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Two Information Revolutions That Weren't

The home computer was not the only information technology marvel of the 1980s. Imagine having a box of electronics in your home, which connected to a wealth of information and services held on distant computers. At the push of a few buttons it allows you to read the news headlines, send electronic messages, look up train timetables, plan your next holiday, check your bank balance or even do the shopping. Hundreds of thousands of pages of information on all manner of subjects, brought to a screen in the comfort of your living room. After the explosion of Internet devices into every aspect of our lives, this is a familiar scene from the twenty-first century, but it could also have been one from the 1980s. For a few years Britain stood on the brink of an information revolution, as a networking system named Prestel promised to put homes and businesses online and open up electronic communications to the masses. Ultimately, Prestel never lived up to its potential, but even as a failed technology it was ahead of its time, and introduced Britain to another aspect of information technology, one that would only become widespread with the dramatic growth of the Internet from the 1990s.*

*Despite the apparent similarities, Prestel had little direct relationship with the Internet or the World Wide Web. The start of the Internet is generally traced to 1969, when the computers of four US universities were linked through ARPANET, named after its funder,

Before the 1980s liberalisation of the telecoms market, the Post Office virtually had a monopoly on telecommunications in Britain, with responsibility for the network, the phones connected to it and researching future developments. In the early 1970s, a Post Office research engineer named Sam Fedida was investigating a 'viewphone' system for making video calls, along the lines of Picturephone, which had been introduced into the US by AT&T in the 1960s. Picturephone was a flop, expensive to use and crippled by its need for telephone lines to be upgraded to handle the heavy data flows of video calls. However, simple textual information required far lower bandwidth and could be sent down normal phone lines. Rather than *viewphone*, Fedida hit upon the idea of *viewdata*, a system to supply information from a computer databank through the phone network to a customer's television set.

Fedida's idea had similarities with Teletext, a system for transmitting data as part of the television signal and displaying it on a television screen, which was being developed at around the same time by the BBC, Independent Broadcasting Authority and electronics manufacturers. Eventually the two systems adopted the same display standard, using 24 lines of 40 characters and 7 colours, but despite the visual similarities, *viewdata* was a much more capable system. Teletext offered very little interactivity and a limited size of databank. *Viewdata* was seemingly unlimited in size and allowed information to be sent through to the databank as well as

the US Department of Defense Advanced Research Projects Agency. Small experimental networks were established in other countries at around the same time, but much of what we regard today as the Internet grew out of the gradual expansion and evolution of protocols of ARPANET. The World Wide Web, the information system behind the Web pages that appear in Web browser windows, was first proposed in 1989 by a British scientist, Tim Berners-Lee, working at CERN.

receiving data from it, opening up the possibility of interactive services.*

By 1972, Fedida had an experimental viewdata system running. As the system developed over the subsequent years, Post Office management saw an opportunity to launch a prestigious and innovative service. 'I think the thought was that if we came up with this thing, almost like the jump jet or Concorde or something, we could be leading the world. It was very appealing,' comments Alex Reid, director of Viewdata in the late 1970s, around the time that the service was renamed Prestel. There was also a serious business case behind the Post Office's interest. 'I think the main thing that interested senior management about this was the potential for traffic generation,' explains Reid. 'The cost of the infrastructure was pretty much fixed. In terms of the financial performance, if you can persuade people to make more calls it's almost all profit.' The Post Office had a promising technology and the infrastructure to make it available across the country, but it was pointless creating an information system that did not have any information on it. Without a mass of interesting content there would be no good reason for customers to sign up to Prestel. With no potential customers there would be no good reason for electronics manufacturers to make Prestel televisions. Content was key to the Post Office's hopes for the system.

*Teletext is essentially a passive, one-way service. All the Teletext pages are broadcast on a repeating cycle. After typing in a page number, viewers have to wait for the page to be broadcast before it appears on the screen. Teletext allows eight 'magazines', each containing up to 256 individual screens listed in hexadecimal. As television remote controls do not have hexadecimal buttons, the full range is not easily available. Another practical limit is that adding more pages to the system slows it down, as all the pages have to be broadcast in each cycle, which takes longer the more pages are in it.

An open medium

Fedida originally envisaged the Post Office playing an active editorial role in the service, but management saw the organisation as being in the business of carrying information rather than creating it. By the late 1970s, thinking had shifted to encouraging other organisations to generate content. However, the underlying structure of the Prestel network placed the Post Office in a powerful gatekeeper position. Unlike the information on today's Internet, which is distributed on computers all over the world and owned by a great variety of individuals and organisations, Prestel was essentially a centralised databank owned by the Post Office. A set of GEC4000 minicomputers holding copies of the databank were dotted around the country to allow people to make local rate telephone calls to access them.* The contents of each databank were kept synchronised, more or less, by a central update computer in London named DUKE.† This arrangement meant that the Post Office essentially owned Prestel, but it raised questions over what responsibilities it had for the information on its system and what controls it should exercise.

The range of potential options held different pros and cons. At one end of the spectrum the Post Office could vet all of the content on the system. Such tight control might safeguard

*Almost like the electronic brains of the 1950s, the GEC Prestel computers all carried individual names, often with local significance or named after old telephone exchanges. One of Manchester's two machines was named ARKWRIGHT, like the Industrial Revolution era inventor, while Edinburgh's were named SCOTT and BURNS.

†The number and location of Prestel databank computers changed over the life of the system. The first computer was at the research centre at Martlesham, but as the system was rolled out computers were installed in London, Manchester, Leeds, Croydon, Birmingham, Chelmsford and Cardiff. Other towns were served by multiplexers, which connected local users to a Prestel computer located elsewhere. As technology improved, more multiplexers were installed and the number of Prestel computers consequently reduced.

quality, but involved more administrative burden, raised awkward questions of censorship and might limit how much information made it into the system. Granting exclusive licences, so that there could be only one approved provider of financial news, for example, was another alternative. A monopoly on certain types of information may have convinced providers to invest in content development, but could leave the Post Office facing criticism over its selections. A more free-market approach, allowing freedom to a range of information providers, had the risk of leading to poor-quality content that would tarnish the prestige of the service. However, it would be far easier to administrate and keep Post Office management out of messy debates over what was on the system. 'The thought that the minister would ring up and say, "the news report was outrageously biased in favour of X, Y or Z," they just didn't want to cope with that,' suggests Alex Reid. The common carrier approach, where the Post Office was responsible for transporting the message but not concerned with its content, was in line with existing postal and telephone services. For an information system of potentially unlimited size there were philosophical arguments in favour of an open market too. 'Because there was no natural limit to the number of pages of information that could appear on Prestel, it was philosophically right to let everybody have a go. It seemed to me this was quintessentially an open medium,' explains Reid.

Prestel's content would come from a range of media companies and other organisations, but content providers and the television manufacturers would need reassurance that Prestel was going to be enough of a big thing to justify the investment. 'In order to get the participation of the media industry and the television-set makers to incorporate the kit into the backs of their sets... we needed to do the thing in a bold way,' explains Alex Reid. 'It was decided that we would actually roll straight out to essentially national coverage or into the major cities.' Rather than the gradual development of the Internet from an academic system as various people found new uses for it, Prestel was planned to have a critical mass of content from the start and roll out to the public.

Launching Prestel on a large scale was an ambitious scheme, particularly for an organisation well known for its bureaucratic ways. At the time it could take months to get the Post Office to install a new telephone line, and there were strict regulations on the sorts of devices that were allowed to be connected to the telephone network. Rather than lose time going through the normal channels, a specialist unit was set up under Alex Reid in 1977, with the backing of Post Office Telecommunications managing director Peter Benton, to bring the system to fruition. Thereafter progress was rapid. In early 1978 the decision was taken to launch a public Prestel service. By summer a test service was functioning, in spite of difficulties with the databank computers and with manufacturers struggling to produce enough working Prestel televisions. In 1979, Prestel was being rolled out to the public, with no less than 100,000 pages of information on all manner of subjects.* In just a few years, the Post Office built an electronic information network of unprecedented scope and scale.

Going online

Using Prestel originally required a special Prestel television with a built-in modem connected to a telephone line. Viewers pressed the Prestel button on the television keypad to dial into the service, and from the welcome screen tapped in a page number to go directly to the information provider they wanted: 221 would go to British Rail, 2020 to electronics newspaper *Viewtel 202*, 92 to their Prestel bill. A moment later a page of information would appear, mostly coloured text with a few pictures made up of blocks. The system could also be navigated through a hierarchical series of menus where users would eventually find what they were looking for in one of the listed categories. 'There was no search facility at all. We didn't have the technology to offer a sort of Google-type search. It was a completely hierarchical menu,' explains Alex Reid. Unlike the

*Technically speaking, Prestel's 'pages' were referred to as 'frames' at the time.

paid-for search rankings and sophisticated algorithms used by search engines to tailor search results, the Post Office naturally did its best to remain impartial. 'We wanted to keep a completely neutral role', recalls Reid. 'There was no editorial judgement or recommendation.'

The information on the system was wide ranging, including news, business information, sports, film reviews, quizzes, gardening advice and recipes. There were also pages from major retailers, such as WH Smith, Currys and Comet, banks and building societies, travel companies, and organisations as diverse as the RAC and the charity Save the Children. The Ministry of Agriculture, Fisheries and Foods even started using the service to provide up-to-date information to farmers. Previously, if you wanted the news you waited for a radio or television bulletin or bought a newspaper. With Prestel a range of providers was there at the click of a few buttons. Today, with Prestel's central computers long shut down and nothing left but screen shots, videos and paper documents, it is hard to appreciate the enormity of the system or how revolutionary it was at the time. 'I would have these high-powered captains of industry around and I'd say, "Here's a television set,"' remembers Alex Reid, who found himself demonstrating the system to a succession of high-profile figures. "'We can access 100,000 pages of information that's being constantly updated and supplied by information providers, so if we wanted to know what the weather is in Madrid, I click here and up would come the weather in Madrid.'" Now, today, people would yawn. Then, these people would be astonished; their jaws would drop.'

The television commercials used to publicise Prestel invoke something of the science fiction nature of the system at the time. They began with a sinister note playing as an animated finger on a display screen beckoned over. Seconds later followed messages explaining the system, punctuated by rapid montages of Prestel pages set to Strauss's *Blue Danube*, the music used to open that most famous of mad-computer films, *2001: A Space Odyssey*. It was a striking display of the overwhelming range of information on offer. *Tomorrow's World*, the BBC's television

showcase of new technology, featured Prestel in 1979. According to *Tomorrow's World*, Prestel would affect the daily lives of everybody, and would be particularly useful if the fuel and job shortages of the 1970s developed into a crisis that confined people to their homes. When the system was launched most commentators presented it as a world leader, a breakthrough in technology with great potential for the future. However, within a surprisingly short time the Post Office's vision of electronic information for the home was in trouble.

The armchair grocer

The Post Office predicted that by the end of 1980 Prestel would have a few tens of thousands of users, with optimistic estimates suggesting as many as a million users after five years. This was not unreasonable given that it already ran most of the nation's telephones. However, uptake of the service was painfully slow. By the end of 1980 there were just 6,000 users. Contrary to the original aim of creating a domestic system, the major users turned out to be businesses. The travel industry was an enthusiastic user of Prestel, and terminals became common in travel agents; indeed, viewdata technology was still in use in this sector in the twenty-first century. A few companies and other organisations, such as British Rail, also used the technology for developing internal information systems. More widely, for a corporate world becoming ever more interested in up-to-the-minute share prices, there was a wealth of financial news and stock market information available. By late 1982 the number of subscribers had increased to about 18,000, all but 2,500 of them businesses.¹

Home users were the original target, but proved to be the market hardest for Prestel to crack. Much of the problem related to cost. The cheapest Prestel television set available when the service launched was a £650 black and white model, at a time when a normal colour portable television could be bought for around £170, but there were few alternatives. Home computers were too rare to be seriously considered as a way for the general public to access Prestel when the service launched. The

introduction of adaptors to fit to existing television sets was hindered by the lengthy approval process before new devices were allowed on the telephone network, and by television companies' opposition to cheaper alternatives. Nevertheless, by 1981 Prestel adaptors were starting to appear, notably the Tanel adaptor manufactured by Tangerine, better known for its role in creating the later Oric-1 home computer.

'Modems were very difficult. Also, you were dealing with the public sector, Post Office Telephones, and there were very strict regulations about wiring anything up to the telephone system,' recalls Tangerine's Paul Johnson. The £170 Tanel adaptor was a neat console containing a modem and a keypad, which plugged into a phone line and television, and almost failed the stringent approval process due to lack of an isolator to protect it from high voltage from the television. 'I said "That wasn't in the spec." He said, "It is now... you'll have to reapply,"' remembers Johnson, who bet a disbelieving Post Office Telephones engineer that he could do the modifications in a week. 'So we turned it round in a week and we got approval,' chuckles Johnson. Thanks to devices like the Tanel, the expense of owning Prestel equipment dropped, but the ongoing running costs were still considerable.

Prestel's subscription charge was £5 a quarter for a home or £15 for a business in 1982. Free to access in the evenings and part of the weekend, there was a 5 pence a minute charge for connecting to the system during the day. Premium content and closed user groups attracted extra fees, with the price noted in the corner of the screen and added straight to Prestel bills. In this respect Prestel was notably in advance of the World Wide Web, providing a straightforward way for information providers to generate revenue long before paywalls or advertising revenue. Given the hefty costs of being a main information provider on the system, £5,500 a year for the basic package, charging by the page did at least provide an incentive for providers. Main information providers could also generate income by renting out pages to smaller sub-providers. Nevertheless, it was a premium service that was most attractive to larger or more forward-thinking organisations.

In 1981, British Telecom (BT), including Prestel, was split off from the Post Office as the telecoms market was liberalised. BT took pains to increase Prestel's appeal to new users by encouraging new interactive services with various partners. 1982 and 1983 saw a renewed effort to widen the uptake of the system with the launch of a range of innovative services, including education, banking and shopping. Among these was Homelink, Britain's first home online banking service, run by the Nottingham Building Society and the Bank of Scotland. Homelink was a premium service, with pricing structures oriented towards attracting wealthier customers, but its uptake was always going to be limited at a time when many people did not have bank accounts. Basic by later standards, it still provided many of the services that are familiar today, such as paying regular credit card and utility bills, and juggling money between accounts. Other banks were slow to follow the example, yet for the Bank of Scotland it was a useful way of reaching customers in England.

Online shopping and ticket booking were much more widely experimented with. In Gateshead, pensioners were offered the chance to order their Tesco shopping using Prestel terminals accessed in local libraries. Catalogue shopping came to Prestel through services like Littlewoods' Shop TV, launched in 1985. One of the biggest experiments in providing two-way services to the public was Club 403, a Prestel service launched in 1982 in the West Midlands with a flat £4 monthly fee and a free terminal to entice users to join. Uptake was slow, as the stores tasked with selling the system did not understand it well enough to perform a convincing sales job. The solution was technological Tupperware-style parties, where free membership was offered to people willing to invite their neighbours over to show them how Club 403 worked.²

Club 403 stands as a remarkable demonstration of what Prestel was capable of. Among the most prominent services was the Armchair Grocer, which allowed people to buy their weekly food shop through Prestel, albeit with the aid of a printed catalogue to make a shopping list. They simply keyed

in the numbers of the shopping, and a little while later a Club 403 van trundled round from the Carrefour supermarket near Sutton Coldfield with a delivery. A range of other shops and businesses provided services through Club 403, including a master butcher and a Beer at Home service. People could also book seats for shows at local theatres and football matches, gamble, book hotels and access the other Prestel services.

To judge from impressed users quoted in the press, the new interactive services, which touted the convenience of avoiding queues and having to go out in the rain, should have been a hit. In fact, they suffered from the same low uptake problem as Prestel as a whole. Club 403 managed to attract just 1,000 users by late 1984. In spite of hopes that it would expand after the end of the subsidised trial period, by 1987 most of the shopping services had been withdrawn. In the latter half of the 1980s the media moved from marvelling at the novelty and convenience of armchair shopping to discussing why it had not taken off. Other interactive services would be launched through Prestel to mixed success during the 1980s, but outside businessmen and the travel industry the biggest new market for Prestel turned out to be the burgeoning new market of home computer users.

Micronet 800

The idea of using a television as a Prestel terminal was conceived at a time when very few homes had computers. However, family televisions were already a contested space. 'In a sense it was a flawed idea in that the television was already family entertainment territory and it was difficult to capture that for solitary information retrieval,' notes Alex Reid. As many people bought computers and portable televisions to go with them, the possibility opened up of connecting a modem to a home computer and using it as a Prestel terminal. However, the Post Office was protective over what was allowed to be connected to its network. Telephones were normally rented from the Post Office and hardwired onto the network by its engineers. Before market liberalisation and the introduction of

the modern telephone socket in 1981, it was unfeasible for people to simply plug a modem into a phone socket. In the meantime, people wanting to go online generally had to resort to the acoustic coupler, a modem fitted with a pair of rubber cups that fitted to a normal telephone handset. A few people were already buying couplers to experiment with connecting their micros to other computers, but outside Prestel, electronic communications was the domain of the enthusiast and on a fairly small scale. The most common systems were bulletin board systems (BBS) for users to connect and leave messages for each other and swap files. Sometimes managed by a computer club, sometimes just a computer run by a hobbyist and online only part of the day, BBSs were a semi-underground world of enthusiasts and people in the know.

Prestel already carried content from computer user groups, but in 1983 East Midland Allied Press (EMAP) began offering a more comprehensive service to computer enthusiasts on Prestel, named Micronet 800. The original idea was 'a computer magazine which came down the phone line, because every ink-on-paper magazine was completely out of date by the time you bought it,' recalls Micronet's founding editor David Babsky. EMAP already owned the Prestel information provider TELEMAT, and had just bought a stable of computer magazines from publisher Richard Hease, and electronic-goods comparison site *Electronic Insight* from its founder Bob Denton. The idea for Micronet built on this, but was more ambitious. 'If we sold programs and provided everyone with an email address and if we gave them news stories, surely this would be a winner,' explains Babsky, who also helped to brand the new service. 'We decided never ever to mention Prestel because Prestel was thought of as a failure. We'd only mention Micronet 800.'

Unlike paper computer magazines, setting up Micronet was not just a matter of recruiting an editorial team and finding some content, but of overcoming some of the technical and financial barriers that had so far held back Prestel. With so many different types of computer on the market, few of which

had a screen mode compatible with Prestel, each machine required specially written software to display Prestel pages. Efforts had to be made to keep the price down too. David Babsky sourced a cheap modem. 'If I'd just paid £400 for a BBC Micro,' explains Babsky, 'the most I'd be prepared to pay would be £49 for a modem to give me access to downloadable programs, so we fixed the price at £49 and Richard Hease put together these various subsidies.' With the liberalisation of the telecoms network, Hease negotiated a subsidy from the Department of Trade and Industry to provide Micronet users with a free telephone socket to allow them to directly plug in a modem. Micronet cost £16.50 a quarter for subscribers, with free off-peak calls to access the service. At £52 a year it compared quite favourably with buying a paper computer magazine once a week.

Key to Micronet's offerings was a mix of free and paid for 'telesoftware' downloadable for different microcomputers, a convenient service at a time of lengthy magazine type-in programs. 'It seemed blindingly obvious that there was a market for selling computer programs down the phone lines instead of people sitting at home mistyping,' recalls Babsky. 'When we first launched it we went to [an exhibition at] the NEC in Birmingham and asked people what do you want?' The service offered a mix of games, and business and education software, for several of the most popular machines. Yet just as in microcomputing more widely, one use came to dominate: 'They said education, of course. But no one ever wanted the education programs or business programs; they just wanted entertainment.'

Prestel did not initially offer electronic mail. In part, this was allegedly because the Post Office feared that it would damage its core business of delivering letters, however, such services did not quite fit the original conception of the system as a databank. By the time Prestel's Mailbox feature for sending short messages was widely available, it already faced more sophisticated rivals, such as BT's own Telecom Gold. All the same, it gave another way of interacting and mail was one of the most popular

services. Indeed, Micronetters sent twice as many electronic mails as other Prestel users.

Micronet also had games that users could play against each other. These included *StarNet*, a one-turn-a-day space strategy game, and the real-time game *Shades*. This was a multi-user dungeon (MUD), a multiplayer text adventure game with hundreds of rooms to explore. Players could put aside their everyday lives, adopt fantasy identities of knights or wizards, and go adventuring together or fight each other to the death with frantically typed commands. Costing nearly a pound an hour to play was no barrier to *Shades*' popularity and the highly addictive game built up a cult following of people willing to run up large phone bills.³

Unlike the static offerings that filled much of the rest of Prestel, Micronet built a community through involving its users in interactive activities. Another popular service was Chatline, online chat rooms where users could discuss anything they liked, subject to moderation. 'Chatline had specific individual chat rooms where you could talk about the price of a bottle of milk or Clive Sinclair, as long as you were careful not to libel him,' recalls David Babsky. Celebrity Chatline brought in well-known figures of the day to answer Micronetters' questions, such as athlete Fatima Whitbread and punk rocker Feargal Sharkey. In another forward-looking move there was a gay Chatline. Individuals in the community who stood out in some way or another might also be offered some pages of their own to fill. 'I spotted people and thought they could do it – they're interesting, so let's give them a page,' explains Babsky.

Micronet gave its users an online space like no other offered to the public before: not just a range of information and software, but a place for all sorts of different people from all over the country to interact as a sort of virtual community. 'There seemed to be no clear demarcation of who they were,' recalls Babsky. 'People doing all sorts of things. The only general coherence that held them all together was that they were all interested to some extent in new technology.' Through

Chatline, Mailbox and games, Micronetters had a space to discuss, argue, explore and maybe even find love through the lonely hearts section. And yet despite all that was on offer, even Micronet never quite matched its original hopes. 'What we found was that there was a high churn rate,' explains David Babsky. 'So we kept getting lots of new people, but at the same time about a third of the people we had disappeared.'

Although it would last until 1991, when BT pulled the plug on its 12,000 users, Micronet never quite managed to attract a sufficiently high number of users. Yet to those who were part of Micronet, it was an exciting place to go when there was nothing else like it. 'The people who used it loved it,' recalls journalist Robert Schifreen, a Micronetter and occasional contributor to the service. 'It was the communication side of things. It was the social side of things because you did chat and email. It was the novelty of being able to log on.' In a sense Micronetters were akin to the computer hobbyists of the 1970s, a gathering of enthusiastic early adopters who cottoned on to what the future might be before everyone else had. 'It was a sense of people don't want to do this stuff in enough numbers to make it pay. But I don't recall anyone saying we really need to go to sleep and come back in 10 years,' recalls Schifreen. 'Because you don't know what's going to happen.'

Good morning Prince Philip

Much like hobbyist computing, Micronet and Prestel fostered a cadre of curious people who were more interested than most in exploring what the technology could do. The meaning of the term computer hacker has shifted over the years. Originally hacker meant someone with a fascination in mastering, modifying, exploring and pushing a technology to do something interesting, without the breaking-and-entering connotations the term later acquired. As one might expect, Prestel and Micronet quickly spawned a community of such enthusiasts fascinated by seeing what they could access on the network. Among them were Micronet contributors Steve Gold and Robert Schifreen. 'It was very much a social thing. We'd get

together and share exploits, and talk about stuff and share passwords,' recalls Schiffreen of the sociable group of Micronet hackers. 'We'd generally meet up in a Chinese restaurant in Soho and get through huge amounts of lemon chicken.'

The early 1980s were the formative years of hacking in popular culture. In 1983, *Making the Most of the Micro – Live*, a live television follow-up to *The Computer Programme*, was disrupted when hackers broke into the electronic mail system being demonstrated. The same year, an American teenager almost triggered a pre-emptive nuclear strike on the Soviet Union after hacking into a military computer, in the science fiction film *War Games*. Around the same time, the FBI swooped in on a group of real-life American teenagers charged with breaking into a series of computer systems, including Los Alamos National Laboratory, a major nuclear research centre. The following year, news broke of a quintessentially British equivalent: the hacking of the Duke of Edinburgh's Prestel Mailbox.

It was all rather embarrassing for BT, who declared hackers the electronic equivalent of shoplifters rather than harmless computer buffs. Seemingly to rub it in, the hackers sent a message to Prestel's administrators from the account, expressing their love of solving puzzles and signed 'ta ta! pip pip! HR Hacker'.⁴ The incident inspired a spate of hacking stories in the media: hacks carried out on television for journalists, suspicions of electronic spies, rumours of moles in Prestel, concerns over online banking systems, claims that computers at the Atomic Energy Research Establishment at Harwell had been infiltrated and gossip that Prestel had a sinister military dual use that was now compromised. To a general public that was still only learning about computing, hackers were presented as having almost magical powers to manipulate information and get at secrets. Newspapers called those involved 'codebusters' or 'computer snoopers' more than 'hackers' at first, a fumbling for terminology that suggests the novelty of the idea. Behind the moral panic was a story of curiosity overcoming some naive security measures, and a

society and its legal system waking up to the new concept of computer crime.

‘It was purely by accident. Purely a bit of fun. Just a bit of an obsessive playing about really,’ recalls Schifreen, who, with Steve Gold, was responsible for the breach. ‘Tapped some random keys, stumbled across some passwords which led me to a closed area that had the telephone numbers of the test mainframes.’ The staff member’s account number was 2222222222 and their password was set to 1234. Unforgivably lax today, but in 1984 computer security was a rather new concept that perhaps was not taken as seriously as it would be later, and BT was much criticised over its handling of security in the wake of the incident.

With the list of test mainframe telephone numbers from the closed group, the hackers could dial in and connect to the machines used by BT for system development, but not normally accessible to the general public. They got no further than the login pages of the test computers at first, but curiosity kept taking them back, until another security lapse opened a door. ‘Eventually I found that someone had left, on the login screen of one of the test mainframes, the system manager’s ID and password,’ recalled Schifreen. ‘Turned out the data on the test computer had been published on the live system, so I now had all the user files and everyone’s user name and password.’ With a bit of curiosity and some security lapses from BT, the hackers had the keys to the entire network. They could access any Prestel computer and login as anyone: as a top-level system administrator, a member of a paid closed user group or even the Duke of Edinburgh.

‘When you got to the little personalised screen you got “Good Morning HRH The Duke of Edinburgh, Welcome to Prestel,”’ recalls Schifreen. Apart from birthday messages to Princess Diana, another service recently offered by Micronet, there was, according to Schifreen, ‘nothing terribly exciting. Nothing of security value. But it was interesting to say that I’ve logged into Prestel as Prince Philip.’ Through Micronet, Schifreen and Gold informed a disbelieving Prestel of the hole

in its system. 'Prestel said there was no way someone could be system manager of Prestel,' recalls Schifreen. To prove their point, the hackers changed Prestel's top-level page 1 to read IDNEX instead of INDEX. 'I was expecting them to say, "Come and tell us how you did it, because this is important,"' recalls Schifreen. 'Rather than that, they phoned Scotland Yard and got the computer crime unit involved.'

But what to charge them with? There was no such crime as computer hacking in 1984. The Metropolitan Police Computer Crime Unit was not set up until 1982. Most of its early trade was in fraud among bank clerks and computer operators, and there were no laws relating specifically to computer crime at the time. Real-world hacking was a novel concept, and Schifreen and Gold's activities were in a legal grey area. Probably the closest thing to the specifics of the case was 'phreaking'. From the late 1960s, telephone networks had been infiltrated by enthusiasts using electronic 'blue boxes' and 'bleepers' to control automatic switching systems to get free calls and access to exotic locations. In one case from 1971, a London student made a free phone call to a Bethlehem hospital on Christmas Day to give his best wishes to the babies born that day. For the phreaks it was less for the free calls and more for the intellectual challenge, but if caught they could still be prosecuted for abstracting the electricity used to make the calls. 'They could have done that with me and Steve,' explains Schifreen, 'but they decided not to because they wanted a precedent for a better piece of legislation that they could use against computer crime in the future.'

Instead of abstracting electricity, Schifreen and Gold were prosecuted for forgery. The case of Bug Hunter and Squeaky Mouse, the 'code names' of the two according to the press that seemed to find something sinister in people having online identities, came to trial in 1985. The prosecution hinged on the idea that entering login details that were not theirs amounted to forging the contents of the Prestel computer's memory, akin to using a fake identity card. The defence made much of how Prestel's security was ridden with holes, and how

the hackers' activities had done a public service by bringing the deficiencies to light. It was a bit of a legal stretch, but the pair was found guilty of forgery and each was fined several hundred pounds.

The convictions were overturned on appeal in 1988. Concluded by the failure of BT's subsequent appeal against the verdict, the case revealed the limits of the law as it stood to address hacking. The hackers had not benefited financially, save for avoiding some trifling access charges. 'What I actually cost paying customers of Prestel was about £11,' recalls Schifreen. The episode was just a bit of fun that occurred in uncharted legal waters. 'I never set out to cause any damage or do anything malicious. I didn't steal any data or anything like that. I was doing it out of fun and to show how insecure this was,' explains Schifreen. 'Nobody ever tried to give the impression that what we'd done was serious. But it was potentially important for the future, a test case to be sorted out one way or the other.' The case was foundational in the formulation of *The Computer Misuse Act 1990*, which explicitly made it illegal to gain unauthorised access to computers. With a few amendments, *The Computer Misuse Act* is still with us today, an underlying piece of British computer law that has far outlived both Micronet and Prestel.

A failed technology?

At its peak, Prestel attracted about 90,000 users, but it was widely considered something of an expensive failure.⁵ The network limped on into the 1990s, increasingly targeted at businesses rather than the general public, only to be run down by BT, who eventually sold its remains in 1994, by which time the Internet was rapidly expanding. Despite its demise, we cannot simply write off Prestel as a failure, nor should we casually dismiss it with the cliché of being ahead of its time. The technology worked satisfactorily enough for tens of thousands of people to make use of it; indeed, Prestel was adopted, with mixed success, in several other countries, and the massive success of the World Wide Web proves that the basic concept

was sound. 'In many ways Prestel was a sort of precursor, a prototype,' suggests Alex Reid. 'The idea that the public could at the touch of a button get access to hundreds of thousands of pages of information over the telephone network.' From the connected world of the twenty-first century it is hard to see why people would not want online access to something like Prestel. So why did Prestel not take off?

The basic nature of the information Prestel could display was a limitation on its uptake. Each frame could only display a few hundred characters of text and some blocky low-resolution pictures. It offered no sound, no photographs and no video. In this respect, Prestel suffered from being a pioneer. As more advanced viewdata systems with better graphics were launched in other countries, such as the Canadian Telidon system, unfavourable comparisons began to be drawn. Placed alongside the more dynamic entertainment capabilities of home computers, Prestel's static pages also looked staid. Even in the early 1980s, journalists complained that they lacked excitement and emotion. A high-resolution 'Picture Prestel' capable of displaying more realistic images was developed, but not rolled out to the public due to the limited uptake of the original.

Almost any contemporary press article about Prestel gives the impression that it was a costly service, and the expense involved in using the system was undoubtedly a major factor in limiting its uptake. The 5 pence a minute daytime connection charge meant it was all too easy to rack up large phone bills, even without adding the costs of any paid for frames. As a system intended to challenge traditional media it seemed expensive in a period of recession, when a daily newspaper cost about 15 pence. At a time before multiple contracts for broadband, mobile phones and satellite television packages, the very idea of paying for extra services was fairly novel too. Despite BT's best efforts, the pricing and business model was not quite right for the time.

Prestel did not have to be a failure, as the experience of Minitel, its French equivalent, demonstrated abundantly.

Launched across France in 1982, Minitel was of a similar level of technology to Prestel, but was massively supported by the French state. Free terminals were handed out to businesses to automate communications with the government, and to home users to replace telephone directories, at the rate of 10,000 a week by 1984. At its high point in the late 1990s, there were nine million Minitel terminals installed across France. Giving away free Prestel terminals was discussed several times in the 1980s, but never came to anything. The British telecoms industry was going through a profound change with liberalisation and privatisation, but old reservations about a public utility indulging in commercial activities probably played a part in limiting the options. 'We said to BT, instead of spending £6 million on an advertising campaign, why don't you spend £3 million on an advertising campaign and buy £3-million worth of Tantel adaptors and give them away?' recalls Paul Johnson of one attempt to convince BT to offer free Prestel adaptors. 'Oh, they couldn't do that because "it's commercial".'

Alongside French government support, at least part of Minitel's success is often attributed to its highly popular sex chat lines, or 'Minitel Rose'. In 1980, not long after Prestel was launched, there was a minor tabloid scandal over it carrying a service called 'A Buyers' Guide to Dirty Books', authored by the implausibly named Rupert Street-Walker. A Conservative MP went so far as to demand a government inquiry, but the allegations generated a robust response from Prestel's managers that it was not their role to act as a censor and the service was a parody anyway. Aside from the illicit activities of individual users messaging each other, sex was never a major feature of what Prestel had to offer. Minitel may have benefited from a bit of titillation, but it probably did not fit the Post Office and BT's vision for their prestige system, not to mention the legal issues involved in a less liberal-minded time.

Prestel was not the only online service available to home computer users in 1980s Britain, but it was the most extensive,

the highest profile and the most ambitious.* The failure of this flagship project says much about how communications was only a minority interest among home computer users. In the short-term communications would have little influence in shaping the development of home computing in Britain. The technology, infrastructure and services were there for it to have grown into a major application of home computers in the 1980s, but compared to the giants of educational computing and gaming it never hit the mainstream. For a few years, computer magazines often carried a few pages of news on 'comms' to cater to the enthusiast community that was interested. However, for most people there would be no going online until the Internet explosion of the 1990s, when the network was opened up to commercial interests rather than just academics.

'Vision of the future' is a term thrown around far too easily and thoughtlessly, but it genuinely applies to Prestel. For a few years it gave a few tens of thousands of people a glimpse of the sort of online world that would become common in the twenty-first century. Then it was gone, only to reappear over the subsequent years in a much slicker form in the Web browsers of many hundreds of millions of people. 'It's not like some perpetual motion machine that never worked and never would work,' sums up Alex Reid. 'It's more like the Wright brothers' aeroplane. Our one crashed, but air travel later became universal, so I think we were the harbinger of something.'

An electronic Domesday Book

The 1980s was a period rich in experiments to find out what computers could do. Prestel was far from the only 'ahead of its

*One other online service that deserves a mention is Compunet, or CNet to the several thousand Commodore computer users who enjoyed it. Started in 1984, when it grew out of the earlier PETNET service for teachers, CNet provided chat, gaming, email and other services. It also gave users the space to upload and share programming efforts, and supported a lively community of hobbyist developers before its demise in 1993.

time' application to be developed, or the only system to try to make vast amounts of information available through computers. Among the most ambitious use of computers as a way to provide information was the creation of an up-to-date version of the *Domesday Book*, the great survey of the realm ordered by William the Conqueror after his invasion of England. With the 900th anniversary of the *Domesday Book* approaching, a BBC producer by the name of Peter Armstrong was asked to consider doing a special programme to mark it. 'Thinking about it, I thought, well, that's all very well, we could do a standard documentary, but what about doing it again?' wondered Armstrong. 'Wouldn't, that be more fun to see what King William could have done if he'd had the kind of opportunities we have today?'

Like Prestel, the notion of a high-technology *Domesday Book* touched on one of the fundamental ideas of the information technology revolution; the expectation that computing would make large volumes of information more easily accessible and bring conceptually new ways of interacting with it. By 1984 this was one aspect of the revolution that had not reached the typical microcomputer user to any great extent. Reference works for home computers were little more sophisticated than small databases on various subjects, such as fact files about countries of the world. The common cassette tape was too slow for effective data retrieval, and faster floppy discs were too small for anything ambitiously encyclopedic. Yet on the horizon were new data-storage technologies that offered new opportunities. Among these was the LaserVision disc, a shiny 12-inch predecessor of the compact disc, which was finding favour among film buffs as a premium home video format. 'If we're hooking up a BBC Micro to all kinds of devices, then how about a LaserVision disc?' pondered Peter Armstrong. 'And if we did that what kind of coverage could we get on it about Britain today?'

LaserVision, developed by the electronics company Philips, was one of a number of formats of laser disc to emerge onto the market in the late 1970s as home video players gained in

popularity. LaserVision offered superior picture quality compared to the tape-based Betamax and VHS systems, but without the ability to record programmes at home, and only storing about 30 or 60 minutes of video, depending on mode used, on each side of the disc. The ability to quickly jump around the data on the LaserVision disc led to much discussion about interactive books, exhibitions, education systems and catalogues, but few actual substantive uses. A rare exception was *The BBC Videobook of British Garden Birds*. This included video, selectable audio tracks of birdsong or narration by David Attenborough and, in a novel step, teletext pages of information about the birds. 'In order to put the teletext magazine onto the disc master we had to take BBC2 off the air over lunch time, because there were only two teletext inserters in the BBC,' chuckles Andy Finney, then of BBC Video, who developed the idea of adding teletext to the *Videobook* and software to allow it to run on the BBC Micro. 'And then one day a guy knocked on my office door and said he'd heard I was the person who knew about video discs. He'd got this idea for something to celebrate the *Domesday Book* anniversary,' recalls Finney, who explained to Armstrong the severe limitations of the technology for developing an interactive documentary. 'As far as my memory goes, he went away and came back the next day with this idea for doing it all using still frames and maps and photographs and so on,' recalls Finney. 'That was it really. It didn't seem too difficult to get the BBC behind the idea.'

Pulling in expertise from various departments across the BBC, and partnering with Acorn, Philips, software firm Logica, professional geographers, universities and others, the project took shape between 1984 and 1986. The result was a *Domesday Book* for the electronic age. The two discs of the project contained not only statistical data, text and maps, but also photographs and videos startlingly more realistic than the blocky graphics seen on computers of the time. *The National Disc* was a wealth of professionally created content on the economy, culture, society and the environment. It included the 1981 census,

newspaper stories, commissioned essays, video clips and a mass of survey data with analysis tools. Complementing this top-down perspective on life in Britain was the grass-roots view offered by *The Community Disc's* 150,000 pages of text and 20,000 photographs created by ordinary people around the country. It was nothing less than a multimedia encyclopedia of Britain in the 1980s with a scope far beyond anything achieved using computer technology before.

Other than its 900-year-old inspiration, pretty much everything about *Domesday* was novel and pushing the edge of current technology. 'That helped a lot because it meant that all the broadcast engineers at the BBC were fascinated and we got lots of cooperation,' recalls Andy Finney. 'We really could get our teeth into something that hadn't been done before and I think that's what it made it really exciting.' *Domesday* ran on a Philips LaserVision player connected to a specially adapted AIV (Advanced Interactive Video) BBC Master computer, the more powerful successor to the original BBC Micro. 'We were pushing it to its absolute limits,' recalls Peter Armstrong. 'It was only an 8-bit machine. It only had eight colours. So everything was extremely tight.'

Realistic colour photographs and video were technically beyond the capabilities of even the adaptable BBC Master, but they were not actually displayed by the computer as such. In fact they were not digital computer files in the sense understood today. LaserVision discs were originally intended to store analogue video, meaning each photograph stored on *Domesday* was an individual video frame, and each video was a stream of such frames. The *Domesday* software displayed the BBC Master's computer graphics and text over the top of video and photographs generated by the LaserVision player; the slightly jarring contrast between blocky 1980s computer graphics sharing a screen with realistic photographs hints at the mix of technologies brought to work together. To allow the discs to work with digital computer data for other sorts of information, Philips replaced the soundtrack on the LaserVision disc with a data track, creating the LV-ROM disc. At a time when a

standard floppy disc was perhaps a few hundred kilobytes, each LV-ROM disc could store 324 megabytes of computer data per side, as well as up to 54,000 video frames, quite sufficient for the task at hand.

The novelty of *Domesday* was not just its sheer amount of data, or the variety of different formats it was in, but how it was accessed. Most computer-user interfaces of the time were text based, relying on typed commands to make things happen. Graphical user interfaces (GUI), based on moving a pointer around a screen of windows, icons and menus, were in their infancy at the time. The \$9,995 Apple Lisa, the first commercially available personal computer with a GUI, was only launched in 1983, and the high price limited its impact and influence. The scope and variety of *Domesday*'s content necessitated a fresh approach to the user interface. 'First of all, what was it like to design a multimedia interface? Because that was completely new,' remarks Peter Armstrong.

A good example of the innovation put into the user interface is *The Community Disc*'s use of maps for navigating through the data. 'I started sketching it on pieces of idea and trying to work out if you start with maps and you wanted to zoom down how many levels of maps would you need?' recalls Peter Armstrong. 'I did some calculations and it was clear you could do a very creditable zoom that would end up with a block of 4 kilometres by 3, due to the 4:3 ratio of the screen in those days.' Alongside typed text commands, *Domesday* used a tracker ball to push a pointer around the screen. Starting with a map of the whole country, the pointer could be moved to click on an area and progressively zoomed in, eventually getting to one of 23,000 'D-blocks', where a click would bring up local information.

Today such an approach has become unremarkably everyday, but it was startlingly novel in 1984. 'No one had had a microcomputer zooming around maps and zooming in. How do you do that? How do you indicate which way you're going? What's the grammar for moving in? For knowing where you are?' asks Peter Armstrong. 'That all had to be invented as we went along.' Another novelty was the 'surrogate walks' on

The National Disc, a series of photographic journeys around different locations such as a farm, a council flat and the Welsh market town of Brecon. To a viewer 30 years later, the similarities with mapping applications or Google *Street View*, not launched until 2007, are striking. Alongside the fancy graphical interfaces, *Domesday* also had a typed keyword search facility. However, in another innovation, *The National Disc* had a virtual reality gallery to wander through and access content by clicking the pictures on the walls.

A time capsule of 1980s Britain

Where King William had used scribes to record the wealth of his realm, the BBC followed with 15,500 schools and community groups, each assigned one or more D-blocks to cover. Schools were a vitally important part of the project. Not only were they spread across the country, but thanks to the government's efforts to fund school computers, they were already huge users of the BBC Micro. 'For schools it was a really good project,' recalls Peter Armstrong. 'They often said, well, we know our local area around our school better, and we've discovered things we never knew were there.' With BBC-issued guidelines, schools and groups compiled information, recording what was in their local communities and what it was like living in them. There were surveys of how much television people watched, what they ate, memoirs of daily life and much more besides. Finally, the floppy discs of data and three slides of the local area were posted off to the BBC to be checked and added to the project. 'That was the main work,' remarks Armstrong, 'it was a team of 25–30 people over two years and it was an absolutely huge amount of work.'

Because of the way it was created, *Domesday's Community Disc* often had the flavour of a school project, albeit on an enormous scale. Told largely from the point of view of children writing about their lives, *Domesday* often showed the 1980s through naive yet revealing minor details. The bitter 1984–85 miners' strike, for example, is recalled as a time of family arguments about money by the child of a mine worker. In 'Life

in Brixton' a child on an inner-city estate, site of riots in 1981 and 1985, complained that because of the robbers and kidnappers in their block of meant they could not go out to play alone. Meanwhile in Ludlow, a class of nine-year-olds hoped that computers would not take over the world in the future, and that there would be jobs when they finished school.

Through countless little observations like these, *Domesday* hinted at the hopes and fears of 1980s Britain, be they socio-economic decline, technological change or even the Cold War. The entry on the Greenham Common cruise-missile base features peace protesters joking about the double meaning of *Domesday*. Other entries say much without saying anything. 'We found that some bits of Britain are not on the map because they're security sites of various kinds, so that was intriguing to find out,' reveals Peter Armstrong. In other cases current affairs influenced the coverage; the entry on Stretford in Greater Manchester is blank but for a note that the teachers were on a work to rule. 'There were some glaring gaps: most of London for a start,' recalls Andy Finney. 'The ILEA (Inner London Education Authority) was probably the only major local authority that used Sinclair Spectrums and it wasn't possible to do the data collection on a Sinclair Spectrum. It wasn't anything we had against Sinclair but just that the machine couldn't do it.'

Domesday succeeded abundantly in creating a time capsule of 1980s Britain, just as its creators hoped. 'It was partly historical, to create a portrait of Britain in the Eighties and lay it down like wine, and think it would get more and more interesting as time went on,' explains Peter Armstrong. Browsing through the *Community Disc* a quarter of a century later, it is impossible not to be struck by the changes in the country since the project. Shipyards, steelworks, mines, factories; *Domesday* recorded the twilight years of Britain's heavy industrial past, scenes soon consigned to history, in part by the changes to the economy that information technology helped to bring about. In contrast to despondent articles by unemployed people and photos of derelict factories, *Domesday* also

recorded the green shoots of economic growth: surveys of how many children in school have a computer, descriptions of the new electronic devices in local businesses and ever-present redevelopment schemes.

Although the historical and educational aspects were obviously important, looking at the publicity around the system at the time, it is clear that the BBC had hopes for *Domesday* as an information resource for the present too. Project publicity outlined how it could be useful for local government, businesses, estate agents, journalists and travel agents. *The National Disc* in particular contained a mass of statistical data on everything from drinking habits to household appliances, which was presented as potentially useful in market research or local government. A wealth of multimedia data created by a million people, the equivalent of 300 paper volumes, and accessed through innovative data analysis and navigation tools, *Domesday* was astounding in its scope and potential utility. Yet there was one fatal flaw: the cost. 'We'd been told by Philips that the cost of the video disc player would be a few hundred pounds,' explains Andy Finney. As a piece of computer hardware, the system would also benefit from the government's 50 per cent discount on computer hardware. 'We felt we were realistic in thinking of these things in terms of thousands,' adds Finney.

Just as the project was on the final lap, Philips dropped a bombshell. 'The last three months, that was when we heard the terrible news... "terribly sorry but the promised price can't be met,"' sighs Peter Armstrong. 'And we'd completely relied on that for the whole business model; the projections for the number who would take it and everything.' Rather than a few hundred pounds, the total cost of a *Domesday* system, including the computer, came out at about £5,000, as much as a small car. The situation was made worse by a change in government support to offer schools 50 per cent off software rather than hardware. 'We thought it would be a third of the cost it turned out to be, and that it would have been in all the schools, it would have been in libraries and in all kinds of places, and a

few individuals would buy it as an add-on to their BBC Micro,' explains Armstrong.

To those who saw *Domesday* at the time, it was extraordinary. 'They all absolutely loved it. Everyone had the same reaction,' explains Armstrong. 'They'd look up where they were born, a natural reaction in a way, but it seemed absolutely universal.' Ultimately about 1,000 *Domesday* systems were sold, meaning most of those who contributed were sadly unable to see the final result. Although a handful of other BBC LV-ROMs was released, including *Volcanoes*, and a nature reserve simulator called *The Eco Disc*, LV-ROM was soon overtaken by the cheaper CD-ROM technology.* *Domesday* stands as another example of what could be achieved with comparatively simple microcomputers and foreshadowed many future technologies, such as multimedia CD-ROM encyclopedias, map software and virtual reality walk-throughs. 'Many people who later claim to have invented things like online encyclopedias and tried to patent them found they couldn't because the BBC had what's called a prior art. They'd done it first,' explains Peter Armstrong.

Domesday could not simply be copied from its analogue LV-ROMs onto digital CD-ROMs without a great deal of expense and effort. Trapped on its obsolete disc format and with no resources to update it for new technology, *Domesday* achieved another innovation by becoming one of the earliest examples of digital obsolescence. By the early years of the twenty-first century, *Domesday* was only accessible on a dwindling number of original systems, and even the robust BBC Masters was not going to last forever. *Domesday* was regularly cited as a warning of what could happen to all

*CD-ROM was considered early in the *Domesday* project, but it was at an early stage of development, and in the absence of compressed image formats at the time, LV-ROM offered far more potential for storing and displaying photographs. Also considered was the experimental Picture Prestel, which was never rolled out to the general public.

electronic data in the future when technology moved on. It was not a problem that could easily have been foreseen in the environment in which it was created. 'Within the broadcast industry in the 1980s, we were used to working with technology that stayed around for decades,' remarks Andy Finney. 'The idea that this technology would disappear within a couple of years didn't even enter our heads.' For a time, it seemed possible that 1986's *Domesday Book* would be inaccessible in decades, while the 1086 original was still readable, albeit only to scholars of Latin, nearly a millennium after it was created.

Lost electronic worlds

Failures can tell us much about the history of technology. In a technical sense Prestel and *Domesday* both worked, and *Domesday*'s historical value will only increase with time. There was nothing wrong with the concepts behind them. Viewed in hindsight, both can be seen as visions of the future; ideas that would become common later, but realised within the technological constraints of the day, and unfortunately at prices that kept them out of the hands of many people. For several years *Domesday* was held up as an example of digital obsolescence. However, in the early twenty-first century a series of efforts was made to rescue the data and make it accessible on modern personal computers, albeit hindered by copyright issues and the idiosyncrasies of the original technology.

Significantly, in 2003 the original *Domesday* masters were backed up on a new, and hopefully more durable, format by the BBC and Public Record Office. In 2011, the BBC celebrated *Domesday*'s twenty-fifth anniversary by launching *Domesday Reloaded*, allowing people to access the *Community Disc* through the Internet.⁶ While the *National Disc* and the pioneering environment *Domesday* used to access the data are generally only available on original systems,* much of

*An exception to this is the Domesday Touch Table installed at the National Museum of Computing at Bletchley Park in 2011.

Domesday is finally available to the people who contributed to it. In sad contrast, Prestel is a far better example of digital obsolescence. This online world, once inhabited by tens of thousands of people, has completely vanished, save for the memories of those who roamed it and screen shots of Prestel pages. Prestel and *Domesday* show the outer technical limits of comparatively simple microcomputers. There was nothing technical stopping 1980s home micros from becoming information terminals or communication systems, but economics and user preferences dictated otherwise until the 1990s. In the meantime, the major use of home computers would turn out to be games.