total finds its way into well over half the pda applications in the world. There is a reason for this.

Historically, the first true pda in the world was the Apple Newton family. As much as a pda, this was a complete personal computer in a hand-held form, but was relatively expensive as these things currently go. Despite reasonable sales and a loyal user-base, it never made much of a profit, and Apple ceased production a year ago. We'll come back to the subject of Apple pdas in a little while.

In parallel, on the Microsoft side of things, Windows CE was being developed to power hand-held computers in a cut-down Windows mode of operation. While these machines are quite popular, and are quite powerful they are big, bulky, quite pricey, and very heavy.

Palm devices, on the other hand, are quite cheap, extremely small (they fit in a shirt pocket) and very light. It's not hard to see why, despite their limited power, they have become so incredibly popular.

The Palm pda saw light of day from USRobotics (now 3Com) and was always a much lower powered device than a Newton or even a Windows CE pda ever was. No bones were made about its limited power, though - it was always classed as an electronic organiser rather than a pocket computer. Whereas the Newton and Windows CE devices have full word processing/spreadsheet/database capabilities, the Palm features only note pad, address book, calculator, diary, to do list and other similar light applications. It's big advantage is its small form factor, and the powerful software that comes with it to run on a desktop computer to link the two. By synchronising data on the Palm with a desktop computer (in a simple process called HotSyncing) you can keep all the data on both devices, that is the pda and computer, perfectly up-to-date. Away from your desk, you rely on your Palm to keep your schedule of appointments going, remind you of birthdays, keep a log of telephone numbers and addresses. When you get back to your desk you HotSync the data back to your computer, and so on. It's an almost perfect combination of portability and power. True you can't do much in the way of creating long textual documents or spreadsheets, but it does keep you up-to-date in most other respects. Basically, in the head-to-head race between Palm pdas and handheld computers in Apple Newton or Microsoft Windows CE factors, the Palm wins hands down (pun intended). Users appear to shun the extra power of the bulkier pdas, for the true portability of the Palm.

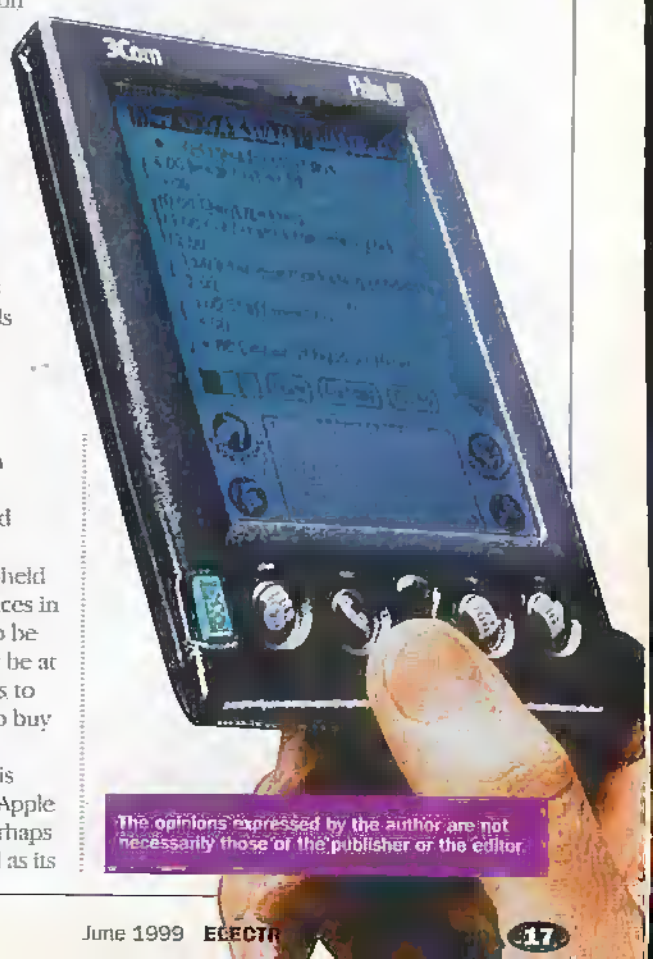
Another company got this part of the equation right too. Psion and its pda had the right balance of size, weight, price and power. Its Series 3 devices sold in huge quantities and did a worthwhile job for many people. But Psion appears to have misjudged what users want in the future, and its Series 5 devices don't appear to have done anywhere near as well, possibly because the operating system the Psion runs on is actually quite an awkward little beast, somewhat reminiscent of DOS on an old PC.

In contrast, each new version of the Palm's desktop synchronisation software gets better and better. The latest version of the Palm MacPac (version 2.1) has recently been released, and is a case in point. It's available as a free download from the Palm Website <http://www.palm.com> for any interested user, and can be used as a standalone personal information manager (PIM) on a Mac without a Palm device, but as its real benefit is when a Palm device is used with it, it's not hard to see that 3Com understands that people who use the software will probably end up buying a Palm device anyway, once they see how good the software is.

The Palm device itself is going from strength to strength, too. New, more powerful, models are being developed which will lift it from the electronic organiser it currently is, to true hand-held computer status but, as further advances in miniaturisation enable its small size to be maintained, this shouldn't necessarily be at the expense of needing larger pockets to put the device into or larger wallets to buy the thing with in the first place.

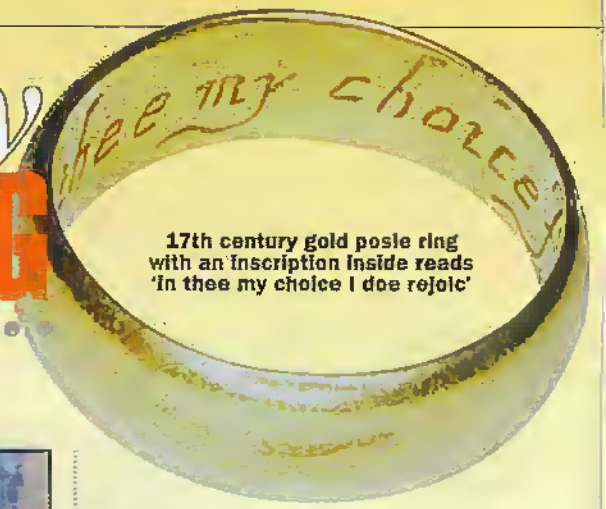
Rumours abound about how 3Com is going to continue marketing the Palm. Apple looks set to license the technology, perhaps producing a badged Palm device to sell as its own. Indeed, the Palm MacPac 2.1 software was developed from a product (Claris Organizer) that Apple sold to 3Com a year ago, so the roots between the two companies are deep. A badged pda is not a precedent, neither as IBM markets a Palm pda from 3Com under its own name, so it's probably just a question of time. If the rumours are true (which I personally think they are) the Apple Palm device should be available shortly after you read this column (but remember, you read it here, first!). Going one stage further, I'll even prophesy that that Apple-badged Palm pda will arrive (like Apple's iMac) in a range of yummy colours.

So 3Com looks as though it got the pda market right. What was originally needed was not a powerful all-singing, all-dancing, micro-portable computer (that weighed a ton, and only just fit into a briefcase, let alone a pocket). Instead, all people wanted was a classy electronic organiser. Now the times are a-changing, and a little extra power wouldn't go amiss. The Palm family looks set to fit the bill for the foreseeable future.



The opinions expressed by the author are not necessarily those of the publisher or the editor.

Modern Day TREASURE HUNTING



17th century gold posie ring with an inscription inside reads 'In thee my choice I doe rejoic'

Gordon Bailey describes how 'rewarding' metal detecting can be!

The author using his metal detector on pasture land.

To most people the word 'treasure' will remind them of thrilling adventures or legends that they read in story books when they were young. Perhaps the account concerned Captain Kidd or Blackbeard sailing across oceans with the Jolly Roger fluttering from the masthead, attacking ships to relieve them of their cargo. The pirates would then sail into a cove of a remote desert island to bury their ill-gotten gains. Centuries later a treasure map would be found hidden in an old book, and an expedition mounted to find the treasure.

Many stories of buried treasure have come down to us over the years. Some have been simply fabrications, while others have proved to have some foundation in fact. The 'King of Pirates' Captain Avery may well have buried his treasure in Cornwall, so it is not just remote tropical islands that could hold untold wealth. In fact, Britain is a treasure island in itself and holds a mass of interesting and valuable finds waiting to be discovered.

Although our country may be small in comparison to other lands it has had a fascinating and turbulent history spanning thousands of years. Since mankind first started to produce items of value - whether in stone, bone, or metal - then others have gone in search of it. In troubled times such as wars or invasions, as people had no banks in which to deposit their wealth they would have concealed it in the floors or walls of their house, or perhaps in the thatching. Many of these hoards have been discovered by chance, or on the odd occasion by following the clues given in a map or written instructions. No doubt many concealed or buried treasures were eventually recovered by their owner and spent or otherwise disposed of. However, many - as finds proved - were never recovered. The reasons for this are many. Possibly the owner simply forgot the exact hiding place, or perhaps he died of illness or in violent circumstances.

Up until recent times those hoards recovered have mainly come to light through chance - as a result of the activities of farm workers, builders, or road workers for example. However, within the last 30 years this situation has changed. Finds have continued to be made in the ways mentioned, but the small number concerned have been totally overshadowed by those that now come to light through the use of the metal detector.

This modern piece of electronic equipment has been responsible for the recovery of thousands of coins, artefacts and

hoards from all regions of the country. A number of these finds have been of such significance that they have hit national, or even international headlines.

It is surprising just how many now valuable items were lost, hidden or discarded over the year's of Britain's history - and how much is still in the soil waiting to be found. Many of the recoveries made have been individual items, particularly coins. This is not surprising as coins circulated freely and passed from hand to hand, rather than being the treasured possession of one individual. However, not all the coins being recovered are modern and in fact coins first started to circulate in Britain around 125-100 BC. These coins, known as Celtic gold staters, may appear crudely designed and produced by modern standards, but have a charm and artistic merit all of their own and are highly sought by collectors. Many of these coins show a disjointed horse, and owe their original inspiration to the gold staters of King Philip II of Macedon (359-336 BC).

Prior to the Roman Invasion, England was

Typical 'finds' one might expect to find with a metal detector.

Ornate spur buckle with makers mark on the inner plate. 17th century.

divided into a number of tribal territories each with its own king. Each of these Celtic tribes had its own name such as Artebates, Regni, Cantii, Trinovantes, Iceni etc. Even after the Roman Occupation the coinage issued by some of these Celtic tribes circulated alongside that of the invaders. However, in AD 60 Queen Boudicca lead the Iceni in a revolt resulting in the sack of London and Colchester and the death of over 70,000 Romans. Queen Boudicca was eventually defeated and the native Britons were no longer allowed to strike their own coins. Due to the Boudicca Revolt and other troubled events of this period, many hoards and valuables were hidden in the ground. As, at their time of concealment, only a few people knew of the burial spot - and these people may have been killed in the resulting battles - a great deal of the wealth of the Celtic tribes remained hidden. In recent years many such hoards have been located by detect users (although, without doubt, there are many more still to be found) and this has given historians a greater understanding of this remote time in our past.

Should any finds be classed as 'Treasure' under the Treasure Act 1996 (normally hoards of gold or silver or individual artefacts of gold or silver over 300 years old) then the finder will be rewarded with 50% of the market value (the other 50%, as is only fair, going to the landowner concerned). If the British Museum or other museums do not wish to retain the item/hoard then it is returned to the finder. Not all gold or silver coins are recovered as part of a hoard, many turn up as individual finds. Such individual coin finds are not covered by the Treasure Act and reporting them is not obligatory. However, in the case or rare and unusual examples reporting them (i.e. Celtic coins to the 'Celtic Coin Index' at Cambridge) does help in building up both our knowledge of the past and the period of history involved. A leaflet is available from the Department of Culture, Media and Sport giving full details of the requirements of the Treasure Act. Since the introduction of this Act (it came into force on 24th September 1997) over 10,000 items have been reported, each adding a little to our knowledge of the past.

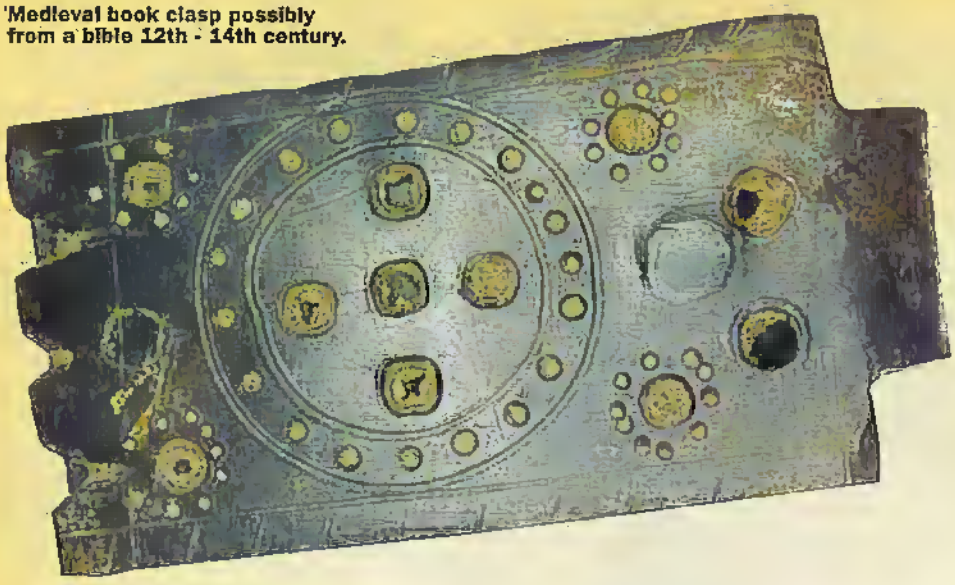
Metal Detection

Over the past 30 years the popularity of the hobby of metal detecting has increased enormously and this has led to a great deal of our past being uncovered that would otherwise remain in the ground and be destroyed by the plough or covered over by building developments.

There are many makes and models of metal detectors on the market and can range in price from under £100 to well over £1,000. Before buying a metal detector the first decision to make is how much you would like to spend. Obviously the price spent on a detector will reflect on what it is able, or not able, to do. Although even a modestly priced metal detector will make finds, some even of great age, what it may not be able to do is effectively discriminate against unwanted junk items (nails, silver paper, ring pulls etc). Sensitivity is also of the greatest importance as the deeper a detector will penetrate the ground - all other factors being equal - the more finds it will make and also the older finds it will make.

Gold guinea of James II dated 1687.

Celtic gold scater issued circa 100BC.



'Medieval book clasp possibly from a bible 12th - 14th century.

Two main types of metal detector are available on the market today: motion and non-motion. 'Motion' means that the search head needs to be moving for the detector to respond to a target, while 'non-motion' detectors do not require movement to register metal. The motion type of detector at present seems to be that most favoured by both users and manufacturers. However, the final decision rests on the potential user of the detector and the type of sites he/she is planning to search.

It may come as a surprise that the two most common types of finds to be made with metal detectors (apart from coins) consist of buttons and musket shot. Many of the buttons being found date to either the 17th or 18th centuries. Those dating to the latter century, and particularly the Georgian period, are the most prolific. In the main these buttons have been made from pewter or copper. The pewter buttons often carry floral decoration. Copper buttons show a massive range of designs and were often originally gilded or silvered. Some, in fact, were coated with quite a thick layer of silver into which were sometimes engraved the owner's initials. Often buttons are found showing a coat of arms of a particular family; these are known as 'livery' buttons and would have been worn on the uniforms of footmen coachmen etc. In the main the livery buttons found by detector users date to the 18th or 19th centuries, although some are still in use today.

Most of the areas searched by metal detector users are farmland, whether arable or pasture. Permission must always be sought from the landowner before any search is made with a metal detector. Arable land, in particular, can prove to be very prolific in finds in that each time it is ploughed more objects are brought to the surface that would otherwise have been beyond detector range. Some finds that turn up may be large - such as buckles - while others could be small such as coins no more than 6mm in diameter.

Ploughing has helped in the recovery of countless thousands of items that had might not otherwise have come to light. One novice detector user, on his first solo search of a ploughed field, uncovered six Roman gold coins, all in mint condition. He took them home to show his wife, and also showed them to a coin dealer to learn a little more about them before reporting his find to the authorities. That evening his mind went over and over the discovery, and whether he had found all the coins. He returned to the find spot the next day and recovered a further 120 coins and the remains of a clay pot.

Another novice detectorist, who had been loaned a detector to use by a friend, unearthed a gold coin of Henry VIII. The coin proved to be unique, and he sold it for £25,000 (it later changed hands for £65,000).

It is not just coins that can command high prices or be of great historic interest. A detector user in Norfolk found a large gold signet ring. After much research the ring's original owner was traced, Thomas Anguishe. The man was a rich merchant in his day and eventually became Mayor of Norwich in 1611. The ring's provenance helped to increase its value and it was sold for £20,700.

In 1986 a detectorist gained permission to search the fields around Middleham Castle in North Yorkshire. After having spent a number of hours searching the area with some friends they decided to call it a day and head back for the car. Walking back along a medieval track one of the party received a signal, and from under some grass roots retrieved a pendant. He took his find home and washed the mud off it. Only then was its full splendour revealed. It was a lozenge shaped gold pendant, with a sapphire inset. It was also engraved with intricate religious motifs and inscriptions. When it was shown to an expert it proved to be one of the most rare and beautiful pieces of 15th century jewellery ever to be found in England. The 'Middleham Jewel' as it came to be known, later sold at auction for £1,300,00.

The above examples, of course, are at the top end of the scale. However, even a simple button, buckle, or coin can be a 'treasure' to its finder. It is an incredible experience to unearth and hold an object that may have last been touched by human hand over 2,000 years ago.

Small hoard of Roman silver coins found on ploughed land in Essex by the author and friend.

Bronze stirrup-shaped ring with a Lapis-lazuli stone 13th-15th century.

Remote Control Fixes FOR TROUBLED SPACECRAFT

Stephen Waddington recounts when US scientist's lost contact with a remote spacecraft travelling through deep space they thought it was game over. But thanks to a series of remote fixes by quick thinking engineers from Cornell University, communication with the NASA craft was restored.

Some 240 million miles from Earth, a spacecraft hurtled through the black void of space, off its intended course. But thanks to the creation of a last-minute fix by Cornell University mission engineers during a tense 24 hours, the $150 million mission now has hundreds of new images of a distant asteroid.

The Near Earth Asteroid Rendezvous (NEAR) had almost been given up for dead after a signal failure on 20 December, 1998, but after faint contact was renewed scientists quickly had to formulate a new mission plan.

But thanks to the ingenuity of researchers at Cornell, NASA's Jet Propulsion Laboratory (JPL) in California, and Johns Hopkins University's Applied Physics Laboratory (APL) in Baltimore, signals were sent enabling the spacecraft to capture images as it approached the asteroid 433 Eros. But it was touch-and-go.

Cornell astronomy professor Joseph Veverka leads the mission's science team in charge of the visual light camera and near-infrared spectrometer, two of the five science instruments carried by NEAR. His operations team designed the spacecraft command sequences that point and operate the instruments.

NEAR's primary mission is to remain in orbit around Eros for one year collecting high-resolution images and other science data.

Spacecraft in Trouble

The drama began Sunday, December 20, when a signal was sent from APL to implement a main engine burn to reduce the spacecraft's speed from 2,180 to 700 miles per hour on its approach to Eros. This was to be followed by three additional burns to further reduce the speed to 11 miles per hour relative to Eros and enable the spacecraft to go into orbit around the asteroid. But the first engine burn went awry.

When the first main engine burn began, the spacecraft's built-in safety devices detected a problem and shut down the burn after one second. The spacecraft began to tumble violently, and onboard communications systems shut down. Contact between scientists and NEAR was lost for 36 hours. Instead of closing in on Eros at a relatively slow pace, the spacecraft continued to speed along at more than 2,000 miles an hour.

"Afterward, it was Black Monday. We thought we had lost the spacecraft. In fact we thought that we had lost everything we had worked toward for the past four years," says Ann Harch, a research support specialist in Cornell's astronomy department, who designs command sequences to acquire camera and spectrometer data.

Waiting Game

The failure of the burn meant the postponement of NEAR's orbit of Eros until next year. But mission scientists calculated that within about 60 hours NEAR would pass Eros, about two weeks ahead of schedule.

Cornell engineers and astronomers, with help from colleagues at APL, cobbled together a plan to salvage at least something from the flyby by commanding NEAR to take photographs and infrared spectrographic images of Eros. But no computer programs were available to send such commands.

"It was nerve-racking. We really weren't sure about the spacecraft. We didn't know if this was perhaps our last and only chance to see Eros. We really weren't sure if the main engine would burn or not," said Harch.

For the impromptu Eros flyby, beginning at about 5.30am GMT on December 23, Harch, Maureen Bell (also a member of Veverka's Cornell team), and Scott Murchie of APL were asked at noon December 22 to write a new, error-free, computer communication and sequence for the spacecraft.

The sequence would have to slew the spacecraft to keep the instruments pointed continuously in the vicinity of Eros throughout the flyby, while simultaneously keeping the spacecraft's photovoltaic cells pointed toward the sun. Since Eros' location was not known precisely, it would require taking a mosaic of four images to guarantee capture of each view of Eros.

Harch had written the command programs for NEAR's flyby of asteroid Mathilde in June 1997, a task that took her six months. But the new sequence would have to be written in just 12 hours in order to reach the spacecraft in time to make the complex onboard revisions.

Using electronic mail and constant phone conferencing, Harch and Bell at Cornell kept in contact with Murchie in Baltimore, and with true grit, and much sweat, the trio wrote the sequence. It was sent electronically to APL in Baltimore close to midnight.

From midnight and into the morning hours, sleep-deprived APL scientists tested the sequence for errors that could permanently incapacitate NEAR. Then, the sequence was sent by microwave transmission to the craft during the early morning hours December 23.

The enable command for the sequence was sent at about 5.00am GMT and received by the craft at about 5.20am, eight minutes before the first scheduled event in the imaging sequence. Had the enabling command arrived eight minutes later, the information would have been too late.

Then, more nail-biting. Scientists at Cornell, APL and JPL waited anxiously to see if the program worked. If it didn't, the scientists would have to wait until the rescheduled February 2000 rendezvous with Eros for a second chance.

Hours later, Harch received an e-mail from Mark Robinson of Northwestern University, a member of imaging science team - We have an asteroid! ... Here's a cut-out (partial frame) of M0089838063-F0-s showing Christmas Dinner! The mission had been saved.

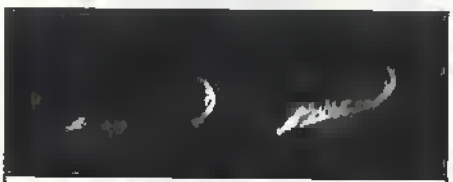


Photo 1. This pair of images of the asteroid Eros was acquired by the Near Earth Asteroid Rendezvous (NEAR) spacecraft on 23 December, 1998, as the spacecraft flew by the night side of the asteroid at a distance of 2300 miles (3800 kilometres) shortly after communication was restored with the spacecraft.

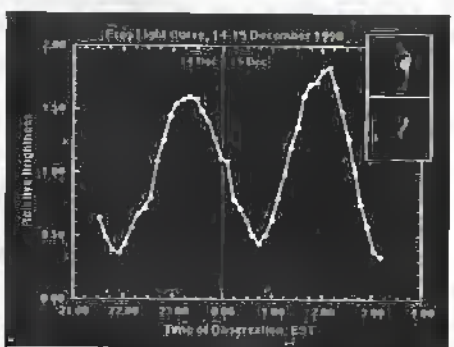


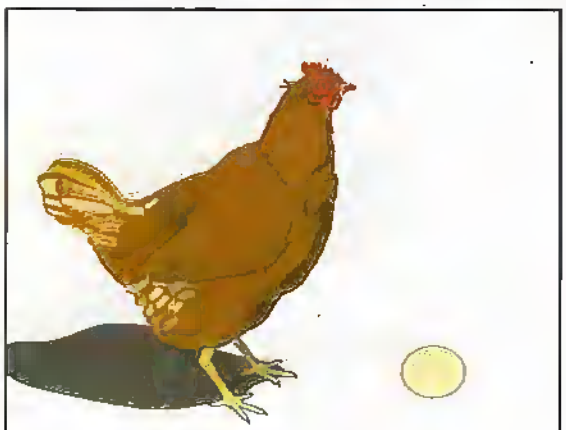
Photo 2. Brightness variations of the asteroid Eros were measured by the multispectral imager on the Near Earth Asteroid Rendezvous (NEAR) spacecraft on 14 to 15 December, 1998, as the spacecraft was closing on the asteroid at a distance of 460,000 miles (740,000 kilometres).

Further Information

Additional information about the NEAR project is available on the Web at: Johns Hopkins Applied Physics Laboratory http://www.jhuapl.edu; www.jhuapl.edu; Jet Propulsion Laboratory www.jpl.nasa.gov ; and the Official NEAR Mission site near.jhuapl.edu

The Science OF SCEPTICISM

Graham Marett takes up our challenge over P.K. with sketches inspired by Anna Marett.



'I came first' 'No, I came first!'

What is the truth?

Just going to dust off my beliefs!

On the night of October 11th 1492 Christopher Columbus "prayed mightily to the Lord" for divine intervention. The crews of the three ships in his expedition to find the Orient by sailing West were close to mutiny, and the captains of his two companion ships Niña and Pinta had begged him to turn back. History might have been different if Columbus had bowed to their entreaties, but whether by divine intervention or not his prayers were answered when at two o'clock in the morning the lookout on the Pinta sighted land in the moonlight.

They made landfall on an island of the Bahamas which Columbus named San Salvador, since it had provided their salvation. Until his dying day Columbus was not aware that he had failed to reach the Orient, and the precise location of his island of salvation has been a hotly debated issue ever since. Today there is general consensus that he landed at Watling Island (which now bears the name San Salvador), but there is precious little in the way of hard evidence.

This story may seem to have little bearing on the issue of scepticism in science, but questions of theory, belief, speculation and truth are not restricted to the scientific domain and we can use this example from history to illustrate several points.

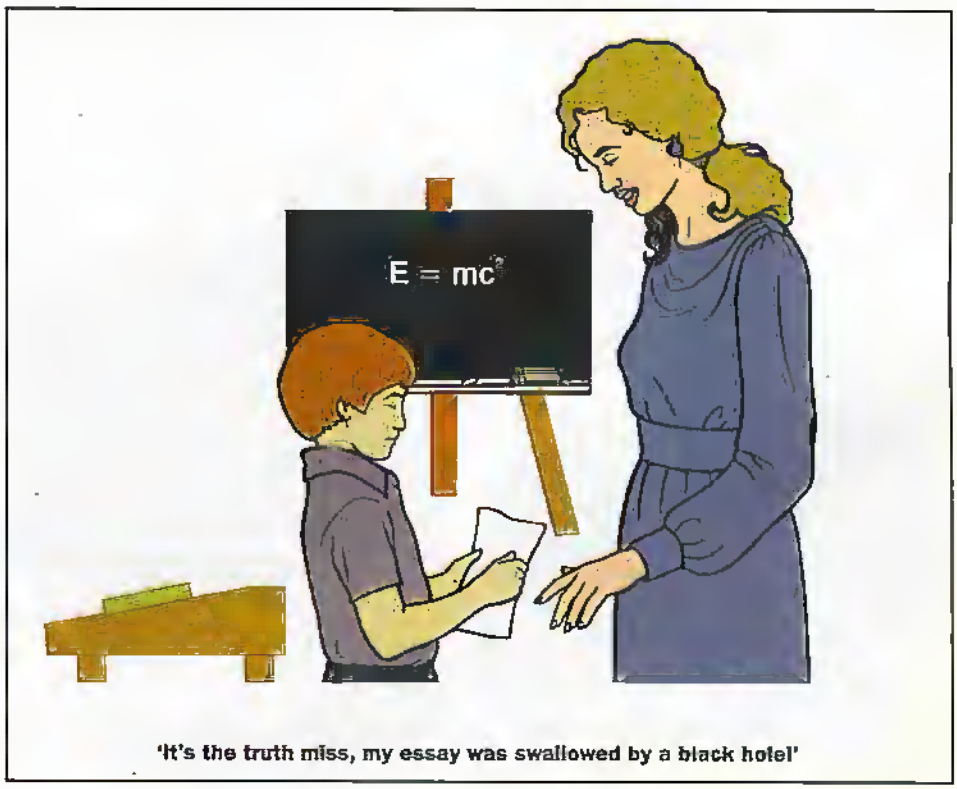
Leaving aside the question of 'divine intervention' we can ask ourselves what was the truth of the matter regarding Columbus's precise landing site, and how it relates to the evidence and the beliefs of those who have researched the subject - (even on the present-day San Salvador there are a number of different sites vying for the honour of being the actual place of landing.)

The 'truth' will probably never be known: We have 'facts', such as Columbus's log giving his description of their journey and the topography of the island, and a pitifully small collection of archaeological artefacts providing evidence for goods of Spanish origin. We have theories (at least half a dozen other islands have been proposed, with varying degrees of evidence), and we have beliefs in abundance (the local inhabitants will argue strongly in favour of the merits of their own favoured site).

What is the interested layman to make of this? He can read the copious literature which has been written on the subject, he can even visit the various locations and form his own opinion if he is so inclined. But what he cannot do is refer to some infallible, absolute source of information for a definitive answer, because no such source exists. The same can be said for all branches of knowledge, and in particular for scientific knowledge.

We have facts (observations and the results of experiment), we have theories (intellectual ideas linking together and explaining the observed phenomena), and each of us has our own personal set of beliefs (facts or theories which we accept as being true). But, as Pontius Pilate famously responded to Christ when he claimed to bear witness to the truth, 'what is truth?' (John, 18:38). In science as in all other branches of knowledge we do not have an absolute source of infallible truth to which we can refer, which is of course why science can be at the same time so fascinating and so frustrating.

Since we lack access to a source of absolute truth we have to rely on the next best thing, which is our own set of personal beliefs based on our assessment of the evidence and theories. If truth and belief are not the same thing, it is perhaps prudent to consider all our beliefs as provisional, and to dust them off and examine them with a critical eye from time to time. 'Facts' have a habit of changing over time (perhaps as new observations are made or as scientific methods become more sophisticated), and theories evolve as new intellects are brought to bear on the issues. Consider the following list of 'truths', and your own 'belief status' regarding each:-



'It's the truth miss, my essay was swallowed by a black hole!'

Theory: Women are better than men at ironing.

- The Earth is round, not flat.
- The Earth revolves around the sun, and not vice-versa.
- Black holes exist in space, and mark the edge of space and time.
- Thermonuclear 'cold fusion' has been observed in the laboratory.
- All living things, including human beings, evolved from common ancestry.
- God exists, and Jesus Christ was his only begotten son.
- Astrologers can accurately predict future events.
- A flying saucer crash-landed at Roswell, New Mexico, in 1947.
- Elvis Presley is alive and well, and his reported death was a hoax.

When I started to prepare this list I imagined that I could list the items in descending order of credibility so that readers would be able to pin-point their own 'cut-off point'. I soon realised that this was impossible! Theological matters will divide people into atheists and believers of various faiths in a different way to issues of a scientific nature such as black holes or cold fusion, and non-scientists who are sceptical about the big issues of science may be convinced of the veracity of fortune tellers. Nevertheless, most people would accept certain items as 'true' to a very high degree of certainty (perhaps that the earth is round? for example), others as flagrantly false (the Elvis Presley myth?), and still others on which they would not like to commit themselves either way.

What would it take to make you change your mind on any particular belief? Perhaps you would be taken aback to meet Elvis face-to-face in your local supermarket (as was featured in a recent advertisement), but you would probably conclude that it was you who had been hoaxed rather than the world at large. On scientific issues which were outside of your own particular field of expertise you would perhaps consider the views of acknowledged experts in the field, and look out for comment from others whose views you respected (you may for example prefer to base your judgements on science columns in the serious broadsheets or science journals, and not on lurid headlines in the tabloid press).

It is often suggested that scientists have closed minds regarding matters on which they have already made up their minds (that is to say formed their beliefs), and are not open to suggestions that they may be wrong. This is especially the case with issues of a paranormal nature, which many scientists are said to dismiss out of hand. How, we might ask, can a scientist justify his belief in outlandish and untestable ideas such as a universe which originated with a 'big bang' billions of years ago, or the outrageous idea that human beings are just another kind of animal with no preordained special status in the greater scheme of things, when that same scientist chooses not to believe in paranormal phenomena which many people seem to experience regularly and which should be easy to put to the test?

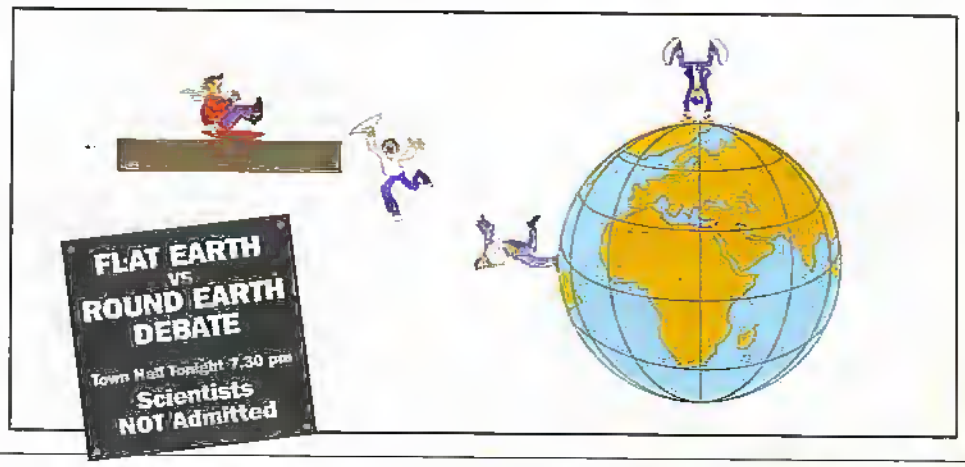
This is a question which many scientists find hard to answer, since the way they formulate their beliefs depends on the subtle interplay between the nature of scientific investigation, observations, and theories. Scientific knowledge is built up over long periods, often measured in centuries or even millennia, and is based on careful, critical analysis of many observations and experimental results, coupled with clear and logical thinking. Occasionally, a great leap forward is made by the deep intuitive insight of a brilliant mind, but these insights are never accepted at face value by the scientific community as a whole but must themselves undergo rigorous analysis and testing by sceptical peer groups.

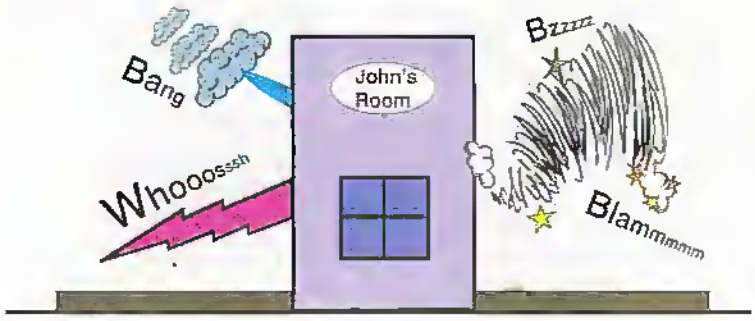
It is often the case that sceptics of the paranormal are challenged to explain particular psychic phenomena, and if they fail to do so it is taken as evidence that the phenomena must have a paranormal explanation. The scientists are then accused of burying their heads in the sand and ignoring the reality of the evidence. Is such criticism of working scientists valid? An important part of a scientist's work includes publication of new results and findings so that data and new theoretical proposals are opened up to critical analysis by peer groups. This process is never plain sailing, and in all branches of science new findings are discussed and criticised in depth, often in heated debate, and often with the debate polarised by the views of non-scientists (the BSE saga and the current furore over genetically modified foods spring to mind!)

Gaining acceptance for new ideas has always been a difficult and challenging enterprise, and this continues to be the case today. Of the many examples which could be cited I will briefly mention three, one from the 17th century, one from early in our own century, and one very recent.

Galileo

In 1633 Galileo was placed on trial, condemned, and imprisoned after his grilling by the Inquisition for his support of the Copernican system, which placed the Sun rather than the Earth at the centre of the solar system. Although the new heliocentric view of the solar system quickly gained almost universal acceptance it was only as recently as 1992 that Pope John Paul II conceded on behalf of the Catholic Church that Galileo had been unjustly treated. On a related theme, I imagine that no readers of this magazine would claim to support the





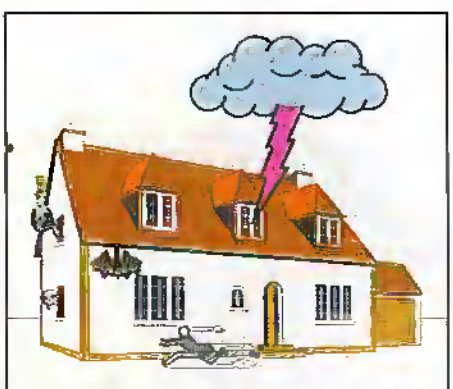
John will be down soon - he's just repeating his cold fusion experiment again.

views of the Flat Earth Society (or will I be proved wrong by a flood of letters?), yet a quick check on the Internet revealed that the society is alive and well and busy denouncing almost all scientific advances since the Middle Ages (interested readers can check out the latest misdemeanours of science on `http://www.talkorigins.org/faqs/flatearth.html`).

Albert Einstein

Albert Einstein published his seminal work on Special Relativity in 1905, and his most famous and important work on General Relativity in 1915. His theories were triumphs of logical reasoning, and his theory of gravity has been described as the most aesthetically beautiful creation in the history of physics. The predictions of the theory have passed every test with flying colours, and today his revolutionary ideas form the heart of modern physics and cosmology. Yet when Einstein was awarded the Nobel Prize for physics in 1921 it was for his work on the photoelectric effect, a major contribution to the fledgling new branch of physics known as Quantum Mechanics, and not for his revolutionary work on relativity, which was then considered too speculative and radical.

Even today there are many who do not accept Einstein's theories. I am sometimes told that, just as Einstein's theories were the death knell of Newtonian physics, so Einstein would be overthrown in the not too distant future. Such views indicate a lack of understanding of the progressive nature of scientific advances, and are not expressed by those who have taken the trouble to study the foundations and implications of relativity theory.



It's haunted! I want my money back!

Cold Fusion

In 1989 spontaneous 'cold fusion' of deuterium (in the form of 'heavy water') was reported to have taken place at modest temperatures under laboratory conditions. These findings were controversial, and have been the result of intense research in many laboratories in the subsequent decade. So far the findings have not been duplicated, and there is widespread doubt in the scientific community about the validity of the original experiments. Yet the proponents of cold fusion battle on against the odds, and who knows? Perhaps the next Millennium will see the advent of an unlimited free source of energy from tap water!

Close scrutiny by peer groups and others is the fate of any new finding in science, and many more examples of scientific advances which have either flourished or fallen on fallow ground could be cited. But when evidence of psychic phenomena consistently fails to pass the rigorous tests of sceptical analysis scientists are routinely accused of bias or a lack of openness to new ideas. It is certainly true that most scientists are wary of devoting their efforts to research into the paranormal, but this is usually due more to the dismal success record of such endeavours in the past than to any lack of interest in the subject. I have not heard of any big lottery winner claiming that (previously acknowledged) psychic powers helped with the selection of the numbers (or are those with paranormal powers too public spirited to use their endowments to their own advantage?), and property vendors are not yet obliged to refund the purchaser's money if the house they sell proves to be haunted (as reported in a recent news item). Nor is government policy, as far as I am aware, influenced by astrological predictions regarding the future of the economy.

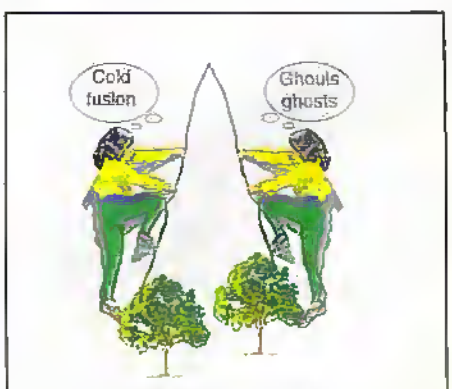
Critics of science sometimes claim that psychic phenomena, like religious faith, lie 'outside' of science and cannot be subjected to the same kinds of analysis or verification. This has always seemed to me to be a rather spurious argument, since science purports to concern itself with the totality of phenomena which make up our universe - how can any phenomenon be exempt from such an all-encompassing endeavour?

It is also often suggested (and has been in this magazine) that sceptics who fail to acknowledge the reality of paranormal manifestations are living in the dark ages, and should take note of the many errors of judgement made by scientists of earlier generations. In particular, it is often stated that if all scientists had been so obtuse we would still believe in a flat Earth and a universe centred on the Earth. This too is a spurious argument, ignoring the fact that the Copernican revolution (and any other major advance in science, for that matter) had nothing to do with open-mindedness about the paranormal but everything to do with careful observation of natural phenomena, clear and logical thought, and the construction of theories which made specific predictions which could be rigorously tested by experiment.

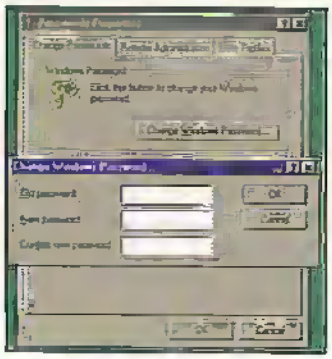
Research into psychic or paranormal phenomena is fraught with difficulties, since the true believer is rarely persuaded by the results of scientific tests, however convincing they may be. As an example of the power of entrenched beliefs consider the case of the Turin Shroud, venerated for centuries as the linen shroud described in the Gospel of St Mark, and in which the body of Christ was wrapped after it was taken down from the cross. The authenticity of religious relics has always been a touchy subject, and scientific analysis is often deemed inappropriate in such a context. However in 1988, after intense historical scholarship and renewed scientific interest in the subject, the keepers of the shroud released small portions for radiocarbon dating. The results were devastating: the shroud was revealed to date from no earlier than the Middle Ages, and although its precise origin could not be established it was almost certainly an elaborate forgery.

This I imagined would be the end of the matter, and certainly enthusiastic believers in the shroud's authenticity were crestfallen and subdued for a number of years. Today, however, millions are said to venerate the shroud, and it is claimed that the samples tested were 'unrepresentative'. The Church has recalled all outstanding samples and declined to sanction further tests. In science new ideas can never be cut off from further study in this way, and the work of any scientist is always open to critical scrutiny.

The true sceptic recognises that the boundaries between religion, science and pseudoscience will always be fuzzy, but he also acknowledges that the power of the scientific method must always take precedence over preconceived ideas and prejudices. It is right and proper that the exponents of the paranormal should face a steep uphill battle to gain respectability for their claims: after all, it is the same uphill battle which scientists in all fields must fight to gain acceptance for new ideas.



Hill of knowledge.



Software HINTS & TIPS

Want to keep prying eyes from personal documents and stop the kids messing up your PC? This month Mike Bedford looks at security.

Unlike the case with networked PCs and the large multi-user systems which went before them, security was not a primary concern in the design of software for stand-alone PCs. For many users this isn't a problem – either they don't store sensitive information on their PCs or the computer is kept in a locked room when it's not in use. For others, though, security is paramount. Someone working on financial or personnel files in a large open plan office, for example, may well need some way of keeping that data from prying eyes while they're away from their PC. Even home users may need some means of securing their PCs. Children with limited knowledge of Windows, for example, are notorious for deleting drivers, changing settings and generally causing mayhem on PCs. A little knowledge can be a dangerous thing.

To achieve a good level of security on your PC you need to invest in some third party hardware or software products. However, an acceptable level of security for many people - something which will provide protection against casual hacking - can be provided using the facilities already available on all Windows 95 PCs. How to provide this level of protection is the subject of this month's column

Setting a Password

In all probability, when you first switch on your PC you'll be launched straight into Windows. However, by setting a password it's possible to configure the system so that Windows will only start up if you type a valid password. To set a password, select Start > Settings > Control Panel > Passwords. Now click on the Change Windows Password button and the Change Windows Password dialog box is displayed. Whenever you use this facility you have to enter the old password (keep this blank if you've not previously used passwords) and the new password twice. The reason for typing the new password twice is to provide some protection against typing errors. If, for example, you intended to type Maplin but actually typed Msplib you'd end up locked out of your own system And it could take you quite some time finding out by trial and error what you'd actually typed. Following the setting up of a password, next time you attempt to start Windows, a password dialogue box will be display and you have to type the correct password in order for Windows to start.

Added Security

Naively, we might assume that having set up a password, the system will be totally secure. Unfortunately, this is far from the truth and its important to understand the limitations of this system. First of all, unlike higher security systems based on retinal scanning or fingerprint recognition, a password protected system will let in anyone who happens to know the password. This is stating the obvious but it's something many people forget. So, if you decide, as do many password users, to invent an easy to remember password such as your initials, your phone number or your wife's name, bear in mind that this is also an easy to guess password. And if you decide to pick something really obscure like Fg56%YN~ but write it down on a scrap of paper to help you to remember it, bear in mind that others could find that scrap of paper. So pick an obscure password but don't write it down.

But there's another and more fundamental flaw with the password protection of Windows '95. Unless you take some additional precautions, it's all too easy to circumvent the Windows password system. Windows 95 allows you to create a start-up disk. If you've never done this, it would be a good idea to make one now since it means you can still get access to your PC even if Windows gets totally corrupted or important drivers get lost. To do this, select Start > Settings > Control Panel > Add/Remove Programs and then the Start-up Disk tab. But just as this will allow you into a corrupted system by bypassing Windows and booting up the PC in a DOS environment, it will also bypass the Windows password. Anyone with a Windows start-up disk can, therefore, boot up your PC into DOS. Certainly they won't be able to get into Windows but they could peruse your hard disk and copy any of the files to diskette.

Fortunately there is a solution, at least with most PCs. Since this is BIOS-specific, however, the exact procedure will differ from one machine to another. The answer is to tell your BIOS in set-up (this is something you can enter by pressing the appropriate key combination - usually Del but check in your motherboard manual - during start-up, that is before you get into Windows) not to allow booting from your floppy drive. And to prevent someone else just changing it back again, you also have to set a password on the BIOS. I suggest you use the same password as for Windows. Using the same password for both isn't really a security risk and it increases your chances of remembering something obscure without writing it down.

Internet Security

Another area which is a concern to many is Internet security. But I'm not talking about the possibility of people hacking into your PC while you're connected to the Net, nor of the advisability or otherwise of giving credit card details on the Web. The wider implication of Internet security is a major topic in itself and this is far too involved to go into here. However, one area which people do express some concern over is other people knowing which Web sites they've visited. I'm not going to question why people have this concern and I certainly wouldn't want to encourage people to abuse their employer's trust by browsing for personal interest during working hours. Nevertheless, for people who don't want to leave tell-tale signs, for whatever reason, here are a few tips on how to prevent that.

The important fact to bear in mind is that Web browsers normally maintain lists of the URL's of pages visited and they even store the contents of those pages. The reason for this is so that links to previously visited sites can be coloured differently (usually purple) and to eliminate a re-transmission when returning to a page which was displayed quite recently. If you don't want to leave evidence of your browsing behind, either you have to tell your browser not to do this or you have to clear out this information after each and every Web browsing session.

Exact procedures differ from one browser to another but you can prevent page contents from being stored by setting the size of the disk cache to zero. And you can avoid lists of URLs from being stored by causing followed links to expire after zero days. You can also specifically clear the disk cache and expire the followed links. You should be aware, however, that eliminating the disk cache will slow down your browsing and that it's sometimes useful to be able to tell whether you've recently a visited a page for which a link is shown on-screen.

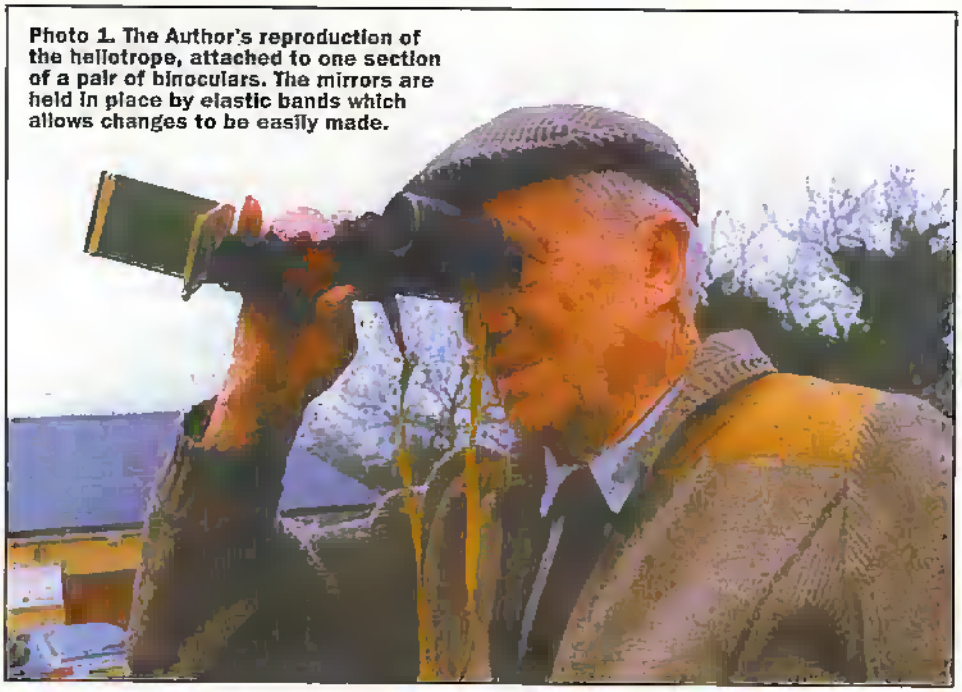


Photo 1. The Author's reproduction of the heliotrope, attached to one section of a pair of binoculars. The mirrors are held in place by elastic bands which allows changes to be easily made.

Signalling BY MEANS OF VISIBLE LIGHT

PART 3

In part 3, George Pickworth looks at variations and electromechanical types.

Marathon

The story goes that after the battle of Marathon in 490BC, the Persians used their shields to flash sunlight signals to Athen. This is a distance of about 30km and it was to tell the Persian supporters to prepare for the arrival of the Persian ships which would sail around the coast to the city. We all know that the Greeks won the battle of Marathon which rather upsets this story.

Later, at the battle of Salamis in 480BC we are told that thousands of Greek soldiers used their shields to concentrate sunlight on the Persian ships and were able to set them on fire. However, a friend who is a classical scholar tells me that there is no mention of sunlight-signalling nor the burning of the Persian ships in classical literature.

But not being mentioned in the classics does not necessarily mean that the above events did not occur. Indeed, my schoolboy experiments showed that sunlight telegraphy would have been entirely possible by the ancient Greeks, plus they had a simple alphabet which is of course vital for any telegraph system.

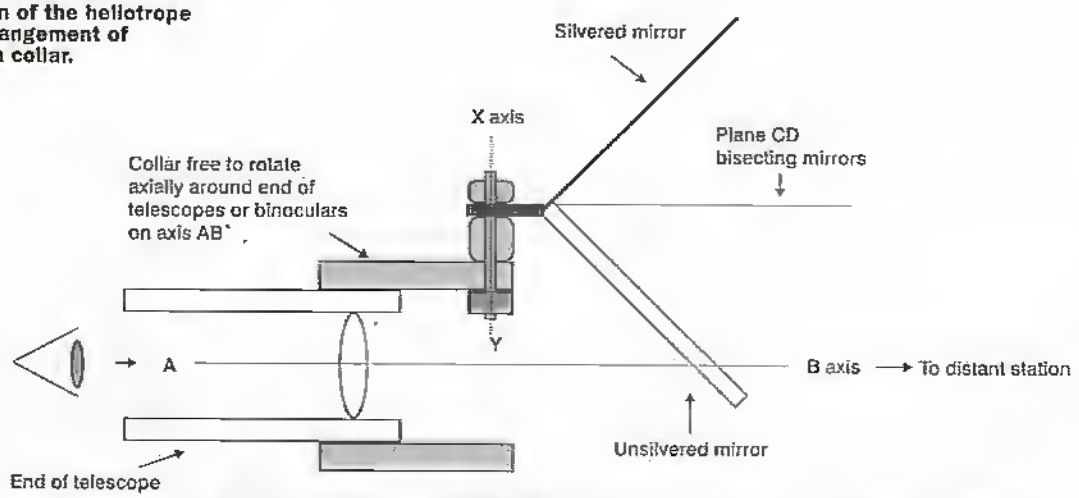
North West Frontier

Other than vague accounts that the Moguls observed flashes warning townsfolk of their advance towards China, the earliest recorded evidence I have of sunlight signalling only goes as far back as the mid 19th century when British troops were moving up to the North West Frontier of India.

The flashes observed by the British troops were found to be made by look-outs using mirrors to flash pre-arranged signals warning of the presence of the troops. This motivated the British authorities to study the possibility developing sunlight as a military telegraph system.

The outcome, as we saw in part 1, was the heliostat, introduced to the British army in 1875 followed around 1880 by the heliograph. Early versions of the heliostat had the sighting rod mounted on a small secondary tripod (shades of my schoolboy system) but this approach was soon abandoned in favour of integrating the sighting arrangement with the actual instrument.

Figure 18. The Author's reproduction of the heliotrope showing arrangement of mirrors on a collar.



Although offset, the view through the telescope is taken to run longitudinally through plane CD, the offset is too small to have any significant effect on alignment with the distant station

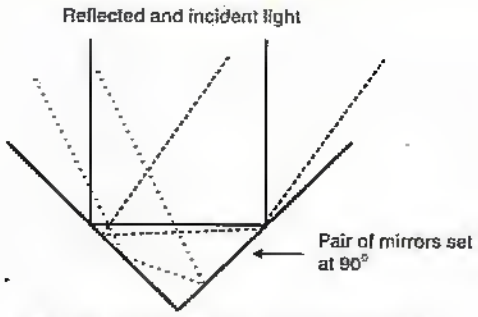


Figure 19. Two mirrors set at 90°.

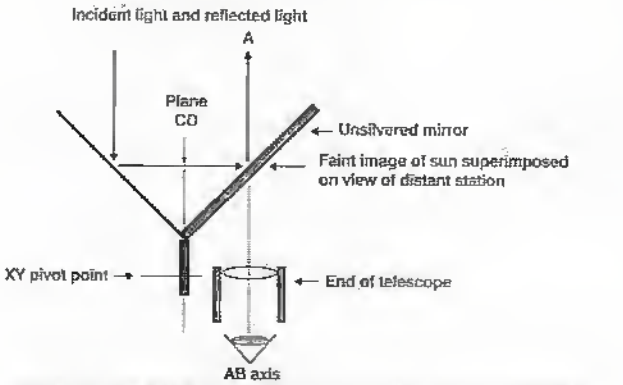
When light falls equally on the two mirrors at an angle within the 'V' it is reflected at 180° within the same plane as the incident light.

towards the distant station. See Figure 21.

The advantage of binoculars was that the left section could be used solely to observe the superimposing of the sun whilst the distant station was viewed though the right section. The mirrors folded flat when not in use so as to take up little space.

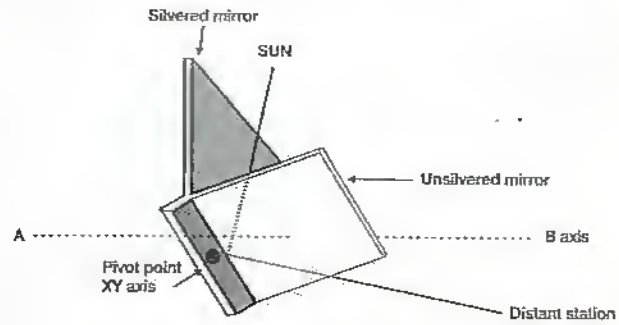
Signalling

With Guass' instrument, the two mirrors were normally held at 90° by a spring arrangement, but during signalling the angle of the mirrors was slightly changed by a trigger operated device which served as the signalling key. The two mirrors then no longer behaved a



One mirror is replaced by an unsilvered mirror i.e. Clear glass. Plane CD has 180° arc centred on the mirror's 'V'. Line of sight through the telescope is through unsilvered mirror = axis AB
View through telescope runs longitudinally through plane that bisects mirror = CD

Figure 20a. The heliotrope's mirrors.



Rotating mirror on axis AB also rotates plane CD. Mirrors are rotated on axis AB until CD corresponds to plane of the sun and distant station. Mirrors are then tilted on axis XY until light from the sun is reflected to distant station.

Figure 20b. Rotating mirrors on axis AB & tilting on axis XY.

The Heliotrope

Paradoxically, there was an earlier sunlight telegraph apparatus known as the heliotrope which was invented by Carl Gauss in 1821, and seems to be the earliest example of an instrument designed for sunlight telegraphy. Remarkably, the heliotrope attracted little attention until around 1860 when it was brought to the notice of the British administration in India and evaluated against the heliostat. The heliotrope could be made very small and was intended to be attached to the end of a telescope or to one section of a pair of binoculars. It was apparently used with success, especially by cavalry officers.

The heliotrope differed to the heliograph in that during signalling the distant station was viewed directly through a glass plate which also served as a mirror. Unfortunately I have been unable to locate an example of the heliotrope but based scant information available I believe Figure 18 & Photo 1 to be a fair reproduction. It is a most ingenious device which I believe has the potential for further development

Theory

The theory of the heliotrope is that when two mirrors are set at 90° they appear to behave as a single mirror that automatically aligns 90° to incident light falling equally on both mirrors. Light is therefore reflected by 180° and both reflected and incident light falls within the same plane (CD). See Figure 19. Although one mirror is unsilvered, i.e. clear glass, it nonetheless reflects an

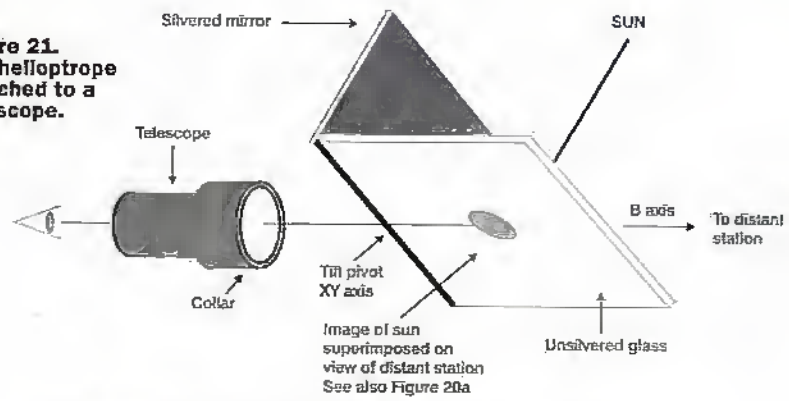


Figure 21. The helioptrope attached to a telescope.

When faint image of the sun is superimposed on the view of distant station, the reflected beam is aligned with the distant station.

appreciable amount of light.

The mirrors are attached to a collar whereby plane CD, which bisects the two mirrors is longitudinally in line with axis AB, this runs through the centre of the telescope and the unsilvered mirror as shown in Figure 18. The collar rotates axially around the end of a telescope or one section of a pair of binoculars. See Figure 18 & 20a.

When the collar is rotated on axis AB, plane CD similarly rotates and a position can be found where this corresponds to the perceived angle of the sun to the distant station as shown in Figure 20b. The mirrors are then tilted on axis XY until a faint image of the sun is superimposed on the view of the distant station. Sunlight is reflected single mirror, but as two separate mirrors reflecting a pair of beams which diverged to either side of the distant station.

It seems that light was directed to the distant station with the key at rest. Morse characters were produced by interrupting the light beam, i.e. the opposite to that with the heliograph.

My Reproduction

I used a piece of plate glass for the unsilvered mirror complemented with a ladies vanity mirror. Unfortunately I have no information of the kind of glass used by Guass. Possibly a different kind of glass would improve results - a better mirror would undoubtedly

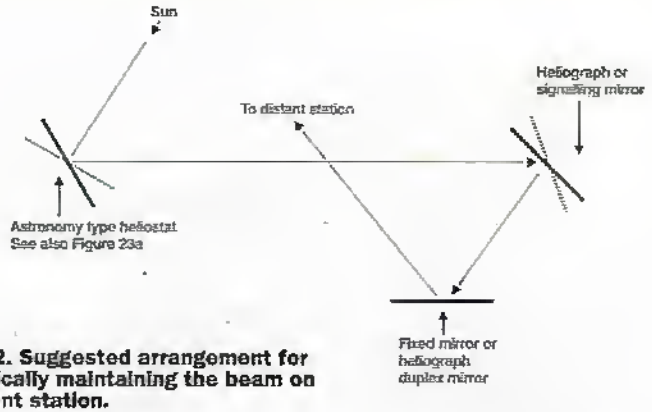


Figure 22. Suggested arrangement for automatically maintaining the beam on the distant station.

Figure 23a. Essential features of an astronomy type heliostat.

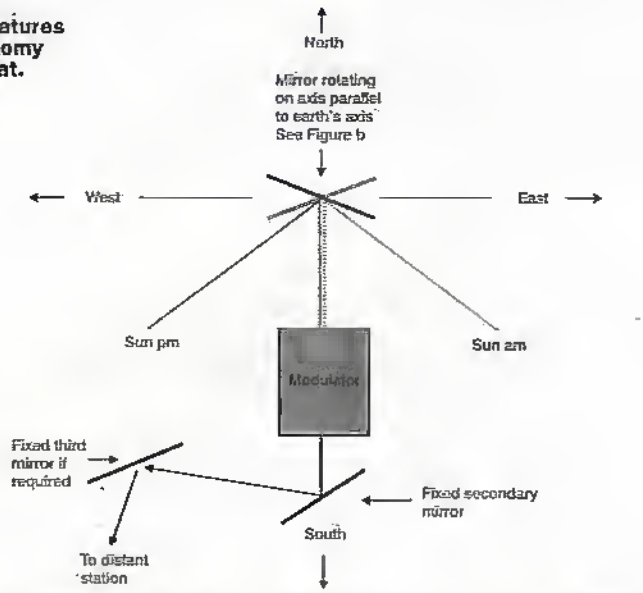
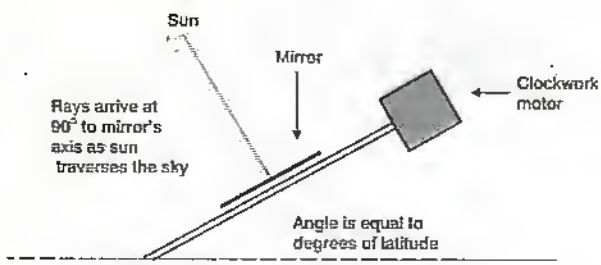


Diagram shows sunlight directed on to modulator, and set up for northern hemisphere. Modulated light can be reflected in any direction by fixed secondary mirrors.

Figure 23b. Diagram showing mirror's axis inclined to be parallel with the earth's axis.



give much improved results.

Ideally, the device should be of precision made, nonetheless, during experiments with my reproduction, I was able to reflect a beam of light to a friend about 1km away with a fair degree of accuracy.

The Future

With any sunlight signalling system it would obviously be a great advantage if the light beam was automatically maintained on the distant station, indeed, devices which could do this have long been used in astronomy but I have no record of such devices being used with sunlight signalling systems.

A suitable device could be modelled on an astronomy type heliostat; this is essentially a mirror that rotates on an axis that is parallel to that of the earth, i.e. inclined at an angle corresponding to latitude. A clockwork mechanism rotated the mirror so as to follow the sun thereby reflecting rays onto astronomy instruments

However, there is no reason why an astronomy type heliostat should not direct the sun's rays onto a heliograph, which would then no longer have be constantly adjusted to follow the sun. Indeed, a much simpler version of heliograph would then be adequate as once the mirror was orientated to direct a beam to the distant station, it would need no further adjustment. See Figure 23a.

There seems to be no reason why an arrangement of photo cells together with the necessary electronics should not automatically align the beam to the distant station. The beam could then be either chopped into Morse characters, or be modulated with speech or data.

Sunlight Telephony For Experimenters

I remember reading several articles on light beam telephony with artificial light in articles published in American journals during the pre-war and immediate post war years and actually experimenting with such systems (See Figure 15 part 2). But there is still a dearth of information on sunlight telephony. It is therefore a field wide open for experiments by amateur scientists.

The principal factor limiting sunlight telegraphy is of course sunlight, so such systems would only be applicable to sunny countries. There is also the matter of the "purity" of sunlight.

Shortly after the discovery of the selenium LDR and the telephone earpiece some pioneers reported that weird sounds were emitted by the sun. These were attributed to disturbances on the surface of the sun and at that time aroused some scientific interest. This phenomenon may well warrant further study by amateur scientists.

Modulation

In its simplest form, rays from the sun would be manually directed to the modulator with a heliograph type mirror, although it would be advantageous for this to be done automatically. Modulators and receivers based on designs originally developed for artificial light telephony should be equally applicable to sunlight as demonstrated by the German WW2 photophone mentioned in part 2.

Many years ago when experimenting with artificial light telephony I employed a modulator based on an old balanced armature loudspeaker which by means of a linkage caused a small mirror to rock on its axis. A moving coil loudspeaker should be perfectly satisfactory. See Figure 24a & 24b.

The mirror deflected a greater or lesser amount of light, depending on the level of modulation, away from the exit slot thereby effectively modulating the light beam. However, as mechanical inertia limits the frequency response of an electro/mechanical modulator, the mirror must be made as light as possible.

On the other hand, the magnetic field modulator (see Figure 17 part 2) has no moving parts and the frequency response would seem to be limited only by the inductance of the solenoid winding. However, during experiments conducted many years ago I found that an intense magnetic field was necessary to give a discernible degree of modulation. Nonetheless, it offers tremendous scope for experimentation especially with regard to substituting other materials for the lead glass rod.

The receiver could be based on my early car-headlamp system (see Figure 15b part 2), with the large photo cell replaced by a tiny photo diode on which the light beam could be accurately focused.

Covert

Only low power would be required by the modulator, this could be conveniently derived from solar panels. Sunlight signalling devices would therefore seem well adapted for use by agents operating in hostile territory.

Moreover, unlike Hertzian wave systems, where even microwave beams are not immune to being picked up by spy satellites, a pencil of light would afford great secrecy as one would have to be in line with the beam in order to observe the signals.

Antiquity

To quote Clerk Maxwell, "Every student of science should be an antiquary in his subject". Indeed, physical laws do not change and that which was valid a 100 years ago is just as valid today. However, today experimenters have the technology that the pioneers lacked.

Indeed, amateur scientists now have access to sophisticated measuring equipment unheard of in my young days - they now have the means to have a fresh look at some of the older systems. So, let us now look at two early systems that were based on ultra violet and infrared light. They are considered worthy of mention in this study because they demonstrate the ingenuity and far sightedness of the pioneers.

Ultraviolet

Perhaps the most ingenious system was conceived by Professor Zickler around 1880. It was based on the phenomenon that the dielectric strength of air is dramatically reduced by the presence of ultraviolet light and the resultant ionisation. I have no record of Zickler's system ever having any practical application so the following notes are included for interest's sake. See Figure 25. Perhaps a reader could find an application for this phenomenon.

With Zickler's system the light source was an arc lamp which is rich in ultraviolet light. A quartz lens, which is transparent to U.V. light, directed a light beam to the distant station. The receiver consisted of a spark gap deliberately made too wide for a discharge to normally occur. When ultraviolet light impinged on the spark gap, the air dielectric broke down and a discharge immediately occurred. This activated a coherer which in turn operated a bell, i.e. a miniaturised Marconi type transmitter and receiver. See Figure 25

Signalling was by means of a glass shutter which was transparent to visible light but

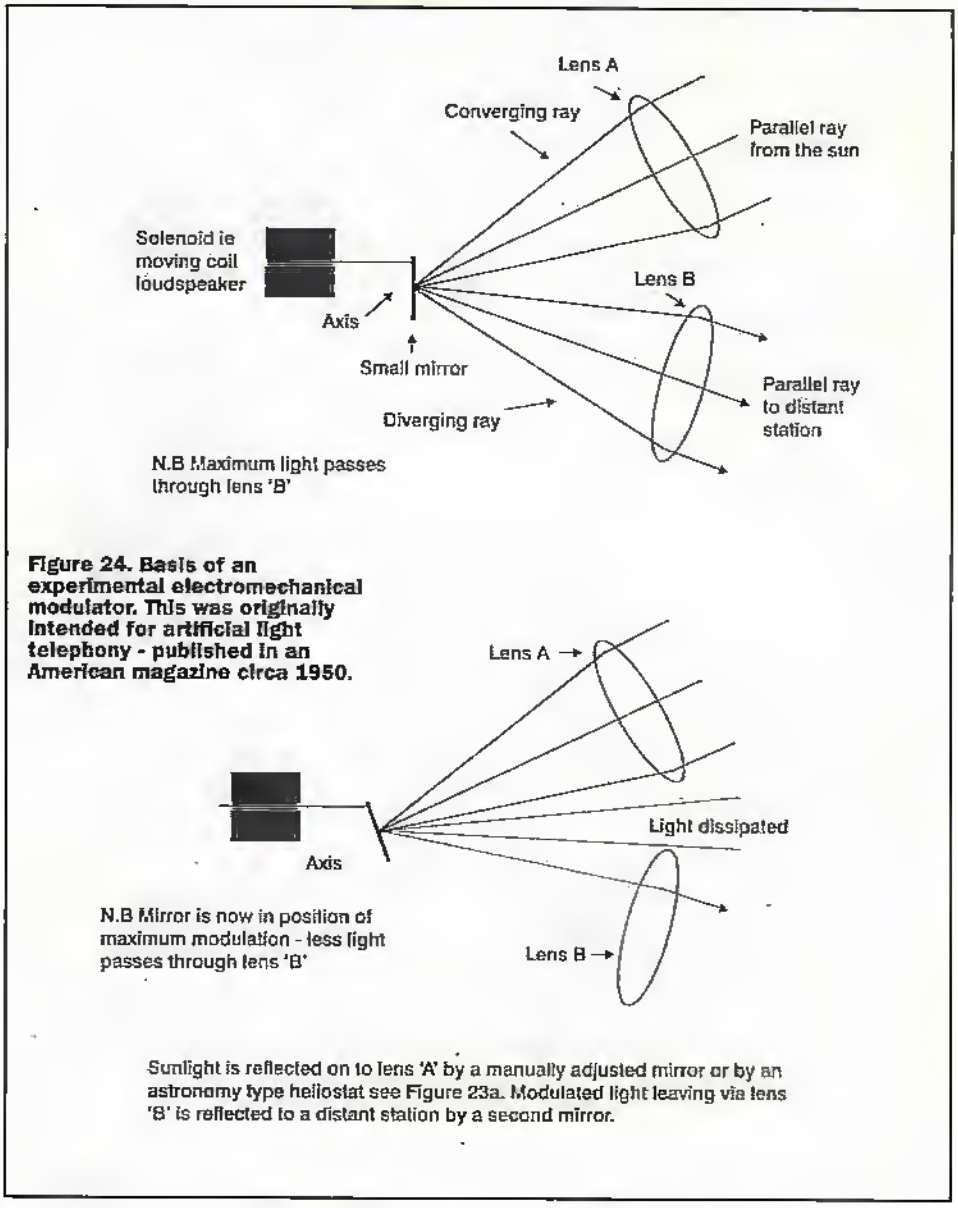


Figure 24. Basis of an experimental electromechanical modulator. This was originally intended for artificial light telephony - published in an American magazine circa 1950.

Sunlight is reflected on to lens 'A' by a manually adjusted mirror or by an astronomy type heliostat see Figure 23a. Modulated light leaving via lens 'B' is reflected to a distant station by a second mirror.

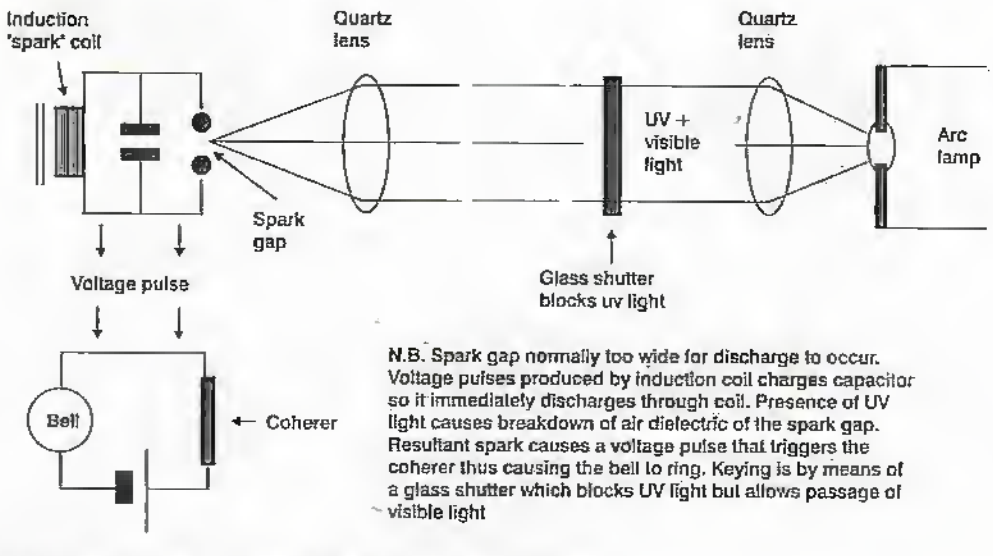


Figure 25. Representation of Zickler's 1880 ultraviloet telegraph system.

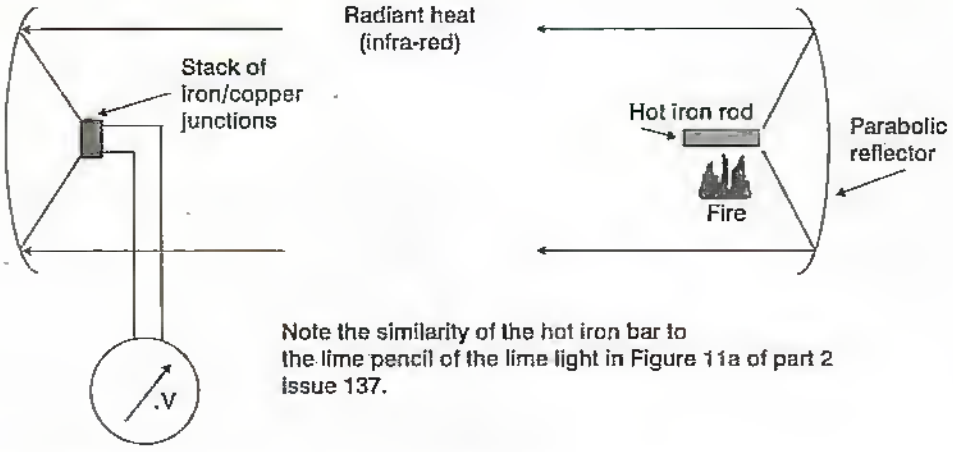


Figure 26. The Author's interpretation of Steinheils radiant heat telegraph system circa 1840.

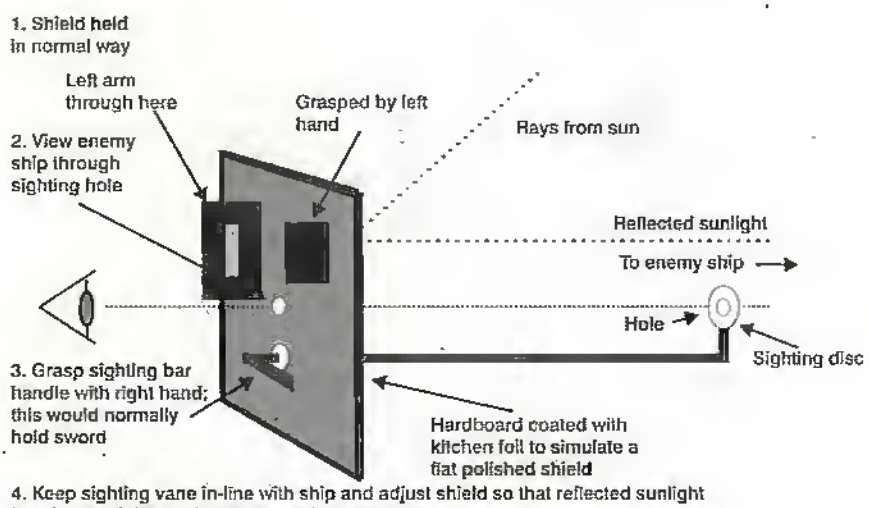


Figure 27a. The Author's simulation of a shield that could have been used by the ancient Greeks to concentrate sunlight on the Persian Ships.

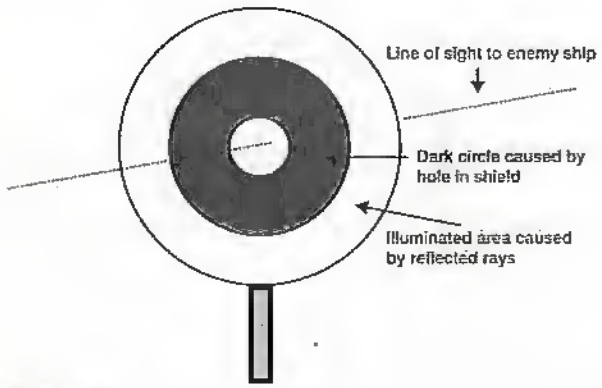


Figure 27b. The sighting disc

not to U.V. light. So, visible light was always present and this facilitated alignment of both sender and receiver. However, as signalling was by ultraviolet light, and therefore not visually apparent, Zickler promoted his system on the grounds that his system afforded great secrecy.

Radiant Heat (Infrared)

Steinheil's radiant heat telegraph system was ahead of its time and the development of a practical IR system had to await for the development of modern infra red lamps and sensitive detectors, typically photo diodes.

With Steinheil's system, See Figure 26, radiant heat produced by a hot iron bar, was directed by means of a parabolic reflector to a distant receiver where a similar reflector concentrated the heat onto a 'thermo-electric pile,' presumably a stack of copper/ iron junctions. This produced a current that deflected the needle of a galvanometer. Signalling was by deflecting the beam of radiant heat away from the distant station.

Salamis

To complete this study, I return to the battle of Salamis. So, let us now assume that the ancient Greeks did indeed have a sunlight telegraph system and therefore had a sighting system. It is logical to assume that with some modification the telegraph sighting arrangement could have been used by Greek soldiers standing on cliffs to direct the sun's rays on to the Persian ships.

Keeping the beam on the Persian ships would of course mean making corrections for both the movement of the sun and the movement of the ships. Nonetheless, my experiments with the arrangement, shown and described in Figure 27, demonstrated that with some practice, the reflected beam could have been maintained on the Persian ships.

Notwithstanding that the Greek shields would have had surfaces far from optically flat, the combined effect of sunlight reflected from thousands of shields would have made life on board very uncomfortable if not actually setting the ships on fire!

Thanks go to...

Major R Pickard of the Royal Signals Museum, Blanford for providing a photograph of the heliograph in Mesopotamia and for literature on the lime light and the German photophone.

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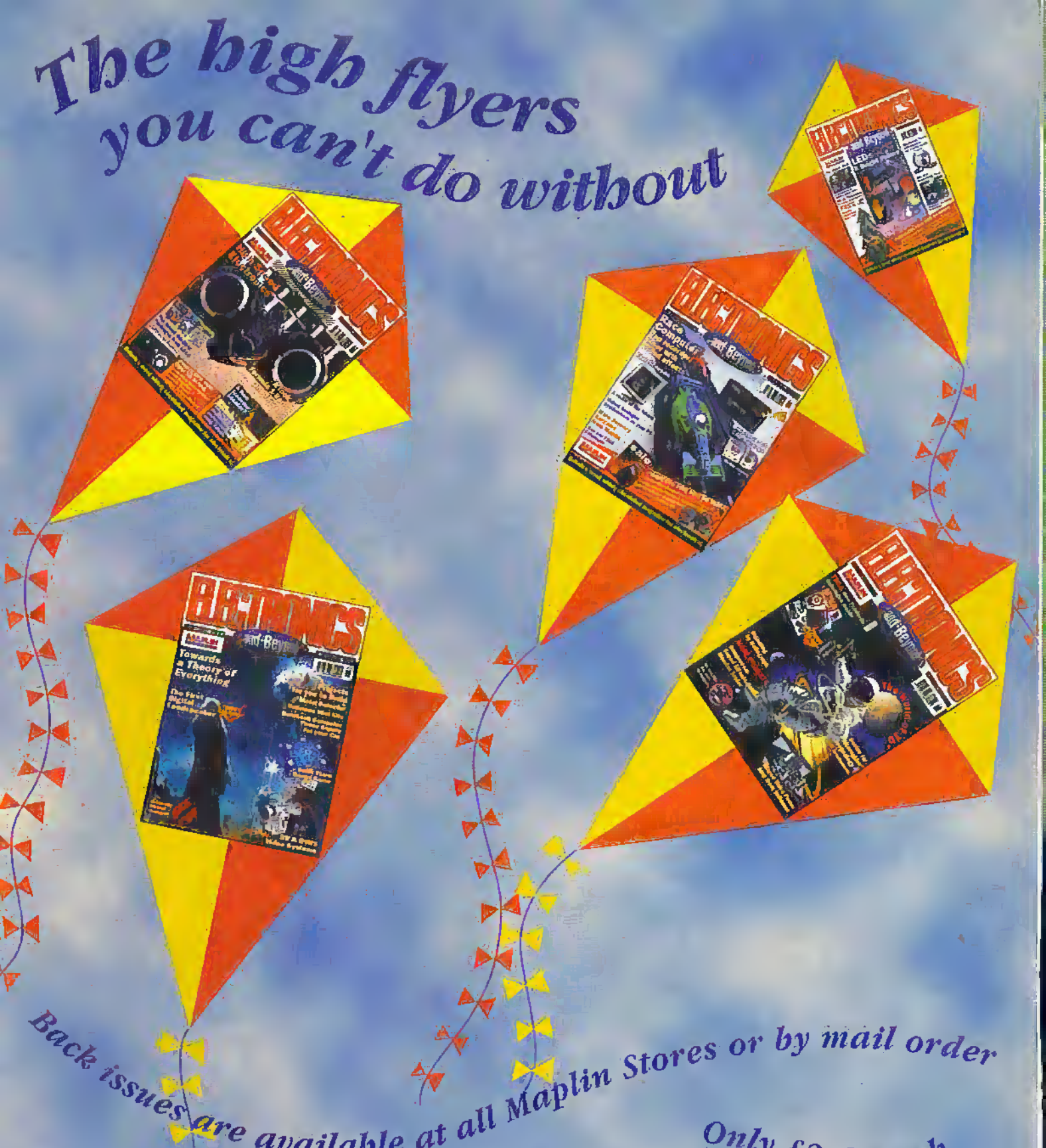
The high flyers you can't do without



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PROJECT Metal DETECTORS

PART 2

Typical Roman silver coins.

In Part 2, Gavin Cheeseman constructs a working detector.

In last months article we looked at some of the fundamental principles behind metal detector design. This month we take a more practical approach and look at the construction of a simple but effective metal detector using some of the techniques discussed.

Many different types of detector are available ready built, some of which provide advanced functions and are microprocessor controlled. The intention is not to try to emulate the performance and features of these units as top of the range detectors are often complex and costly. The project is aimed at those who are new to metal detecting and are interested in experimenting with a basic detector that is relatively easy to build.

Overview

The design makes use of the beat frequency principle whereby a metal object in close proximity to a search coil modifies the frequency of an oscillator. When mixed with a second oscillator, a mixing product relating to the difference in frequency between the two oscillators is produced in the audible frequency range. This is known as a beat note, hence the term beat frequency oscillator. The change in frequency depends on the size of the metal object and distance from the search coil. When amplified the audio frequency output may be used to drive a small loudspeaker or headphones. Figure 1 shows a simplified block diagram for the circuit.

Circuit Description

Figure 2 shows the circuit diagram for the unit. Electrolytic capacitor C1 decouples the 9V power supply line. This helps to ensure that the power supply rails remain relatively free of noise. Regulator RG1 provides a stabilised 5V supply for the oscillator stages of the circuit. Decoupling of the 5V supply is provided by C2 and further high frequency filtering is accomplished by R1, C5, R4 and C8. Inductor L2 is the search coil, and together with capacitors VC1, C3 and C4 it forms a parallel resonant tuned circuit. The tuned circuit determines the operating frequency of the oscillator formed by field effect transistor TR1 and associated components. C3 and C4 effectively act as a capacitive tap and provide a suitable point to apply feedback to the tuned circuit without the need to tap the search coil directly. This simplifies the construction of the search coil. Resistor R2 ensures that there is a DC path for TR1 and sets the DC bias level.

TR2 and associated components form a second oscillator which is mixed with the search coil oscillator to produce a beat frequency. This time the operating

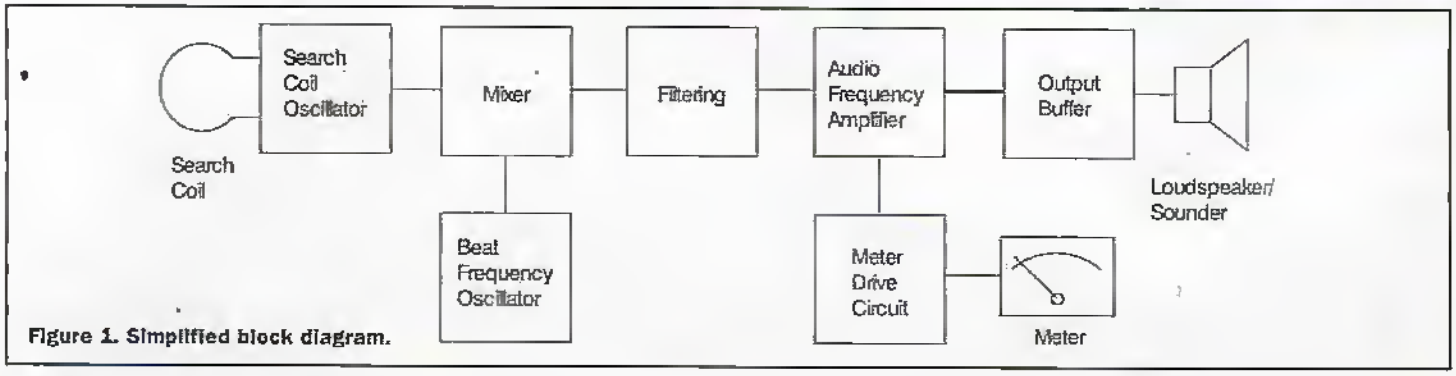
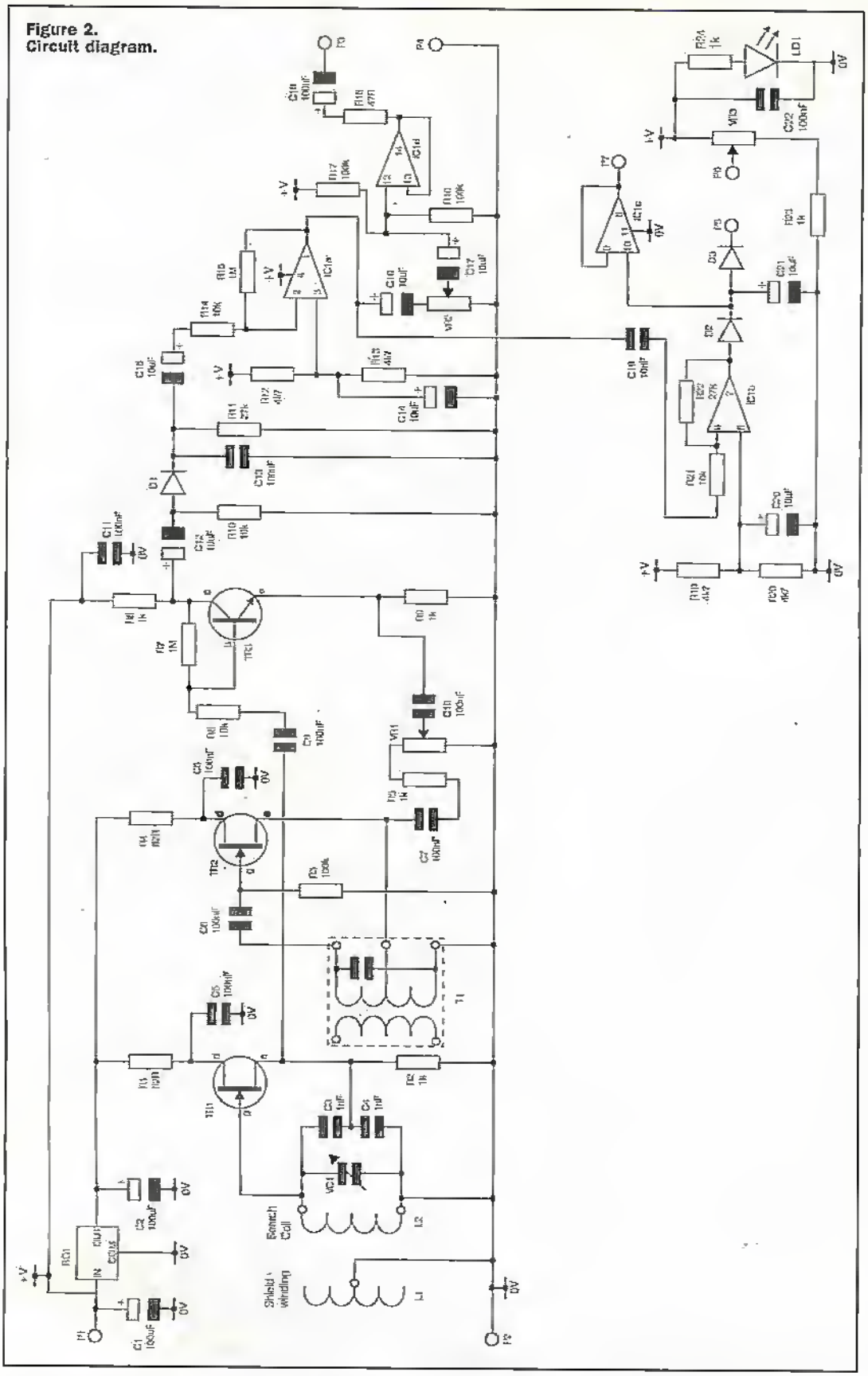


Figure 1. Simplified block diagram.

Figure 2.
Circuit diagram.



frequency is determined by tuned circuit T1, a standard IF oscillator tuning can with an integral capacitor. The operation of this stage is slightly different to the search coil oscillator as the feedback is applied directly to a tap in the inductor as opposed to using a capacitive tap.

The outputs from the search coil oscillator (TR1) and the beat frequency oscillator (TR2) are fed to the next stage comprising TR3, R6 - 11, C9 - C13 and D1. This section acts to mix the signals from the two oscillators and provide a filtered audio frequency output corresponding to the difference between the oscillator frequencies. The circuit is relatively simple but nevertheless generally provides an acceptable level of performance in this application. Preset variable resistor VR1 allows the level of the search coil oscillator to be adjusted as required.

The level of the audio frequency output produced at D1 is relatively small (in the region of a few mV) and is generally not enough to usefully drive a transducer. Operational amplifier IC1a is used to amplify the signal up to a higher level. Resistors R12, R13 and C14 provide a reference level for the device whereas R14 and R15 set the amplifier gain. The output is fed to volume control VR2 via coupling capacitor C16 and then on to a buffer stage formed by IC1d and associated components. C18 acts as a DC blocking capacitor at the output.

A further stage based around IC1b produces a DC level derived from the A.F. signal at the output of IC1a. This may be used to drive a moving coil meter (specifically LB80B). A second (auxiliary) DC output is provided at P7. The meter can be useful when tuning the oscillators to 'zero beat' and also provides some indication of battery condition when correctly set up. Variable resistor VR3 and resistor R23 set the maximum deflection of the meter. It should be noted that IC1a - IC1d all form part of the same quad op-amp package.

Construction

There are several aspects to consider with regard to construction. In addition to building and aligning the circuit it is also necessary to construct a suitable housing. It is also possible to use different coil arrangements to modify the response of the detector. These points are dealt with separately.

Circuit Construction

The circuit may be built on matrix board or printed circuit board. It is necessary to provide a means of fixing the circuit board into the case. For the prototype unit, threaded spacers were used at each of the four corners of the board (Figure 3). Depending on the housing it may be necessary to replace the screws supplied with the spacers with longer types. It is advantageous to work out the required position for the circuit board in the case and drill any necessary fixing holes in the board before mounting any components. It is worth taking some time over this, as trying to drill holes at a late stage in a completed circuit board is awkward and it is easy to damage components if the drill slips. Similarly, it is sensible to double check the connections and layout of the completed board visually before it is installed into the case. There is nothing worse than completing the construction and installation only to realise that some critical component is missing or wrongly connected.

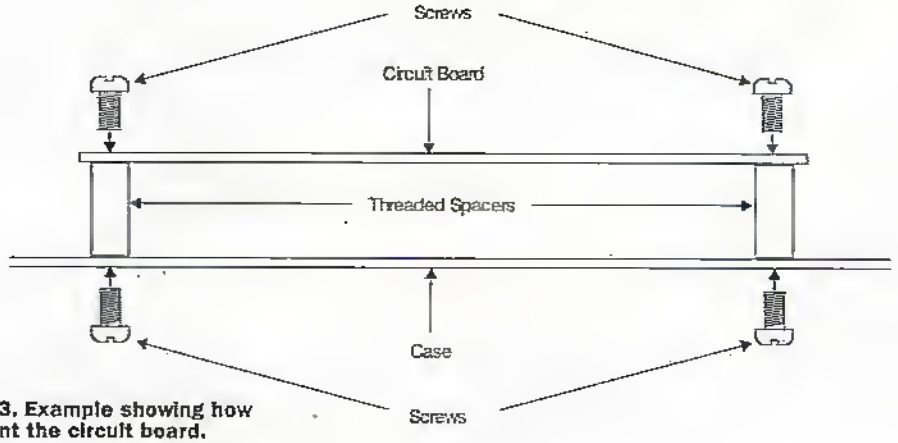


Figure 3. Example showing how to mount the circuit board.

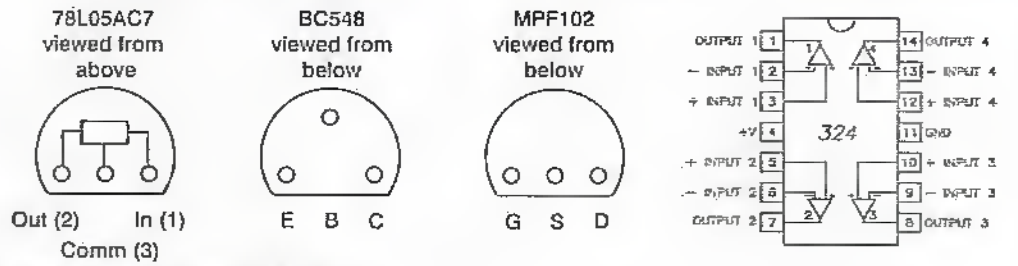


Figure 4. Semiconductor pinouts.

Although the layout of the circuit is not over critical, there are relatively high frequencies involved so the usual common sense rules should be applied. In particular avoid long wiring runs between components on the circuit board as stray coupling may otherwise result. The components should be set out in a similar order to that of the circuit diagram. Try to keep high frequency de-coupling capacitors as close as possible to associated components as this helps to reduce noise and instability on the supply rails.

When fitting polarised components such as semiconductors and electrolytic capacitors, please ensure that the devices are connected observing the correct polarity. Connecting components incorrectly may result in damage to the circuit and can also present a safety hazard. Figure 4 gives semiconductor pinout information. The polarity of diodes is indicated by a band on the body of the device adjacent to the cathode lead. The cathode lead of LED's is normally the shortest of the two and is often also indicated by a flat edge on the component body as shown in Figure 5. As regards electrolytic capacitors, the negative lead is normally indicated by a negative (-) symbol on the capacitor body adjacent to the relevant lead. The negative lead is also normally the shortest of the two. It is recommended that a DIL socket is used for IC1.

It is required to mount some of the components off board, the most obvious being the search coil. The volume and tuning controls may either be mounted directly onto the circuit board or wired off. The wiring to the tuning control is effectively part of the search coil tuned circuit and therefore should be kept as short as possible so as to avoid proximity effects and mechanical instability. Screened lead may be used to reduce these problems if necessary. Variable capacitor connections are shown in Figure 6 for guidance. It may be necessary to extend the capacitor spindle depending on the type of housing used. When mounting the VC1, take care not to insert the fixing screws too far into the capacitor case as this may damage the component. Figure 7 shows battery, meter and sounder wiring. The meter may be fixed into the case using a suitable adhesive. There are also optional items such as a headphone socket that may be considered.

As discussed earlier, the audio output of the circuit is derived from the output of an operational amplifier via a small limiting resistor. Therefore the output level is limited but should be loud enough in many circumstances. The circuit may be used to drive high impedance (64Ω) loudspeakers (e.g. YT27E) or piezo transducers (e.g. YUS2D). In noisy environments it may be useful to use headphones. A switched headphone socket may be fitted so that the output normally connects to a loudspeaker but when the headphones are inserted the loudspeaker is disconnected.

Coil Construction

There are several different methods of constructing the search coil. The coil used for the prototype was constructed from insulated hook-up wire (BL00A) and consists of 25 turns of 18cm diameter. This is illustrated in Figure 8. It is important to use the correct dimensions and number of turns so that the resonant frequency falls within the correct range. If different parameters are used, it will be necessary to take steps to ensure that the circuit resonates at the correct frequency. An old paint can was used as a former when winding the coil. The turns may be secured using electrical insulating tape. The shape of the coil affects the response and sensitivity of the metal detector. In general a smaller coil will provide less sensitivity than a larger coil but will also provide better pinpointing accuracy. Therefore, there is always a compromise. It is also possible to modify the response by forming the coil into different shapes. For example by forming a large coil into a 'double D' or dumbbell configuration (Figure 9A) it is possible to obtain a null for pinpointing whilst still maintaining some of the sensitivity of a larger coil. The example shown in Figure 9B provides narrower coverage that can also be useful for pinpointing a find. Other than the requirement to resonate the circuit at the correct frequency, it is entirely up to the user to decide on the final size and configuration of the coil. The search coil should be connected to the circuit board using coaxial cable.

In addition to the main coil winding there is also a shield winding that helps to reduce electrostatic effects when the search coil is in close proximity to non metallic objects. The centre of the shield winding is connected to 0V. The shield winding must be broken half way along its length so that it does not act as a short circuit secondary winding to the search coil, as this would result in undesirable effects such as quenching the oscillator. Once again, although less than ideal, insulated hook-up wire has been found to be quite effective. The shield windings should be close spaced and cover the

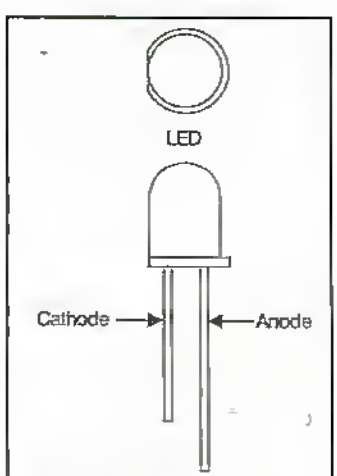


Figure 5. LED polarity.

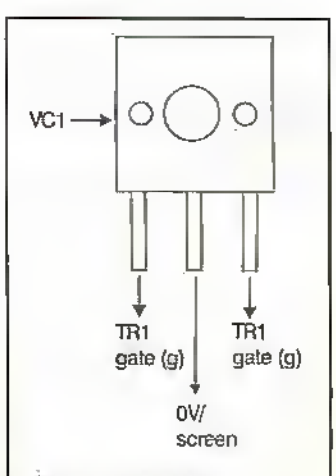


Figure 6. Variable capacitor connections.

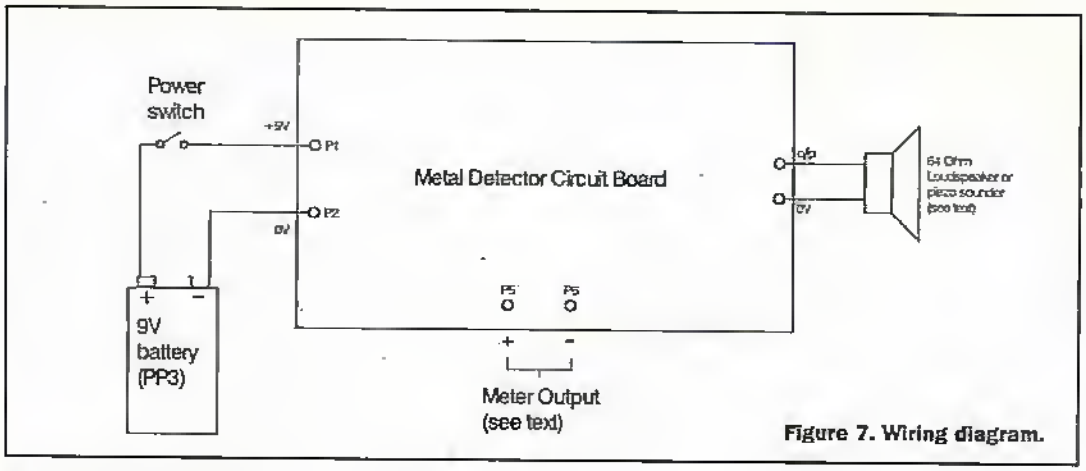


Figure 7. Wiring diagram.

whole of the search coil as far as possible. The precise number of turns is not particularly critical. An alternative is to use metallic tape. There will inevitably be some detuning of the search coil circuit but this can be compensated for when aligning the circuit.

Choice of Housing

The choice of housing is up to the user. Figure 10 shows a typical example. It is not necessary to purchase specialised parts to produce an effective housing, readily available household materials may be used. The parts that are not stocked by Maplin are available from DIY stores etc. A length of standard plastic water pipe was used to create the boom section and a conveniently shaped utility hook forms the handle. The overall length of the boom may be adjusted by drilling a number of mounting holes along the length of the plastic pipe. An alternative is to slide a length of smaller diameter pipe into the main boom as illustrated in Figure 11.

In keeping with the best traditions of children's television, the search coil housing is nothing more than a pair of plastic dinner plates bolted or glued together. The presence of metal objects in proximity to the search coil (such as fixing bolts) will obviously modify the frequency of the search coil oscillator but this is not generally a problem as long as the final circuit alignment is carried out after mechanical construction is complete. It is important that the search coil is held firmly in position inside the search head. Any variation in position relative to metal fixings will affect the oscillator frequency and can produce an annoying form of mechanical instability. The coil should be as close to the base of the search head as possible so as to provide the maximum effective detection range. If necessary the search head can be waterproofed using silicone rubber sealant. The search head is mounted to the boom using two angle brackets as shown in Figure 12.

Fixing hardware such as bolts, nuts and washers have not been specified as the requirements will vary with individual housings and fixing arrangements. Suitable fixings can be found in the Fixings and Hardware section of the current Maplin catalogue or in most good DIY stores.

As mentioned the search coil is connected to the circuit board using coaxial cable. This may be fed through the centre of the boom for convenience. The circuit board is housed in a plastic box stock code BZ74R. Make sure you leave enough space for the loudspeaker or transducer. The box is mounted onto the boom using suitable brackets. The final position should be chosen to allow a clear view of the meter and easy access to controls. It is useful to label the controls as illustrated in Figure 13.

Depending on the intended application for the metal detector, it may be wise to waterproof at least the lower part of the unit. Silicone rubber is often the best type of sealant for this application but, in any case, it is always wise to check that the sealant is suitable for the material it is being used on. It may be possible to encapsulate the search coil in epoxy resin without significantly degrading the performance but remember that once this has been done it is not normally possible to make any further modification to the coil dimensions etc. It is therefore

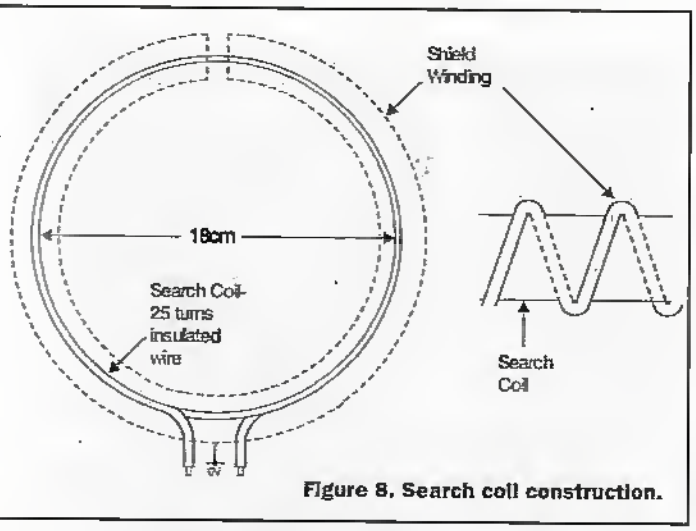


Figure 8. Search coil construction.

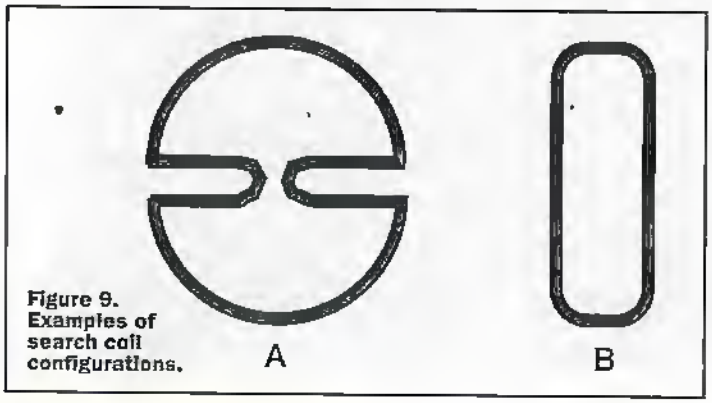


Figure 9. Examples of search coil configurations.

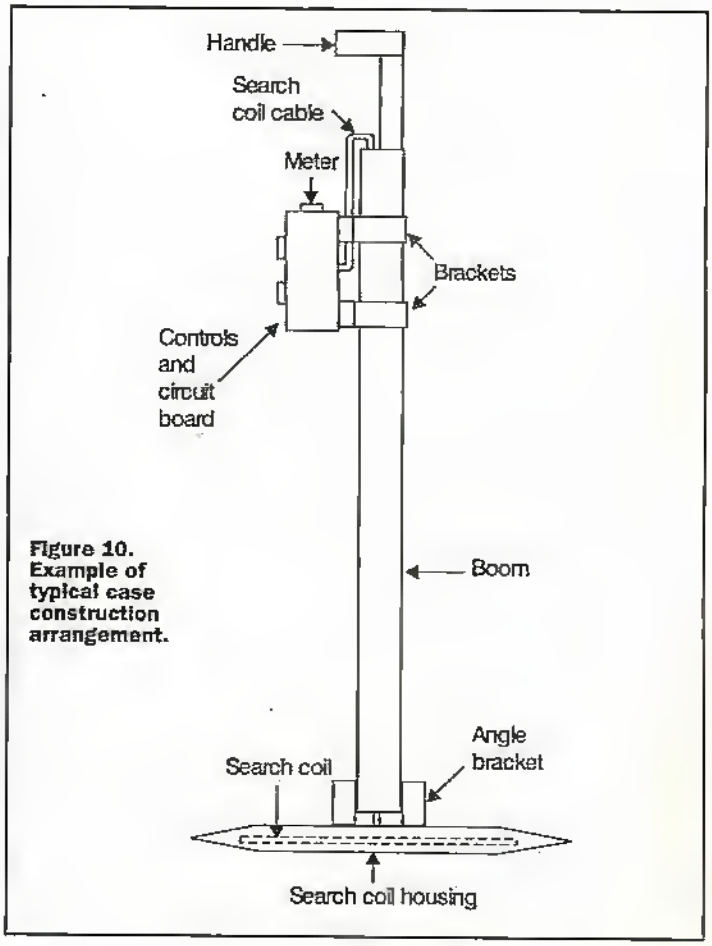


Figure 10. Example of typical case construction arrangement.

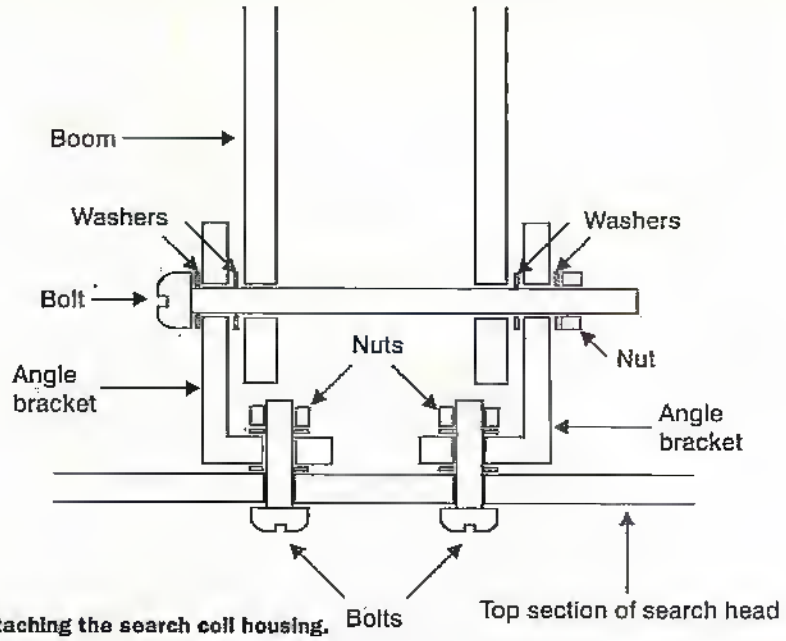


Figure 12. Attaching the search coil housing.

advisable to ensure that the detector is aligned and working correctly before carrying out any final waterproofing.

Testing and Alignment

Testing and alignment of the unit is possible without any specialised test equipment; however, an oscilloscope or frequency counter make the job considerably easier. It is also advisable to connect a multimeter set to measure current in series with the power supply to the metal detector in order to check the input current is not excessive at switch on. Before connecting the battery, please ensure that VR3 is set to the +V end of its travel; this helps to avoid the meter hitting the endstop which may result in possible damage.

Apply power to the detector circuit. The power supply connects between P1 (+V) and P2 (0V). The circuit is designed to operate from a 9V PP3 battery. Please ensure that you connect the battery observing the correct polarity as the circuit may otherwise be damaged. Set the power switch to the 'ON' position. Set VC1 to the centre of its travel, VR1 to mid position and VR2 to maximum. At this point, it may be useful to check the voltage at the output of RG1 (5V).

For the circuit to operate correctly it is necessary to align T1 so that the beat frequency oscillator (TR2) operates at approximately the same frequency as the search coil oscillator (TR1). The exact operating frequency is not too critical from an operational point of view as long as the frequency of the two oscillators approximately coincide. The frequency is typically in the 400kHz - 500kHz range. If a frequency counter with a high impedance input is available, this can be used to check the oscillator frequencies making the whole process somewhat easier. If not, the simplest way is probably to slowly adjust the core of T1 until an audio frequency note is heard from the output transducer. Once you have an A.F. output, adjust VR1 for optimum performance. This adjustment is relatively important as if the oscillator level is too high, distortion will often result. Once optimised, carefully trim the setting of T1 to reduce the pitch of the A.F. output until a 'zero beat' is produced (oscillators at the same frequency). It should now be possible to change the pitch using tuning capacitor VC1. The zero beat should occur around mid position but this will tend to vary with external factors such as temperature.

As with most analogue circuits of this type where some parameters may vary considerably, it may occasionally be necessary to make small changes to circuit values to allow correct alignment. In particular, depending on the search coil arrangement, it may be necessary to disconnect one gang of the tuning capacitor VC1 to allow the oscillators to be aligned to the same frequency (if the search coil oscillator frequency is too low). Conversely, if the frequency is too high connecting an additional small capacitance (a few pF) in parallel with VC1 will result in the oscillator running at a lower frequency.

If everything appears to working correctly the meter circuit may then be aligned. Set tuning control VC1 to provide an output frequency of around 1kHz and adjust VR3 until the meter reads full scale deflection. When the tuning control is returned to zero beat position, the meter should then read zero. Take care to avoid the meter indicator hitting the end stop. If the meter deflects in the wrong direction at any stage switch off and re-check the circuit connections.

Hold a metal object close to the search coil. The meter

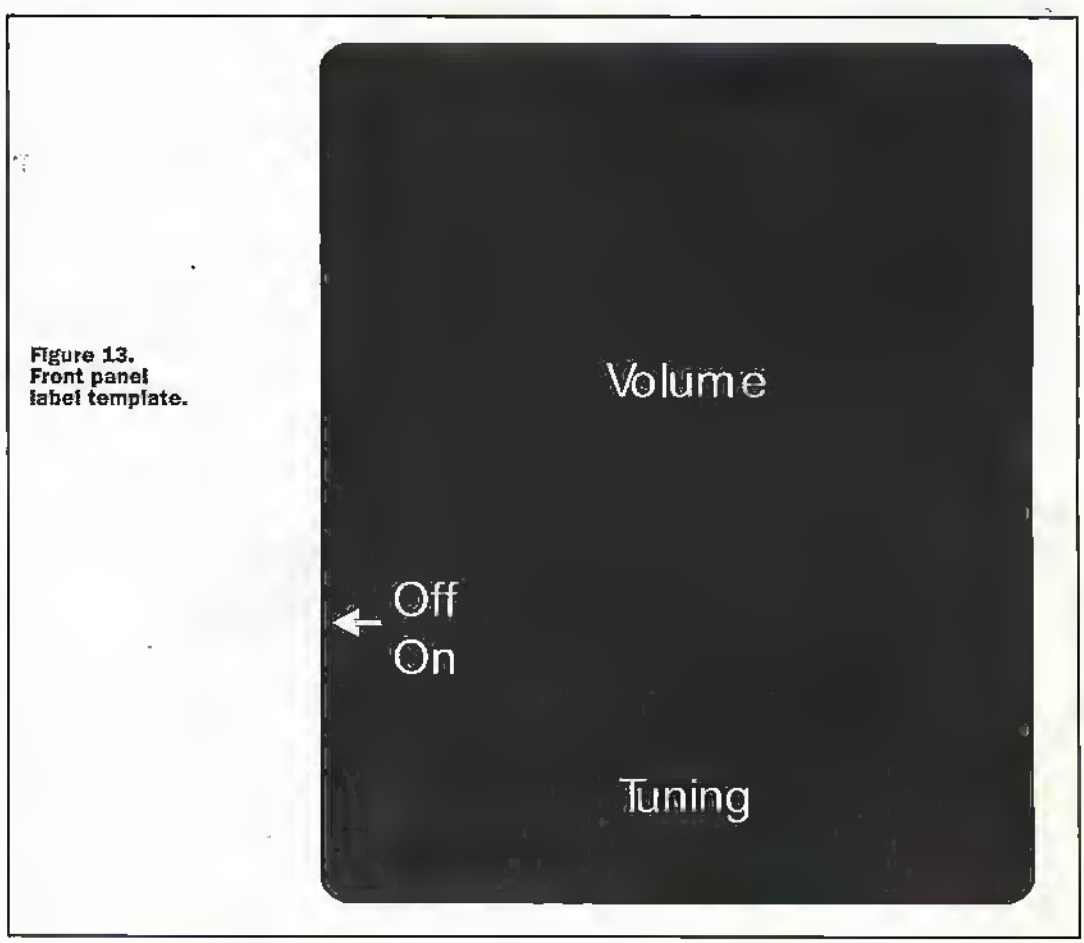


Figure 13. Front panel label template.

should deflect and the audio frequency should change. Try different settings of VC1 to obtain the most sensitive setting.

Using the detector

Once alignment is complete, the detector is ready for use. The unit should be capable of detecting metal objects up to a few cm away from the search coil (depending on size). The detector may either be set to zero beat such that it is silent until a metal object is detected or can be set so that it produces a continuous tone which varies if metal is present. The latter method is useful for detecting small objects which may only produce small changes in pitch. Non-metal objects may also produce a response under some circumstances but this should generally be less pronounced than when metal is detected.

Experimentation

The circuit shown is not fully optimised and more experienced readers may wish to experiment with different component values and configurations and with different search coils. As mentioned, it is relatively simple to change the operating frequency to suit individual requirements by changing the number of turns on the search coil and by connecting additional capacitance in parallel with T1. It may also be possible to improve stability by using higher tolerance components in the oscillator stages.

An audio power amplifier is not included as it was considered that the additional current consumption would reduce battery life. However, there is no reason why a small audio amplifier cannot be added if extra volume is required. A glance through the Semiconductors section of the Maplin catalogue will show that there are a wide variety of off-the-shelf power amplifier ICs that are suitable for this purpose. Examples are the well tried and trusted TBA820M and the TDA7052.

Legal Requirements

There are various legislative requirements regarding metal detectors and 'treasure hunting' in general. It is outside the scope of this article to cover these issues and readers are advised to make themselves aware of any specific requirements before using the detector. In any case, users should always seek the permission of the land owner before using a metal detector at any location.

Finally...

The metal detector described in this article is relatively simple but illustrates how a basic unit may be produced at relatively low cost. Even simple units of this type can provide surprisingly good results when carefully set up and used. Who knows what treasures you may find?

PROJECT PARTS LIST

RESISTORS			
R1, 4	82R	2	M82R
R2, 5, 8, 9, 23, 24	1k	6	M1K
R3, 16, 17	100k	3	M100K
R6, 10, 14, 21	10k	4	M10K
R7, 15	1M	2	M1M
R11, 22	27k	2	M27K
R12, 13, 19, 20	4k7	4	M4K7
R18	47R	1	M47R
VR1, 3	Hor Encl Preset 10K	2	UH03D
VR2	Pot Log 4k7	1	FW21X
CAPACITORS			
C1, 2, 18	GenElect 100µF 16V	3	AT40T
C3, 4	1% Polysty 1nF	2	BX56L
C5 – 11, 13, 22	MiniDisc 0.1µF 16V	9	YR75S
C12, 14-17, 20, 21	GenElect 10µF 63V	7	AT77J
C19	Ceramic 10nF	1	WX77J
VC1	Min AM Tuner Cap	1	FT78K
SEMICONDUCTORS			
TR1, 2	MPF102	2	QH59P
TR3	BC548	1	QB73Q
RG1	LM78L05ACZ	1	QL26D
D1-3	1N4148	1	QL80B
IC1	LM324N	1	UF26D
MISCELLANEOUS			
	DIL Socket 14-pin	1	BL18U
T1	YMCS17104	1	YG32K
P1-6	Pin 2145	6 pins	FL24B
	SPST Ultra Min Tggle	1	FH97F
	Sig Strength Meter	1	LB80B
	Knob K7B	2	YX02C
	7/0.2 Wire 10M Blk	1	BL00A

Velleman Kits

METRONOME & WATER ALARM

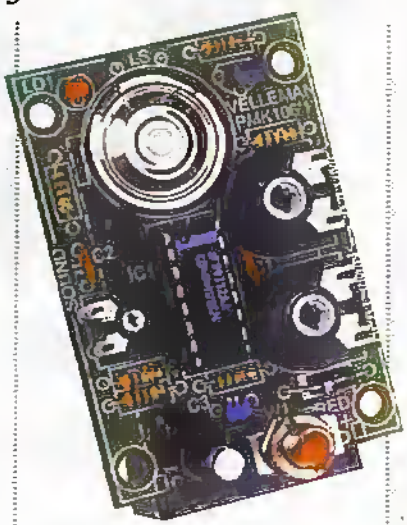
John Mosely constructs two more mini kits.

The opening pages of the Projects & Education section of the latest Maplin Catalogue list 11 kits in the Minikit range from Velleman, a range that includes a water alarm several 'visual' kits (LEDs, sound-to-light) and various sound kits such as the metronome and signal generator discussed last month. All the kits cost less than a fiver - £4.99 including VAT - and all but one are powered by a 9V PP3 battery (not supplied).

This month we pick two diverse kits from the Velleman Minikit range -a water alarm and a metronome. Both of these kits have very practical applications. The water alarm is very simple and is ideal for the young beginner and student of electronics, as within a very short period of time, a working project can be constructed. Velleman even provide the colour codings for the resistors and the markings, where appropriate for capacitors, so that placing the right value component in the correct place on the board is simple. It is this attention to detail that makes these kits suitable for the young and student of electronics.

Water Alarm

As circuits go this could not be much simpler, but it does have very practical uses. Under normal circumstances the circuit is effectively 'off,' and is only switched on when the two probes have a resistive path between them i.e. water. The BC517 Darlington transistor is then switched on and a current passes through the buzzer - which produces a very loud irritating noise that requires your attention!



The circuit can be literally constructed in under 10 minutes. But before starting construction it is worth deciding whether you wish the sensor probes to be remote from the board and sounder. This can be up to two metres and so does provide some flexibility in any application, and Velleman thoughtfully provided a convenient 'break' point on the board so that the sensor pads can be placed remotely. Carefully use a small hack saw to separate the boards. Insert the two resistors first followed by the transistor, the sounder and the battery holder.

Once constructed, the kit can be tested by moistening a finger and placing across the two sensor pads. If all is well the buzzer should emit a loud noise. I did check that steam will, after a couple of seconds, trigger the alarm.

The circuit will effectively only consume current when activated, so battery life should be considerable.

WATER ALARM PARTS LIST

RESISTORS

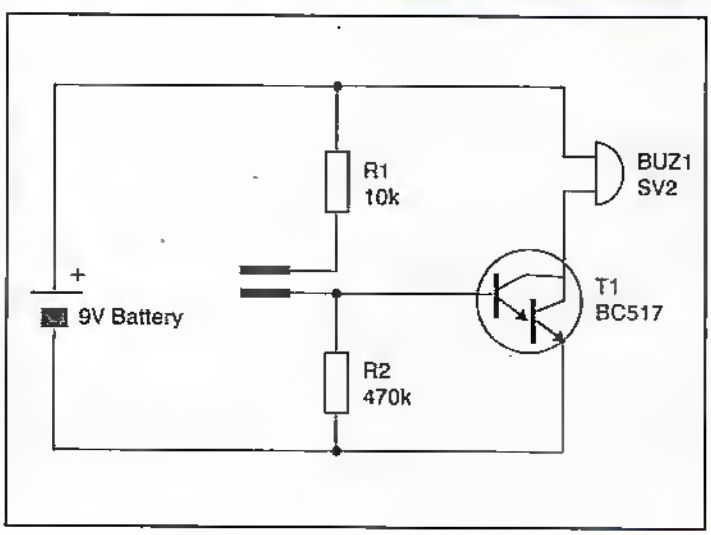
R1	10k Min Res
R2	470k Min Res

TRANSISTORS

T1	BC517

MISCELLANEOUS

9V PP3 Battery
PP3 Battery Holder
Sounder



Metronome

A metronome is a device designed to mark exact time by a regularly repeated tick. Originally they were clockwork devices, invented by Johann Maelzel in 1814 and used a sliding weight to regulate the speed of a pendulum to assist in setting tempo. They are now, in general, silent digital display type devices. The Velleman kit offers an audible and visual output, although only simplistic, via a sub-miniature loudspeaker and a 3mm red LED.

Construction

Construction is very straight forward, and should start with the small components first, they are: resistors, diodes, capacitors, transistor, electrolytic, LED, variable resistors, DIL IC sockets switch etc. It is important to observe correct polarity of the transistor, diode, electrolytic and LED. The board legend clearly indicates correct polarity. I would normally leave insertion of the IC to last, but a word of caution. The tiny speaker supplied resides in a circular cut-out in the PCB, and is held in place by two solder pieces of single core wire. This operation requires a great deal of care, as it is very easy to damage the speaker, either mechanically and electrically, or both! Avoid touching the silver 'cone' and do not apply excessive heat to the lugs on the back of the speaker. Solder the leads to the speaker first and then trim to the desired length. I left a sufficient length of lead to allow me to bend the ends to right angles to insert in the two holes. This made soldering the speaker to the board a lot easier. Do not be tempted to use sticky tape to hold the speaker in place while soldering as this could very easily damage the 'cone' when attempting to

METRONOME PARTS LIST

RESISTORS

R1, 2	1M Min Res
R3, 4	100k Min Res
R5	1k Min Res
R6	220 Min Res
RV1, 2	1M Trimpot
RV3	100 Trimpot

CAPACITORS

C1	100pF Ceramic
C2	2n2F Ceramic
C3	1µF
C4	100µF 16V PC Elect

SEMICONDUCTORS

D1	1N4007
LD1	3mm Red LED
T1	BC517
IC1	CD4093

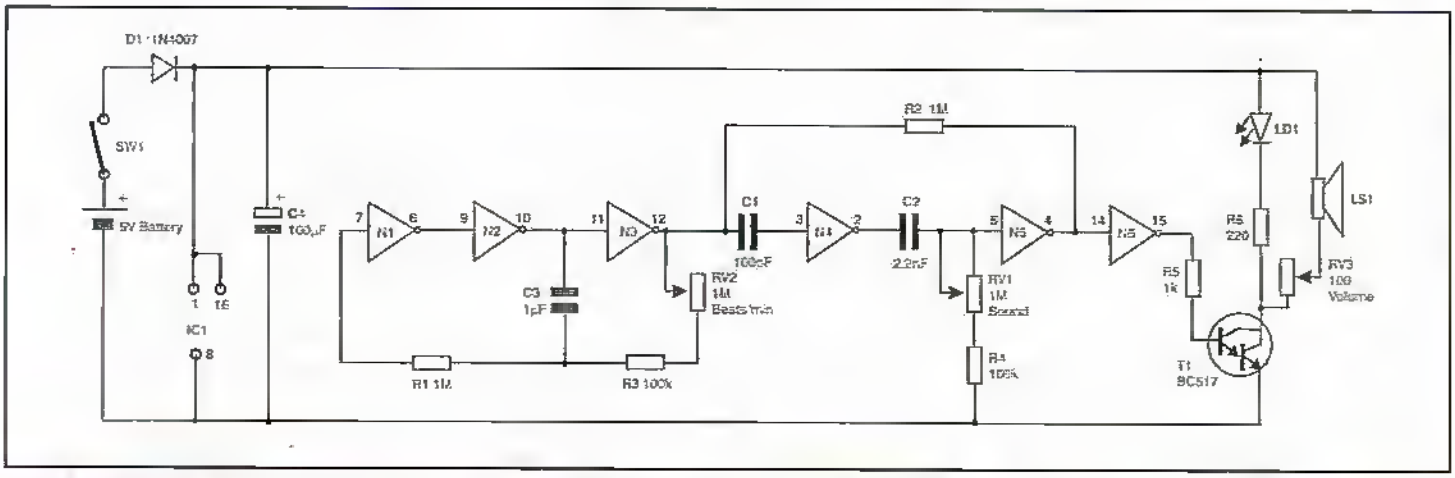
MISCELLANEOUS

16-pin IC holder
1-pole 2-way Min Switch
Sub-min Loudspeaker
9V PP3 Battery
PP3 Holder

remove the tape.

As with the majority of these Minikits, the battery holder is screwed to the PCB, and power connection is via two flying leads. As always, please check your handiwork for shorts, dry joints etc., a few minutes carefully checking the board can save a lot of time and heartache. When you are happy with the assembled kit insert the battery and switch on. Depending on where the variable resistors are set, the LED should flash and you may hear a ticking noise from the speaker. Adjust the three variable resistors for speed, sound and output level and check that they all work.

With the battery insert in place, the board will sit on a flat surface, so does not require a box.



THE WORLD OF 3D

PART 3

In the last part, Mike Bedford explains the techniques behind autostereoscopic electronic displays.

For a couple of months now we've been encouraging you either go cross-eyed or to don a pair of cardboard glasses with red and blue lenses before looking at these pages. But this wasn't some sort of Jeremy Beadle prank, this was the necessary procedure to cause three dimensional images to jump out of the page at you. And so far in our investigation of 3D we've investigated the depth cues which our eyes use to perceive depth and we've looked at the various ways our eyes can be fooled into seeing depth when we're actually looking at a perfectly flat page, TV screen or computer monitor. And most of these methods either require you to engage in visual gymnastics – in the case of left-right pairs and Magic Eye images – or to wear special glasses or other head gear – in the case of red-blue anaglyphs, computer screens with LCD shutters, and virtual reality headsets. However, we did look at one autostereoscopic technique - that is a form of three dimensional imaging which doesn't require you to learn any unnatural viewing techniques or to wear strange head gear. The technique in question is holography but in its normal form this is a purely photographic technique, not a technology which lends itself to electronic displays or computer hardcopy. In this month's article, the concluding part of our series on the third dimension, we're going to look at autostereoscopic electronic displays and computer output devices. And unlike the types of electronic display gear we saw last month, which were really just bringing the Victorian stereogram up to date, our investigations this month will take us to the technological leading edge.

The Cambridge Autostereo Display

The first method we're going to investigate is the subject of research by the University of Cambridge in association with Autostereo Systems Ltd. In some ways the technology isn't too far removed from the LCD shutter displays we saw last month but it provides motion parallax in addition to binocular disparity. It is also an improvement over the conventional LCD shutter method in that it's an autostereoscopic technique, that is, you don't have to wear any special glasses and you don't even have to go cross eyed to see the image in all its glory.

As with the common LCD shutter displays, slighly different images are generated and displayed on the screen in sequence. However, unlike the method we saw last month in which just a couple of images was generated - one for the left eye and one for the right eye - now a whole sequence of images representing up to 16 different horizontal viewpoints is displayed in sequence, see Figure 1. Clearly this means that the monitor must have an extremely fast refresh rate. If the overall image is to have a 50Hz refresh (and this is generally considered to be the absolute minimum as a lower refresh rate will result in very noticeable flicker), each of those 16 images must be displayed at a refresh rate of

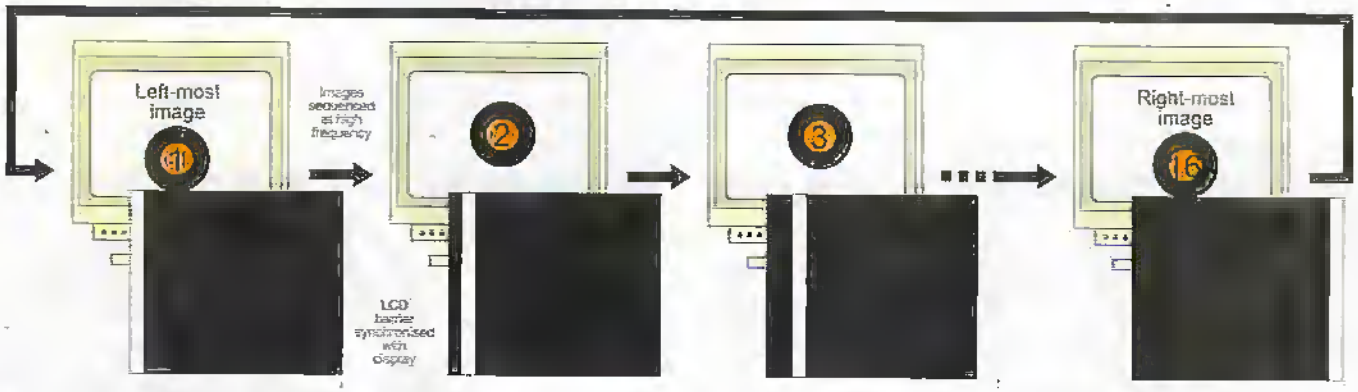


Figure 1. The Cambridge autostereo display provides stereoscopy and horizontal motion parallax by displaying 16 images - each corresponding to a different horizontal viewpoint - in sequence. A 16-slit LCD barrier is synchronised with the on-screen images.

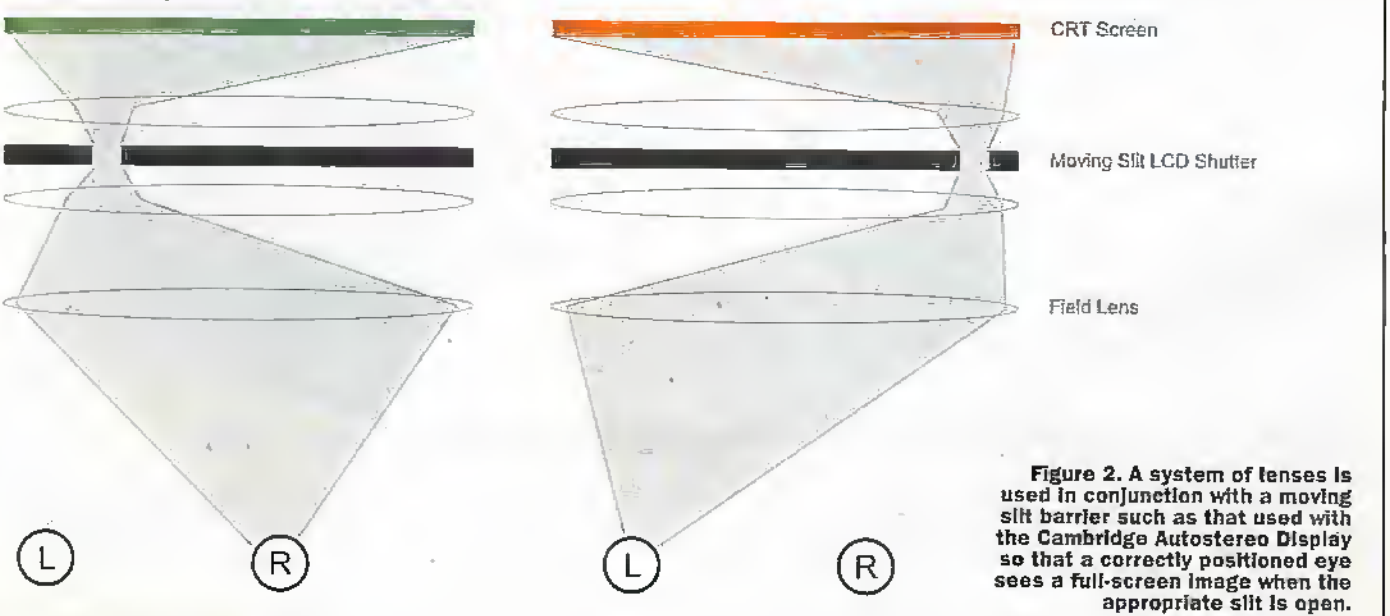


Figure 2. A system of lenses is used in conjunction with a moving slit barrier such as that used with the Cambridge Autostereo Display so that a correctly positioned eye sees a full-screen image when the appropriate slit is open.

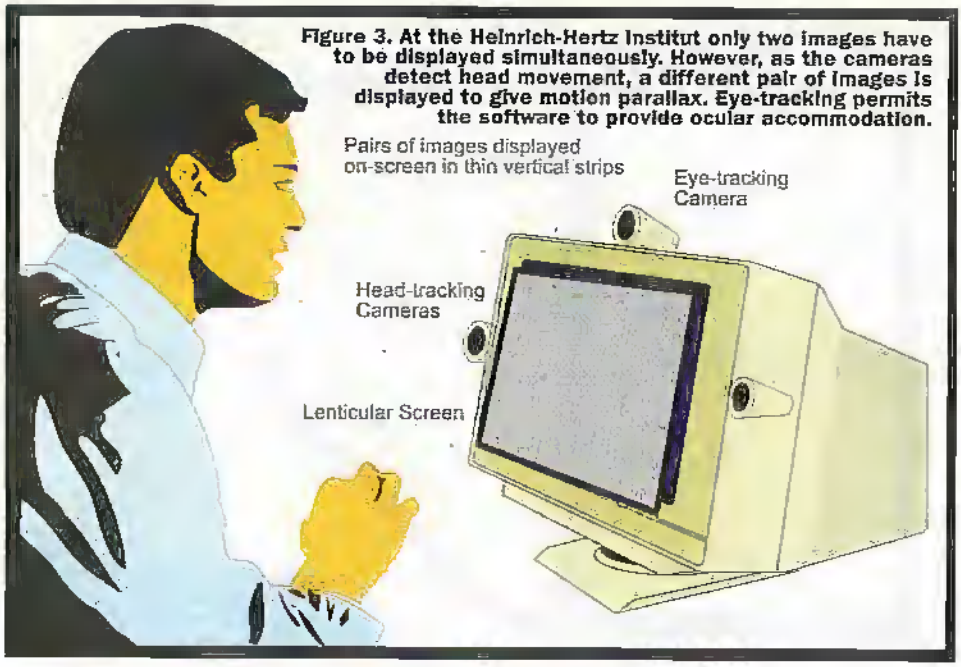


Figure 3. At the Heinrich-Hertz Institut only two images have to be displayed simultaneously. However, as the cameras detect head movement, a different pair of images is displayed to give motion parallax. Eye-tracking permits the software to provide ocular accommodation.

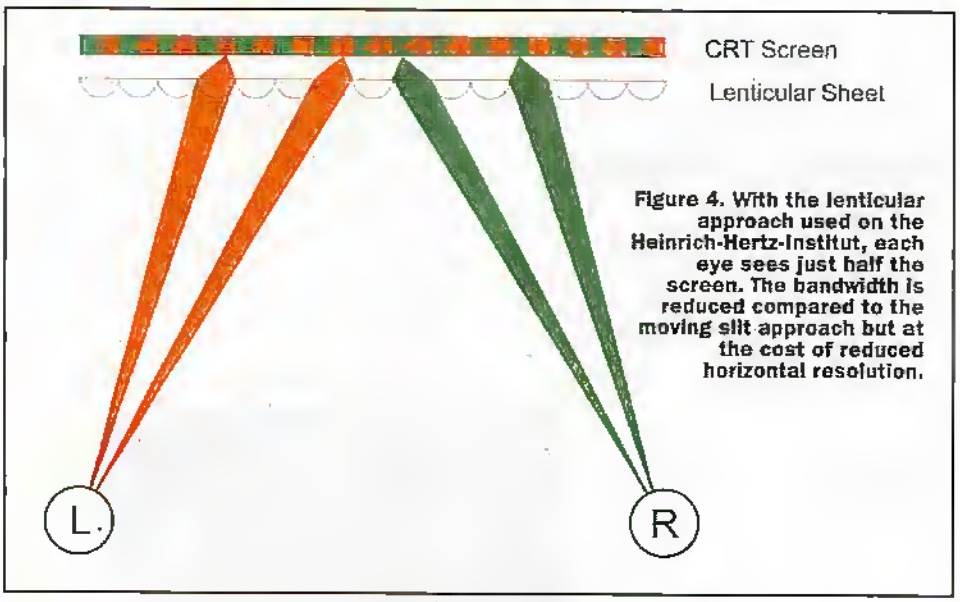


Figure 4. With the lenticular approach used on the Heinrich-Hertz-Institut, each eye sees just half the screen. The bandwidth is reduced compared to the moving slit approach but at the cost of reduced horizontal resolution.

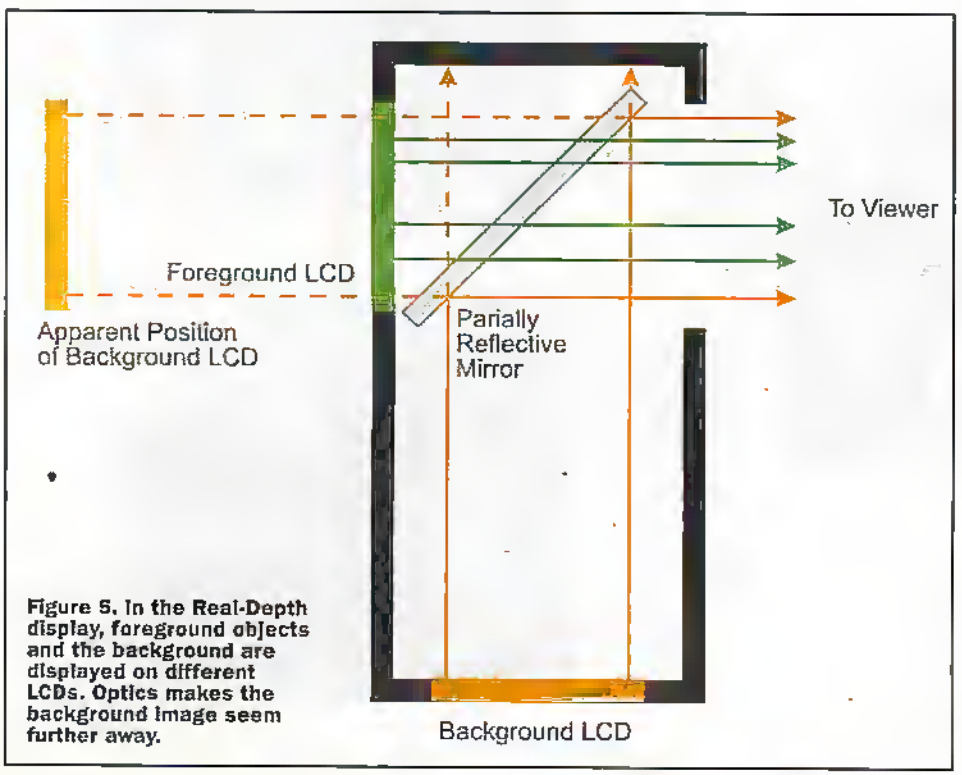


Figure 5. In the Real-Depth display, foreground objects and the background are displayed on different LCDs. Optics makes the background image seem further away.

800Hz or one picture every 1.25ms. In fact, a CRT with this sort of refresh rate is one of the more demanding elements of this display method. Not only is ultra-fast electronics required - almost an order of magnitude faster than run-of-the-mill displays - but the phosphor must be ultra bright and have a very fast decay time.

With the conventional monitor fitted with an LCD shutter, the display of alternating images on the screen is synchronised with a pair of active LCD glasses. When the left-eye image is on the screen the left lens is transparent and the right lens is opaque and vice versa. With this autostereoscopic display, the cycling of the 16 images is also synchronised to an LCD barrier but unlike the conventional method, this barrier is placed in front of the screen rather than on the observer's head. The LCD barrier is divided into 16 vertical strips each of which is an independently addressable LCD shutter. So, as the left most image is displayed only the left most strip is transparent and so only an eye in front of this part of the screen will see the image corresponding to that particular viewpoint. Similarly, as the second from the left image is displayed the second from the left strip of the shutter is made transparent and so on until all 16 images have been displayed. Normally if a 'moving slit' barrier (see Figure 2) was placed immediately in front of the screen the viewer would only see thin strips of the overall image. By using a suitable system of cylindrical lenses, however, the complete screen can be seen through the slit. The result, therefore, is similar to that produced by a conventional LCD shutter if you keep your head still. However, you'll also see different views as you move your head from left to right so motion parallax is also provided.

Clearly this sort of display is eminently suitable for displaying computer generated images, indeed the developers envisage visualising molecular models in organic chemistry, visualising complicated mathematical functions and computer aided design as likely applications. What they do admit, however, is that the onset of 3D TV in our homes is still some way off. And this particularly technology is probably one of the least suitable for this purpose as it would require TV cameras with 16 widely separated lenses and transmission would require a bandwidth significantly greater than that required for today's monocular TV.

Head and Eye Tracking

In a sense, the Cambridge Autostereo Display is similar to the lenticular stereogram or lenticular panoramogram approach which we looked at in the first part of this series and which has been adapted to use with electronic displays. The major difference, however, is that the Cambridge display is time multiplexed whereas the lenticular display is multiplexed spatially. The disadvantage with a lenticular display is that the horizontal resolution is compromised as a result of this spatial multiplexing. The Cambridge display, on the other hand, permits an image to be displayed at full screen resolution but requires a much higher bandwidth than that needed for the lenticular display. Without a doubt, it will always be necessary to increase the analogue bandwidth by a factor of two (but

the increase will be less than this when the signal is digitally compressed) in order to provide a stereo image at full screen resolution but increasing it by a factor of 16 may seem a bit of an over-kill. The reason for the 16-fold increase is to provide motion parallax but, nevertheless, one person will only ever see two of the 16 images at any one time. Work at MIT's Media Lab and the Heinrich-Hertz-Institut involves using display-mounted cameras to track the viewer's head and then transmit just the two images corresponding to the calculated eye positions. This way, motion parallax is maintained at full screen resolution but the bandwidth is significantly reduced. In fact, this display system uses a lenticular screen so the bandwidth is the same as that of an monocular display but the horizontal resolution is reduced by a factor of two. Despite this limited horizontal resolution, however, the Heinrich-Hertz-Institut approach does have one additional feature which isn't often encountered in 3D displays. To supplement the pair of head-tracking cameras, an eye-tracking camera is also used. Part of the reason for tracking eye movement is in connection with research into a novel new form of computer input. Instead of moving a pointer over the screen with a mouse and clicking on the appropriate button or menu option, the user simply looks at an object on the screen for a given length of time. But eye tracking also allows one of the more tricky visual depth cues – ocular accommodation – to be produced. Ocular accommodation is the ability of the eye to focus selectively on objects at different distances. By determining exactly which on-screen objects the viewer is observing, objects at the same distance as that object are rendered in focus by the software while closer and more distant objects are de-focussed to varying degrees.

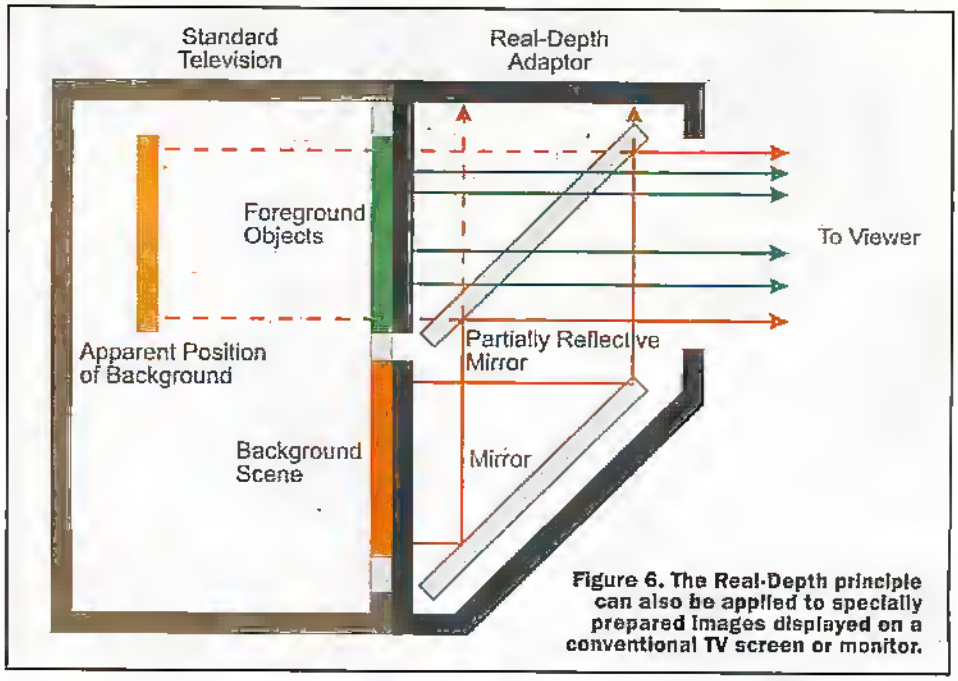


Figure 6. The Real-Depth principle can also be applied to specially prepared images displayed on a conventional TV screen or monitor.

Real-Depth™ Imaging

The next type of autostereoscopic display we're going to take a look at has been developed by Floating Images Inc. of Westbury, NY. It is, perhaps, the closest thing we'll find to a practical volumetric display, a concept we looked at last month and discounted as impractical for most applications. A volumetric display is one which actually has depth as opposed to virtually all other 3D displays which are, in reality, perfectly flat and just fool the eye into seeing depth. In a volumetric display, individual three dimensional pixels, otherwise known as voxels, are illuminated within the display's volume. The Real-Depth display, on the other hand, has two planes, a foreground plane and a background plane, and the foreground plane is arranged to be physically closer to the viewer than the

Figure 7. Real-Depth is ideally suited to use with computer-generated images but processing conventional imagery such as movies, requires the foreground to be separated from the background.

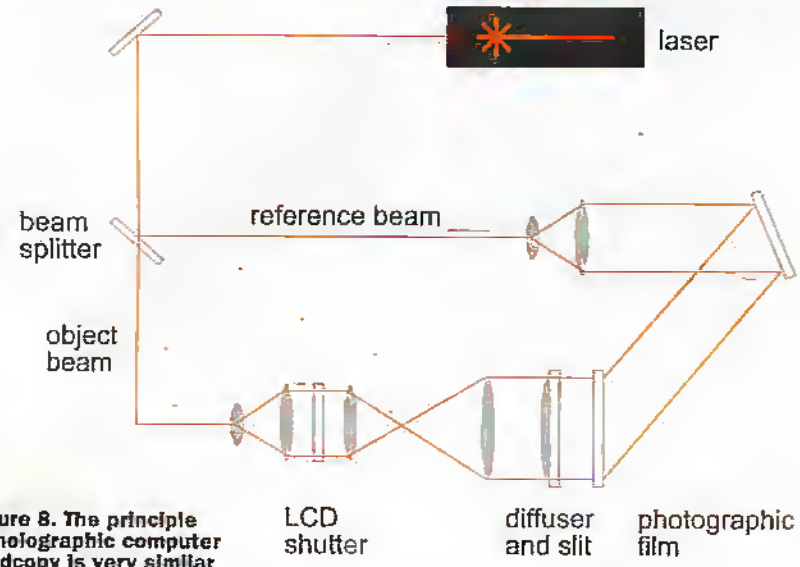


Figure 8. The principle of holographic computer hardcopy is very similar to that of conventional holograpghy.

background plane. The principle is that the use of these two planes will give binocular disparity, ocular accommodation, and motion parallax – vertical as well as horizontal. The other depth cues which are present in all forms of photography and photo-realistic computer imaging – perspective, texture gradient, shading and so forth – will allow the eye to "fill in" objects at intermediate distance, that is objects which are between the two planes. So a viewer will think the scene has continual depth rather than being constrained to two discrete planes. Well that's the theory, let's see how a display of this type can be constructed.

The foreground image and the background image are each displayed on CRTs or LCD screens within the display housing. The foreground screen is arranged so that it's in direct line with the viewer and is viewed through a semi-reflective mirror. The background screen is positioned at right angles to the foreground screen such that its image is directed at the viewer by the semi-silvered mirror. So long as the total distance to the background screen is greater than the distance to the foreground screen, the background image will indeed appear to be further away than the foreground image. Foreground objects are displayed on a black background so that the background will be seen wherever there are no foreground objects. And foreground objects are displayed more brightly than the background so that they appear solid and obscure the background as opposed to seeming to be transparent. The illustrations should clarify all of this. The developers also point out that it's possible to adapt an ordinary TV screen or computer monitor for Real-Depth viewing as shown in the accompanying diagram. The foreground is displayed in the top half of the screen, the background is displayed in the bottom half of the screen and slightly different optics is used to combine the images such that the background image appears further away. And unless you want to view in wide-screen or letterbox format, the optics would also need to stretch the images vertically. The technique could even lend itself to transmission over a normal bandwidth digital TV channel. Since the overall amount of information is not significantly greater than that in an ordinary TV signal – objects will be in one plane or the other but not both – MPEG2 compression should reduce the amount of data to the same sort of ballpark as that required for a conventional TV signal.

Clearly software will require significant modification for use with a Real-Depth display. However, all the information will be available to make a decision on whether an object should be put in the foreground or the background planes. Nevertheless, some

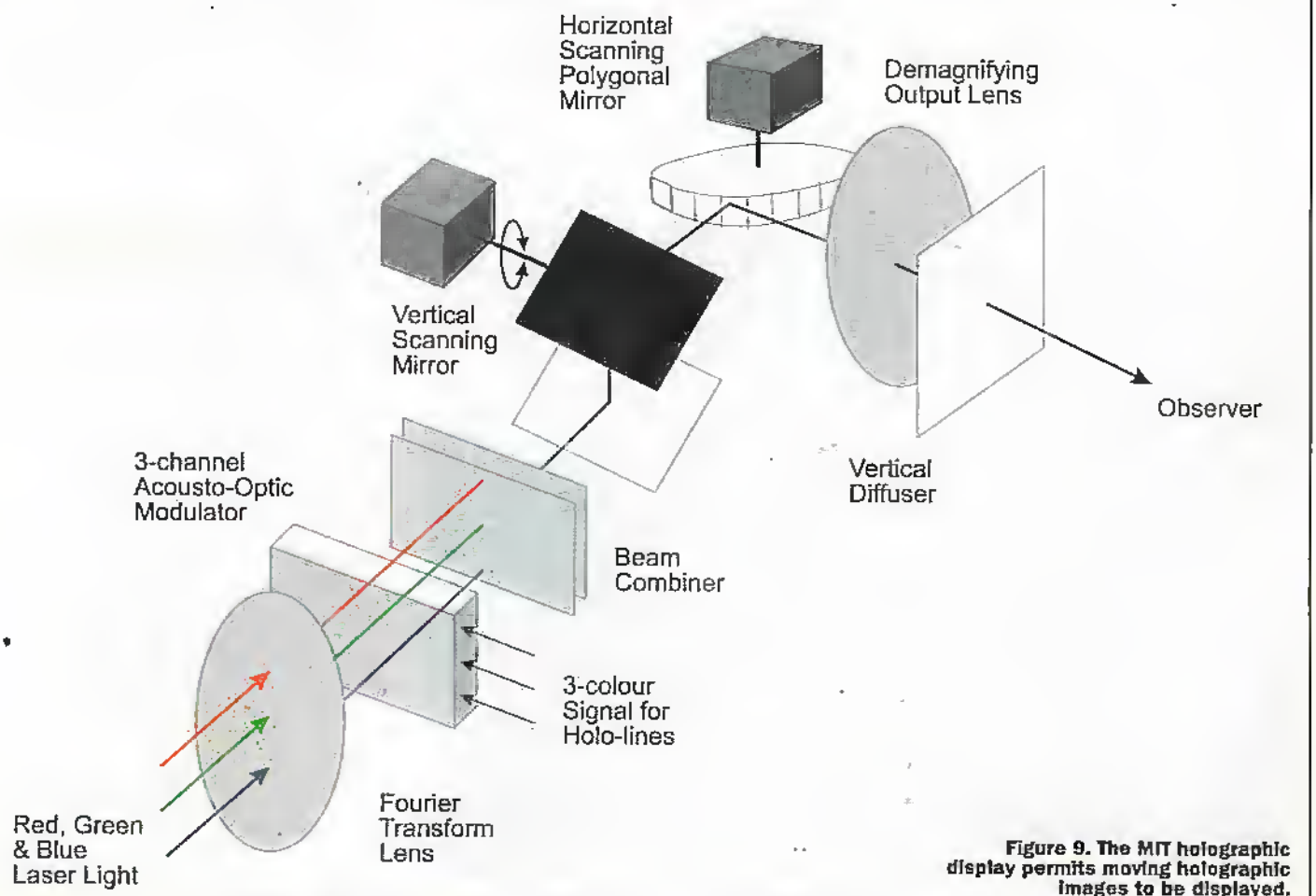


Figure 9. The MIT holographic display permits moving holographic images to be displayed.

skill will be required in handling objects which are in more than one plane – e.g. a long train or corridor going away from the viewer – and objects which are required to make a transition between the foreground and the background planes. What would be significantly more difficult is adapting existing 2D imagery such as movies or TV programmes for Real-Depth display. In this case it would be necessary to make some sort of decision about which objects should be extracted as foreground objects. Not only that but having extracted the foreground object, the holes remaining in the background must somehow be filled in. Performing this task manually or semi-manually would obviously be a very long-winded and tedious task whereas devising an algorithm to do it automatically is certainly not without its difficulties.

Holographic Computer Hardcopy

Last month we took a look at holography, a special form of photograph which reproduces every one of the visual depth cues. We're now going to see how holograms can be produced by computer, either as a hardcopy or as a moving display. A knowledge of the basics of holography is essential to understand this section so if you're not au fait with holography and you missed the earlier article, I suggest you get hold of a copy of last month's Electronics and Beyond and read up on the subject.

The set-up for making a computer generated hardcopy is little different from that required for making a normal hologram of a real object. So a laser beam is split by a semi-silvered mirror into a reference and an object beam, the reference beam is directed onto a photographic plate and the object beam illuminates the object being photographed such that light reflecting off this object also falls on the photographic plate. The only difference, however, is that we don't have a real object, all we have is a computer model of the object. So the object which gets photographed is a liquid crystal shutter/diffuser combination onto which views of the object, calculated from different horizontal viewpoints, are displayed one after the other. As each view is displayed a slit moves in steps across the photographic plate so that the hologram is built up a strip at a time. Following initial work at the Massachusetts Institute of Technology's Media Lab, Sony and Zebra Imaging are working on the principle with the aim of bringing out a commercial product within a year or so. The holographic printers will be self-contained - that is no post processing in a darkroom will be required - and will produce output in between one and three minutes. The printers will be targeted at design, advertising and portraiture. Initial printers will provide monochrome images but the technique can be adapted to full colour.

There's another, quite different, way of generating a hologram by computer. The hardware is a lot simpler but the processing overhead increases significantly. Instead of generating the hologram's interference fringes in the same way as in conventional holography, that is by causing two beams of light to interact on a photographic plate, the interference patterns are actually calculated in software by modelling how the two beams interact. Having performed the calculations, all that is required is to write these interference fringes to a photographic film or plate using a laser beam focussed to a tiny point and scanned over the film. In effect, this is similar in operation to the optical plotters which are used for generating PCB artworks but with a much higher resolution. Alternatively, the pattern could be output onto paper using conventional means and reduced photographically. But despite the apparent simplicity of the hardware, the amount of number crunching required is absolutely phenomenal.

Holograms have feature sizes of the same order of magnitude as the wavelength of light so, as a rule of thumb, a resolution of at least 1000 lines per millimetre is required. So, a tiny hologram just 1mm square contains at least one million points. You might reasonably expect that to generate a hologram numerically it would be necessary to carry out some calculation for each of these points. In fact, the processing overhead is much greater than this. Calculations are required for every point on the three dimensional object being recorded for every one of those point on the hologram. Plus, each of those calculations involves three squares, three sums, a square root, and a cosine. One researcher reported that it took him 20 minutes on a Pentium 150MHz with 32 megabytes of RAM to generate a 1mm square hologram of a single point object. Admittedly a 150MHz Pentium isn't exactly state-of-the-art so let's assume that a newer machine, a 450MHz Pentium II for example, is six times faster. This brings the computing time down to three minutes but it has to be admitted that we're not exactly looking at a large hologram or, for that matter, a complicated object. So let's scale things up to an A4 sized hologram of an object with 50,000 points - still a pretty modest object - and even with the faster PC the computing time goes through the roof - we'd be talking of no less than 296 years. There has to be a better way and there is as we'll see later.

Holographic Displays

Before we go any further it's appropriate to consider why anyone would want to generate a hologram numerically when we've already seen an alternative optical method of making a hologram by computer. And this is a method which lends itself to generating a hologram in as little as a minute. For computer-generated holographic hardcopy there's probably no advantage in using the numerical method in preference to the optical method. However, a holographic real time display is another matter entirely. We'll look at the principle of an electronic holographic display shortly but for now let's just say that it is necessary to generate holograms electronically and look at some of the advances which make this feasible. After all, the method we've seen so far requires almost 300 years to generate a single image whereas for a real time moving display this time would have to be reduced to a fiftieth of a second.

Work on reducing the computational overhead of numerically generated holograms has been carried out as part of MIT's research into holographic displays. Significant gains have been achieved by streamlining the computation method – by the use of pre-computed look-up tables, for instance – but this gets very mathematical and is only part of the story. One other major gain has been achieved by aiming for a display which only exhibits horizontal motion parallax. Clearly this isn't entirely life-like but it is true to say that horizontal motion parallax is far more important than vertical motion parallax. And as soon as this approach is taken the amount of data reduces phenomenally. Holographic resolution is only required in the horizontal direction, an ordinary optical resolution of perhaps 10 lines per millimetre is adequate vertically. In effect, therefore, the final hologram will be a number of horizontal holographic lines - referred to as holo-lines - and already the workload has reduced by a factor of one hundred. MIT's holographic displays are still of a quite modest size (32mm wide) and this further reduces the amount of number crunching but it's still quite an eye opener how far that 297 years has been reduced. On a Sun 4 UNIX workstation, this new approach requires 22 milliseconds per object point so if we return to our 50,000 point object, the total time required is almost 20 minutes. Certainly this represents a vast improvement but there's still some way to go before real time moving holograms could be made this way. So MIT's final trick was to enlist some serious processing muscle in the form of a Connection Machines CM-2 supercomputer. Boasting 16,000 separate processors, this machine reduces the processing time to 0.084ms per object point or 4.2 seconds for the 50,000 point object. OK, we're still short of the goal of 50 frames per second but clearly the point has been reached at which it's possible to numerically generate small holograms of simple objects (~500 points) at a normal video rate or more complicated objects at the lower sort of refresh rate which is typical of Web-based video.

So all that remains to be seen is how the electronic holographic display works and here you're referred to the schematic diagram. The heart of the system is an acousto-optic modulator (AOM) a device which changes its refractive index in response to the application of an acoustic signal. As an acoustic device, the AOM clearly isn't pixel addressable like an LCD panel. Instead the acoustic signal and the corresponding change in refractive index propagates through the AOM at the speed of sound in that material. So by applying a varying signal corresponding to one holo-line, a moving holo-line is set up in the AOM and by shining a laser through the AOM, that holo-line can be projected onto a screen. To compensate for the fact that the holo-line isn't stationary, a horizontal scanning polygonal mirror is used to scan the holo-line onto the screen and thereby fix its position on the screen. Once you've grasped this concept, the rest of the holographic display is fairly easy to understand. Holo-lines are applied to the AOM one at a time and are directed to different vertical positions on the screen using a separate "nodding" vertical scanning mirror to build up a complete picture. And finally, this has been extended to full colour by using red, green and blue lasers and a three-channel AOM in place of the single channel device.

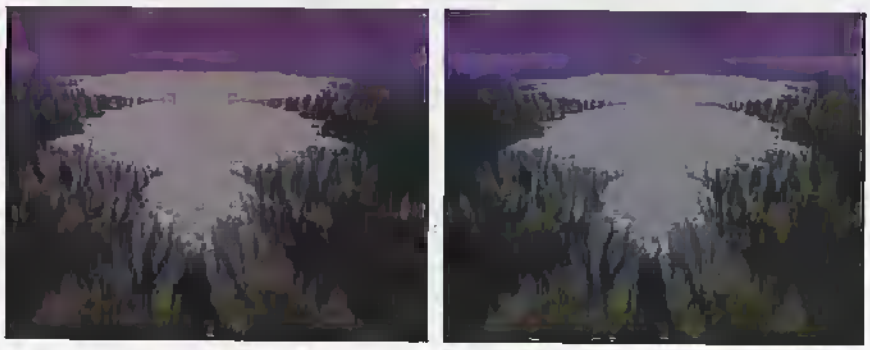


Figure 10. These images show that it is possible to generate 2D images using standard software - here is a left/right pair of images of a Mandelbrot landscape that I generated.

The Future

As we've seen over the last three months, there seems to be no end to the number of ways of generating images – photographically or by computer – which are three dimensional to a lesser or greater extent. We've seen 3D photographic techniques which are almost as old as photography itself, we've seen how these have been brought up to date for use with display screens, and this month we've seen various leading edge autostereoscopic technologies which are relevant to the electronic image. So it would be reasonable to ask when all this technology is going to escape from the research labs and from niche applications such as molecular modelling and computer aided design. In other words, when are we going to get 3D television?

Perhaps I'm sticking my neck out here but my guess is that this is one development which is still well over the horizon. Part of my reasoning is historical and part is technological – first the historical. 3D photography in the form of the anaglyph first made its appearance well over a hundred years ago. OK, it only provides binocular disparity in addition to the usual 2D depth cues but the results are, nevertheless, pretty impressive. Furthermore, it would be reasonably straightforward to produce a low cost stereo camera and digital processing would allow anaglphs to be generated cheaply. Alternatively, if you don't fancy the idea of having to view your photographs through red-blue glasses, lenticular stereograms could be produced. In fact, a low cost 3D camera intended for the mass market was introduced almost 20 years or so ago by a company called Nimslo. Your photographs were turned into lenticular stereograms so you didn't have to wear funny glasses. Sounds ideal but the product flopped – why? I can only suggest that 3D only has appeal to the man in the street as the occasional novelty. This is not something which most people are prepared to pay extra for on a regular basis. My other reason is technological and here I'd have to point to the fact that we've not yet seen a technology which really lends itself to 3D television – computer graphics yes but TV no. OK, it might be possible to provide the addition of binocular disparity at the cost of a two-lensed TV camera and double the transmission bandwidth (less with digital encoding) but to provide additional depth cues the complexity of the camera and the transmission bandwidth would increase significantly. Alternatively, some rather tricky processing task such as the separation of a scene into foreground and background is required. And electro-holography? Well, to achieve a display featuring horizontal motion parallax only at the same sort of size, refresh rate and resolution as today's TV, we'd need an analogue bandwidth of around 50GHz or 5,000 times that of an ordinary analogue TV signal. None of this means, of course, that 3D technology won't be further developed and improved for niche applications but as the next big breakthrough in TV I suggest you don't hold your breath.

DIY 3D

The technology of 3D, for still photography, TV and computer graphics is, without doubt, a niche technology and it looks likely that it will remain so for the immediate future. This doesn't mean, however, that you can't take 3D photographs and prepare them for viewing either as left-right pairs or as anaglyphs on your PC. Alternatively, it's quite feasible to generate three dimensional computer graphics. And although you'll probably need some dedicated software if you get serious about 3D, in the first instance you can make use of standard graphics and CAD packages – it's even possible, with some care to hand draw, stereograms and/or convert them to anaglyphs. To prove the fact, here is a left-right stereo pair and a coloured red-blue anaglyph of a Mandelbrot landscape which I created with the landscaping package VistaPro in conjunction with the photo manipulation software CorelPhoto Paint.

Dedicated enthusiasts around the world have set up stereoscopy societies and there is also a wealth of Web sites on three-dimensional imaging. Some contain 3D galleries of various types of stereogram, some have 3D software for downloading, and others give instruction on 3D photography and computer graphics. If you fancy delving into the world of 3D in a bit more depth, here are some useful Web sites to get you started.

http://dot.digibel.be/~guru/3dsoft.html – links to sites from which you can download various types of 3D software

http://www.biy.com/usa/iblink.htm – links to red-blue anaglyph galleries

http://www.3d-web.com/gallery.htm – gallery containing 3D images as red-blue anaglyphs, left-right pairs and for use with LCD shutter displays

http://www.stereoscopy.com – interesting site with tutorials on stereoscopy, 3D book store, information on 3D clubs and societies, links etc.

Sources

Remember that if you didn't get hold of a pair or red-blue glasses to view the various anaglyphs which have been reproduced throughout this series, these are still available free of charge. To obtain two pairs of glasses, simply send a stamped self-addressed envelope to 3D Images Ltd. at 31 The Chine, Grange Park, London, N21 2EA indicating whether you want red-green glasses, red-blue glasses (the type you'll need for the anaglyphs reproduced with the earlier articles), or one pair of each.

A wide range of 3D products and services are available from 3D Images Ltd Tel: 0181 364 0022 or `http://www.stereoscopy.com/3d-images`. The company specialises in most 3D technologies including anaglyphs, lenticular stereograms, side-by-side stereo pairs, Magic Eye type stereograms and holograms. They can also provide stereo cameras (including digital), stereo projection systems and LCD shutter displays.

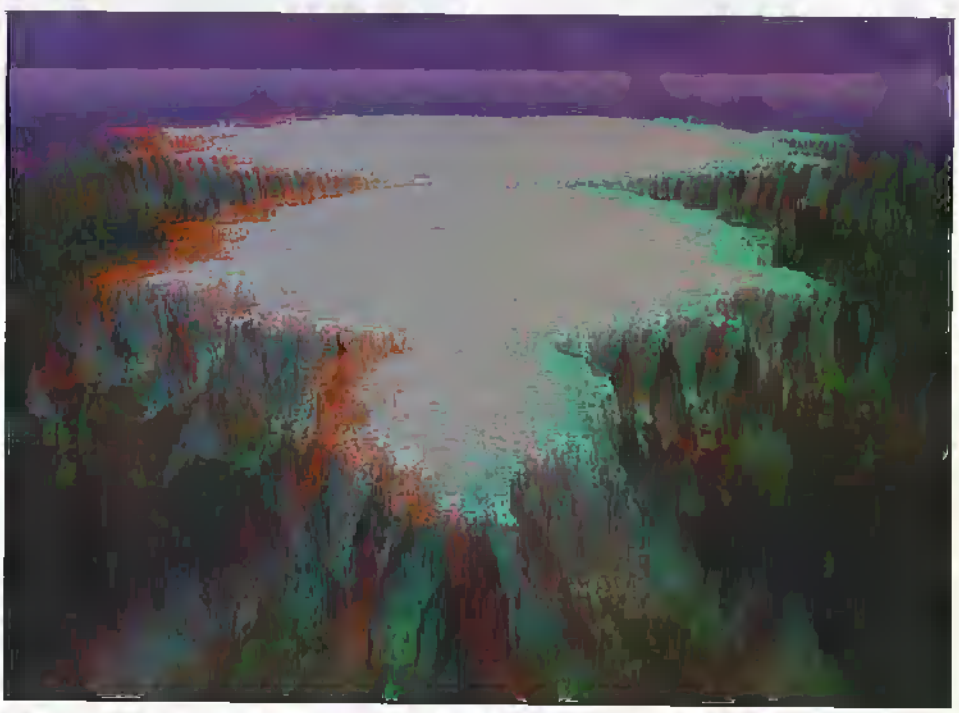


Figure 11. Same scene as Figure 11 but produced as a red/blue anaglyph.

Towards A THEORY OF EVERYTHING

PART 2

Douglas Clarkson delves into the universe, particle physics, and life!

Technology Yields Some Answers

The very advances in technology, in semiconductors, in computers, space technology and superconductors has made it possible to create scientific tools that have allowed science to roll back time almost to the instant of creation itself. To a large extent, in terms of Big Science, the series of

Type	Relative Intensity	Binding Particles
Strong nuclear force	1	gluons
electro-magnetic	10^{-3}	photons
weak nuclear	10^{-6}	W, Z
gravitation	10^{-38}	graviton

Table 1.
Summary of known particle forces.

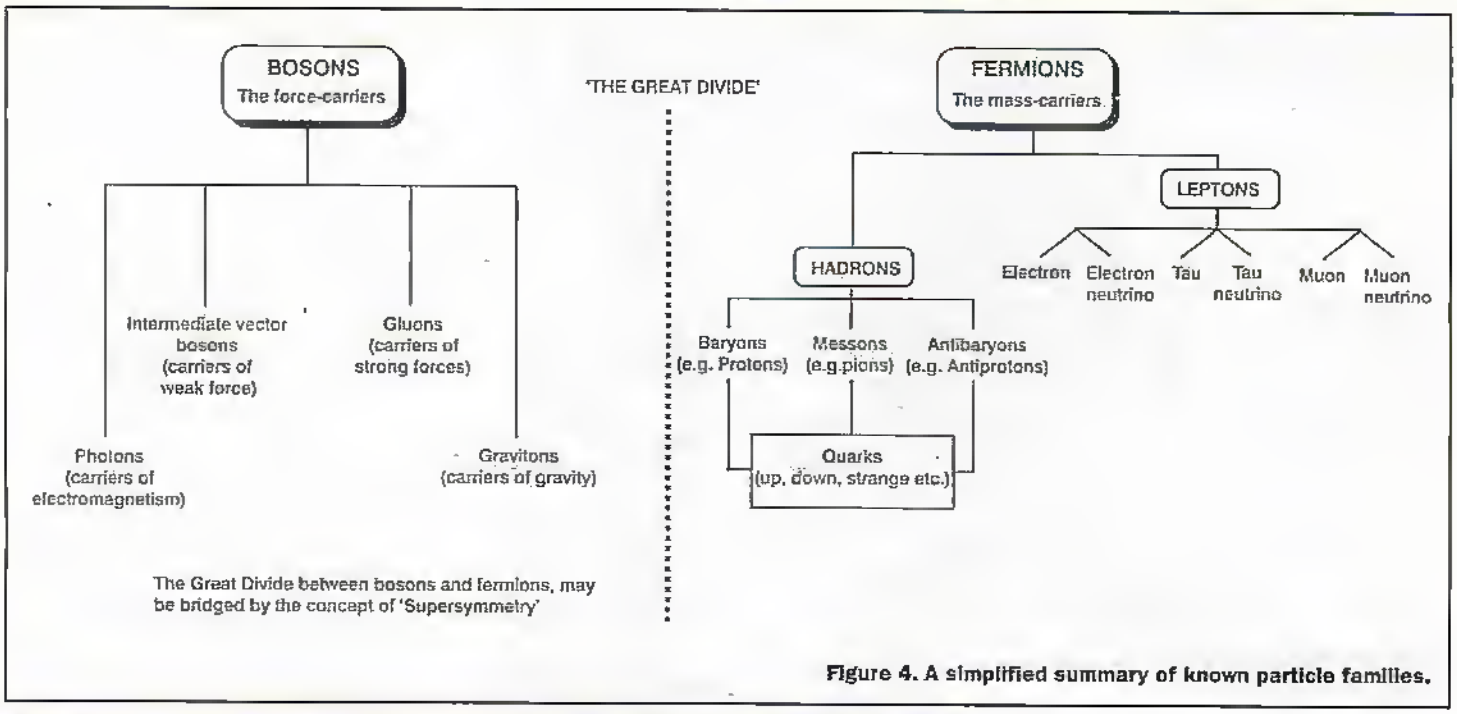


Figure 4. A simplified summary of known particle families.

Particle	Rest Energy (MeV)	Threshold (109 K).	Mean Life (seconds)
Photon	0	0	stable
electron	0.511	5.93	stable
muon	105.66	1226.2	2.197×10^{-6}
pi meson (0)	134.96	1566.2	0.8×10^{-16}
proton	938.26	10888	stable
neutron	939.55	10903	920

Table 2. Summary of properties of main particles.

experiments at CERN in Geneva and those in preparation with the Large Hadron Collider designed to be operational in 2005, have had a crucial impact on consolidating particle theory. The increasing amounts of energy available for colliding particles, usually protons, has allowed particle scientists to simulate articles/energy interactions increasingly close in time to the instant at which the Universe came into being. It is indicated that a very extensive period of experimental research - around 25 years - lies ahead for the Large Hadron Collider at CERN.

The Trail of Clues

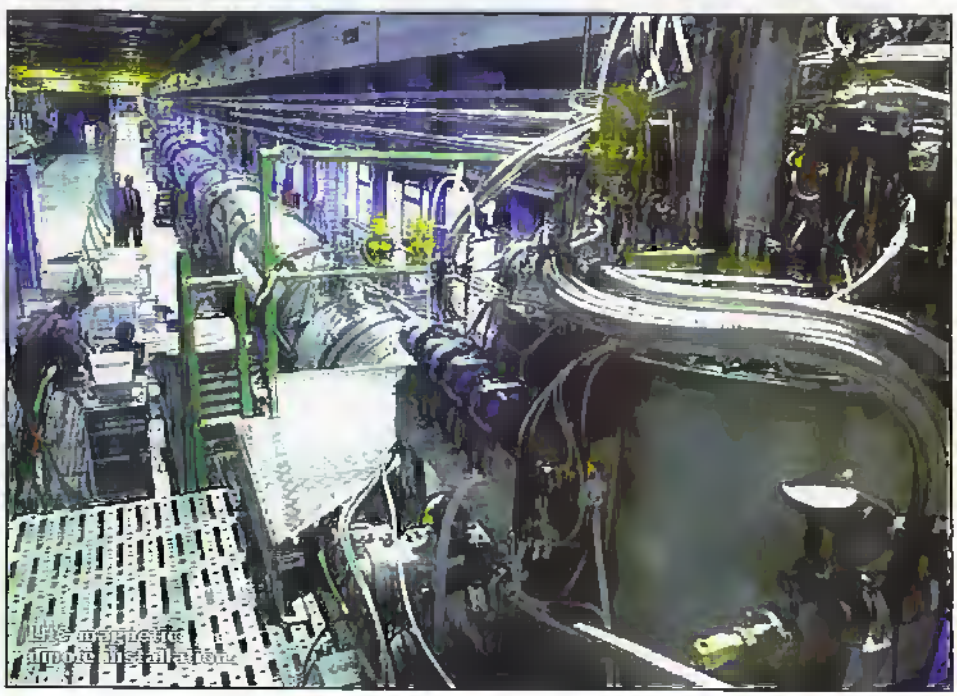
With the 'discovery' of the nucleus by Rutherford in 1909 and neutrons by Chadwick in 1932 the picture of particle physics was looking relatively simple - if not rather basic. There was a real puzzle, however, in explaining the apparent stability of the nucleus. What was keeping the protons in the nucleus from breaking apart due to electrostatic repulsion? There had to be some sort of 'nuclear force' of attraction.

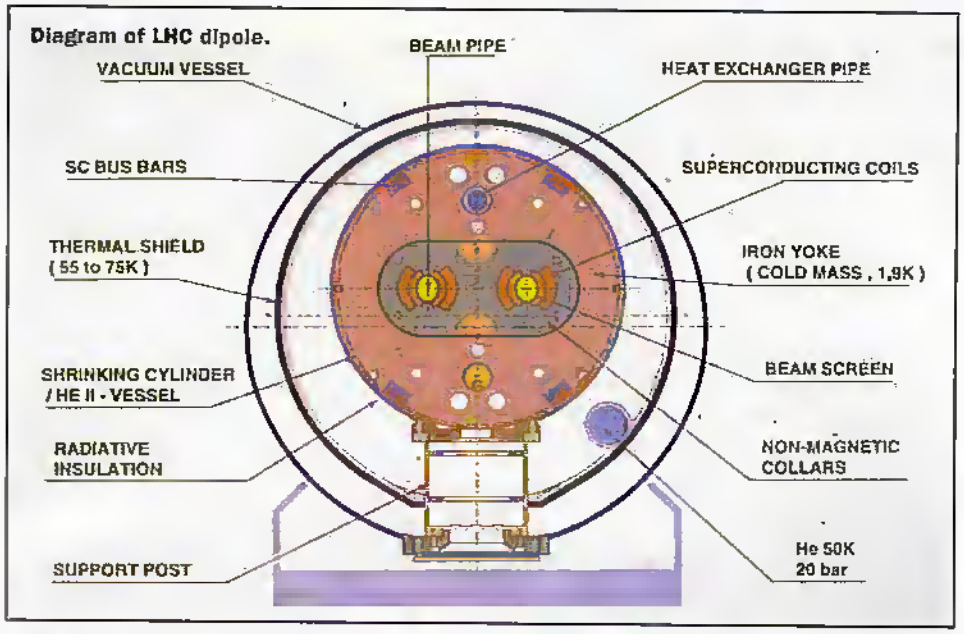
As increasing energies became available in particle research laboratories during the 1950's and 1960's, new particles began to be discovered faster than theories could be devised to account for them. A new property in addition to mass, charge and spin - that of strangeness was identified which led in turn to predictions of 'missing particles'. These in due course were identified from subsequent particle physics experiments.

During this period, however, there was a drive to rationalise the description of all detected particles. The first distinction was to identify particles with whole number amounts of spin - bosons - and particles with fractional amounts of spin - fermions. Fermions were also considered the mass carrying particles - being either baryons such as protons and neutrons or relatively light leptons such as electrons. Also baryons such as neutrons and protons that could feel the effect of the strong nuclear force were called hadrons.

Mathematical models to explain the so called 'eightfold way' of particle symmetry led to advances in theories of particle structure. In particular, Murray Gell-Mann and George Zweig derived a theory that the family of baryons and mesons were in turn made up of smaller building blocks or 'quarks'. Initially three types, up, down and strange were considered adequate to account for the 30 or so hadrons that had been discovered by the 1960's. By 1976, a further two quarks, the charmed quark and the bottom quark were added to the quark family. The family was finally expanded in the late 1980's to include the top quark - which still has eluded discovery.

The strong nuclear force is considered to be created by the mediation of so called gluon particles which prevent quarks from flying apart. According to the theory of quantum chromodynamics or QCD, the 'colour force' has the strange property of becoming stronger the further the quarks are apart from one another - as if they are indeed attached with 'strings' of elastic.





W and Z Particles

The beta decay of a radioactive atom is associated with the transformation of a neutron to a proton, electron and anti-neutrino. Also, if neutrons are isolated from other particles outside of the nucleus, they have a half life of around 920 seconds - to give the same set of particles.

In 1961, Sheldon Glashow in association with Steven Weinberg postulated that the decay of the neutron was mediated by the exchange of W and Z particles, which are related in properties to photons. It was already determined that so called electromagnetic forces were moderated by the exchange of photons and so this led to the unification of electromagnetic/radioactive force as the 'electo-weak' force. From a position of extreme scientific isolation in the early 1960's, the theory became so well founded that the vast resources of CERN were directed to proving the existence of the particles during the early 1980's. In what was a vast process of data reduction, millions of proton/anti-proton collisions of the SPS accelerator became resolved to just 39 events, from which 16 were finally selected to prove the existence of the W particle. Later with higher energy available, the Z0 particle was also discovered.

Thus by the mid 1980's all of the particles had been discovered that were required to build all of the matter in the Universe. In terms of leptons - three types of neutrinos, the electron, muon and taon and with association with six types of quarks. Further determination of, for example, core structure of quarks remains to be verified by experimentation from higher energy accelerators such as the LHC at CERN. A simplified summary of particle families is shown in Figure 4. A summary of the known forces are summarised in table 1 and table 2 summarises information on the main set of known particles.

Old and New Debates

So far, however, gravity has not yielded to theories of unification to link the various forces together into a 'theory of everything'. According to Einstein, gravity is essentially a curvature of space time. Objects move as they do under gravity on account of the fact that the local space time is distorted by gravity.

So in the deliberation of scientists, an increasingly clear picture has emerged of the known building blocks of matter in the universe. This has at the same time enabled theories of the Big Bang to be set back to even earlier in the first instants from the time when the 'clock struck zero'. With the new LHC facility at CERN due to be commissioned around 2005, particle experiments will simulate the universe some 10-12 seconds after its 'beginning'.

String theories are very much the domain of theoretical physicists and very much at the outer limits of what is capable of being intellectually understood. Having emerged in the late 1960's, string theories relate to mainstream science like some Creationist/ Darwinian division of Victorian science. They represent some of the most complex, abstract mathematical models ever developed, with some systems requiring up to 26 dimensions to establish model properties.

One of the objections which some scientists have against such theories is that the structures they define are too compact to explore with present energies of accelerators - and hence cannot be verified by experiment.

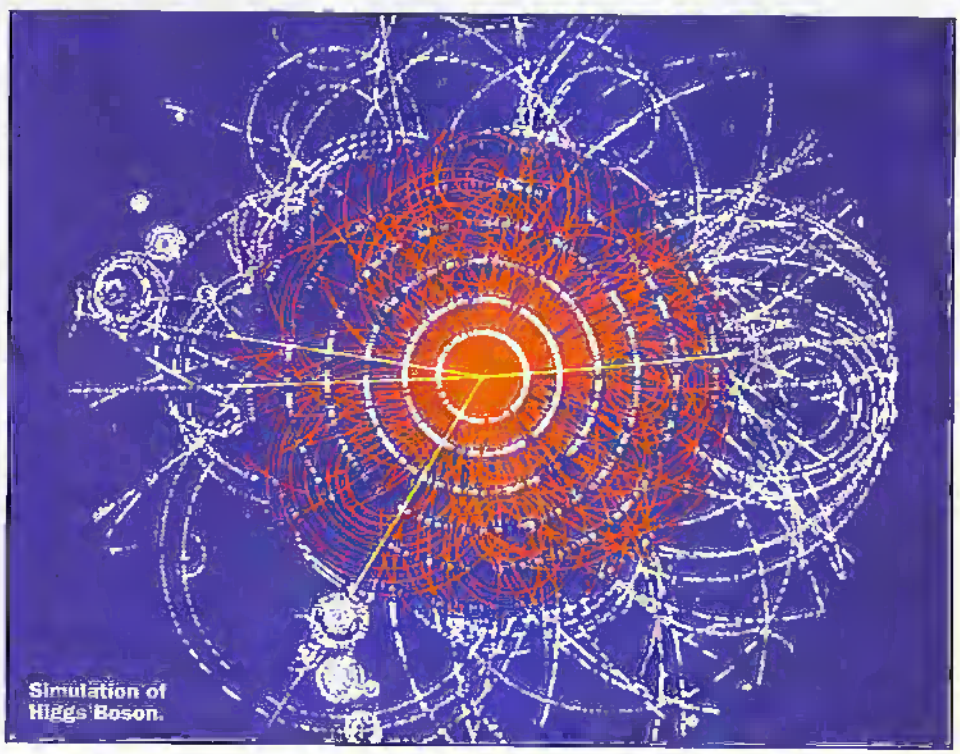
The Briggs Elevator

Robert Mathews in his excellent book, 'Unravelling the mind of God', formulates a construction he terms the 'Briggs Elevator', in part tribute to Henry Briggs, a 17th century English mathematician who popularised the notion that any number can be expressed in terms of powers of ten. In this elevator, with objects such as people, dogs, cars assigned a nominal value of 1, objects of larger scale are expressed in terms of positive powers of ten and smaller objects in terms of negative powers of ten as indicated in Figure 5.

Our awareness of the physical universe has extended as far as level 26, the order of the scale of the universe itself and down to as far a negative level 18 - the dimension of the quark. This is a total excursion of the order of 44 orders of magnitude. We do not know how far science will be able to resolve structures at smaller and smaller scale or even if the scale of superstrings is the end point of dimension in the universe.

The Higgs Field

One of the recent theories, that of the Higgs mechanism, will be tested by the new LHC experiment at CERN. In this mechanism, space is identified as being filled with the Higgs field. Particles appear to have mass by the degree of interaction with this field - with heavy particles such as protons having a relatively strong field interaction while particles such as neutrinos having hardly any interaction at all. Also, it is considered that the Higgs field can establish itself out of a concentration/cluster of the Higgs field. The mass of the Higgs particle is not well predicted


Simulation of Higgs Boson.

from theory with electro-weak theories suggesting it is less than 1000 proton masses.

We can try to follow an 'explanation' provided in a CERN booklet on the LHC. 'To understand the Higgs mechanism, imagine that a room full of physicists quietly chattering is like space filled only with the Higgs field. A well known scientist walks in, creating a disturbance as he moves across the room, and attracting a cluster of admirers with each step. This increases his resistance to movement, in other words, he acquires mass, just like a particle moving through the Higgs field. If a rumour crosses the room, it creates the same kind of clustering, but this time among the scientists themselves. In this analogy, these clusters are 'Higgs particles.'

The Large Hadron Collider Experiment

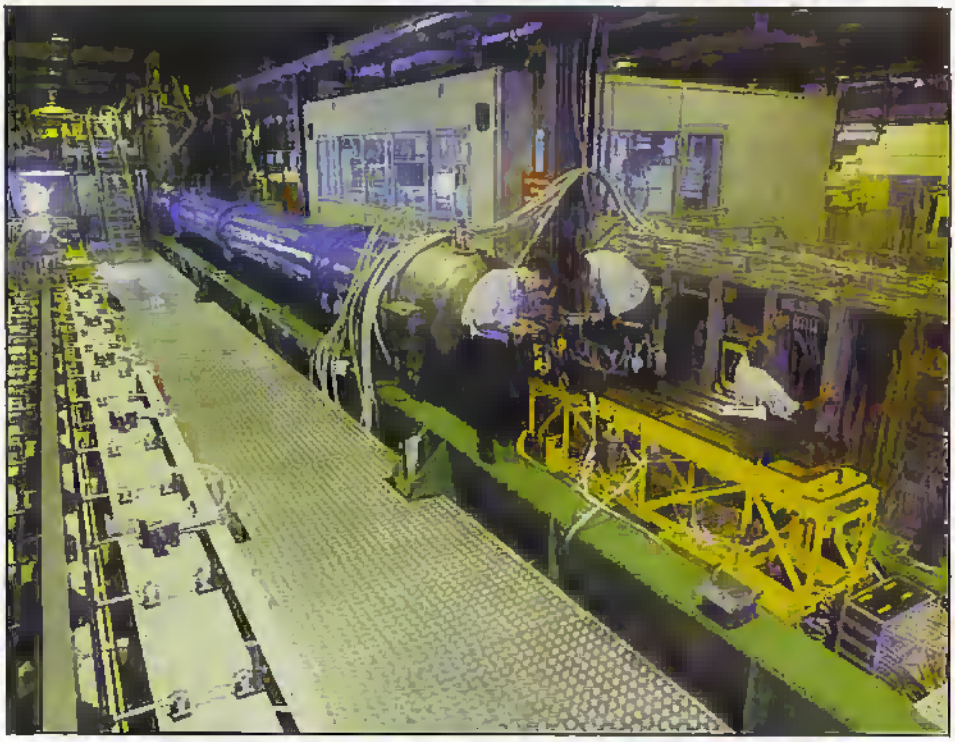
The main active experiment at CERN is currently the Large electron/positron (LEP) collider which is able to attain energies of 90GeV (1GeV = 109eV). Insight provided by LEP indicates that new classes of reaction should be observable at energies around 1T eV (= 1000GeV = 10^{12} eV). In the current phase of developments at CERN, the Large Hadron Collider (LHC) will use the existing 27 kilometre circumference tunnel which houses the LEP system and also with utilisation of existing particle sources and pre- accelerator/injection systems.

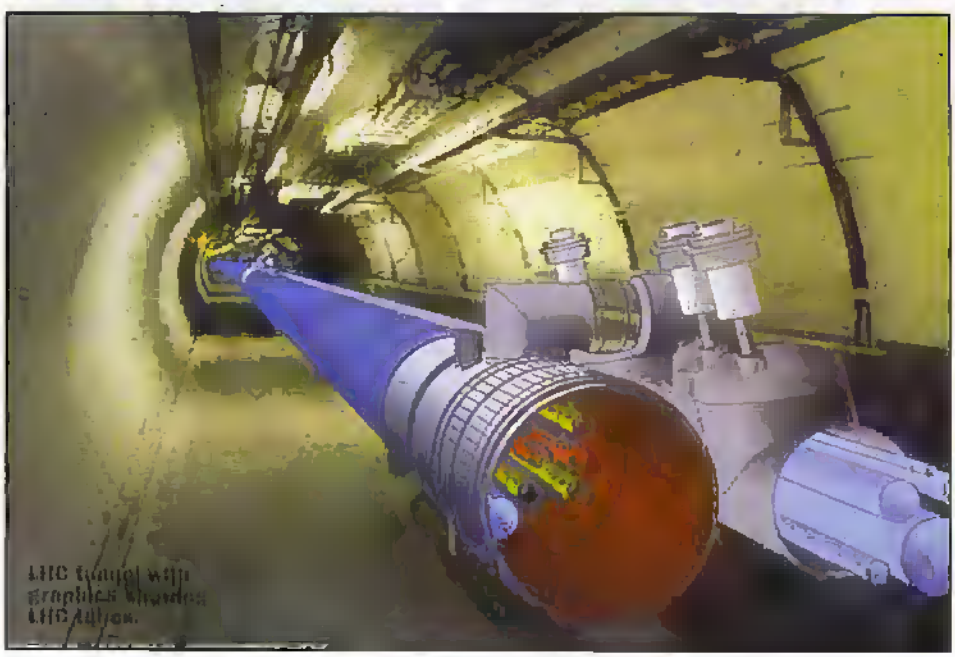
The main function of the LHC will be to collide 7-on-7TeV protons together, though other particle streams of 1250TeV heavy ions such as Lead and proton/electron collisions at 1.5TeV are also available - providing significant potential for new discoveries. Inside the vacuum system, protons are accelerated in opposite directions. ALICE derived from 'A Large Ion Collider Experiment' is designed to probe the 'quark-gluon plasma' of such heavy nuclei.

The construction of the LHC facility is only made possible by significant developments in technology. Within the existing geometry of the LEP tunnel, the LHC dipoles are required to develop magnetic fields of 8.6 Tesla - over five times the levels that were being used in the SPS proton/anti-proton collider.

Superconductivity is essential for the operation of the magnetic dipole systems. The coils of the LHC dipoles are made of copper clad Niobium-titanium cables - a technology initially developed in the 1960's at the Rutherford Appleton laboratory in the UK. While previous field limits were of the order of 5.5 Tesla at temperatures of 4K, the higher field strengths of the LHC will be achieved by using temperatures of 1.9K - colder than outer space. The mechanical strengths of such structures have also to be made to withstand colossal forces developed by the intense magnetic fields.

European industry is already manufacturing superconducing cables capable of carrying 15,000A at 1.9K. The large number of dipole units (1296) in the LHC system is forcing the development of large scale manufacturing techniques for such systems - which in turn is improving the competitive edge of European industry in this field. This could have significance for





LHC tunnel with Graphics showing LHC Author.

future implementation of superconducting technology in the fields of energy generation and distribution.

The development of the LHC is in many ways being grafted onto the existing LEP facility. This is certainly true of the cryogenics system used to maintain the dipole elements at 1.9K. The existing LEPII 4.5K cryoplants will be increased in capacity and the essential 1.9K stages added to these. The LHC will then become the world's largest cryogenic facility, with 31,000 tonnes of material being cooled and with a total inventory of 700,000 litres of Helium.

When charged particles are held in circular orbit they generate synchrotron radiation. Such an effect is more serious for lighter electron/positron particles and where such systems can be constructed to deliberately produce intense x-ray radiation. For protons in the LHC, such effects will not be as severe though it is calculated some 3.7 kW of power will be radiated by each beam. Problems arise when this radiation in the form of 'hard' ultra violet radiation strikes the inside of the containment system - releasing in turn trapped gas molecules which become ionised and strike against the containment system. As circular accelerators in the future seek to achieve energies around 100TeV, then significantly more synchrotron radiation will be produced which will require appropriate remedies in system design to be implemented.

Another inherent difficulty of increasing the energy of particles such as protons in the LHC is as a result of the corresponding decreasing effective cross section of energetic particles. The De Broglie wavelength, characteristic of the effective physical size of such particles, decreases as 1/E, so the area of cross section decreases as $1/E^2$. The luminosity (particle density) of the beam has had to be increased by a factor of about 100 to cope with an increase in particle energy of approximately a factor of 10 compared with the LEP.

Part of the scope of the LHC set of

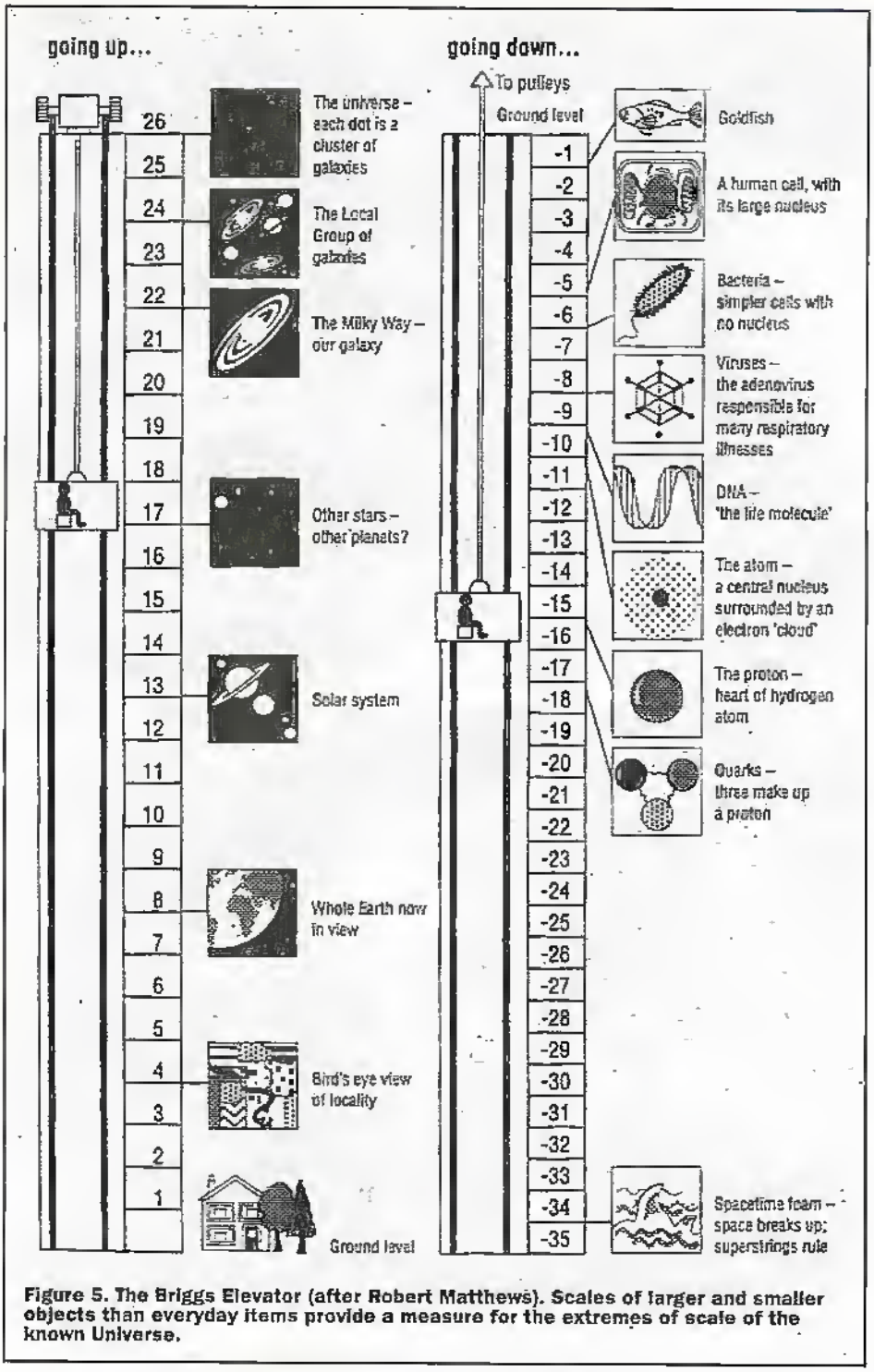


Figure 5. The Briggs Elevator (after Robert Matthews). Scales of larger and smaller objects than everyday items provide a measure for the extremes of scale of the known Universe.

experiments is to probe why the masses of particles are the way they are. Also, it may be possible to test some of the theories of so called super symmetry - with the possibility of discovering the presence of particles of dark matter. CERN will become the dominant site of high energy particle research. What appears to be emerging is a new phase of experimentation/development of theories about the nature of things.

A New Force

Astronomers and cosmologists and indeed particle physicists are having to come to terms with the possibility of the existence of an 'anti - gravity' force that is sufficiently strong to overcome gravitational attraction and ensure that the universe will keep on expanding - for ever. This is the new insight provided by a group of astronomers who have utilised new ultra sensitive CCD technology to scan the most distant visible galaxies for supernova events - as they appear to happen.

By using these events as 'cosmic flashbulbs' of calculated brightness, much in the way of Hubble initially using variable brightness stars in local galaxies, the findings point to the universe expanding at an increasing rate.

It will take some time for astronomers to come to terms with such new discoveries and likewise, the particle physicists will seek to review their assessment of particle forces and methods of interaction with matter. The nature of the 'anti-gravity' force is, however, not altogether new. From some time there had been the theory of virtual particles - that even 'empty space' is a world in which virtual particle of matter and antimatter were constantly manifesting but so rapidly that they could not be detected. The effect is predicted by the so called Casimir effect when the force on two parallel plates is measured by virtue of the fact that there is more force on the outer plates pushing in than from the narrow gap pushing out.

The introduction of the new concept of zero point energy in the Universe is an interesting one. For the moment, the emphasis is on undertaking more research, particularly in Astronomy to verify the measurements. However, in the last year of the 20th century Cosmology is indeed in a spin.

Summary

The outcome of scientific research into the nature of matter has been the expansion of the mind of the scientist, so that science has become more open, less predictable and consequently full of surprises. The 20th century has been an era of the opening up of minds to embrace things of vast and minuscule scale. It is reasonable to expect that similar advances will be made in the 21st century.

We must hope that in looking back on the 20th century that greater efforts will be made to make the world a safer place in which to live and that material advances will be shared by an even broader cross section of the world's population.

Further Reading

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The Search For Infinity, Gordon Fraser, Egil Lillestol and Inge Sellevag, Mitchell-Beazley, 1994

Big Bang Science, PPARC (available on request: see contact points)

Scientific American, January 1999, Special Report: *Revolution in Cosmology (Is the expansion of the Universe accelerating?)*

Points of Contact

Public Relations Office, Particle Physics and Astronomy Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire, SN2 1SZ
tel 01793 442123 (PR office)
fax 01793 442002
Email: pr.pus@pparc.ac.uk
URL:http://www.pparc.ac.uk

CERN, Geneva (excellent!)
URL:http://www.cern.ch/

Fermi National Accelerator Laboratory
URL:http://fnnews.fnal.gov/

Stanford Linear Accelerator, California
URL:http://heplibw3.slac.stanford.edu/

Brother has the MAGIC P-TOUCH

Sarah Graham checks out this range of labelling machines.

The P-touch range from Brother is the most extensive electronic labelling series currently available. With over 2,000,000 sold worldwide, it has become the preferred way of creating laminated, smudge and scratch-proof adhesive labels.

The labels can be put to countless uses; in retail stores, hospitals, offices, laboratories, factories and within a multitude of industrial applications - and also in the home, both indoors and out.

The machines themselves come in a complete range, from easily portable hand-held to desktop computer compatible, each offering a variety of easy-to-use features for smart, professional looking results.

Lamination Labelling

Brother produces a variety of tape styles, sizes and materials for use in their P-touch machines. Label sizes range from 6-36mm, and come in a variety of background and text colours, including black on red, blue on white or white on green for example. Tapes can be laminated or matt, fabric, security or instant lettering tape.

Print Head

The machines use thermal transfer printing. The thermal print head has a heat generator consisting of 384 heating elements, which are vertically aligned as shown in Figure 1. Each heating element is 0.08mm wide by 0.0705mm high. The character size (dots) determines the number of heating elements used, see Figure 2. Print speed is normally 285 dots (20.1mm) per second.

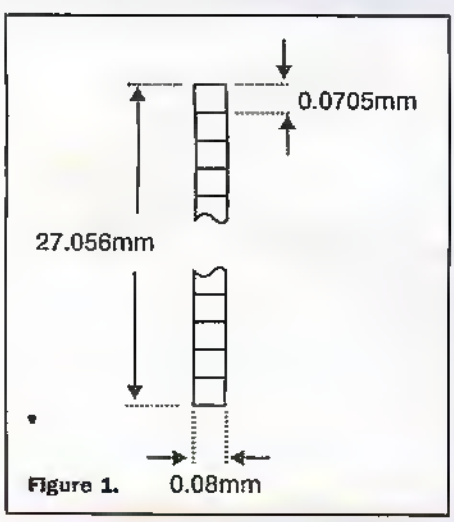


Figure 1.

Tape Structure

Brother's laminated tapes - the TZ, TC and TX lines - consist of six layers of materials, resulting in thin, yet extremely strong, labels. Characters formed with thermal transfer ink are actually printed onto the underside of a laminate. Sandwiched between two layers of PET (polyethylene) film, the characters are virtually indestructible. The lamination protects ink from the sorts of hazards which abound in industrial environments; abrasion, chemicals, oil and water.

Tape Durability

Brother has extensively tested the tape used in its labelling machines, to ensure the reliability of performance and durability of the printed labels.

Abrasion Resistance:

Tapes tested with a weighted (1kg) sand eraser device were only slightly scratched after 50 'return' passes, while the characters underneath were completely unaffected.

Dielectric Strength:

In tests, white P-Touch tapes with black characters began to lose their electric resistance at an applied voltage of 8kV, and lost their resistance entirely at 11kV. Most other colour variations will have a similar resistance, although Brother recommends that they are not used as electrical insulation.

Adhesive Strength:

Obviously an important requirement, as a label that falls off ceases to perform its function; the reduced surface adhesion area of embossed stiff film decreases the tape's ability to cling to items.

Surface

Brother tested the tape's adhesive strength under ordinary conditions when applied to various materials. Though the exact forces required to remove the labels varied, the finding was that in a general working environment, even after handling, P-Touch tapes will remain affixed.

Surface	Adhesive Strength (gf/12mm)
Stainless Steel	780
Glass	730
PVC	880
Acrylic	700
Polypropylene	340
Polyester-coated wood	650

N.B: gf 12mm is the required equivalent force to remove 12mm wide tapes.

Exposure To Heat And Cold

Tapes attached to stainless steel slightly roughened with abrasive paper were heated and cooled. After 2 hours in -50°C, an equivalent force of 710gf was required to move the P-Touch tape. No change in tape or adhesive colour had occurred. Heating, on the other hand, actually increased the tapes' adhesive strength, due to slight softening and spreading of adhesive.

Temperature	Adhesive Strength (gf/12mm)
-50°C x 2 hours	710
200°C x 2 hours	1100

High Temperature and High Humidity

The highest adhesion strengths of any test were registered after the tapes' exposure to 40°C temperatures and 5% salt water baths. No change in ink colour occurred, and no adhesive was left behind when tapes were removed.

Humidity Levels	Adhesive Strength (gf/12mm)
40°C distilled water x 24 hours	1440
40°C 5% salt water x 24 hours	1560

Objects: stainless steel rubbed with abrasive paper #280.

Rounded Objects

Tapes were attached to stainless steel poles of various diameters, prepared with #280 abrasive paper. The poles were then placed in a variety of environments. On tightly rounded, 8mm diameter poles, after 24 hours in 65°C and 80% humidity, some labels' ends pulled up slightly from the pole (up to 3mm), and in a few cases, the background tape remained attached, whilst the laminate pulled up (i.e. some tape separation occurred). In both normal and cold temperatures, even on the 8mm diameter poles, no loss of adhesion was noted. More importantly, on all poles with larger diameters (from 12mm to 24mm), no loss of contact between label and pole resulted.

Rough Surface

Stainless steel samples were prepared using a variety of abrasive paper weights. Roughening the surface actually increased adhesion strengths.

Surface Type	Adhesive Strength (gf/12mm)
Specular Gloss stainless steel	560
Stainless steel rubbed with A.P. #280	780
Stainless steel rubbed with A.P. #240	750
Stainless steel rubbed with A.P. #180	710
Stainless steel rubbed with A.P. #120	730
Stainless steel rubbed with A.P. #80	660

Point Size	6	9	12	18	24	36	48	60	72
Number of heating elements used	28	45	60	90	120	180	240	300	360

Figure 2. Point size vs number of heating elements used.

Heat Resistance

The P-touch tapes retain their integrity even at extremely high temperatures. Tapes were placed in an analysis chamber then starting at room temperature, the chamber was heated at a rate of 20°C increase per minute.

Decomposition of the tapes did not begin until the temperature reached 365°C. Under general working environments the tapes will retain their form and readability. Tapes began to decompose more rapidly after temperature reached 415.5°C.

Chemicals and Water

P-touch tapes, attached to glass, were bathed in a variety of materials for two hours. Despite some changes in appearance and structure, all tapes remained affixed to their slides. Rubbing P-Touch labels with cloths soaked in those same chemicals had no effect on the tapes - suggesting if chemicals are spilled, quick wiping should prevent damage.

User Safety

The tapes were tested by the Japanese government food research laboratory, in the event of labels being attached to food containers, food packages or food preparation equipment. Tapes met all food sanitation laws. Similarly, in tests to determine the effects of accidental affixation of tapes to skin, the tapes caused no skin irritation and are safe according to OECD guidelines.

Guide To The P-Touch Range From Brother

Whatever your labelling requirements, Brother has the answer, from portable hand-held devices to PC compatible machines, to create labels for use on scientific apparatus, test tubes or chemical trials, in factories, warehouses, hospitals and offices, or for cabling and parts in the telecommunications and computing industries.

Maplin stock all P-Touch products. Some of the labelling machines on offer include:

PT-300SP

Small desk-top machine, with 300 character memory. Labels can be printed in six different font sizes on four different tape sizes.

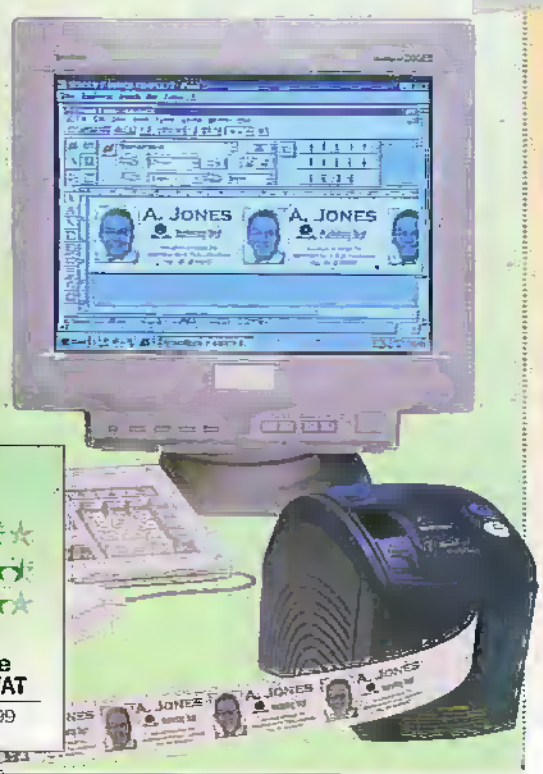
PT-300SP

Ease of Use	★★★☆☆
Versatility	★★★☆☆
Overall value	★★★★★

Item	Order code	Price inc. VAT
PT-300SP	PN45Y	£39.99

P-touch 9200

Allows virtually anything created on a PC screen to be turned into a self-adhesive label, with its integrated graphic function offering a wealth of creative layouts. Windows 95/98 and NT 4.0 compatible, it offers Plug and Print technology with an Icon-based graphic user interface giving a WYSIWYG (what you see is what you get) view of labels. It can process and print scanned originals (logos, pictures or graphics) and can take information from other databases such as Microsoft Access. There's a choice of 6 label widths (from 6-36mm), 360dpi resolution for high quality printing of text or graphics at up to 27mm high, an option for 11 lines of text, and it can print 10 industry standard bar-codes.



PT-9200PC

Ease of Use	★★★½☆
Versatility	★★★★½
Overall value	★★★★☆

Item	Order code	Price inc. VAT
PT-9200PC	PN46A	£399.99

P-touch 9400

Ease of Use	★★★½☆
Versatility	★★★½☆
Overall value	★★★★☆

Item	Order code	Price inc. VAT
P-touch 9400	PN47B	£499.99

P-touch 9400

Also PC compatible, it features a full-size QWERTY keyboard, WYSIWYG display and Automatic Currency Calculation. Converting Pounds into Euros while simultaneously calculating up to four currencies at current exchange rates, PT-9400 can create labels showing the price in Euros and the local currency. Also offers six tape widths and 360dpi resolution for high quality printing of text or graphics, plus 10 built-in fonts, 16 built-in font styles, horizontal and vertical printing, framing and automatic numbering. Other features include up to 10 lines of text, 99 multiple print outs, PC connectivity, 10 industry standard barcodes and memory capacity.

PT-550

Ease of Use	★★★★☆
Versatility	★★★½☆
Overall value	★★★★★

Item	Order code	Price inc. VAT
PT-550	PJ65V	£249.99

PT-550

Can be used 'standalone' or connected to a PC, and is Windows 95 and Windows 3.1 compatible, printing up to 7 lines of text on each label. It can print 11 industry-standard barcode protocols, has a 3,000-character memory, can print on six tape widths, from 6-36mm and features a total of 8 fonts, 452 characters and 260 symbols. Applications for the PT-550 range from the labelling of library shelves and fuse boxes, to warehouse racking, shelving and even door signs.

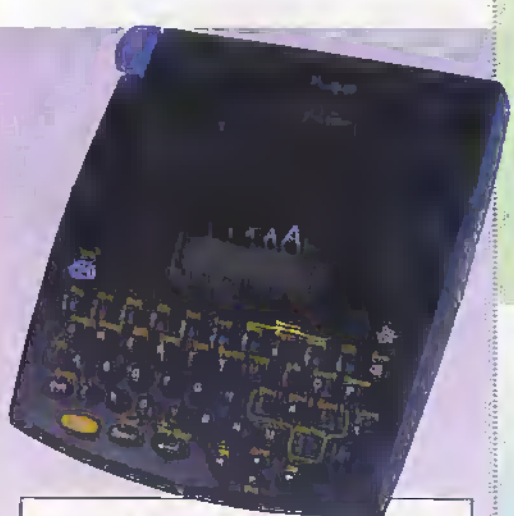
PT-200

Ease of Use	★★★☆☆
Versatility	★★★★☆
Overall value	★★★★★

Item	Order code	Price inc. VAT
PT200	MG92A	£69.99

PT200

Portable battery or mains powered machine, this handy light-weight design enables creation of labels wherever and whenever you want. It can produce labels in 8 fonts and 5 character sizes and has a 300 character memory with up to 55 characters per label.



PT-350

Ease of Use	★★★★☆
Versatility	★★★★☆
Overall value	★★★★☆

Item	Order code	Price inc. VAT
PT350	MG94C	£139.99

PT350

Desk mounting labelling machine incorporating a QWERTY keyboard, 3 built-in fonts, 8 font styles and the ability to print labels up to 4 lines deep. The machine has the ability to print bar codes as well as text and symbols and can also print out calendars for any month between 1901 and 2099.

PT85

Portable battery, lightweight design and excellent performance at a very reasonable price. It can produce labels in 9 fonts, vertical or horizontal printing with 179 characters and symbols. It has a 5 character display with 2 line printing, text framing and underlining.

PT-85

Ease of Use	★★★★☆
Versatility	★★★☆☆
Overall value	★★★★★

Item	Order code	Price inc. VAT
PT85	MG91Y	£29.99

PT-220

Portable, professional label printer, it can be hand-held or desk mounted and battery or mains powered. Supplied with a carrying case, the PT-220 offers 8 font styles, 12 character two line LCD display and can produce labels with up to 4 lines of text. A key function is its ability to print bar codes, as well as text and symbols.

PT-220

Ease of Use	★★★☆☆
Versatility	★★★★½
Overall value	★★★★☆

Item	Order code	Price inc. VAT
PT-220	MG93B	£99.99

Reviewer assessed star rating.

Stamp Creator

Ease of Use	★★★½☆
Versatility	★★★★★
Overall value	★★★★½

Item	Order code	Price inc. VAT
Stamp Creator	PN48C	£99.99

Stamp Creator

This machine allows you to produce quality custom stamps on demand. Units can be stand-alone or connected to a PC to enable more graphic intensive designs to be created. It has 25 built-in ready to use stamp messages and 30 auto format templates. PC connection gives an additional 8 built-in fonts, 320 built-in symbols, 67 auto format samples, 30 patterned boxes, 30 patterned frames and the ability to import graphics files.

For more information on the P-Touch range please call 0161 330 6531, or visit one of the 49 Maplin stores nationwide.

RESEARCH NEWS

This month Dr. Chris Lavers looks at new forms of rocket propulsion for space exploration.

Matter/Antimatter Engines

Three relatively 'independent' and revolutionary research announcements are set to change the face of both manned and unmanned space exploration within the first decade of the next century. The first had been dreamt of for some time - the desire to harness energy from the annihilation of matter with antimatter in order to control the release of enough energy to send a rocket into space and beyond. Until very recently, antimatter drives lay distinctly in the realms of science fiction, because there was simply no way to successfully contain enough of the exotic anti-matter. Paul Dirac (1902-1984) predicted the existence of the positive electron (positron) and other more complex antimatter particles in 1928, for which in part he received the 1933 Nobel physics prize. The positron was verified experimentally by C. D. Anderson in 1932. Antiparticles are usually short lived as they are rapidly annihilated in collisions with their corresponding matter particles. These *complete* mass-energy conversions occur in pair annihilation where a positron-electron pair is annihilated, resulting in the creation of two (or more) photons, as shown in Figure 1. At least two photons must be produced in order to conserve both energy and momentum. In order to find the energy released from an annihilation event between an electron and a positron initially at rest, the initial momentum of the electron-positron pair will be zero, and the photons must travel in opposite directions with equal energies. Applying conservation of energy yields

$$2\,m_0c^2 = 2\,E\gamma$$
$$\text{or } E\gamma = 0.511\text{MeV}$$

Clearly to form a useful drive photons must be directed backwards at the point the electron-positron 'jets' contact. Proton-Anti-proton annihilation liberates significantly greater energy as would neutron annihilation, however, neutrons being uncharged are not readily restrained by electric and magnetic fields! Institutions such as CERN in Switzerland have for some time been able to contain very small amounts of anti-matter within 'magnetic field traps' but not enough to drive a spaceship to Mars - and certainly not beyond to the stars. Suspicions have circulated for some time that NASA scientists have been edging closer and closer to such an elusive drive. Research scientists at the Propulsion Research Division of NASA's Research Laboratories in Alabama have been involved in work moving towards successful containment of enough antimatter to operate such a drive. A recent announcement by the NASA team lead by Dr George Schmidt, Chief Propulsion Division scientist, has revealed that they have now found a way not only to contain enough antimatter for long enough, but also, and more importantly from the point of a drive, have found a way to safely control its release. Progress is already underway in their laboratory on building a prototype antimatter-matter annihilation engine that will hopefully be ready for initial testing sometime in spring 2000. The equivalence of matter and energy, now a basic tenet of physics, was first put forward by Albert Einstein, and is governed by the now famous equation $E=mc^2$. Basically the annihilation of 0.5kg of anti-matter with 0.5kg of matter would release a fantastic 9×10^{16} J of energy. As Dr Schmidt has been quoted as saying "One gram of antimatter produces as much energy as 23 Space Shuttles." However, the implications of even one gram, let alone 1kg of direct mass-energy conversion all released in one accident at launch are too staggering to contemplate. Atomic energy until now has merely scratched the surface of the binding energy that holds the nucleons, (protons and neutrons) together, either breaking up unstable atomic nuclei (e.g Uranium and Plutonium) to release energy, or by fusing light atomic species such as Hydrogen with Deuterium and Tritium (isotopes of Helium) releasing more binding energy, but essentially leaving the atomic nucleons intact. *Total* annihilation of both antimatter and matter however, will release a vast quantity of pure radiation which could form an advanced form of space drive. Usually antimatter only exists for a fleeting fraction of a second after being produced by smashing together atomic particles in a particle accelerator, like the ring generator at CERN in Switzerland.

The antimatter trap developed by Schmidt is a hollow tube half a metre long. After sucking out the air from it to create a vacuum (even air contains atoms that will annihilate with the antimatter) a series of powerful electrical fields hold or contain the antimatter away from the sides of the containment vessel. Any contact with the trap walls will also be potentially catastrophic. By modulating the voltage at one end of the trap, a tightly focused beam of antimatter may be directed out of the trap and made to collide with a suitable supply of ordinary matter in the form of Deuterium and Helium-3. The computer controlled annihilations in the ship's 'reactor' core in a series of annihilation events will propel the ship forward at any appropriate acceleration rate in the vacuum of space (see Figure 2).

If all goes to plan, NASA scientists aim to take the prototype antimatter containment vessel to a particle accelerator antimatter generator in Chicago. According to Schmidt in five years time a millionth of a gram of antimatter could be generated which would power a rocket into space.

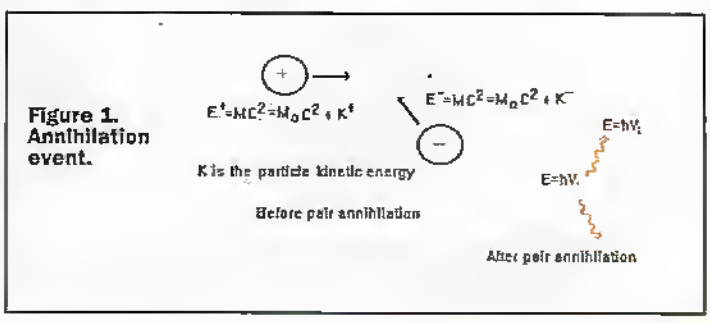


Figure 1. Annihilation event.

The Most Violently Explosive Substance?

At the same time Dr Karl Christe of an American research team working for the US Air Force has succeeded in forming one of the most violently explosive substances ever known to man. The recent surprising formation of Nitrogen 5 or N_5 ($N5$) holds out significant promise to the development of more effective rocket fuels. Dr Christe leads a team of 15 chemists using the latest computer aided design technology to create this highly unstable man-made form of nitrogen. Ordinarily gaseous nitrogen comprises two atoms joined together as N_2, which is stable and especially unreactive. Nitrogen was first separated from the atmosphere in 1722, by the British scientist Henry Cavendish, and a second form of nitrogen, $N3$ (azides) was found in the 1890's, as a temporary binding of three nitrogen atoms. Azides are so unstable that they are usually kept in a crystalline lattice at low temperatures that isolates one azide complex from another so they do not come into contact with their neighbours. Once again contact ensures a highly exothermic explosive reaction. Christe's form is an unstable bonding of five nitrogen atoms into a V-shape. Previously such a configuration of atoms was thought impossible.

The US Air Force initiative to develop highly energetic and

Figure 2. Possible Anti-matter drive

more efficient rocket fuels, is based at the Edwards Air Force Base, in California, a designated landing site for the Space Shuttle. Even the most powerful rocket propellants have a performance ceiling that limits their efficiency. Typically only 10% of the initial rocket mass is actually delivered as payload into space, with about half of the mass as fuel. However Christie's group may very well be able to significantly enhance the ratio of delivered payload/(fuel + fuel tanks).

It took four months to synthesise a stable form of N_5^+ by combining gaseous nitrogen with a toxic negatively charged mixture of arsenic and fluorine. Because of the severe instabilities they have to keep it packed in dry ice at -80°C in ampoules of Teflon.

Air-Breathing Rockets

NASA has also successfully completed two years testing new, radical air-breathing rocket engines that could change the future of space travel, lowering cost and potentially making it more affordable to everyone from business travellers to tourists. NASA and its industry partners have successfully ground-tested rocket engines that 'breathe' oxygen from the air and are planning to conduct flight tests in the near future (see Figure 3). The spacecraft deployed would thus be completely reusable, taking off and landing at airport runways and could be ready to fly again within only a few days, rapidly decreasing the current turn around time by at least an order of magnitude.

"Air-breathing rocket engine technologies have the potential of opening the space frontier to ordinary folks," said Uwe Hueter, manager of NASA's Advanced Reusable Technologies project at Marshall Space Flight Centre in Huntsville, Alabama. An air-breathing rocket engine inhales atmospheric oxygen for about half the flight. It does not have to store all the oxygen gas onboard, therefore at takeoff an air-breathing rocket is carrying less fuel than a conventional rocket, getting off the ground is the most expensive part of any mission. Weight reduction decreases costs significantly. Specially designed rockets boost the air-breathing engine's performance by 15% over conventional rockets at takeoff. When aircraft velocity reaches twice the speed of sound, the

rockets are turned off, and the engine total relies on atmospheric oxygen to burn the hydrogen fuel onboard. The compression of sufficient tenuous oxygen in the upper atmosphere at these speeds is sufficient to power the engine. As the vehicle's speed increases to about ten times the speed of sound, the rocket-powered system takes over to propel the vehicle into orbit.

How do these ideas really come together in a future space launch scenario? Well a possible future scenario would include an air-breathing engine launch, or at least a partial air-breathing engine launch powered by a possibly smaller, but certainly more powerful and efficient, N5 rocket taking the payload for the space mission into orbit, with a small containment of antimatter for storage and assembly in space of a planetary probe or Interstellar mission. Safely assembled in space (!), outside of the Earth's gravitational well, an antimatter powered drive would soon accelerate a space probe very close to the speed of light, allowing time dilation effects to deliver a relatively young sensing system to one of our nearer

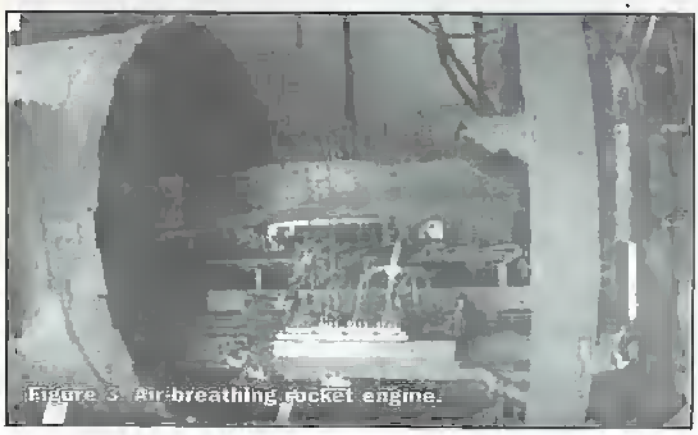


Figure 3. Air-breathing rocket engine.

star's within perhaps two decades for close up analysis of both the star and any existing planetary system. Then some really interesting space science results can take place!

Forthcoming Electronics and Electronics related conferences

Introduction to Electronic Imaging 19-21 April 1999 Bromley Court Hotel, Bromley in Kent. A two and a half day course providing step-by-step introduction to all aspects of an electronic imaging system, including capture, transmission and storage.

Digital Image Compression 22 April 1999 This course will provide an introduction to the basic concepts used in image compression and existing JPEG standard and the emerging JPEG-2000 standard that is based on discrete wavelet transforms. For both of these courses contact: Sira Technology Centre Training Registration South Hill, Chislehurst, Kent BR7 5EH, England. Telephone: 0181 467 2636 Fax: 0181 467 6515
E-mail:courses@sira.co.uk
http://www.sira.co.uk

International Workshop on Adaptive Optics for Industry and Medicine will be held between July 12-16 at Durham University. Contact: Gordon Love, Physics Department, University of Durham, South Road, Durham DH1 3LE, UK Fax: +44 191 374 3709 E-Mail "ao.conference99@durham.ac.uk".

Two workshops for the Sensors for Water Interest Group (SWIG) are due to be held shortly. *On-line particles Characterisation* on the 20th May at Cranfield University in the Lord Kings Norton room. This workshop will be valuable to researchers, designers, suppliers and users who have to make on-line measurements of particles in water, and, *Confidence in measurements* to be held at Esholt Works, Yorkshire Water in Bradford on the 20th April. This workshop will consider the factors which contribute to the derivation and interpretation of high quality data.

The cost of both Workshop is £55 inc. VAT for Members and £85 inc. VAT for non-Members. Contact: SWIG, 27, West Green, Barrington, Cambridge, CB2 5RZ Tel/Fax 01223 870967
E-Mail:mfchaeljscott@compuserve.
SWIG is a forum for the UK aqueous sensor and monitoring community and holds about 10 workshops a year and publishes a newsletter.

Figures Courtesy of NASA

New Drive System FOR KEELE OBSERVATORY 24" REFLECTOR TELESCOPE

PART 1

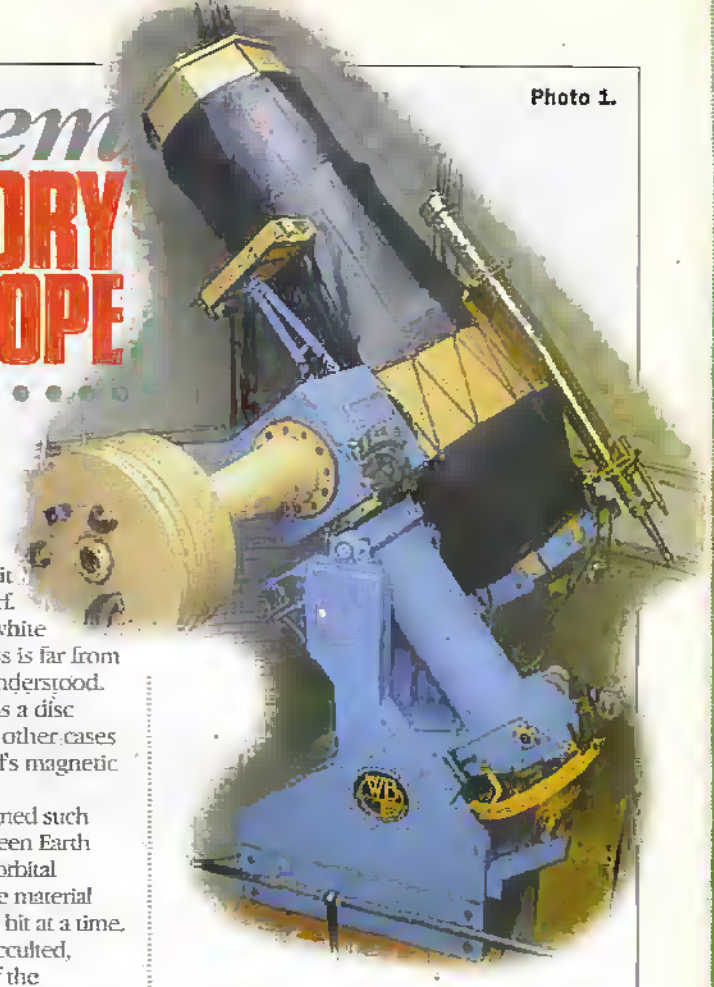


Photo 1.

Keith Garwell details improvements to the Keele Observatory telescope.

First a little bit of scene setting. Keele University Observatory has a Saturday afternoon team. Team is not quite the right word, if they were objects a collection would be more appropriate as they fit together amiably. Between them they possess a variety of skills, sheet metal workers, teachers, model-makers to name but a few, and they contribute considerably to the development of the telescope. I have never really discovered their origins but I guess that they come from various local astronomy clubs. Although I count myself as a member of this team I am not really an astronomer, not even an amateur one. Nonetheless I find it an interesting subject.

For the readers who are not astronomers (like myself) I should perhaps explain before going any further that Right Ascension (invariably abbreviated to RA) is the motion which counteracts the earth's movement and enables the telescope to remain pointing to the same position in the sky. The telescopes axis is parallel with the earth's axis but is required to rotate at a slightly different rate to the earth because its position is governed by the stars, not the sun. This is shown in the Photo 1.

The second motion, the Declination (and again invariably abbreviated to Dec) is the motion which allows the telescope to be moved to any angle between the horizon and the zenith. It is in line with the counterweight seen in the photograph.

Curiously I became involved because of a common interest in reading the *New Scientist* at my local library. The other reader of the magazine was one of the Saturday team, who, one day invited me up on the following Saturday afternoon. From there it was but a short step to being invited to design a new drive system for the telescope. This, to me, was an interesting challenge in control systems and hopefully as the story unfolds will also be interesting to the other non-astronomers.

Dr. Tim Naylor (Director of the Keele Observatory) explains the main direction of their work. "The scientific work at Keele is almost exclusively the study of variable stars, chiefly binary stars, where one star orbits the other in a matter of hours. The stars are so close together that they appear as a single object in the telescope.

One of the pair is a white dwarf, a star of approximately the mass of the Sun, but with the radius of the Earth. The star in orbit around it, a relatively normal star, though less massive and cooler than the Sun, is having material torn off it by the gravity of the white dwarf. This material will fall onto the white dwarf, but this accretion process is far from straightforward and is poorly understood.

Sometimes the material forms a disc around the white dwarf, and in other cases is channeled by the white dwarf's magnetic field into 'accretion columns'.

Some of these binaries are aligned such that the normal star comes between Earth and the white dwarf once every orbital period. As the red star occults the material being accreted, it covers it over a bit at a time. The light drop as each piece is occulted, allows us to map the structure of the accretion region by taking repeated images with a CCD camera attached to the telescope.

The raw data for this mapping is a light curve, which represents how the light output of the binary star changes with time. However, in practice much of the variation one would observe would be due to the changing absorption of the Earth's atmosphere. So we observe at least two stars simultaneously, our target star and another star to monitor the atmosphere's absorption.

The Telescope

Although there are but two axes of rotation there are four motion systems. Two provide coarse movement in RA and Declination for initial positioning, these are fitted with position indicators. Photo 2 shows the coarse declination motor and gearbox and also the encoder for the RA position. This view is from the opposite side to that shown in the first picture. The remaining pair are used whilst observing, again for RA and Declination. There are a number of electromagnetic clutches which allow the various couplings/uncouplings to take place as control is passed between the initial positioning and the observing activities.

The first two systems, the coarse control were well established and performed well, but is was the second pair which provided the cause for concern. These are the systems used to maintain the telescopes position while observing.

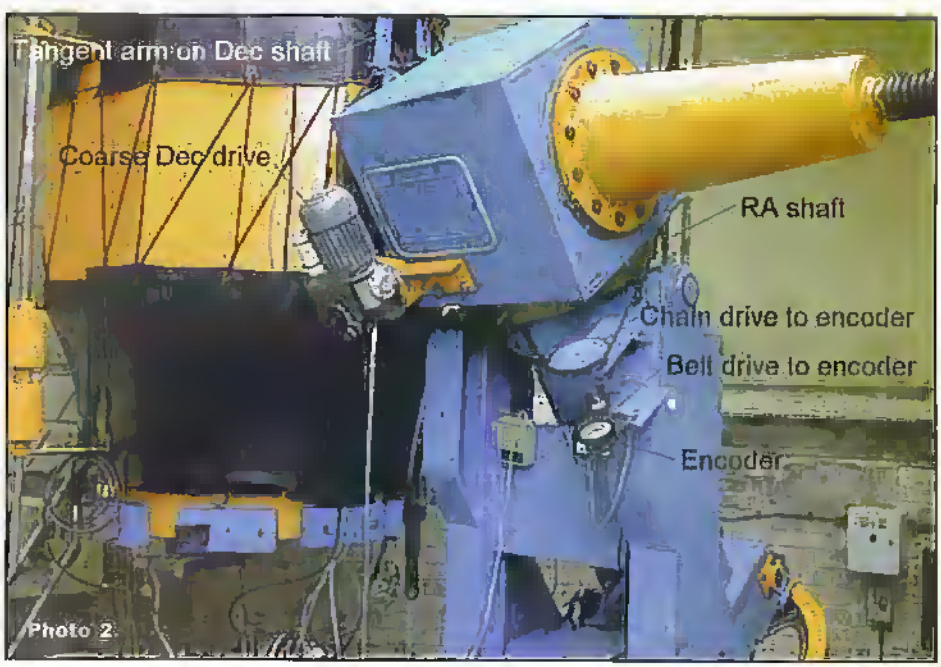
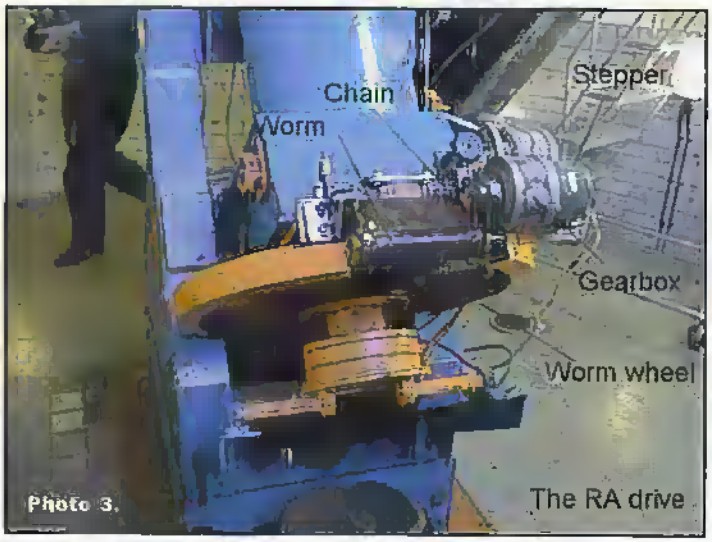
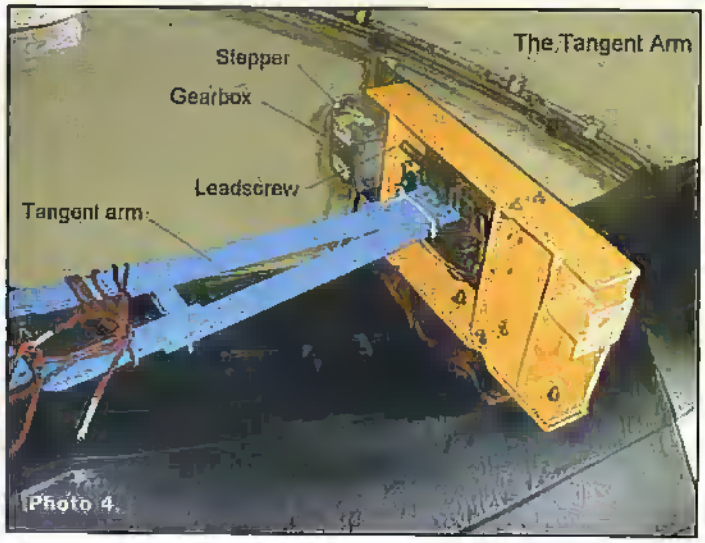


Photo 2.





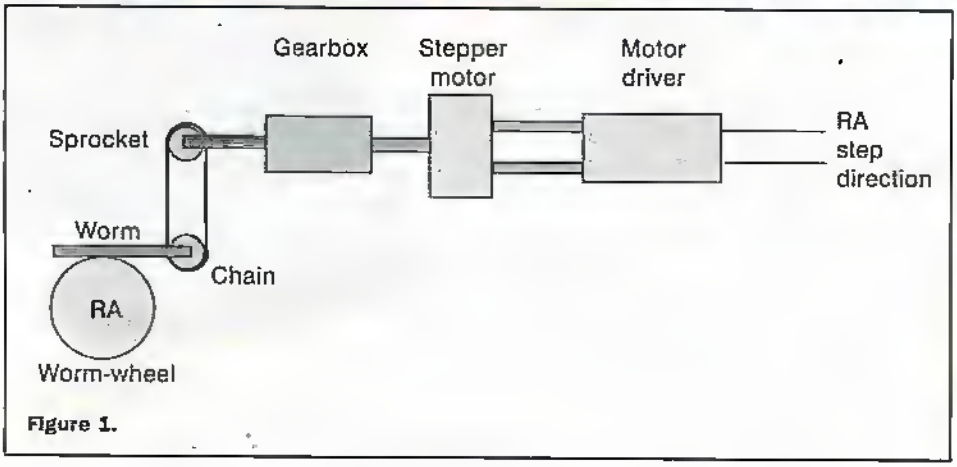


Figure 1.

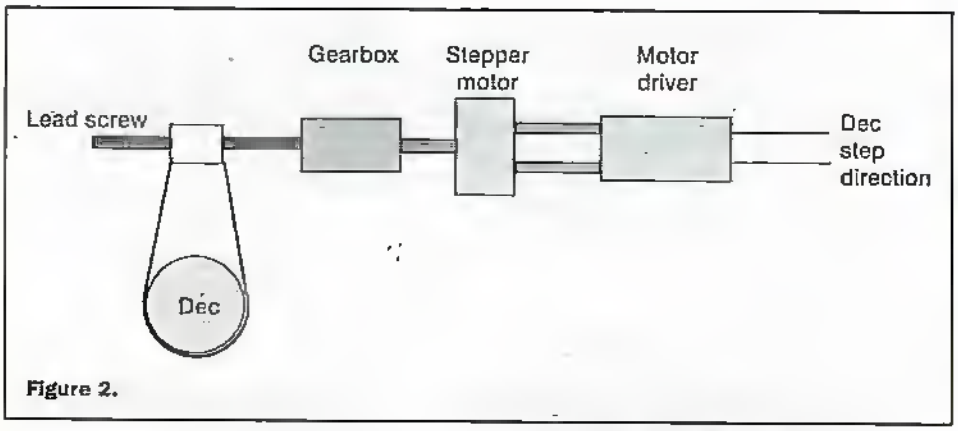


Figure 2.

For the RA drive the mechanics consist of a stepper motor driving, via a gearbox and worm the main shaft. Bottom right in the main photograph and in detail in the Photo 3.

There is a particular difference between the RA and Dec drives. RA is a continuous drive that is it is moving continuously during the observing period. However, declination is rather different. As it is only needed to provide a fine adjustment when selecting an object for observation its movement is small (about 2°) and is achieved by a 'tangent arm.' This is visible in the main picture, and in detail in Photo 4.

In this case the stepper motor drives, via a gearbox, the leadscrew which adjusts the telescopes angle. Micro-switches exist to indicate to the controller that the tangent-arm had reached the end of its travel. A second set of micro-switches exist as a safeguard. If either of these is operated they remove power from the stepper motor.

Existing System

The pictures have shown how the mechanics of the telescope are arranged, and are driven by four electric motors. Two of these are conventional bi-directional commutated motors which are controlled by push buttons mounted at the end of a cable. This can be used either in the telescope dome shown in the photographs or down below in the viewing room. This arrangement allows the course setting to be done manually, and by reference to either the encoders or the perceived image.

Now at last we come to the interesting bit. The observing system using the second pair of motors, the steppers. Figure 1 shows a schematic representation of the RA drive from the great worm-wheel via gearbox, stepper, and its four phase driver to the point at which only two signals are required to control the motion of the telescope.

Direction defines the direction of rotation whilst a pulse on the step line moves the motor one 400th of a revolution. (They are 200 step per revolution motors and the drivers run in half-step mode).

We are now in a position to take a mathematical diversion and calculate the required step rate. First how many seconds in a siderial (star) day:

Earth days per year	365.25 approx.
Rotations per year	365.25 + 1 (we've been round the sun once)
Seconds per day	24 x 60 x 60 = 86400
Seconds per siderial day	86400 x 365/366.25 = 86105.119

However, the astronomers say its 86164.0906, so much for approximations!

So the required step rate must be:

Worm	Gearbox	Motor	Siderial day mean solar seconds
720:1	500:1	400ppr	86164.0906

i.e. 720 x 500 x 400 steps in 86164.0906 seconds = 1671.2299sps

Figure 2. shows the equivalent arrangement for the declination drive. However, this is not a time dependent function merely an adjustment so that the step rate in this case is chosen for the convenience of the user, and is in fact about 300sps.

Existing Controller

This function was entirely defined by software which generated both RA and Dec pulses as required.

The hardware consisted of a BBC B machine plus two 6502 slave units. The two slaves generating the RA and Declination pulses for the stepper motors. These pulses were applied to the four-phase motor drivers.

The software for this system was written entirely in machine code and it was believed that there were errors in this code, and in fact subsequent checks with a frequency meter showed that there were noticeable frequency variations in the RA pulses.

Although the prime objective is to achieve correct tracking it is closely followed by the requirement to provide the graduate and post-graduate students with a convenient and friendly interface which only requires

instructions in terms of sky and camera details.

The user screen displayed by this interface had a heading at the top which showed the current position in RA and declination. The position of the tangent arm on the lead-screw in terms of degrees of movement available, and whether the telescope had crossed the celestial pole (in this case the sign of the Dec figures have to change).

Below this heading a window showed the commands as they were typed in. This allowed the last few commands to be displayed as it was scrolled up to allow new commands to be entered at the bottom.

Typical commands were:

Track	- switch on the RA step pulses.
Halt	- switch off the RA pulses.
Setpos	- sets the current RA and Dec positions in degrees, minutes and seconds.
Movem	- has two arguments, the distance to move in minutes. Zero is valid.

There were other commands which referred to the camera in terms of pixels. (CCD cameras are used).

Why Change?

There are several reasons

- The difficulties which might exist if a part of the BBC system failed. Although there are doubtless plenty of Beebs gathering dust and a cry for help would soon produce one, it would not be so easy to replace a 6502 slave as these were custom built and linked to the main processor by a Beebex expansion board also custom built.
- The interrupt mechanism linking the slaves and the Beeb could not cope with the correction of periodic errors.
- It was effectively impossible to change the program as it was written in BBC assembler language and contained in EPROM in the slaves. Neither tools nor expertise were available to update it. There were bugs in the program which prevented accurate tracking. (tracking means the RA motion).
- There is inevitably mechanical flexure in the telescope which makes it necessary to modify the tracking rate depending on the telescopes attitude. Not possible on the existing system.
- There is a cyclic error in the tracking.
- With the advent of improvements to the structure, better cameras, digital imaging etc. it would be desirable to achieve pulse generation of a high degree of accuracy so that the tracking achieved was only limited by the telescope structure not by the computer system.
- The improvement, in figures, means tracking with a short term accuracy of better than 0.1 arc seconds over 30 seconds, which translates freely into better than 1 part in 12960000 over 30 seconds. The long term accuracy required was better than 5 arc-secs per hour. (1 in 259200 per hour).
- A more powerful user interface would be helpful in particular the ability to change system parameters quickly and easily for example when cameras are changed.

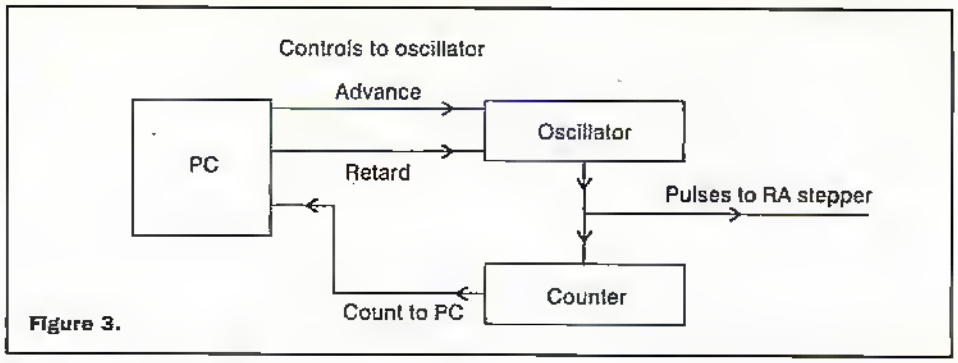


Figure 3.

New RA Drive

The solution to the obsolete control hardware problem required up-to-date equipment. However money is a problem. What's new ?!!

The university had a fine collection of PCs. Obtained chiefly by virtue of the kindness of ICL. Although these were not modern machines (they used 286 processors) they would be quite suitable as there was no necessity for absolute speed. There were also plenty of suppliers of plug in I/O boards for such a machine which would provide input and output lines to the outside world. Moreover, I had an early PC, an Amstrad machine, which already had a suitable board fitted. This appeared to be a no contest situation. The PC was the obvious machine to use, and doing so would mean that neither the University nor myself had to buy new equipment. Obviously it would be of considerable advantage if I could do as much of the development work at home as possible. Otherwise it would be restricted to Saturday afternoon working which would make it a long job and if there was any hardware to be built then all my facilities were at my home. A PC in this context means a computer based on the original IBM PC design. A device which has been copied, cloned and is now more or less a world standard made by many manufacturers.

The existing system had used the computer system to generate both sets of pulses and this seemed to me were it had run into trouble. I believed that the best system would be to generate the RA pulses by means of a local external oscillator, and then use the PC to ensure that the oscillator always ran at the correct frequency. The oscillator could be compared with the PC clock which is crystal controlled and if this was not sufficiently accurate then an external time source could be imported. Probably the Rugby 60kHz transmission, or one of the other time standards.

Analogies can be misleading, but suppose one wants to keep a mechanical clock at the correct time. Assume that there is no access to the hands. Thus if the clock was slow it had to be corrected by speeding it up. Conversely if the clock was fast then it could only be corrected by slowing it down. The clock is checked periodically (perhaps daily) by comparing it with a suitable reference. The BBC time signal perhaps?

Figure 3 shows a translation of this idea into electronics. The oscillator and counter could be in an external hardware unit having two input lines from the PC, Advance and Retard. The binary counter output lines would be inputs to the PC to be read by an interrupt routine called by the PC system clock.

To convert this idea into reality, the next question is "How many bits are needed in the counter"? Since each bit requires a line to the PC it would not do to go mad otherwise the I/O board would be run out of lines before the design had really started. By now the favourite I/O board was one based on the 8255 which has 24 lines which can be configured as either input or output. The configuration has to be based on two bundles of 8-bits, and two bundles of 4-bits.

We know that the RA step frequency should be 1671 which is outside the capability of 8-bits but is acceptable for 12-bits (maximum count 4096). In fact the count could be accumulated over two seconds to improve the accuracy of the check. The PC clock interrupts are at 0.055s intervals and 36 of these would give 1.98s and an expected count of 3309.

Figure 4 shows the hardware detail of the of the pulse generator developed from the Figure 3 idea. All the supplies are 5V with the exception of the supply to the CA3140 which is 12V. The latter is done so that the CA3140 can handle the full range of control from 0V up to 5V. The two supplies +5V and 0V to components are marked, but the supplies to the ICs are not shown as they are defined by their data sheets.

The Retard input from the PC I/O board is top left, and below it the potentiometer used for setting the at rest frequency. Again below this is the Advance input. The two 100k pots are ganged and provide the system loop gain adjustment. There are thus only the two controls on the hardware front panel.

The Very Fast input is used for move instructions, described later. At the very bottom is the RA Reverse input which directly drives an open collector stage which is the required input to the stepper drivers.

The output of the CA3140 summing amplifier passes to the frequency changing input of the 7555, via the RC network of 10k and 220µF. This latter network ensures that there are no rapid changes in the oscillator frequency which would cause the stepper motor to lose steps.

The 7555 is in the standard oscillator configuration required by all the 555 type devices. The two 33K resistors together with the 4700pF capacitor set the operating frequency in the region of 1671 Hertz. Final adjustment being made by the frequency adjust pot. This by the way is a 10 turn wire wound. A carbon based potentiometer is not sufficiently stable. The output from pin 3 drives the 4040 counter. N.B. The reset input is not used. The 12 output lines from the counter are returned as input to the I/O board in the PC.

Because of a special requirement of the

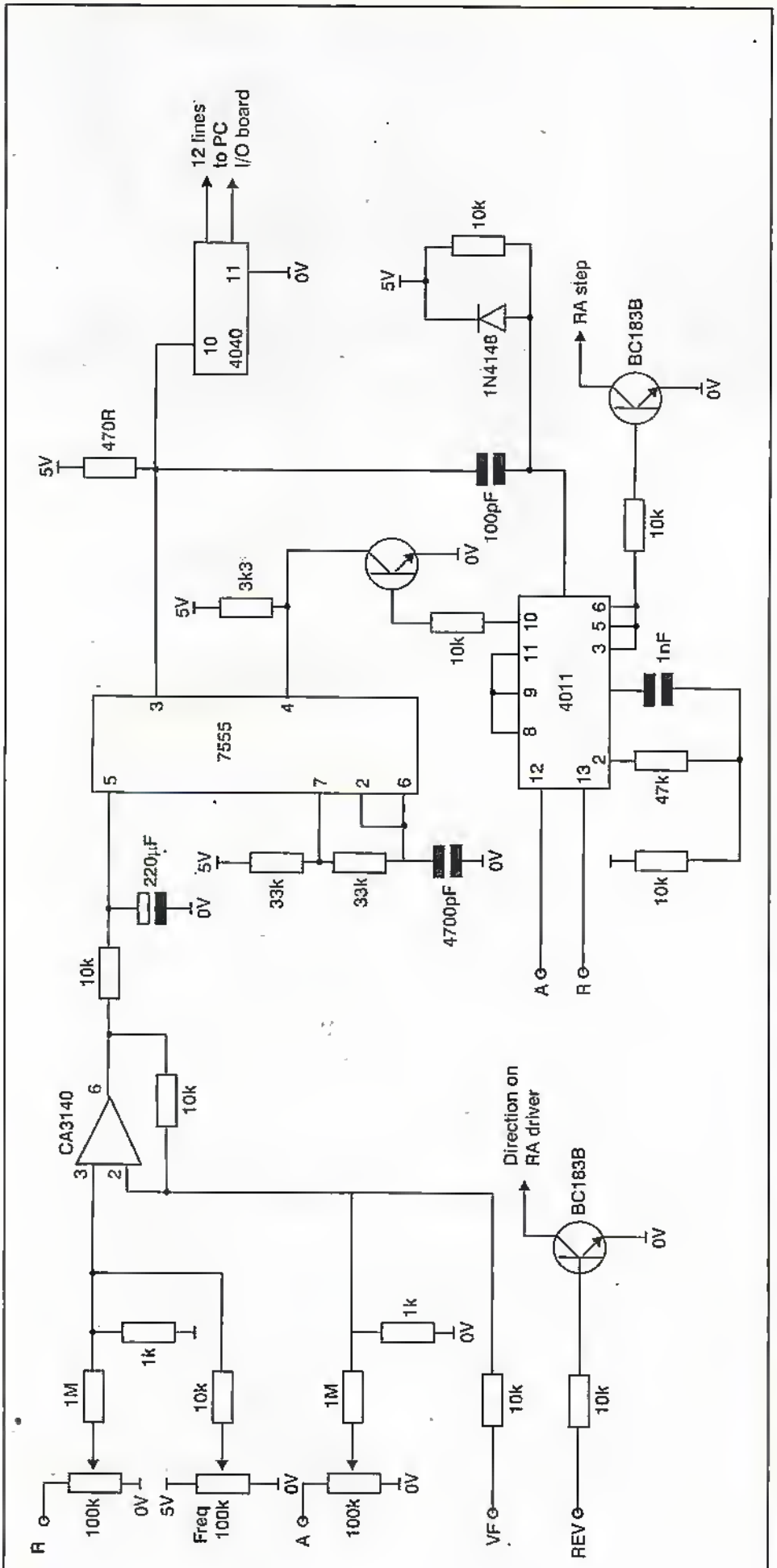


Figure 4.

particular driver used for the RA (a specified length for the pulse) a one-shot had to be added between the oscillator output and the stepper driver step input. (The oscillator output mark to space ratio changes with frequency). This is achieved using pins 1 to 6 of the 4011 IC. The output from this IC drives the BC183 to give the open collector output required by the stepper board.

Later in the development it was realised that a stop command would be needed and by this time we were running out of lines between the PC and the hardware module. To solve this problem it was decided that selecting both Advance and Retard simultaneously would generate Stop. Pins 8 to 13 provide the logic output at pin 10 of (A & B). When true this turns on the BC183 transistor which holds the reset line of the 7555 down to zero volts.

The 'C' language seemed to be the most suitable for writing the control program. I regard this language as a high level assembler and it is well suited to driving a hardware based project. It is also well know, and it is one in which I claim to be fluent!

The hardware module in Figure 4 is almost entirely driven by the timer interrupt routine. This interrupt occurs every 55 milliseconds approximately, the design of the RA system is not dependent upon the precise timing of this interrupt, only that its timing does not vary.

One of the first things to happen when the program is run is to set up the PC system so that each interrupt initiates the timing routine which I will describe in hopefully understandable English rather than 'C'. For this purpose the routine has been simplified considerably, particularly by the omission of several interlocks with other routines.

Figure 5 gives the main points of the routine, in which there are several important numbers which are used as follows -

- Number of interrupts. 1 is added each time the routine is performed. This is used as a cross check for various operations.
- Action control. Tells the rest of the program what is happening. Particularly used to synchronise the data on the user display. Sequence switch. Controls the action of the routine and counts off the sets of 36 timer interrupts.
- Hardware count. 12-bit count obtained from the 4040 in the hardware module.
- Cumulative difference. Running total of the difference between what the count was and what it should have been. Consequently records the error since observation started.
- S1. What the count should be over the 36 interrupt period.
- V1 & V2. Provision for a vernier adjustment. Currently not used.

S1, V1 and V2 are among the control variables which are read from disc when the system is initialised, but more about this later.

Remembering that the routine is actioned every 55ms and takes precedence over all else. On the first entry to the routine the sequence switch will be zero (given this value by the initialisation of the program upon first entry).

This causes the hardware counter to be read and the cumulative difference to be calculated by adding the counter value and subtracting S1. Having done this the routine is ended by adding one to the value of the

```
void interrupt timer_int()
   Add 1 to the number of interrupts.
   If the sequence switch = 0 then
        read the hardware counter
        calculate the cumulative difference
        cumulative difference=cumulative difference+counter-51
        ie. the cumulative difference will be negative if slow
   If the sequence switch = 1 then
        calculate any correction needed
        (this will have the same sign as the cumulative difference)
   If the sequence switch = 2 then
        If the correction required is positive
            set Advance and the time required
        If the correction required is negative
            set Retard and the time required
   If the sequence switch is greater than 2
        If the time switch is greater then the time required
            set Tracking ie. adjustment is finished
   Add 1 to the sequence switch value
   If the sequence switch is greater than 35
       set the sequence switch to 0 ie repeat the cycle
end of routine
```

Figure 5. Timer interrupt routine.

```
int read_counter()
     set repeat = 3
        read port b, read port c
        again read port b, read port c
        subtract 1 from repeat
        If repeat is 0 then
            set error of count read failure and finish
        If the two sets of readings are not the same then
            read again until repeat is less than zero.
        If repeat is zero declare an error and finish.
     If the read is good (repeat greater then 0)
     multiply the port c reading by 256 and add to port b reading
     Subtract the previous reading from this one
     If the answer is negative add 4096
     return the answer to the calling interrupt routine
end of routine
```

Figure 6. Read counter routine.

sequence switch and a check to see if this has increased the value of the sequence switch to more than 35. Remember that the sequence starts at 0 and 0 to 35 is 36 steps.

At the next entry 55ms later the sequence switch will be set to 1 consequently an algorithm calculates any correction needed, zero if the cumulative difference is zero. The correction can be between 0 and 30. Again the routine ends by updating the value of the sequence switch.

At the next entry the sequence switch equals 2 and the correction is applied if necessary to Advance or Retard. At this point the oscillator frequency will start to change as the A or R line in Figure 4 is made true (positive). This is applied to the control input (pin 5) of the oscillator via the summing amplifier and the RC network. The sequence switch is updated.

On subsequent steps (sequence switch greater than 2) the sequence switch is checked against the correction required. If the switch is the greater value the oscillator control is set back to tracking ie. both A an R set to false (0V).

The sequence ends with the switch being greater than 35 and thus set back to zero so the whole cycle is repeated. The oscillator frequency is thus checked every 1.98s and adjusted if necessary.

The question will doubtless arise – "why isn't all the count checking and calculation done on the first step, leaving 35 other steps to apply any correction needed?" The answer is simply that it was not known initially how much time would be required for firstly the interrupt, and secondly, for all the other work e.g. reading keyboard, putting up display, handling user interface etc. Consequently, I decided to spread the load over three interrupts.

Now just to take a look at the routine which reads the counter as there are two important points to be made, but before this, two lines are generated by the software - step and direction. These two are connected via the hardware module to the stepper driver in exactly the same fashion as the REV line shown on Figure 4 i.e. via an open collector transistor.

Figure 6 shows the read counter routine which is called from the interrupt routine just discussed. There are twelve lines used as inputs to the PC, 8 in port B and 4 in port C. Port B is the least significant bits.

Because of the shortage of lines between the PC and the hardware module the counter has to be run without a reset line. (Originally a reset was used - the shortage crept up upon us)! This leads to the fact that when the counter reaches 4095 the next count is 0.

The second point is that the counter must not be read whilst it is being incremented and so when a read is called for the counter is read in succession until two readings agree. Just three tries are allowed before a counter error is declared.

Hopefully Figure 6 will now make some sense. On entry the value of repeat is set to 3. Then port B is read and then port C, the two values being saved in variables. They are both read again and 1 is subtracted from repeat.

If the two sets of readings do not tally they are read again. If the two sets do not tally before the repeat value falls to zero an error is declared.

If the two sets agree then the port C value is multiplied by 256 and added to the port B reading to give the answer.

Finally if the current count is less than the previous count then the counter must have spilled over and 4096 is added to the value to correct it.

Next month we look at the declination drive, system parameters, user interface and user commands.

Although this system is entirely specific to the Keele Telescope its principles may be applied to other systems. Correspondence with the author will be welcomed at:

5 College Road, Alsager, ST7 2SS, or by phone Tel: 01270 875159.

PROJECT

Universal INFRA-RED PRINTER ADAPTOR

Richard Grodzik constructs a universal printer adaptor.

Introduction

Most Laptop computers today come equipped with a built-in IrDa (infra-red) option, which enables the user to make a 'wire-less' connection to a printer. However, my printer does not have an IrDa interface, and the choice was to scrap a good working printer and replace it with an IrDa compliant printer or find another solution.

My first port of call was the Internet. Microsoft have an IrDa-specific driver available for downloading at their Website:

```
http://www. microsoft.
com/windows95/downloads/
default. asp
```

Look for the entry 'Windows 95 IrDa 2.0 (Infrared Driver) W95ir.exe. Once this is downloaded to your laptop and run, the infra-red facility becomes active. I am told that Windows 98 has this driver included in it's operating system. Now, some kind of infra-red receiver is required at the printer end, along with a serial to parallel converter since most printers have a centronics (parallel) interface connection. In the past, I have experimented with RS232 infra-red transmissions but have only managed reliable communications at relatively low baud rates, typically 1200 baud.

Scanning the Internet once again, revealed an I-R module, the HSDL8000 produced by Hewlett Packard. This comes as a low cost development package consisting of two pre-built I-R transceivers. Although the IrDa standard is based on the RS232 serial link having the same communication baud rates of 9600 19200 57600 etc., the bits making up the data are transmitted differently. For example at a baud rate of 9600 each bit is 104µs wide in it's transmission along a RS232 wire interface. With IrDa, much smaller width pulse widths are used - typically 3/16 of the bit time are transmitted in the infra-red beam. Therefore, a decoder of some sort is required, either in hardware or software to extract the raw serial RS232 data. The HSDL 8000 has one other useful feature - a built-in hardware decoder - the HSDL7001, which is ideal for the job. It is now a relatively simple matter to convert 8-bit serial data from the module to the parallel format required by the printer. I chose a ubiquitous PIC chip, and with a couple of hardware handshake lines was able to establish an I-R communications link at 9600 baud, printing 360 x 360 graphics on my Canon bubble jet at a range of 10ft. See Figure 1 for a simple block diagram.

Limitations

The project described here is a 'pseudo IrDa' link using only a simplex I-R link from laptop to printer. No handshaking is involved and therefore the link is fragile. If the I-R link is broken when printing say, by placing a hand inadvertently between the laptop and the printer, the link cannot be re-

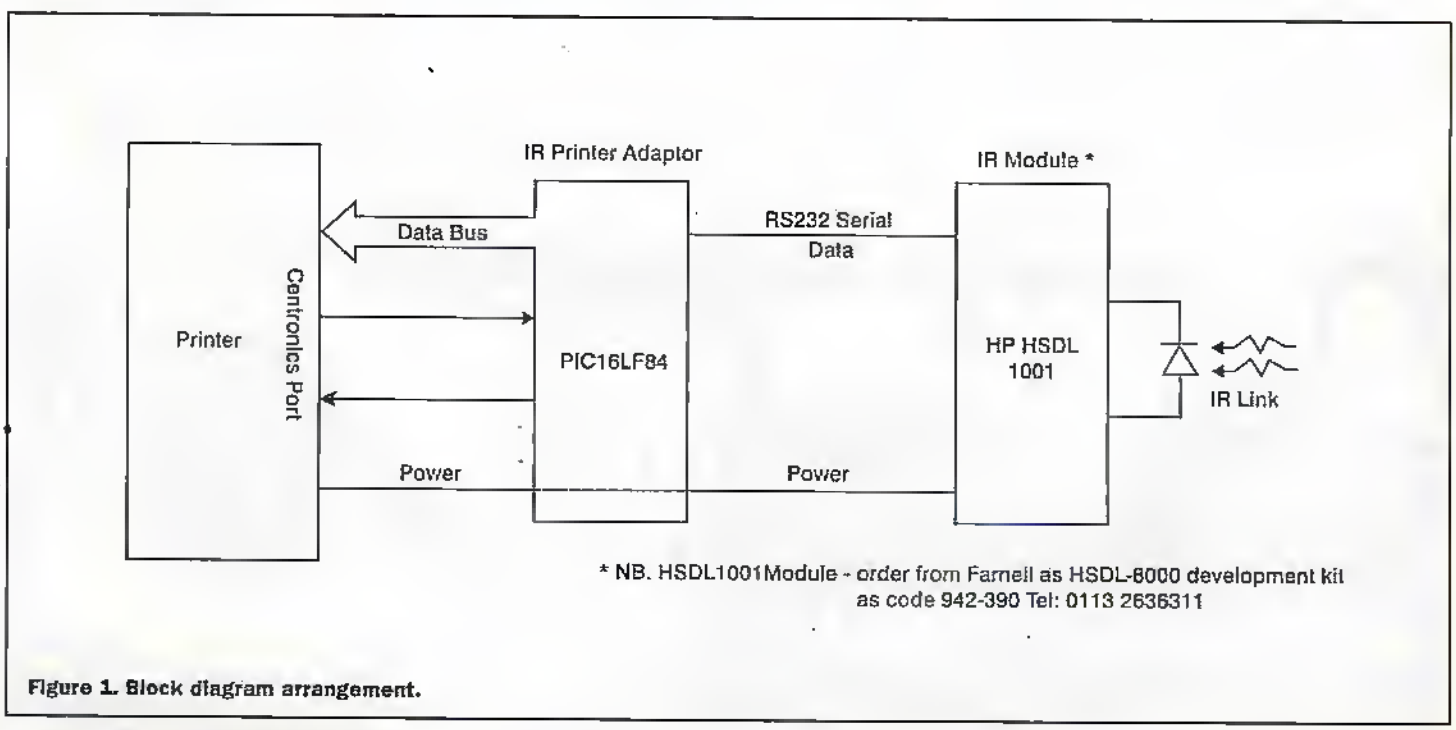


Figure 1. Block diagram arrangement.

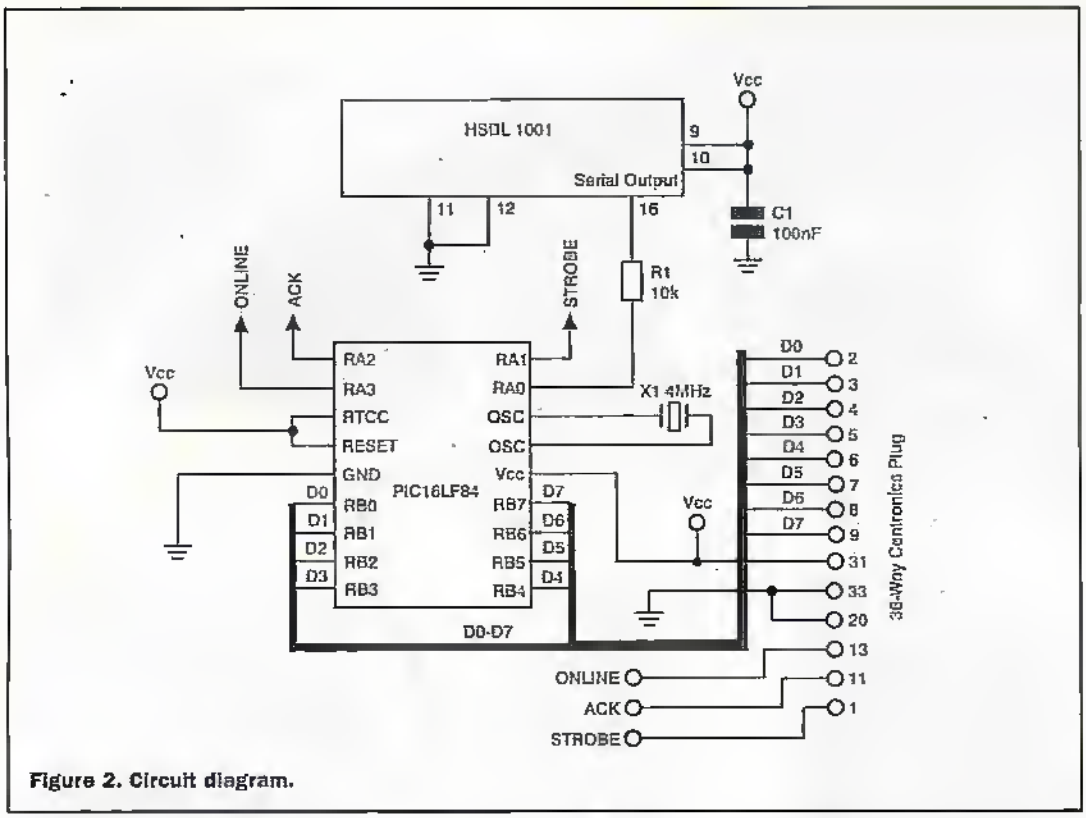


Figure 2. Circuit diagram.

established and the printing sequence has to re-commence from the beginning. Multiple page printouts are possible if the printer has a large enough buffer, since even at a baud rate of 9600, the printers buffer soon becomes full. If using a laser printer this should not present a problem since most have at least 2Mbytes of buffer space. The IrDa link is also constrained by the need for line-of-sight (±8°) between the printer and I-R transmitter and the printer I-R interface. No, you cannot bounce the beam around the walls as you can with your TV remote control. Even so, a guaranteed range of 0 to 1m is stated by the IrDa protocol under all lighting conditions. Figure 2 is the circuit diagram.

Setting-up the Laptop for I-R communications

Once the W95ir.exe file has been downloaded from the Internet and run, the printer driver needs to be set up. In this case a duplicate printer driver is installed and configured for I-R transmissions. In this way you can easily switch between a conventional parallel or I-R link. Assume we are using Windows 95 then:

At the start button in the desktop select SETTINGS and then CONTROL PANEL. Select PRINTERS, your original printer driver is displayed as an Icon. Select ADD PRINTER -the add printer wizard will pop up to guide you through the next process. Click NEXT, Select LOCAL PRINTER, click NEXT. A selection of printers will appear - choose the one that you already have since we require a duplicate. Click OK. Click on KEEP EXISTING DRIVER (this is recommended) click NEXT. Select COM2:GENERIC IR SERIAL PORT. Note that the COM number may vary according to laptop manufacturer. Printer name COPY1 appears. Click NEXT. Click on FINISH. Click

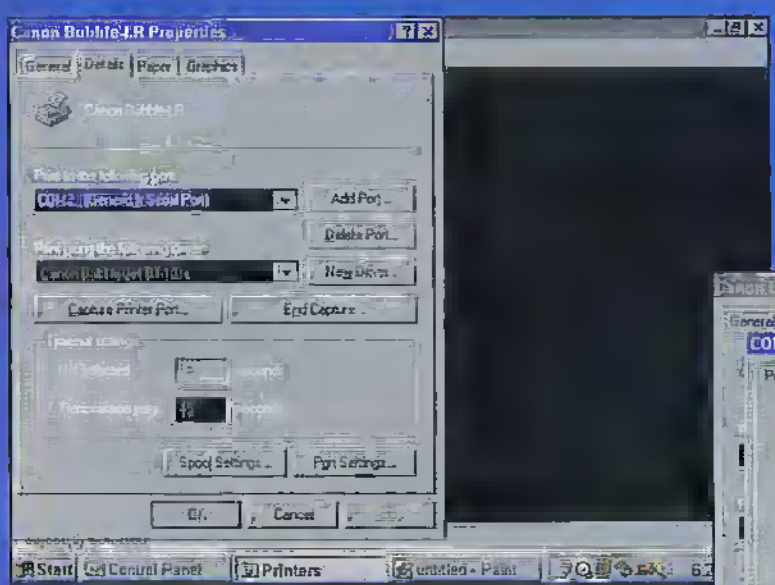


Figure 3.

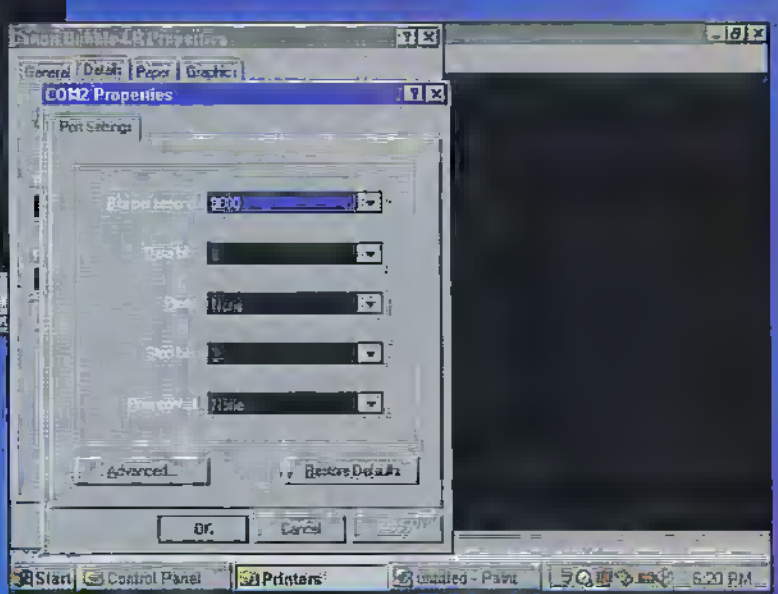


Figure 4.

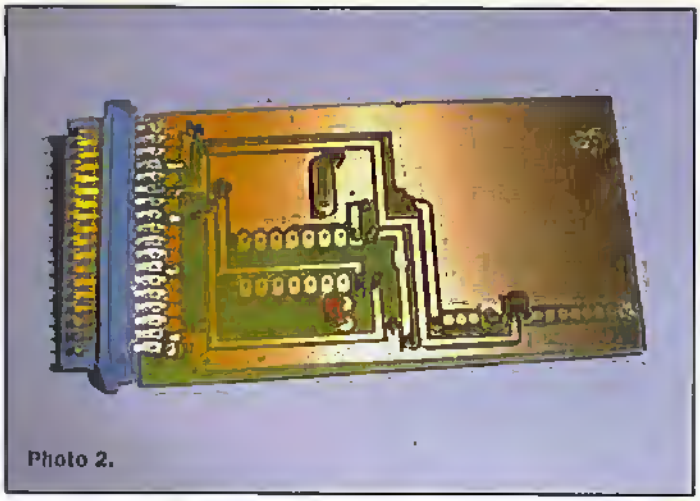
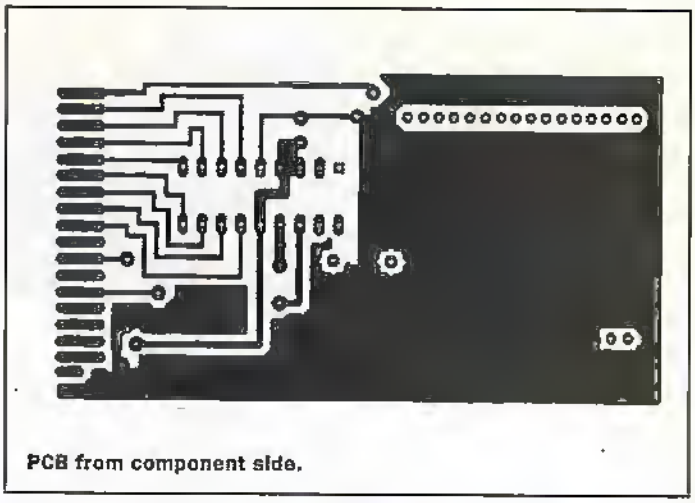
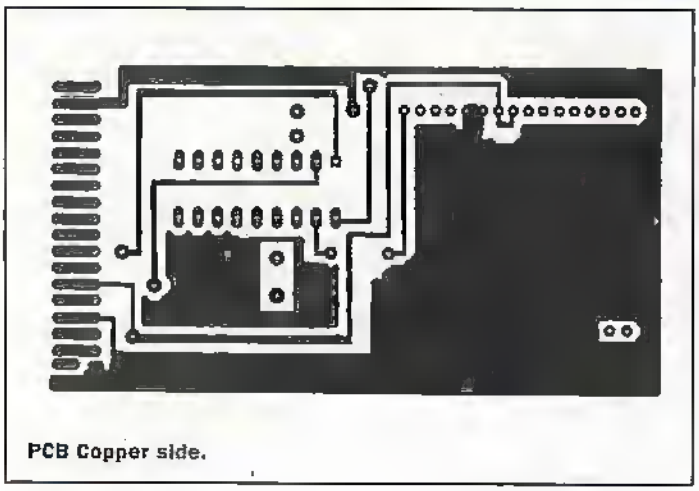


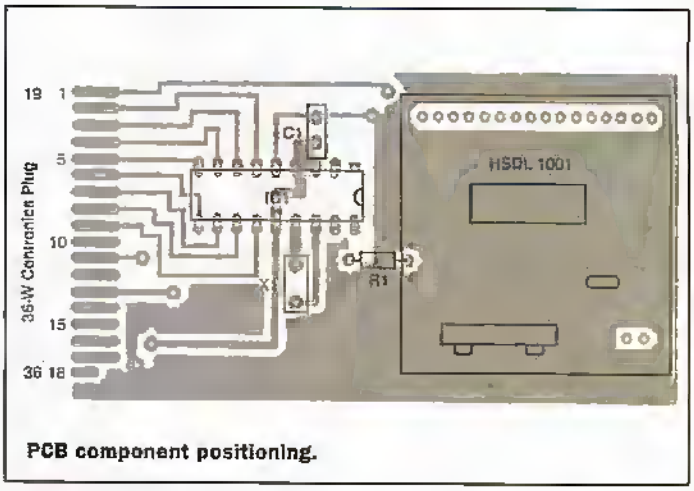
Photo 2.



PCB from component side.



PCB Copper side.



PCB component positioning.

with the right-hand mouse button on the new printer Icon and choose PROPERTIES. See Figure 3.

Select PORT SETTINGS See Figure 4. The port settings must be setup to 9600 baud, 8-data bits no parity, 2-stop bits. Now select SPOOL SETTINGS. Choose PRINT DIRECTLY TO PRINTER and click OK and then click on APPLY. To select between parallel and I-R printer click with right-hand mouse button on printer icon in Printers menu and click on SET AS DEFAULT using left-hand mouse button.

Construction

The I-R printer interface is built on a double-sided PCB witch fits snugly between the two rows of pins on the centronics printer plug. If the board is a loose fit, place the connector into a small vice and tighten slowly, so that both rows of pins make contact with the board. The fabrication of a double-sided PCB is time consuming but achievable if the correct procedure is used:

Cut the photo-resist double-sided board slightly larger (1in overlap) than the actual size required. Remove the protective backing of the board on one side and secure the component side artwork with tape along the edge. The artwork needs approx. 1/4 inch overlap, so that it can be tapped to the board. Drill two small 0.8 mm holes diagonally opposite through the artworks and the board. Remove the protective film on the reverse side of the photo-resist board and offer the copper side artwork to the board. Correct positioning is achieved by holding up the sandwich of artwork-board-artwork to a light source and lining up the two drill holes in line with the artwork. Secure with tape

The board can now be exposed in ultra violet light on each side in turn and then processed as normal.

The plate-through-hole connections on the board are simply achieved by soldering a small piece of wire on both sides of the board. The PIC chip is positioned on the component side of the board and all pins are soldered on the component side. In addition, pins 1, 2, 17 and 18 are also soldered on the copper side. The 10k resistor is placed on the component side.

At this stage observe static precautions when handling the HSDL1001 module. This module is mounted on the main board by means of header pins which serve a dual purpose of electrical connections and as hardware spacers to separate the two boards by approximately 10mm. An additional pin at the LED location on the module only serves as a spacer and there is no electrical connection. Slide the completed board unit in-between the centronics plug contacts and solder both sides.

Now check the board for short and open circuits and then connect into the printer. A voltage of approximately 3.8V should be measured at pin 14 of IC1, but this will vary according to printer type. No external voltage supply is required since the small current and voltage requirements of the I-R printer adaptor is drawn from the centronics port of the printer.

PROJECT PARTS LIST

RESISTORS

R1	10k Min Res	M1K

CAPACITORS

C1	100nF Ceramic	YR75S

SEMICONDUCTORS

IC1	PIC16LF84	See Note
H. P. 1001 I-R Transceiver/Endec from Farnell Electronics Code 942-390		

SUNDRIES

X1	4MHz Crystal	FY82D
	36-way Centronics plug	FJ61R
	pin headers	as reqd. JW59P

Note. A pre-programmed PIC is available for £14.50 including p&p exclusively from:
R. Grodzik (Micros) 53 Chelmsford Road, Bradford, BD3 8QN, U.K.

TECHNOLOGY WATCH

with Martin Pipe

For those prepared to brave the lousy roads and miserable weather, this years Sound and Vision Show held in Bristol at the end of February had some interesting treats in store. This annual event showcases all that is best in hi-fi and AV equipment, and is attended by all the big names - as well as some companies you might not have heard of, unless you are a serious audiophile. Sound and Vision is not like your average consumer electronics show. This is not an aircraft hangar-sized hall populated with hundreds of stands all trying to outdo each others SPL figures - with often-painful results. Thankfully, the Bristol show is rather more subtle. The Marriott hotel that hosts it is basically taken over for the February weekend. Rooms that normally accommodate weary business travellers are filled with the hi-fi products from a particular manufacturer or distributor, usually with listening facilities so that you can try before you buy - often at a preferential price. In terms of sales, Arcam - which demoed its DAB radio tuner and home cinema-upgradable Alpha 10 amplifier - came out tops. Speaker manufacturer Mission, which took over one of the larger downstairs rooms with its impressive range, came second.

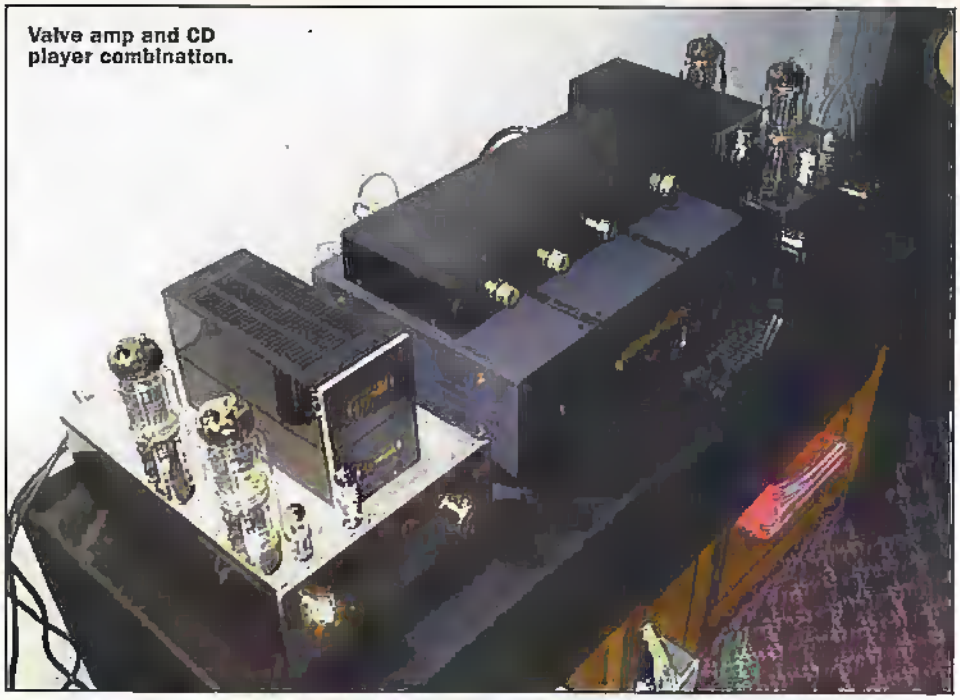
There is nothing like a decent demo to get your wallet open. Although the acoustics of hotel rooms are far from ideal - not least because of unwanted sounds wafting through the dividing walls - they do at least bear some kind of resemblance to the domestic listening environment. Some high-profile manufacturers, such as the relatively-new Tag McLaren, did set up glitzy stands in the more capacious downstairs rooms. If you wanted to hear its products, you had to travel to a local hi-fi shop - thankfully Tag McLaren provided free transport. Another company that made minibus companies a little richer over the weekend was Technics, which took over the nearby Swallow Hotel to give UK audiophiles a chance to hear the new super-fidelity DVD Audio format for the first time. A prototype player was hooked up to top-of-the-line Technics power amps and floor-standing studio monitor speakers. High-resolution stereo (24-bit, at a sampling rate of 192kHz) and surround (6 discrete 96kHz/24-bit channels) modes were experienced with specially-produced music from Enya and Bach amongst others. The sublime results were well worth the travel. Sony, sadly, did not go to such extremes with its rival SACD format - its Mariott demonstration, in conjunction with What Hi-Fi, wasn't quite up to the same standard, although it certainly proved popular with visitors.

Both SACD and DVD Audio are essentially based around DVD-type technology - short-wavelength lasers, multiple recording layers and increased data packing densities are drawn upon. These technologies are, however, employed in slightly different ways - although the results are comparable. Both DVD Audio and SACD offer a specification that is several leagues better than CD. You get a dynamic range of 120dB or more, coupled with a frequency response of DC to around 100kHz, and support for discrete 6-channel surround sound. Each system has its own disadvantages and advantages, and these - together with the availability of affordable software and hardware - will determine the ultimate winner. SACD was co-developed by Philips and Sony. Its biggest selling-point is downwards-compatible media. You can start buying SACD discs as soon as they arrive, and play them on your existing equipment - albeit with the sound quality of standard (Red Book) CD. To get the full benefit, you would need to invest in a

Tag McLaren AV32.

Sony DVD player.

Tact Millennium



Valve amp and CD player combination.

Well cared for second hand records.

Well tempered turntable.

SACD player. Expect to pay a lot of money for first-generation players.

SACDs dual compatiblity is achieved by means of a dual-layer disc. A 650-megabyte surface layer contains the audio in 16-bit PCM stereo form. This layer, which is to all intents and purposes a regular CD, can hence be read by the infra-red laser of conventional hardware. A deeper high-density layer, which has a DVD-magnitude capacity of 4.7Gb, contains the SACD stereo (or multi-channel) audio. This layer, which requires a short-wavelength laser (ultra-violet) laser to read, is encoded to a new bitstream-like standard known as DSD (Digital Stream Digital). So far, so good. Unfortunately, dual-layer discs are expensive to produce, which is why all current DVD movies are single-layered (and single-sided, come to think of it). SACDs competitor, DVD Audio, is not backwards-compatible with CD. The surface layer is not Red Book-compliant. Instead, its the same high-density 4.7Gb variant that is associated with DVD movie discs. As with DVD movies, discs do not have to be dual-layer. Single-layer DVD movies are in volume production, and the same plants will be able to churn out DVD Audio discs without much trouble.

A single-layer disc is enough to store just over an hour of music recorded at the highest-quality possible (192kHz sampling, 24-bit resolution). In theory, you could get over four hours of better-than-CD quality (48kHz/24-bit) music on one single-layer disc. Whether this will happen is another matter - punters will think they are getting better value for money if their compilations are delivered on multiple discs! If dual-layer recording is employed, the maximum playback time at the highest possible quality is increased to nearly 2 hours. Although Technics demonstration involved a prototype audio-only player, I was told by a company representative that a combined DVD video/audio player would eventually make it to market. Because the required mechanisms are very similar, it should not be that difficult to make a combined SACD/DVD Video player. Indeed, this was not ruled out by Marantz, which demonstrated a prototype SACD player in its ground-floor room. A does-everything SACD/DVD Video/DVD Audio player is unlikely, though - politics, rather than technology, is the barrier here. As a point of interest, Sony has a hand in both technologies. In addition to its involvement with SACD, its also part of the 40-strong WG4 consortium responsible for DVD Audios development. Sony does, however, own record companies. So too do other major hardware manufacturers, which must surely influence which way the wind blows. Software alliances are clearly an important variable in the success equation, which is why many of the giants acquired controlling interests in the relevant companies ten or so years ago.

DVD Audio and SACD were not the only technologically-interesting items at Bristol. Tucked away on the NAD stand was a very innovative amplifier, although its name hardly suggests originality. TACT Audios Millenium is the first commercially-available digital amplifier - although experiments in this field date back to the early days of CD. So how is the Millenium different? Most amplifiers designed for digital sources employ a digital-to-analogue converter, followed by a conventional analogue amplifier to drive the speakers. The Millenium,

Naim CD player.

Lifestyle subspace systems concept.

conversely, uses pulse-width modulation (PWM) techniques to directly amplify a S/PDIF digital output from a CD player or other digital audio source. The PWM-amplified signal is then subjected to filtering, yielding an analogue signal that can power the speakers. This approach eliminates several stages that can detract from sound quality - TACT claim that the end result is characterised by an excellent dynamic range, low distortion/noise and outstanding neutrality. Efficiency is also high - there is little heat generated. Unfortunately, NAD had not wired up this 6000 amp when I visited its stand, and so I could not experience these claims for myself. If you want to experience Millenium with conventional analogue sources, an analogue-to-digital converter is needed. This will be available as an option, when full production - expected before the summer - begins.

Most manufacturers showed off their CD hardware, DVD players, home cinema systems and other digital products. You could also see (and buy) a self-contained CD recorder from Traxdata - similar products are available from Philips (who were not at the show) and Pioneer (who were). Although much emphasis was given to digital wizardry, analogue fought back bravely. Many high-end audiophile demo rooms gave visitors the chance to listen to vinyl records amplified by valves. Indeed, some of the most natural sounds of the show were experienced in this way. But then again, you should expect real high-fidelity if you are prepared to spend nearly £10,000 on the turntable/tonearm/cartridge combination alone! Vinyl is less and less common in record shops these days, but Bristol harboured several specialist stands selling well cared-for second-hand records and expensive audiophile pressings. Hybrid mixes of new and old technologies were also in evidence - I saw valve amps coupled with latest-generation CD players. There are, would you believe, also audiophile CD players that employ valves in their analogue signal processing circuitry!

What else was there to see? A welcome announcement was the return of Nakamichi - purveyors of fine cassetate decks. This is perhaps a little strange, seeing that cassettes are slowly being replaced by Minidiscs and recordable/rewritable CDs. Indeed, there were plenty of Minidisc recorders, in both stand-alone deck form and as part of several audiophile mini systems from the likes of Denon, Onkyo, Teac and others. The new Nakamichi line-up has only two cassette decks - the DR-8 (2-head) and DR-10 (3-head) models, both of which are re-hashes of existing popular models. There are no

Wharfdale flat-panel speaker.

Minidisc recorders from Nakamichi, although the range does include AV amplifiers (integrated multi-channel amps with built-in surround-sound decoders) and a DVD player. The most exciting Nakamichi products, however, are a unique range of integrated lifestyle audio systems, which represent a radical departure for the company. The smallest Soundspace model, the Three, is a £500 bedside CD clock/radio, with detachable speakers and a subwoofer. Its clearly pitched at the Bose end of the market. The top-of-the-range Soundspace 11, which is planned to sell for around £5000, includes Dolby Digital, DTS and Dolby Pro-Logic surround decoding, a 5-disc DVD/CD autochanger, and all speakers (including a subwoofer). The drive units of the front/stereo speakers can be raised or lowered to correspond with the listening position. There is also an optional flat-screen TV with an 18in. TFT screen. We were shown mock-ups, but all models should be available by the end of the year.

Home cinema was well-represented at the show. Most of the bigger manufacturers offered worthwhile demonstrations, usually with DVDs, Dolby Digital surround and widescreen TVs. DVD players were abundant - just about every Japanese marque had at least one on show. Meridian and TAG McLaren flew the British DVD flag. Arcam demonstrated off its new 850 DAVE (Digital Audio Video Entertainment) module, which converts the highly-regarded Alpha 10 integrated amp into the basis of a high-performance AV system. The factory-fitted DAVE features Dolby Digital/Pro-Logic/DTS decoding, a learning remote and multiple source switching (including provision for composite and S-video). You'll need extra power amps for the surround channels, though. Arcams DAB tuner also generated excitement - similar products were shown by Technics and Meridian. Cabling was much in evidence - whether speaker cabling, video cabling, line-level cabling or mains cabling. Mains cabling? That's right, one company claims that its mains cable makes all the difference to sound quality. Hmm, better start trying to persuade the local electricity company to do its best - and upgrade its infrastructure to something a little more audiophile-friendly. Audio cables can, however, yield a subtle improvement. But then again, this is hardly surprising - the stuff bundled with hi-fi equipment tends to be of crap quality. Beware of the nonsense and pseudo-science spouted by cable suppliers, though (skin effect at audio frequencies indeed). Although line-level interconnects and speaker cables can make a difference, the benefits of ultra-fidelity video cables are somewhat more dubious. After all, VHS is of poor technical quality to start with - and the often-noticeable MPEG-2 artifacts of DVD video are not that impressive either. One thing is for sure - all of that extra equipment to connect up means boom time for the cable vendors!

Cable companies are not the only ones that love the concept of surround sound. By far the biggest beneficiaries are the speaker manufacturers, who can now sell five (or more) units, where two would once have sufficed. There were plenty of these - big and small - to be seen and heard, including new launches from Mission, Jamo, Elac, KEF and Monitor. Flat-panel speakers from Wharfedale (LoudPanel) and Mission (nxt) sounded remarkably clear, with a remarkably well-defined soundstage to boot. Unfortunately, bass isn't their strong point - they are best partnered with a subwoofer. One such design was the TS300 from REL subsidiary Tsunami. This diminutive £285 sub, which looks more like a tiny air conditioning unit than a piece of hi-fi hardware, has a very useful feature. There are four bass equalisation/level presets, which can be assigned to different listening modes - such as movies, dance and classical music. In all, there was quite a lot to see at the show - although Linn Products (the turntable-turned-lifestyle-hi-fi manufacturer) was conspicuous by its absence.

Next years Sound and Vision Bristol takes place between Friday 18th and Sunday 20th February 2000. HFC

Martin Pipe welcomes comments and ideas. E-mail him as: bhatnet@cix.compulink.co.uk. Or look out for him online! His ICQ ID is: 15482544.

@Internet

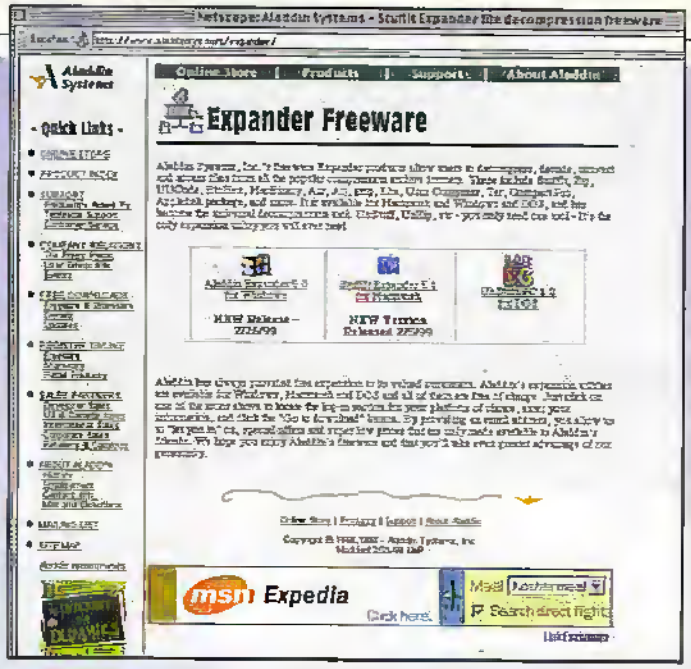
Speak To Me

We've all heard of HTML, hypertext markup language, which is the language that drives all of the Internet's current Web pages. This is a text-based language that allows straightforward control over linking between pages and the layout of the pages themselves. Well, a new group comprising three large players in the communications field - Lucent Technologies, AT&T, and Motorola - are combining forces to start development of a new Web language called voice extensible markup language (VXML) that is to allow voice control of Internet access and surfing. It's pretty much an obvious step in the development of the Internet when you think about it, but so far plans to generate voice controllability have been largely too complex and certainly too diverse, depending more on the surfing computer's ability to decode and utilise voice commands rather than incorporating the facility in the language that actually drives the Internet. The aim of VXML is not only to allow voice control from your computer though, instead it's a good stab at allowing Internet access by voice over a telephone - the idea being that even people without a computer can have Internet access. If it succeeds it's likely to have a large effect on how we use telephones and, indeed, on the type of telephones available.

The three companies have formed the VXML Forum which aims to standardise the methods whereby control by voice is used, in much the same way that HTML standardised the way we all now point and click our way around the World Wide Web by mouse control. According to the group, over 13 other large companies have agreed to participate in the forum and, as a result, VXML looks set to actually work.

Genie In The Lamp

Aladdin Systems has long been the developer of the best-used compression product available for the Mac - Stuffit. Even non Mac users will probably have come across stuffed files in the Stuffit format (usually spotted as having the file extension .sit). The main tool used to decompress stuffed files - Stuffit Expander - is installed by default within the Mac OS, and many Mac users won't even realise that a file



they try to open is decompressed automatically before it opens. PC users who try to decompress a stuffed file, on the other hand, won't generally be able to. Aladdin Systems does make both Windows and DOS versions of Stuffit Expander, and they're available for free download from its Website, at <http://www.aladdinsys.com/expander>. The brand-new latest version for Windows (version 5.0) is there, as is version 5.1 for Mac. Not only does Stuffit Expander decompress stuffed files, it will also decompress (and decode) files in Zip, UUCode, BinHex, MacBinary, Arc, Arj, gzip, Lha, Unix Compress, Tar, Compact Pro, and more. Whatever of the main platforms your computer runs on, it's worth downloading a free copy for that odd occasion when you can't access a compressed file.

Centre for Virtual Teachers

The British Educational Communications and Technology Agency (Becta) <http://www.becta.org.uk> has been tasked by the Government to ensure that technology supports the Department of Education and Employment's drive to raise educational standards in general, and in particular to provide the professional expertise the DfEE requires to support the future development of the National Grid for Learning (NGfL). As such, Becta works closely with the DfEE, other government departments and agencies and local educational authorities to provide the advice and support needed to assist the Government in meeting its objectives. What this means in principal is a coordination of the NGfL, and in particular, the set up and coordination of things like the Virtual Teacher Centre which has already been launched on the NGfL.

The VTC is a place where, it is hoped, teachers will congregate on-line, swap ideas, and find resources that will aid in classroom development and teaching. It's worth a look, even if you're not a teacher, and you'll find it at <http://vtc.ngfl.gov.uk/>.

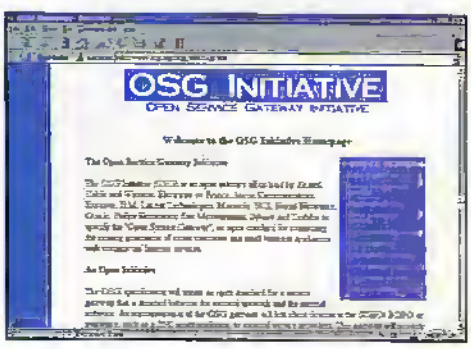
Leaders Create Standard for Domestic Internet Services

Fifteen leading technology companies have announced a new alliance to create and maintain the Open Service Gateway specification at <www.osgi.org>, the industry's first open interface for connecting consumer and small business appliances with Internet services.

The Open Service Gateway specification will be designed to provide a common foundation for Internet service providers (ISPs), network operators and equipment manufacturers to deliver a wide range of Internet services to gateway servers running in the home or remote office.

Alcatel, Cable & Wireless, Electricite de France, Enron Communications, Ericsson, IBM, Lucent Technologies, Motorola, Network Computer, Inc., Nortel Networks, Oracle Corporation, Philips Electronics, Sun Microsystems, Sybase, and Toshiba intend to jointly define the Open Service Gateway specification to allow the consolidation and management of voice, data and multimedia communications to and from the home.

The specification will also be designed to provide secure wireless or wired links between high-value home services - such as security, energy management, emergency healthcare and electronic commerce services - and the



computer systems of external computer networks and Internet service providers.

World's Largest Video Store Online

Black Star at **<www.blackstar.co.uk>** is a true British success story. The UK's biggest video store, Black Star brings an innovative, highly customer-driven approach to the emerging market for goods bought on-line. Two factors - customer obsession and continuous innovation – lie behind its drive to become a pioneering global force in e-business.

Based in Belfast, Northern Ireland, the groundbreaking, privately-held company sell more than 60,000 videotape and DVD titles, including every release currently available in the UK, compared with an average of around 2,500 titles in a traditional High Street outlet.

Black Star is on a high growth curve. Launched early in 1998 they have consistently achieved an average sales growth of 40% month on month, and currently have customers in 78 countries.

All items are delivered free and within 48 hours in the UK, and with monthly promotions on hundreds of titles, Black Star provides a compelling alternative to High Street video shopping. Purchases are made on-line using a secure ordering and transaction processing system that accepts all major credit cards, cheques and money orders. Once dispatched all orders are tracked automatically until they reach their final destination – the customer's letterbox.

Dell Debuts Online Superstore

Dell Computer is launching an online store that will sell 30,000 electronic products in addition to the company's made-to-order PCs. The Gigabuys.com store at **<www.gigabuys.com>** store will offer customers everything from memory chips to digital printers and 3Com PalmPilots.

Meanwhile IBM and Dell have reached an agreement under which Dell will buy $16 billion worth of disk drives and other equipment from IBM over a seven-year period at a level of discounted pricing appropriate for such a large purchase.

Wired Digital's Webmonkey Provides Beginner's Guide to the Net

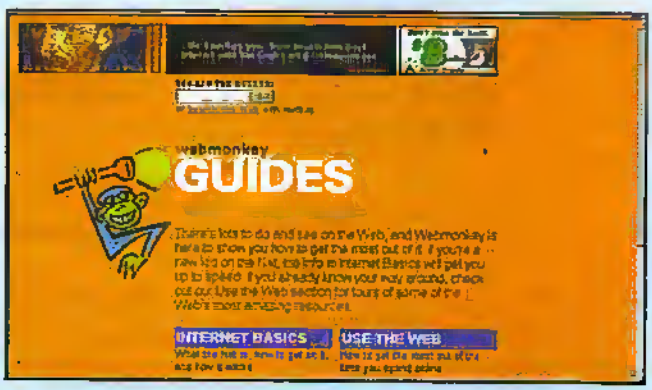
In anticipation of the more than 110 million new Web users poised to go online over the next four years, Wired Digital's leading Web-developer site, Webmonkey at **<www.webmonkey.com>**, a Lycos Network site, has launched a new companion Web site that helps beginning users harness the power of the Internet in their daily lives.

The new site, called Webmonkey Guides at **<www.webmonkey.com/guides>** provides in-depth, easy-to-understand tutorials that impart the best ways for new users to get online and use the Web's powerful underlying communications technologies, including browsers, email, chat, and newsgroups.

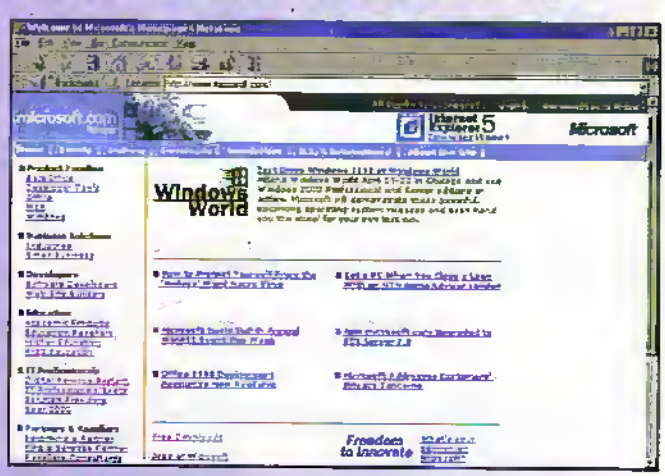
In addition, the site offers valuable lessons about how to perform traditionally time-consuming tasks and errands via the Web, such as finding a job, planning a trip, buying a car, and managing personal finances.

Developed by the editorial team that launched the seminal HotWired site at **<www.hotwired.com>** in 1994, Webmonkey has quickly grown in popularity to become a definitive online information resource for professional and amateur Web developers.

Webmonkey Guides continues the tradition by incorporating Webmonkey's time-tested tutorial format and upbeat, informal editorial style to effectively convey information to Web newcomers.



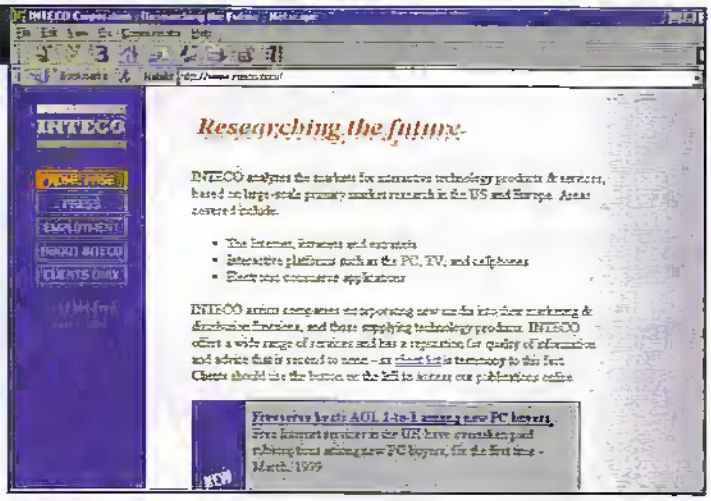
Microsoft Releases New Browser



Microsoft at **<www.microsoft.com>** is set to unveil its Internet Explorer (IE) 5.0 Web browser, which includes a junk e-mail filter, improved video-conferencing technology and a feature that alerts users to Web pages with content similar to that which they are browsing.

A tie-up with RealNetworks enables IE users to connect to the RealGuide, a directory of sites offering video and audio clips that can be downloaded using RealNetworks' streaming media technology. The new IE also will include Microsoft Agent technology and improved Wallet software to make online shopping more convenient.

Freeserve Beats AOL 2-to-1



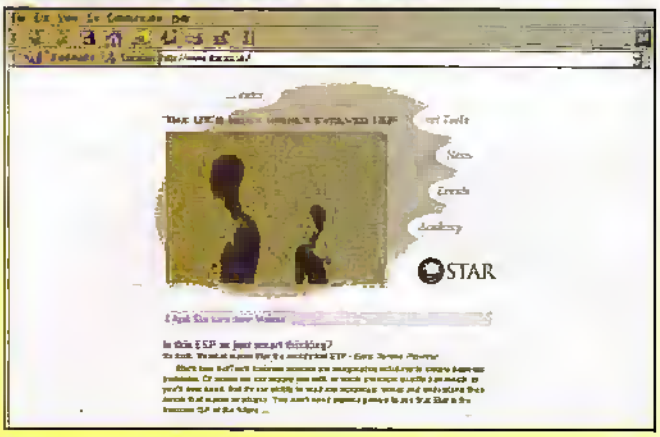
Free Internet services in the UK have overtaken paid subscriptions among new PC buyers, for the first time. More than half of new buyers are online, the Internet is now second only to games as the most common use, but still not cited as the reason for purchase.

The latest quarterly wave of Inteco's PC Home Tracking research reveals that, for the first time, the proportion of recent buyers in the UK that are online using free-ISPs is higher than that for paid Internet and online service subscription.

Freeserve, with a 36% share of all service providers mentioned, has displaced AOL, with 19%, as the leader among recent PC buyers. AOL held the top spot for the previous five waves of research.

Overall, Inteco's new research shows that the proportion of recent PC buyers in the UK who are online continues to increase steadily, now at 53% up from 48% three months earlier.

One in a Thousand Emails is a Potential Virus Carrier



Tens of thousands of emails pass through ISPs' systems every day. According to research published by Star, one in a thousand will contain a virus. The company has published the figures to highlight the need for ISPs and computers users to protect businesses against computer virus infection.

Since it launched the first ISP virus scanning system earlier in March, Star has intercepted a variety of malicious and benign viruses.

Star currently handles up to 10,000 emails per hour. Out of these, the scanning system catches, on average, 100 infected mails each day, which could threaten corporate security with a variety of problems if not identified.

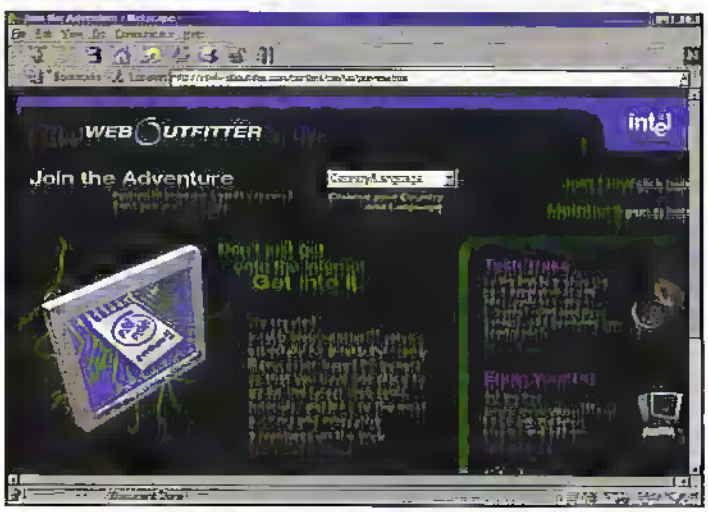
Star produces a weekly report on viruses caught, including a chart of the week's most prevalent viruses. The report is published on-line at <www.star.co.uk>.

Intel WebOutfitter Service Goes Live

The Intel WebOutfitter service at <intelWeboutfitter.com>, a new Internet service for Pentium III processor owners, is now live on the Web. The Intel WebOutfitter service delivers cutting-edge content, tools and tutorials that are designed to enhance the Internet experience for consumers of Pentium III processor-based computers.

Members of the Intel WebOutfitter Service will be equipped with specially tuned plug-ins, have access to expert guidance on topics that interest them, and directed to Web sites relevant to the featured theme. The service is broken down into three easy to use sections: 'Tech Treks', 'Equip Your PC' and 'Site Seeing'.

Intel plans to evolve this new service to include next-generation content, technologies and services in an effort to provide significant value to users of high-performance Intel based PCs.



AMD and Microsoft Unite for Game Championship

AMD and Microsoft have joined forces with The Playing Fields and Dennis Publishing to bring together PC gamers from across the country to find the ultimate UK Champions.

£20,000 worth of cash and prizes goes to the team that proves that they are winners in a variety of games categories which will test their all-round skill, reflexes and dexterity.

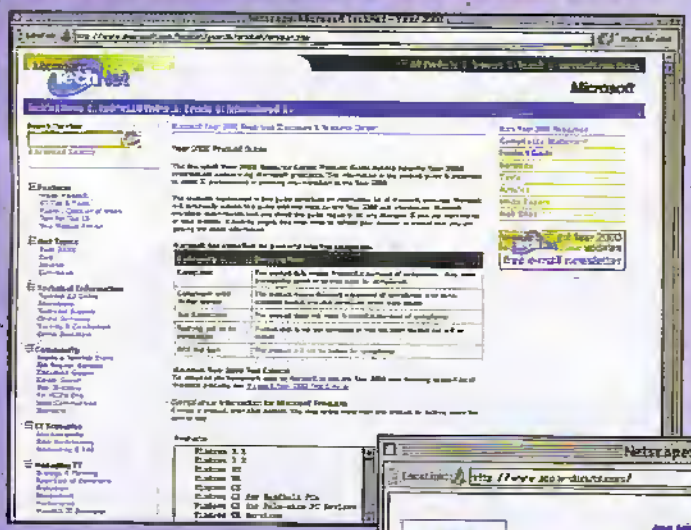
The event is designed to test the PC game playing skills of teams of up to four players who will compete using the latest PC technology, powered by AMD's K6-III Processors with 3DNow! and Microsoft's award winning gaming hardware. Teams will also be able to make use of Microsoft's MSN Gaming Zone UK at <www.zone.msn.co.uk> to practice their skills on-line, find team partners and follow the event itself.

Five regional qualifiers in London, Birmingham, Glasgow, Cardiff, and Manchester, held between June and August 1999 will each see 36 teams compete for the right to progress to the Grand Final in London in September.

Teams may submit entries by returning coupons on forthcoming press advertisements in Computer Shopper, PC Zone, PC Pro, Computer Buyer and Maxim, or by printing out and mailing the interactive coupon on the UK PC Games Championship Web site at <www.ukpcgc.com>.

Site Survey

The month's destinations

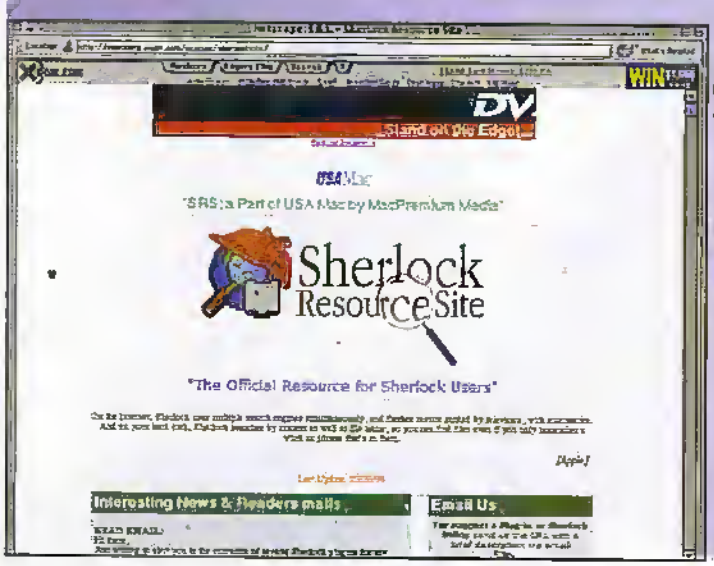


If you're still not certain whether your PC is Y2K compatible, or whether the Millennium Bug's going to strike it dead at the end of the year, checkout Microsoft's Year 2000 technical information site, at: **<http://www.microsoft.com/technet/year2k/product/product.htm>**. There you'll find a searchable index of all Microsoft products, with full listings of whether they are compliant or not, together with notes and details of which parts aren't compliant. Makes you wonder how, in the final year of the final decade of the final century of the millennium, anyone can still be selling products that aren't Y2K ready, but there they are in all their glory, for all to see. Frightening, isn't it?

In last month's @Internet, Mac OS 8.5 (and it's worth pointing out that Macs have been Y2K ready since 1984, so there's no worries about Millennium Bugs here) was given the once-over, and Sherlock - its incredibly powerful search tool for Macs and the Internet - was looked at closely. Here's a couple of sites worth surfing to, to download Sherlock plug-ins. First is Apple-Donuts, at **<http://www.apple-donuts.com/>**, while second is the Sherlock Resource Site, at **<http://members.xoom.com/usamac/sherlocksite/>**. Sherlock plug-ins, if you remember, are tools that you add to a Mac running Mac OS 8.5 to gain searchable access to Internet sites. There are several hundred plug-ins available so far, with many, many more being developed.

Good to see that Byte Online is back up and running again, after fears about whether it could make its own way again. The Byte Online Website is the Internet version of Byte magazine, which hopefully should reappear again soon in paper at a newsagents near you, despite being a US publication. Byte Online is at **<http://www.byte.com>**. In computer terms, Byte really is a most informed journal and way better than the run-of-the-mill PC rag available in the UK.

If you've got a DVD drive in your computer, you'll have noticed a distinct lack of software for it - in the form of films and so on. DVD Wave is an on-line store of DVD material where you can pick up just about every available title as soon as it's released. See for yourself, at **<http://www.dvdwave.co.uk/>**.



Project Ratings

Projects presented in this issue are rated on a 1 to 5 for ease or difficulty of construction to help you decide whether it is within your construction capabilities before you undertake the project. The ratings are as follows:

Simple to build and understand and suitable for absolute beginners. Basic of tools required (e.g., soldering, side cutters, pliers, wire strippers, and screwdriver). Test gear not required and no setting-up needed.

Easy to build, but not suitable for absolute beginners. Some test gear (e.g. multimeter) may be required, and may also need setting-up or testing.

Average. Some skill in construction or more extensive setting-up required.

Advanced. Fairly high level of skill in construction, specialised test gear or setting-up may be required.

Complex. High level of skill in construction, specialised test gear may be required. Construction may involve complex wiring. Recommended for skilled constructors only.

Ordering Information

Kits, components and products stocked at Maplin can be easily obtained in a number of ways: ❶ Visit your local Maplin store, where you will find a wide range of electronic products. If you do not know where your nearest store is, telephone (01702) 554002. To avoid disappointment when intending to purchase products from a Maplin store, customers are advised to check availability before travelling any distance; ❷ Write your order on the form printed in this issue and send it to Maplin Electronics PLC, P.O. Box 777, Rayleigh, Essex, SS6 8LU. Payment can be made using Cheque, Postal Order, or Credit Card; ❸ Telephone your order, call the Maplin Electronics Credit Card Hotline on (01702) 554000; ❹ If you have a personal computer equipped with a MODEM, dial up Maplin's 24-hour on-line database and ordering service, CashTel. CashTel supports 300-, 1200- and 2400-baud MODEMs using CCITT tones. The format is 8 data bits, 1 stop bit, no parity, full duplex with Xon/Xoff handshaking. All existing customers with a Maplin customer number can access the system by simply dialling (01702) 552941. If you do not have a customer number, telephone (01702) 554002 and we will happily issue you with one. Payment can be made by credit card; ❺ If you have a tone dial (DTMF) telephone or a pocket tone dialler, you can access our computer system and place your orders directly onto the Maplin computer 24 hours a day by simply dialling (01702) 556751. You will need a Maplin customer number and a personal identification number (PIN) to access the system; ❻ Overseas customers can place orders through Maplin Export, P.O. Box 777, Rayleigh, Essex SS6 8LU, England; telephone +44 1702 554000 Ext. 376, 327 or 351; Fax +44 1702 554001. Full details of all the methods of ordering from Maplin can be found in the current Maplin Catalogue.

Internet

You can contact Maplin Electronics via e-mail at **<recipient>@maplin.co.uk** or visit the Maplin web site at **http://www.maplin.co.uk**.

Prices

Prices of products and services available from Maplin shown in this issue, include VAT at 17.5% (except items marked NV which are rated at 0%). Prices are valid until 3rd June 1999 (errors and omissions excluded). Prices shown do not include mail order postage and handling charges. Please add £2.95 to all UK orders under £30.00. Orders over £30.00 and MPS Account Holding customers are exempt from carriage charges.

Technical Enquires

If you have a technical enquiry relating to Maplin projects, components and products featured in *Electronics and Beyond*, the Technical Service Dept. may be able to help. You can obtain help in several ways: ❶ Over the phone, telephone 0897 501353 between 9.00am and 5.30pm Monday to Saturday, except public holidays (calls charged at £1/min BT rates); ❷ By sending a facsimile, Fax (01702) 554001; ❸ Or by writing to Technical Services, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Don't forget to include a stamped self-addressed envelope if you want a written reply! Technical Services are unable to answer enquiries relating to third-party products or components which are not stocked by Maplin.

Maplin 'Get You Working' Service

If you get completely stuck with your project and you are unable to get it working, take advantage of the Maplin 'Get You Working' Service. This service is available for all Maplin kits and projects with the exception of: 'Data Files'; projects not built on Maplin ready etched PCBs; projects built with the majority of components not supplied by Maplin; Circuit Maker Ideas; Mini-Circuits or other similar 'building block' and 'application' circuits. To take advantage of the service return the complete kit to: Returns Department, Maplin Electronics PLC., P.O. Box 777, Rayleigh, Essex, SS6 8LU. Enclose a cheque or Postal Order for the servicing cost (£2.50 inc. + parts) as indicated in the current Maplin Catalogue. If the fault is due to any error on our part, the project will be repaired free of charge. If the fault is due to any error on your part, you will be charged the standard servicing cost, plus parts. A kit building service is on offer for any of our kits. Please contact our customer service department for any pricing details.

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