1/ The Dollar-a-Year Man

How John Lomax set out to record American folk music

In the early 1930s, folklorist, platform lecturer, college professor and former banker John Avery Lomax was trying to recapture a sense of direction for his life. For two decades he had enjoyed a national reputation for his pioneering work in collecting and studying American folk songs; no less a figure than President Theodore Roosevelt had admired his work, and had written a letter of support for him as he sought grants for his research. He had always dreamed of finding a way of making a living by doing the thing he loved best, collecting folk songs, but he was now beginning to wonder if he would ever realise that dream.

Lomax wanted to embark on a nationwide collecting project, resulting in as many as four volumes, and 'complete the rehabilitation of the American folk-song'. Eventually this was modified to where he envisioned a single book tentatively called American Ballads and Folk Songs, designed to survey the whole field. It called for first- hand field collecting, and would especially focus on the neglected area of black folk music.

In 1932, Lomax travelled to New York, and stopped in to see a man named H.S. Latham of the Macmillan Company. He informally outlined his plan to Latham, and read him the text of an earthy African American blues ballad called 'Ida Red'. Latham was impressed, and two days later Lomax had a contract, a small check to bind it, and an agreement to deliver the manuscript about one year later. The spring of 1932 began to look more green, lush and full of promise.

Lomax immediately set to work. He travelled to libraries at Harvard, the Library of Congress, Brown University and elsewhere in order to explore unpublished song collections and to canvas the folk song books published over the past ten years. During his stay in Washington, D.C., Lomax became friendly with Carl Engel, Music Division chief of the Library of Congress. Engel felt that Lomax had the necessary background and energy to someday direct the Archive of Folk Song. Through funds provided by the Council of Learned Societies and the Library of Congress, Lomax ordered a state-of-the-art portable recording machine. More importantly, the Library of Congress agreed to furnish blank records and to lend their name to his collecting; Lomax simply had to agree to deposit the completed records at the Library of Congress. He did so without hesitation. On July 15, 1933, Lomax was appointed an 'honorary consultant' for a dollar a year.

Together with his eighteen-year-old son Alan, he began a great adventure to collect songs for American Ballads and Folk Songs, a task that was to last for many months. Lomax's library

research had reinforced his belief that a dearth of black folk song material existed in printed collections. This fact, along with his early appreciation of African American folk culture, led Lomax to decide that black folk music from rural areas should be the primary focus. This bold determination resulted in the first major trip in the United States to capture black folk music in the field. In order to fulfill their quest, the two men concentrated on sections of the South with a high percentage of blacks. They also pinpointed laboring camps, particularly lumber camps, which employed blacks almost exclusively. But as they went along, prisons and penitentiaries also emerged as a focal point for research.

The recordings made by the Lomaxes had historical significance. The whole idea of using a phonograph to preserve authentic folk music was still fairly new. Most of John Lomax's peers were involved in collecting songs the classic way: taking both words and melody down by hand, asking the singer to perform the song over and over until the collector had 'caught' it on paper. John Lomax sensed at once the limitations of this kind of method, especially when getting songs from African-American singers, whose quarter tones, blue notes and complex timing often frustrated white musicians trying to transcribe them with European notation systems.

The whole concept of field recordings was, in 1933 and still is today, radically different from the popular notion of recording. Field recordings are not intended as commercial products, but as attempts at cultural preservation. There is no profit motive, nor any desire to make the singer a 'star'. As have hundreds of folk song collectors after him, John Lomax had to persuade his singers to perform, to explain to them why their songs were important, and to convince the various authorities - the wardens, the trusties, the bureaucrats that this was serious, worthwhile work. He faced the moral problem of how to safeguard the records and the rights of the singers a problem he solved in this instance by donating the discs to the Library of Congress. He had to overcome the technical problems involved in recording outside a studio; one always hoped for quiet, with no doors slamming or alarms going off, but it was always a risk. His new state-of-the-art recording machine sported a new microphone designed by NBC, but there were no wind baffles to help reduce the noise when recording outside. Lomax learned how to balance sound, where to place microphones, how to work echoes and walls, and soon was a skilled recordist.

2/ Children's literature

I am sometimes asked why anyone who is not a teacher or a librarian or the parent of little kids should concern herself with children's books and folklore. I know the standard answers: that many famous writers have written for children, and that the great children's books are also great literature; that these books and tales are an important source of archetype and symbol, and that they can help us to understand the structure and functions of the novel.

All this is true. But I think we should also take children's literature seriously because it is sometimes subversive: because its values are not always those of the conventional adult world. Of course, in a sense much great literature is subversive, since its very existence implies that what matters is art, imagination and truth. In what we call the real world, what usually counts is money, power and public success.

The great subversive works of children's literature suggest that there are other views of human life besides those of the shopping mall and the corporation. They mock current assumptions and express the imaginative, unconventional, noncommercial view of the world in its simplest and purest form. They appeal to the imaginative, questioning, rebellious child within all of us, renew our instinctive energy, and act as a force for change. This is why such literature is worthy of our attention and will endure long after more conventional tales have been forgotten.

An interesting question is what - besides intention - makes a particular story a 'children's book'? With the exception of picture books for toddlers, these works are not necessarily shorter or simpler than so-called adult fiction, and they are surely not less well written. The heroes and heroines of these tales, it is true, are often children: but then so are the protagonists of Henry James's What Maisie Knew and Toni Morrison's The Bluest Eye. Yet the barrier between children's books and adult fiction remains; editors, critics and readers seem to have little trouble in assigning a given work to one category or the other.

In classic children's fiction a pastoral convention is maintained. It is assumed that the world of childhood is simpler and more natural than that of adults, and that children, though they may have faults, are essentially good or at least capable of becoming so. The transformation of selfish, whiny, disagreeable Mary and hysterical, demanding Colin in Frances Hodgson Burnett's The Secret Garden is a paradigm. Of course, there are often unpleasant minor juvenile characters who give the protagonist a lot of trouble and are defeated or evaded rather than reeducated. But

on occasion even the angry bully and the lying sneak can be reformed and forgiven. Richard Hughes's A High Wind in Jamaica, though most of its characters are children, never appears on lists of recommended juvenile fiction; not so much because of the elaborations of its diction (which is no more complex than that of, say, Treasure Island), but because in it children are irretrievably damaged and corrupted.

Adults in most children's books, on the other hand, are usually stuck with their characters and incapable of alteration or growth. If they are really unpleasant, the only thing that can rescue them is the natural goodness of a child. Here again, Mrs. Burnett provides the classic example, in Little Lord Fauntleroy. (Scrooge's somewhat similar change of heart in Dickens's A Christmas Carol, however, is due mainly to regret for his past and terror of the future. This is one of the things that makes the book a family rather than a juvenile romance; another is the helpless passivity of the principal child character, Tiny Tim.).

Of the three principal preoccupations of adult fiction - sex, money and death - the first is absent from classic children's literature and the other two either absent or much muted. Money is a motive in children's literature, in the sense that many stories deal with a search for treasure of some sort. These quests, unlike real-life ones, are almost always successful, though occasionally what is found in the end is some form of family happiness, which is declared by the author and the characters to be a 'real treasure'. Simple economic survival, however, is almost never the problem; what is sought, rather, is a magical (sometimes literally magical) surplus of wealth. Death, which was a common theme in nineteenth-century fiction for children, was almost banished during the first half of the twentieth century. Since then it has begun to reappear; the breakthrough book was E.B. White's Charlotte's Web. Today not only animals but people die, notably in the sort of books that get awards and are recommended by librarians and psychologists for children who have lost a relative. But even today the characters who die tend to be of another generation; the protagonist and his or her friends survive. Though there are some interesting exceptions, even the most subversive of contemporary children's books usually follow these conventions. They portray an ideal world of perfectible beings, free of the necessity for survival.

3/ The birth of our modern minds

When did we begin to use symbols to communicate? Roger Highfield reports on a challenge to prevailing ideas

Anyone who doubts the importance of art need do no more than refer to the current account of human evolution, where the emergence of modern people is not so much marked by Stone Age technology as a creative explosion that rocked Europe 40,000 years ago. Our ancestors began to adorn their bodies with beads and pendants, even tattoos; they painted representations of animals, people and magical hybrids on cave walls in Lascaux, France and Altamira in Spain. They sculpted voluptuous stone figures, such as the Venus of Willendorf. This cultural Big Bang, which coincided with the period when modern humans reached Europe after they set out, via the Near East, from Africa, marked a decisive point in our story, when man took a critical step beyond the limitations of his hairy ancestors and began to use symbols. The modern mind was born.

Or was it? Britain's leading archaeologist questions the dogma that the modern human mind originated in Europe and, instead, argues that its birth was much more recent, around 10,000 years ago, and took place in the Middle East. Lord Renfrew, professor of archaeology at Cambridge University, is troubled by what he calls the 'sapient behaviour paradox': genetic findings, based on the diversity of modern humans, suggest that our big brains emerged 150,000 years ago, when Homo sapiens evolved from Homo erectus, and were fully developed about 60,000 years ago. But this hardware, though necessary, was not sufficient for modern behaviour: software (culture) is also required to run a mind and for this to be honed took tens of millennia. There is something unsatisfactory about the genetic argument that rests on the 'potential' for change emerging, he argues. Ultimately, little happened - or at least not for another 30,000 years. Although there is no doubt that genes shaped the hardware of the modern brain, genetics does not tell the whole story. 'It is doubtful whether molecular sequences will give us any clear insights,' said Lord Renfrew, adding that the current account of our origins has also become sidetracked by placing too much emphasis on one cultural event. Either side of the boundary between the Middle and Upper Palaeolithic, 40,000 years ago, people lived much the same way. To the casual observer, the archaeological record for Homo sapiens does not look much different from Homo erectus's, or even our beetle browed European cousins, the Neanderthals. 'There are detailed changes in tools and so on but the only one that really strikes you is cave art.’

And this artistic revolution was patchy: the best examples are in Spain and France. In Britain, the oldest known cave art consists of 12,000-year-old engravings in Creswell Crags. Indeed, was there an artistic revolution 40,000 years ago at all? Two pieces of ochre engraved with geometrical patterns 70,000 years ago were recently found at Blombos Cave, 180 miles east of Cape Town, South Africa. This means people were able to think abstractly and behave as modern humans much earlier than previously thought. Lord Renfrew argues that art, like genetics, does not tell the whole story of our origins. For him, the real revolution occurred 10,000 years ago with the first permanent villages. That is when the effects of new software kicked in, allowing our ancestors to work together in a more settled way. That is when plants and animals were domesticated and agriculture born. First there were nests of skulls and unusual burial practices, cult centres and shrines. Then you have the first villages, the first towns, like Jericho in Jordan (around 8000 BC) and Catalhöyük in Turkey (est 6500 BC), then the spread of farming to Europe. Before long, you are accelerating towards the first cities in Mesopotamia, and then other civilisations in Mexico, China and beyond.

Living in timber and mud brick houses led to a very different engagement between our ancestors and the material world. 'I don't think it was until settled village communities developed that you had the concept of property, or that "I own these things that have been handed down to me". This in turn could have introduced the need for mathematics, to keep a tally of possessions, and written language to describe them. In the Near East, primitive counters date back to the early farming period and this could have marked the first stages of writing, said Lord Renfrew. 'We have not solved anything about the origins of modern humans until we understand what happened 10,000 years ago,' he said. He is excited by excavations now under way in Anatolia, a potential birthplace of the modern mind, in Catalhöyük, one of the earliest places where close-knit communities were born, and Göbekli Tepe, a shrine that predates village life. These spiritual sites may have seeded the first human settled communities by encouraging the domestication of plants and animals.

4/ Emigration to the US

American history has been largely the story of migrations. That of the hundred years or so between the Battle of Waterloo and the outbreak of the First World War must certainly be reckoned the largest peaceful migration in recorded history; probably the largest of any kind,

ever. It is reckoned that some thirty-five million persons entered the United States during that period, not to mention the large numbers who were also moving to Argentina and Australia. Historians may come to discern that in the twentieth and later centuries this movement was dwarfed when Africa, Asia and South America began to send out their peoples; but if so, they will be observing a pattern, of a whole continent in motion, that was first laid down in nineteenth-century Europe. Only the French seemed to be substantially immune to the virus. Otherwise, all caught it, and all travelled. English, Irish, Welsh, Scots, Germans, Scandinavians, Spaniards, Italians, Poles, Greeks, Jews, Portuguese, Dutch, Hungarians, Czechs, Croats, Slovenes, Serbs, Slovaks, Ukrainians, Lithuanians, Russians, Basques. There were general and particular causes.

As regards the general causes, the rise in population meant that more and more people were trying to earn their living on the same amount of land; inevitably, some were squeezed off it. The increasing cost of the huge armies and navies, with their need for up-to-date equipment, that every great European power maintained, implied heavier and heavier taxes which many found difficult or impossible to pay, and mass conscription, which quite as many naturally wanted to avoid. The opening up of new, superbly productive lands in the United States, Canada, Australia and New Zealand, coupled with the availability of steamers and steam trains to distribute their produce, meant that European peasants could not compete effectively in the world market: they would always be undersold, especially as the arrival of free trade was casting down the old mercantilist barriers everywhere. Steam was important in other ways too. It became a comparatively easy matter to cross land and sea, and to get news from distant parts. The invention of the electric telegraph also speeded up the diffusion of news, especially after a cable was successfully laid across the Atlantic in 1866. New printing and paper- making machines and a rapidly spreading literacy made large-circulation newspapers possible for the first time. In short, horizons widened, even for the stay-at-home. Most important of all, the dislocations in society brought about by the French Revolution, the Industrial Revolution and the various wars and tumults of nineteenth-century Europe shattered the old ways. New states came into being, old ones disappeared, frontiers were recast, the laws of land- tenure were radically altered, internal customs barriers and feudal dues both disappeared, payment in money replaced payment in kind, new industries stimulated new wants and destroyed the self-sufficiency of peasant households and the saleability of peasant products. The basic structure of rural Europe was

transformed. Bad times pushed, good times pulled (American factories were usually clamouring for workers): small wonder that the peoples moved.

Particular reasons were just as important as these general ones. For example: between 1845 and 1848 Ireland suffered the terrible potato famine. A million people died of starvation or disease, a million more emigrated (1846-51). Matters were not much better when the Great Famine was over: it was followed by lesser ones, and the basic weaknesses of the Irish economy made the outlook hopeless anyway. Mass emigration was a natural resort, at first to America, then, in the twentieth century, increasingly, to England and Scotland. Emigration was encouraged, in the Irish case as in many others, by letters sent home and by remittances of money. The first adventurers thus helped to pay the expenses of their successors. Political reasons could sometimes drive Europeans across the Atlantic too. In 1848 some thousands of Germans fled the failure of the liberal revolution of that year (but many thousands emigrated for purely economic reasons).

If such external stimuli faltered, American enterprise was more than willing to fill the gap. The high cost of labour had been a constant in American history since the first settlements; now, as the Industrial Revolution made itself felt, the need for workers was greater than ever. The supply of Americans was too small to meet the demand: while times were good on the family farm, as they were on the whole until the 1880s, or while there was new land to be taken up in the West, the drift out of agriculture (which was becoming a permanent feature of America, as of all industrialized, society) would not be large enough to fill the factories. So employers looked for the hands they needed in Europe, whether skilled, like Cornish miners, or unskilled, like Irish navvies. Then, the transcontinental railroads badly needed settlers on their Western land grants, as well as labourers: they could not make regular profits until the lands their tracks crossed were regularly producing crops that needed carrying to market. Soon every port in Europe knew the activities of American shipping lines and their agents, competing with each other to offer advantageous terms to possible emigrants. They stuck up posters, they advertised in the press, they patiently asnwered inquiries, and they shepherded their clients from their native villages, by train, to the dockside, and then made sure they were safely stowed in the steerage.

5/ How bugs hitch-hike across the galaxy

Mankind's search for alien life could be jeopardised by ultra-resilient bacteria from Earth. David Derbyshire reports

What was the most important discovery of the Apollo programme? Some have argued that it was the rocks that explained how the Moon was formed. Others believe it was the technological spin-offs. But according to Captain Peter Conrad, who led the 1969 Apollo 12 mission, it was life. On the apparently dead lunar surface, a colony of bacteria was thriving. The organisms were not native to the Moon, but were visitors from Earth who had hitch-hiked a ride on board one of Nasa's five Surveyor probes from the 1960s. To the astonishment of biologists, between 50 and 100 Streptococcus bacteria survived the journey across space, at an average temperature 20 degrees above absolute zero with no source of energy or water, and stayed alive on the Moon in a camera for three years. Captain Conrad, who returned the bacteria to Earth, was later to confess: 'I always thought the most significant thing we ever found on the whole Moon was the little bacteria that came back and lived.

The ability of life to survive, adapt and evolve never fails to astonish. Over the past three decades, bacteria and archaea have been found in some of the most inhospitable places on Earth. Known as extremophiles, these organisms have coped with life in a vacuum, pressure as high as 70 tons per square inch, depths of four miles beneath the surface and scorching waters around deep-sea volcanic vents. They have also survived 25 million years inside a bee preserved in resin. Their resilience has renewed enthusiasm for the search for alien life a quest that many had assumed had been banished to fantasy fiction. Mars and the moons Titan, Europa and Callisto are once again plausible candidates for extraterrestrials.

As interest in alien life has grown, so have concerns that mankind could spread its own microscopic bugs, contaminating the places we want to explore. In 2003, Nasa ended the Galileo probe's mission by smashing it into Jupiter. The fear was that it could be carrying bacteria that might contaminate Europa's oceans.

The team behind Beagle 2 - the British probe that went to search for life on Mars in 2003 - was forced to take contamination particularly seriously. If Beagle carried to Mars life or dead spores picked up during the manufacture of the spacecraft, its science would be jeopardised. Prof Colin Pillinger, the Open University scientist who headed the Beagle project, said: 'What we've learnt since the Apollo missions and the Viking Mars missions of the 1970s is that bugs are far more tenacious than we ever imagined. They seem to be very tolerant of high temperatures, they lie

dormant at low temperatures for long periods, they are immune to salt, acid and alkali, they seem to survive on substrate that are not what people expect. Extremophiles are extremely adapted to hanging on to life.'

Beagle had to be assembled in a 'clean room' - and one was specially put together in a converted BBC outside broadcast van garage in Milton Keynes. It had enough room to include an enormous set of fans that circulated and filtered the air 500 times an hour. Only a handful of trained researchers were allowed inside. "I wasn't allowed in,' says Prof Pillinger.

There was special training for people going in there and special conditions. There was a ban on beards and a limit of four people at any one time. The team kept samples of everything that could have contaminated the craft and monitored every stage of assembly.

To reduce the workload, the idea was to build as much as possible before sterilising it and banishing it to the difficult working conditions inside the clean room. The easy stuff was heated to 115C for 52 hours, more than enough to kill off bugs. Electronic equipment can't cope with those sorts of temperatures, so the team used a hydrogen peroxide plasma, created in a microwave, to kill off bugs at low temperatures. Parachutes and gas bags were zapped with gamma radiation. It wasn't just facial hair that was banned. 'You've heard of the paperless office,' says Prof Pillinger. 'We had the paperless assembly line. The guys normally go in armed with loads of papers and diagrams, but we didn't allow any of that. They were given information through a glass wall, over mikes and monitors. And sometimes on a piece of paper stuck to the glass with sticky tape.'

Beagle's heat shield doubled as its biological shield. So once the instruments were encased and sealed, the craft could be brought back into the real world. The shield heated up to 1,700 degrees on its descent through the Martian atmosphere, so bugs on the casing were not a worry. Mars Express - the craft carrying Beagle - did not need sterilising. Its trajectory was designed so that if something went wrong, the craft would not simply crash into the planet. Its course could be corrected en route. Eventually, space scientists hope to return samples of Mars to Earth. While the risks of alien bacteria proving hazardous on Earth may be remote, the rocks will still need to be quarantined. Moon rocks from Apollo were analysed in vacuum glove boxes for the first two missions. Later, researchers stored rocks in nitrogen. Prof Pillinger believed the first Mars rocks should be sterilised before they are studied on Earth. 'For security purposes it would be the most

sensible thing to do. You don't have to sterilise it all, you can contain some of it and then sterilise the sample you want to look at, but it would lower the risk and make it easier to analyse.

6/ Finding out about the world from television news

In The Ideological Octopus (1991), Justin Lewis points to an important issue concerning the formal structure of television news. As he notes, television news lacks the narrative element which, in other genres, serves to capture viewer interest and thus motivate viewing. Lewis posits this as one of the key reasons why television news often fails to interest people and why, when they do watch it, people often cannot understand it. Lewis argues that one fundamental problem with watching television news is that its narrative structure means that the viewer is offered the punchline before the joke because the main point (the headline) comes right at the beginning, after which the programme, by definition, deals with less and less important things. Thus, in television news Our interest is not awakened by an enigma which is then gradually solved, to provide a gratifying solution - as so often happens in fictional narratives. In Lewis's terms, in television news there is no enigma, the solution of which will motivate the viewing process. As he baldly states, "If we decided to try to design a television programme with a structure that would completely fail to capture an audience's interest, we might (finally) come up with the format of the average television news show' (Lewis 1991).

What Lewis also does is offer an interesting contrast, in this respect, between the high-status phenomenon of television news and the low-status genre of soap opera. The latter, he observes, offers the most highly developed use of effective narrative codes. To that extent soap opera, with its multiple narratives, could be seen, in formal terms, as the most effective type of television for the cultivation of viewer interest, and certainly as a far more effective form than that of television news for this purpose. Clearly, some of Lewis's speculation here is problematic. There are counter- examples of his arguments (e.g. instances of programmes such as sports news which share the problematic formal features he points to but which are nonetheless popular at least among certain types of viewers). Moreover, he may perhaps overstress the importance of structure as against content relevance in providing the basis for programme appeal. Nonetheless, I would suggest that his argument, in this respect, is of considerable interest.

Lewis argues not only that soap opera is more narratively interesting than television news, in formal terms, but, moreover, that the world of television fiction in general is much closer to most

people's lives than that presented in the news. This, he claims, is because the world of television fiction often feels to people like their own lives. They can, for example, readily identify with the moral issues and personal dilemmas faced by the characters in a favourite soap opera. Conversely, the world of television news is much more remote in all senses; it is a socially distant world populated by another race of special or 'elite' persons, the world of them' not 'us'. This is also why most people feel more able to evaluate TV fiction than TV news because it seems closer to their own lives and to the world they live in [whereas] the world of television news... might almost be beamed in from another planet' (Lewis 1991). It is as if the distant world of the news' is so disconnected from popular experience that it is beyond critical judgement for many viewers. Hence, however alienated they feel from it, they monetheless lack any alternative perspective on the events it portrays.

One consequence of this, Lewis argues, is that precisely, because of this distance, people who feel this kind of alienation from the 'world of news nonetheless use frameworks to understand news items which come from within the news themselves. This, he argues, is because in the absence of any other source of information or perspective they are forced back on using the media's own framework. Many viewers are simply unable to place the media's portrayal of events in any other critical framework (where would they get it from?). To this extent, Lewis argues, Gerbner and his colleagues (see Gerbner et al. 1986; Signorielli and Morgan 1990) may perhaps be right in thinking that the dominant perspectives and associative logics' offered by the media may often simply be soaked up by audiences by sheer dint of their repetition. This is not to suggest that such viewers necessarily believe, or explicitly accept, these perspectives, but simply to note that they have no other place to start from, however cynical they may be, at a general level, about 'not believing what you see on television', and they may thus tend, in the end, to fall back on 'what it said on TV. In one sense, this could be said to be the converse of Hall's 'negotiated code (1980), as taken over from Parkin (1973). Parkin had argued, that many working-class people display a 'split consciousness', whereby they accept propositions from the 'dominant ideology' at an abstract level, but then negotiate' or 'discount the application of these ideological propositions to the particular circumstances of their own situation. Here, by contrast, we confront a situation where people often express cynicism in general (so that not believing what you see in the media' is no more than common sense), but then in any particular case they often find themselves pushed back into reliance on the mainstream media's account of anything

beyond the realm of their direct personal experience, simply for lack of any alternative perspective.

7/ Working in the movies

Subtitling is an exacting part of the translation profession. Melanie Leyshon talks to Virginie Verdier of London translation company VSI about the glamour and the grind.

When people ask French translator Virginie Verdier what she does for a living, it must be tempting to say enigmatically: 'Oh me? I'm in the movies. It's strictly true, but her starring role is behind the scenes. As translating goes, it doesn't get more entertaining or glamorous than subtitling films. If you're very lucky, you get to work on the new blockbuster films before they're in the cinema, and if you're just plain lucky, you get to work on the blockbuster movies that are going to video or DVD.

Virginie is quick to point out that this is as exacting as any translating job. 'You work hard. It's not all entertainment as you are doing the translating. You need all the skills of a good translator and those of a top-notch editor. You have to be precise and, of course, much more concise than in traditional translation work.'

The process starts when you get the original script and a tape. 'We would start with translating and adapting the film script. The next step is what we call 'timing', which means synchronising the subtitles to the dialogue and pictures. This task requires discipline. 'You play the film, listen to the voice and the subtitles are up on your screen ready to be timed. You insert your subtitle when you hear the corresponding dialogue and delete it when the dialogue finishes. The video tape carries a time code which runs in hours, minutes, seconds and frames. Think of it as a clock. The subtitling unit has an insert key to capture the time code where you want the subtitle to appear. When you press the delete key, it captures the time code where you want the subtitle to disappear. So each subtitle would have an 'in' point and an 'out' point which represent the exact time when the subtitle comes in and goes out. This process is then followed by a manual review, subtitle by subtitle, and time- codes are adjusted to improve synchronisation and respect shot changes. This process involves playing the film literally frame by frame as it is essential the subtitles respect the visual rhythm of the film.'

Different subtitlers use different techniques. 'I would go through the film and do the whole translation and then go right back from the beginning and start the timing process. But you could

do it in different stages, translate let's say 20 minutes of the film, then time this section and translate the next 20 minutes, and so on. It's just a different method."

For multi-lingual projects, the timing is done first to create what is called a 'spotting list', a subtitle template, which is in effect a list of English subtitles pre-timed and edited for translation purposes. This is then translated and the timing is adapted to the target language with the help of the translator for quality control.

'Like any translation work, you can't hurry subtitling, says Virginie. 'If subtitles are translated and timed in a rush, the quality will be affected and it will show. Mistakes usually occur when the translator does not master the Source language and misunderstands the original dialogue. 'Our work also involves checking and reworking subtitles when the translation is not up to standard. However, the reason for redoing subtitles is not just because of poor quality translation. We may need to adapt subtitles to a new version of the film: the time code may be different, the film may have been edited or the subtitles may have been created for the cinema rather than video. If subtitles were done for cinema on 35mm, we would need to reformat the timing for video, as subtitles could be out of synch or too fast. If the translation is good, we would obviously respect the work of the original translator.'

On a more practical level, there are general subtitling rules to follow, says Virginie. 'Subtitles should appear at the bottom of the screen and usually in the centre. She says that different countries use different standards and rules. In Scandinavian countries and Holland, for example, subtitles are traditionally left justified. Characters usually appear in white with a thin black border for easy reading against a white or light background. We can also use different colours for each speaker when subtitling for the hearing impaired. Subtitles should have a maximum of two lines and the maximum number of characters on each line should be between 32 and 39. Our company standard is 37 (different companies and countries have different standards).'

Translators often have a favourite genre, whether it's war films, musicals, comedies (one of the most difficult because of the subtleties and nuances of comedy in different countries), drama or corporate programmes. Each requires a certain tone and style. 'VSI employs American subtitlers, which is incredibly useful as many of the films we subtitle are American, says Virginie. 'For an English person, it would not be so easy to understand the meaning behind typically American expressions, and vice-versa.'

8/ Complementary and Alternative Medicine

What do scientists in Britain think about “Alternative” therapies? Orla Kennedy reads a surprising survey.

Is complementary medicine hocus-pocus or does it warrant large-scale investigation? Should science range beyond conventional medicine and conduct research on alternative medicine and the supposed growing links between mind and body? This will be hotly debated at the British Association for the Advancement of Science.

One Briton in five Uses complementary medicine, and according to the most recent Mintel survey, one in ten uses herbalism or homoeopathy. Around £130 million is spent on oils, potions and pills every year in Britain, and the complementary and alternative medicine industry is estimated to be worth £1.6 billion. With the help of Professor Edzard Ernst, Laing chair of complementary medicine at The Peninsula Medical School, Universities of Exeter and Plymouth, we asked scientists their views on complementary and alternative medicine. Seventy-five scientists, in fields ranging from molecular biology to neuroscience, replied.

Surprisingly, our sample of scientists was twice as likely as the public to use some form of complementary medicine, at around four in 10 compared with two in 10 of the general population. Three quarters of scientific users believed they were effective. Acupuncture, chiropractic and osteopathy were the most commonly used complementary treatments among scientists and more than 55 per cent believed these were more effective than a placebo and should be available to all on the National Health Service.

Scientists appear to place more trust in the more established areas of complementary and alternative medicine, such as acupuncture, chiropractic and osteopathy, for which there are professional bodies and recognised training than therapies such as aromatherapy and spiritual healing. 'Osteopathy is now a registered profession requiring a certified four-year degree before you can advertise and practise,' said one neuroscientist who used the therapy.

Nearly two thirds of the scientists who replied to our survey believed that aromatherapy and homoeopathy were no better than placebos, with almost a half thinking the same of herbalism and spiritual thinking. Some of the comments we received were scathing, even though one in ten of our respondents had Used homoeopathy. 'Aromatherapy and homoeopathy are scientifically nonsensical,' said one molecular biologist from the University of Bristol. Dr Romke Bron, a molecular biologist at the Medical Research Council Centre at King's College London, added:

'Homoeopathy is a big scam and I am convinced that if someone sneaked into a homoeopathic pharmacy and swapped labels, nobody would notice anything.'

Two centuries after homeopathy was introduced, it still lacks a watertight demonstration that it works. Scientists are happy that the resulting solutions and sugar pills have no side effects, but are baffled by how they can do anything.

Both complementary and conventional medicine should be used in routine health care, according to followers of the integrated health approach', who want to treat an individual as a whole'. But the scientists who responded to our survey expressed serious concerns about this approach, with more than half believing that integrated medicine was an attempt to bypass rigorous scientific testing. Dr Bron said: 'There is an awful lot of bad science going on in alternative medicine and the general public has a hard time to distinguish between scientific myth and fact. It is absolutely paramount to maintain rigorous quality control in health care. Although the majority of alternative health workers mean well, there are just too many Frauds out there preying on vulnerable people.'

One molecular biologist from the University of Warwick admitted that 'by doing this poll I have realised how shamefully little | understand about alternative therapy. Not enough scientific research has been performed. There is enough anecdotal evidence to suggest that at least some of the alternative therapies are effective for some people, suggesting this is an area ripe for research.'

When asked if complementary and alternative medicine should get more research funding, scientists believed the top three (acupuncture, chiropractic and osteopathy) should get money, as should herbalism. It seems that therapies based on physical manipulation or a known action - like the active ingredients in a herb on a receptor in the body - are the ones that the scientific community has faith in. Less than a quarter thought that therapies such as aromatherapy, homoeopathy and spiritual healing should get any funding.

Scientists believed that the 'feelgood' counselling effect of complementary medicine and the time taken to listen to patients' problems was what worked, rather than any medicinal effect. In contrast, the average visit to the doctor lasts only eight minutes, says the British Medical Association. Dr Stephen Nurrish, a molecular biologist at University College London, said: 'Much of the benefit people get from complementary medicine is the time to talk to someone and be listened to sympathetically, something that is now lacking from medicine in general.'

But an anonymous neuroscientist at King's College London had a more withering view of this benefit: On the validity of complementary and alternative medicines, no one would dispute that 'feeling good' is good for your health, but why discriminate between museum-trip therapy, patting-a-dog therapy and aromatherapy? Is it because only the latter has a cadre of professional 'practitioners'?'

There are other hardline scientists who argue that there should be no such thing as complementary and alternative medicine. As Professor David Moore, director of the Medical Research Council's Institute for Hearing Research, said: 'Either a treatment works or it doesn't. The only way to determine if it works is to test it against appropriate controls (that is, scientifically).'

9/ THE CLOUD MESSENGER

At six o'clock one evening in December 1802, in a dank and cavernous laboratory in London, an unknown young amateur meteorologist gave the lecture that was to make him famous

Luke Howard had been speaking for nearly an hour, during which time his audience had found itself in a state of gradually mounting excitement. By the time that he reached the concluding words of his address, the Plough Court laboratory was in an uproar. Everyone in the audience had recognized the importance of what they had just heard, and all were in a mood to have it confirmed aloud by their friends and neighbours in the room. Over the course of the past hour, they had been introduced not only to new explanations of the formation and lifespan of clouds, but also to a poetic new terminology: 'Cirrus', 'Stratus', 'Cumulus', 'Nimbus', and the other names, too, the names of intermediate compounds and modified forms, whose differences were based on altitude, air temperature and the shaping powers of upward radiation. There was much that needed to be taken on board.

Clouds, as everyone in the room would already have known, were staging posts in the rise and fall of water as it made its way on endless compensating journeys between the earth and the fruitful sky. Yet the nature of the means of their exact construction remained a mystery to most observers who, on the whole, were still in thrall to the vesicular or 'bubble' theory that had dominated meteorological thinking for the better part of a century. The earlier speculations, in all

their strangeness, had mostly been forgotten or were treated as historical curiosities to be glanced at, derided and then abandoned. Howard, however, was adamant that clouds were formed from actual solid drops of water and ice, condensed from their vaporous forms by the fall in temperature which they encountered as they ascended through the rapidly cooling lower atmosphere. Balloon pioneers during the 1780s had confirmed just how cold it could get up in the realm of the clouds: the temperature fell some 6.5°C for every thousand metres they ascended. By the time the middle of a major cumulus cloud had been reached, the temperature would have dropped to below freezing, while the oxygen concentration of the air would be starting to thin quite dangerously. That was what the balloonists meant by 'dizzy heights'.

Howard was not, of course, the first to insist that clouds were best understood as entities with physical properties of their own, obeying the same essential laws which governed the rest of the natural world (with one or two interesting anomalies: water, after all, is a very strange material). It had long been accepted by many of the more scientifically minded that clouds, despite their distance and their seeming intangibility, should be studied and apprehended like any other objects in creation.

There was more, however, and better. Luke Howard also claimed that there was a fixed and constant number of basic cloud types, and this number was not (as the audience might have anticipated) in the hundreds or the thousands, like the teeming clouds themselves, with each as individual as a thumbprint. Had this been the case, it would render them both unclassifiable and unaccountable; just so many stains upon the sky. Howard's claim, on the contrary, was that there were just three basic families of cloud, into which every one of the thousands of ambiguous forms could be categorized with certainty. The clouds obeyed a system and, once recognized in outline, their basic forms would be 'as distinguishable from each other as a tree from a hill, or the latter from a lake', for each displayed the simplest possible visual characteristics.

The names which Howard devised for them were designed to convey a descriptive sense of each cloud type's outward characteristics (a practice derived from the usual procedures of natural history classification), and were taken from the Latin, for ease of adoption 'by the learned of different nations': Cirrus (from the Latin for fibre or hair), Cumulus (from the Latin for heap or pile) and Stratus (from the Latin for layer or sheet). Clouds were thus divided into tendrils, heaps and layers: the three formations at the heart of their design. Howard then went on to name four other cloud types, all of which were either modifications or aggregates of the three major

families of formation. Clouds continually unite, pass into one another and disperse, but always in recognizable stages. The rain cloud Nimbus, for example (from the Latin for cloud), was, according to Howard, a rainy combination of all three types, although Nimbus was reclassified as nimbostratus by meteorologists in 1932, by which time the science of rain had developed beyond all recognition.

The modification of clouds was a major new idea, and what struck the audience most vividly about it was its elegant and powerful fittingness. All of what they had just heard seemed so clear and so self-evident. Some must have wondered how it was that no one not even in antiquity - had named or graded the clouds before, or if they had, why their efforts had left no trace in the language. How could it be that the task had been waiting for Howard, who had succeeded in wringing a kind of exactitude from out of the vaporous clouds? Their forms, though shapeless and unresolved, had at last, it seemed, been securely grasped. Howard had given a set of names to a radical fluidity and impermanence that seemed every bit as magical, to that first audience, as the Eskimo's fabled vocabulary of snow.

10/ Groucho Marx Arthur Sheekman

In a show-business career that spanned over seventy years, Groucho Marx successfully conquered every entertainment medium, becoming a star of the vaudeville stage, Broadway, motion pictures, radio and television. But, as the author of seven books, a play, two film screenplays and over one hundred magazine articles and essays, Groucho quietly conquered another medium, one in which he was as proud to work as any of the others. His writing is often overlooked in studies of his career, perhaps due to the quantity and variety of his other work. Throughout his literary career, Groucho was dogged by the incorrect and unfair assumption by many critics and even by his biographer that he used a ghost writer. Most Hollywood celebrities who wrote books had professional writers do the actual work. The fact that Groucho publicly stated on many occasions that he abhorred ghost writers is clouded by his relationship with Arthur Sheekman. Friends for many years, Groucho and Sheekman had an unusual literary relationship. They worked in collaboration and each offered the other editorial help. For a brief time in the early 1940s, Groucho fronted for Sheekman, who was having trouble selling his work. By thus lending his name to another writer's work, Groucho subjected all of his literary endeavors to suspicion from critics who simply refused to believe that an entertainer could write.

That some of Sheekman's magazine pieces got into print under Groucho's byline becomes apparent from reading the unedited correspondence between the two of them. The letters indicate that Groucho's essays from this period fall into three categories: first, pieces written by Groucho with no input from Sheekman at all. In a July 1, 1940, letter to Sheekman, Groucho asked, 'Did you see that little piece I wrote for Reader's Digest?' On March 17, 1941, he wrote, 'My drool is coming out in next week's issue of This Week so cancel your subscription now. Clearly Sheekman could not have had anything to do with a piece that he was told to look for.

The second and probably largest category of Groucho's essays of this period consists of those written by Groucho and sent to Sheekman for editorial assistance. On July 20, 1940, Groucho wrote: 'I'm enclosing a copy of the piece I wrote. Probably another page or so is needed to complete it, but our starting date [for filming Go West] came and I just haven't had time to finish it. Let me know what you think of it and be honest because any other kind of opinion would be of no value to me. I won't attempt to influence you by telling you the reactions I've already had, so for the love of God tell me the truth.' Shortly thereafter, on October 10, Groucho wrote: 'I received your suggestions on my piece - I'm glad you liked it, if you did - you're probably right about the beginning. I'll do it over again. By the time Groucho wrote to Sheekman on July 25, 1942, it appears that some sort of financial arrangement had been made regarding Sheekman's suggestions. On that date Groucho also wrote: 'I'm writing an unfunny piece on insomnia and I'll send it in a week or so, I hope, for you to read - I'd like your opinion, proofread - correcting all the glaring illiteracies and, otherwise, do a fine polishing job.'

The remainder of Groucho's essays from this period comprise the third category, Sheekman compositions with varying degrees of input from Groucho. The level of Groucho's contributions to the articles in the third category ranges from actually suggesting the topic and drawing up an outline to simply rewriting a few paragraphs for the purpose of injecting his own style into the piece. In a July 10, 1940, letter Groucho wrote: 'I think you ought to try another political piece - a campaign thing - for This Week or some other magazine. This will be an extremely hot topic for the next few months and I think you should take advantage of it. If you'll write to me, I'll try to jot down a few items that you could complain about.' Presumably, the chain of events would continue with Sheekman sending an essay to Groucho for his approval and whatever rewrites were needed. On May 29, 1940, Groucho wrote, 'Received your piece and looked it over. In these letters to Sheekman, Groucho always referred to a piece as either 'my piece' or 'your piece'.

The letter continued, 'I thought the piece was good... and I'll send it to Bye and see if he can sell it ... I'll just rewrite a couple of paragraphs in your piece - not that I can improve them, but perhaps they'll sound a little more like me. Groucho was concerned enough about this arrangement to take the care to at least make the piece somewhat his own

Groucho really had no need for this entire enterprise. He gave the money to Sheekman and had no trouble getting his own work published. The principal reason for him submitting Sheekman's work to magazines as his own was that it made Sheekman's material easily marketable based on Groucho's celebrity. Sheekman couldn't have been altogether happy with the arrangement, but the reality was that he was periodically unemployed and the use of Groucho's name brought in occasional paychecks. So it is not quite fair to call Sheekman Groucho's ghost writer. A more apt description of their literary relationship at this time is that Groucho occasionally fronted for Sheekman and offered him the services of his literary agent, while each offered the other editorial advice. The reasons for some of their collaborative efforts not being credited as such remain unexplained, but Groucho was never shy about crediting his collaborators, and in every other case he did so.

11/ An earth-shaking discovery

The discovery of sea floor spreading is earth-shaking, yet those responsible are forgotten, says Anna Grayson

In 1963, a paper appeared in the journal Nature that radically changed the way we view this planet and its resources. Its authors, Fred Vine and Drummond Matthews, did for the Earth sciences what Crick and Watson did for biology and Einstein did for physics, and new areas of scientific development are still emerging as a result.

Yet both men are largely forgotten and unrecognised. What Vine and Matthews did was to provide proof that continents really do drift across the surface of the globe. This understanding profoundly affects the way we use the planet today - it directs the way we prospect for resources such as oil and minerals; it has enabled us to predict most volcanic eruptions and to understand patterns of earthquakes. Incredibly, perhaps, an understanding of the mobile dynamic nature of the Earth is helping an understanding of long-term global climate changes. Despite the significance of their work, neither man received great honour or fame.

The idea of continental drift was first proposed in a serious way by the German meteorologist Alfred Wegener in 1915. People had noticed the neat jigsaw-like fit between South America and

Africa, but Wegener found actual fossil evidence that the two continents were once joined. No one took him seriously; in fact he was ridiculed by most of the geological community. This was partly because, not being a geologist, he was perceived as an outsider. But the main reason for the hostility, according to Vine, was that Wegener was unable to come up with an explanation as to how whole continents could possibly move even an inch, let alone dance to the music of time around the globe.

In the 1920s, the Scottish geologist Arthur Holmes hypothesised that convection currents within the Earth 'could become sufficiently vigorous to drag the two halves of the original continent apart. In the late 1950s, an American, Harry Hess, came up with the hypothesis that new sea floor is constantly being generated at the mid- ocean ridges by hot material rising in a convection current. But neither man could find evidence to prove it. It was no more than just a hunch that it had to be right, and a hunch is not enough for science.

Vine had been fascinated by the apparent fit of the continents since the age of 14, and as a graduate student at Cambridge was assigned a project analysing one of the new magnetic surveys of the ocean floor. He found what he describes as 'parallel zebra stripes of normal and reversed magnetism' around the mid-ocean ridge. Most significantly, these stripes were symmetrical either side of the ridge crests. There had to be a reason for this. The young Vine and his supervisor Matthews proposed that the magnetic stripes were caused by new ocean floor being formed as molten rock rose at the mid-ocean ridges and spread each side of the ridge.

As the molten rock solidified, it became weakly magnetised parallel to the Earth's magnetic field. It was just becoming recognised in the early 1960s that the Earth's magnetic field flips every so often, so magnetic north becomes a magnetic south pole and visa versa. These flips in magnetic field were being recorded in the new sea floor. It was like a giant tape recording of the ocean floor's history. As new sea floor was made, it pushed the last lot aside, widening the ocean and in turn pushing the continents either side further apart. In other words, they had discovered the mechanism driving drifting continents that was missing from Wegener's work. The science of the Earth was never the same again.

By the end of the 1960s, confirmation of global sea floor spreading led to plate tectonics - the view of the outside of the Earth comprising just a few rigid plates which are shunted about by growing sea floor. There was a realisation that mountains are formed when two plates collide,

and that most volcanoes and earthquakes occur on the edges of these plates. All this was accepted as fact by all but a few diehard dinosaurs in the geological world.

It is now in the impact of shifting continents on the global environment that Vine feels the most exciting and significant research lies: 'The distribution of continents and the opening and closing of ocean gates between continents has had a profound effect on climates and has caused flips from Ice house Earth to Green-house Earth. The recognition that the Earth's hydrosphere, atmosphere and biosphere are all intimately linked with the drifting continents and the goings- on deep within the Earth has spawned the term 'Earth Systems Science'. It is a great oak tree of science that has grown from the acorn of truth supplied by Vine and Matthews. The holistic approach of earth systems science is very much welcomed by Vine: 'I'm rather pleased that this has come together.' He feels that the future for understanding the planet lies in an integrated approach to the sciences, rather than the isolated stance the geologists took throughout the 20th century: 'There was an incredible polarisation of science and I was caught between the boundaries. It was anathema to me the whole of environmental science should be integrated.'

12/ Think Happy

It's no joke: even scientists at the Royal Society are now taking the search for the source of happiness very seriously

What would Sir Isaac Newton have made of it? There he was, painted in oils, gazing down at one of the strangest meetings that the Royal Society, Britain's most august scientific body, has ever held. If Newton had flashed a huge grin, it would have been completely appropriate, for beneath him last week a two-day conference was unfolding on a booming new field of science: investigating what makes people happy. Distinguished professors strode up to the podium, including one eminent neurologist armed with videos of women giggling at comedy films; another was a social scientist brandishing statistics on national cheerfulness. Hundreds of other researchers sat scribbling notes on how to produce more smiles.

The decision by the Royal Society to pick 'the science of wellbeing' from hundreds of applications for conferences on other topics is no laughing matter. It means that the investigation of what makes people happy is being taken very seriously indeed. 'Many philosophies and religions have studied this subject, but scientifically it has been ignored,' said Dr Nick Baylis, a

Cambridge University psychologist and one of the conference organisers. 'For the Royal Society to give us its countenance is vital, because that states that what we are doing deserves to be acknowledged and investigated by the best scientific minds.'

At first sight, the mission of Baylis - and the growing number of other scientists working on happiness research appears fanciful. They want to deploy scientifically rigorous methods to determine why some people are lastingly happy while others tend to misery. Then they envisage spreading the secret of happiness across the globe and, in short, increasing the sum of human happiness. 'If someone is happy, they are more popular and also healthier, they live longer and are more productive at work. So it is very much worth having,' he says.

Baylis, the only 'positive psychology' lecturer in Britain, knows that the aims of happiness research might sound woolly, so he is at pains to distance himself from the brigades of non-academic self-help gurus. He refers to 'life satisfaction' and 'wellbeing' and emphasises that his work, and that of others at the conference, is grounded in solid research. So what have the scientists discovered has a theory of happiness been defined yet?

According to Professor Martin Seligman, probably the world's leading figure in this field, happiness could be but a train ride and a couple of questionnaires away. It was Seligman, a psychologist from Pennsylvania University, who kick-started the happiness science movement with a speech he made as President of the American Psychological Association (APA). Why, asked Seligman, shocking delegates at an APA conference, does science only investigate suffering? Why not look into what steps increase happiness, even for those who are not depressed, rather than simply seek to assuage pain? For a less well- known scientist, the speech could have spelt the end of a career, but instead Seligman landed funding of almost £18m to follow his hunch. He has been in regular contact with hundreds of other researchers and practising psychologists around the world, all the while conducting polls and devising strategies for increasing happiness.

His findings have led him to believe that there are three main types of happiness. First, there is 'the pleasant life' - the kind of happiness we usually gain from sensual pleasures such as eating and drinking or watching a good film. Seligman blames Hollywood and the advertising industry for encouraging the rest of us, wrongly as he sees it, to believe that lasting happiness is to be found that way. Second, there is 'the good life', which comes from enjoying something we are good or talented at. The key to this, Seligman believes, lies in identifying our strengths and then

taking part in an activity that uses them. Third, there is 'the meaningful life'. The most lasting happiness, Seligman says, comes from finding something you believe in and then putting your strengths at its service. People who are good at communicating with others might thus find long-lasting happiness through becoming involved in politics or voluntary work, while a rock star wanting to save the world might find it in organising a charity concert.

Achieving 'the good life' and 'the meaningful life' is the secret of lasting happiness, Seligman says. For anybody unsure of how to proceed, he has an intriguing idea. To embark on the road to happiness, he suggests that you need a pen, some paper and, depending on your location, a railway ticket. First, identify a person to whom you feel a deep debt of gratitude but have never thanked properly. Next, write a 300-word essay outlining how important the help was and how much you appreciate it. Then tell them you need to visit, without saying what for, turn up at their house and read them the essay. The result: tears, hugs and deeper, longer-lasting happiness, apparently, than would come from any amount of champagne.

Sceptics may insist that science will always remain a clumsy way of investigating and propagating happiness and say that such things are better handled by artists, writers and musicians - if they can be handled at all. And not everybody at the conference was positive about the emerging science. Lewis Wolpert, professor of biology as applied to medicine at University College London, who has written a bestseller about his battle with depression, said: 'If you were really totally happy, I'd be very suspicious. I think you wouldn't do anything, you'd just sort of sit there in a treacle of happiness. There's a whole world out there, and unless you have a bit of discomfort, you'll never actually do anything.'

13/ The birds of London

There are more than two hundred different species and sub-species of birds in the London area, ranging from the magpie to the greenfinch, but perhaps the most ubiquitous is the pigeon. It has been suggested that the swarms of feral pigeons are all descended from birds which escaped from dovecotes in the early medieval period; they found a natural habitat in the crannies and ledges of buildings as did their ancestors, the rockdoves, amid the sea-girt cliffs. 'They nest in small colonies,' one observer has written, usually high up and inaccessible' above the streets of London as if the streets were indeed a sea. A man fell from the belfry of St Stephen's Walbrook in 1277 while in quest of a pigeon's nest, while the Bishop of London complained in 1385 of

malignant persons' who threw stones at the pigeons resting in the city churches. So pigeons were already a familiar presence, even if they were not treated with the same indulgence as their more recent successors. A modicum of kindness to these creatures seems to have been first shown in the late nineteenth century, when they were fed oats rather than the customary stale bread.

From the end of the nineteenth century, woodpigeons also migrated into the city; they were quickly urbanised, increasing both in numbers and in tameness. 'We have frequently seen them on the roofs of houses,' wrote the author of Bird Life in London in 1893, apparently as much at home as any dovecote pigeon.' Those who look up today may notice their 'fly-lines' in the sky, from Lincoln's Inn Fields over Kingsway and Trafalgar Square to Battersea, with other lines to Victoria Park and to Kenwood. The air of London is filled with such 'fly-lines', and to trace the paths of the birds would be to envisage the city in an entirely different form; then it would seem linked and unified by thousands of thoroughfares and small paths of energy, each with its own history of use.

The sparrows move quickly in public places, and they are now so much part of London that they have been adopted by the native population as the 'sparrer'; a friend was known to Cockneys as a 'cocksparrer' in tribute to a bird which is sweet and yet watchful, blessed with a dusky plumage similar to that of the London dust, a plucky little bird darting in and out of the city's endless uproar. They are small birds which can lose body heat very quickly, so they are perfectly adapted to the 'heat island' of London. They will live in any small cranny or cavity, behind drainpipes or ventilation shafts, or in public statues, or holes in buildings; in that sense they are perfectly suited to a London topography. An ornithologist who described the sparrow as 'peculiarly attached to man' said it never now breeds at any distance from an occupied building'. This sociability, bred upon the fondness of the Londoner, is manifest in many ways. One naturalist, W.H. Hudson, has described how any stranger in a green space or public garden will soon find that 'several sparrows are keeping him company ... watching his every movement, and if he sits down on a chair or a bench several of them will come close to him, and hop this way and that before him, uttering a little plaintive note of interrogation - Have you got nothing for us? They have also been described as the urchins of the streets -'thievish, self-assertive and pugnacious' - a condition which again may merit the attention and admiration of native Londoners. Remarkably attached to their surroundings, they rarely create 'fly-lines' across the city; where they are born, like other Londoners, they stay.

There are some birds, such as the robin and the chaffinch, which are less approachable and trustful in the city than in the country. Other species, such as the mallard, grow increasingly shyer as they leave London. There has been a severe diminution of the number of sparrows, while blackbirds are more plentiful. Swans and ducks have also increased in number. Some species, however, have all but vanished. The rooks of London are, perhaps, the most notable of the disappeared, their rookeries destroyed by building work or by tree-felling. Areas of London were continuously inhabited by rooks for many hundreds of years. The burial ground of St Dunstan's in the East and the college garden of the Ecclesiastical Court in Doctors' Commons, the turrets of the Tower of London and the gardens of Gray's Inn, were once such localities. There was a rookery in the Inner Temple dating from at least 1666, mentioned by Oliver Goldsmith in 1774. Rooks nested on Bow Church and on St Olave's. They were venerable London birds, preferring to cluster around ancient churches and the like as if they were their local guardians. Yet, in the words of the nineteenth-century song, 'Now the old rooks have lost their places'. There was a grove in Kensington Gardens devoted to the rooks; it contained some seven hundred trees forming a piece of wild nature, a matter of delight and astonishment to those who walked among them and listened to the endless cawing that blotted out the city's noise. But the trees were torn down in 1880. The rooks have never returned.

14/ Psychology and personality assessment

Our daily lives are largely made up of contacts with other people, during which we are constantly making judgments of their personalities and accommodating our behaviour to them in accordance with these judgments. A casual meeting of neighbours on the street, an employer giving instructions to an employee, a mother telling her children how to behave, a journey in a train where strangers eye one another without exchanging a word – all these involve mutual interpretations of personal qualities.

Success in many vocations largely depends on skill in sizing up people. It is important not only to such professionals as the clinical psychologist, the psychiatrist or the social worker, but also to the doctor or lawyer in dealing with their clients, the businessman trying to outwit his rivals, the salesman with potential customers, the teacher with his pupils, not to speak of the pupils judging their teacher. Social life, indeed, would be impossible if we did not, to some extent, understand,

and react to the motives and qualities of those we meet; and clearly we are sufficiently accurate for most practical purposes, although we also recognize that misinterpretations easily arise particularly on the part of others who judge us!

Errors can often be corrected as we go along. But whenever we are pinned down to a definite decision about a person, which cannot easily be revised through his 'feed-back', the inadequacies of our judgments become apparent. The hostess who wrongly thinks that the Smiths and the Joneses will get on well together can do little to retrieve the success of her party. A school or a business may be saddled for years with an undesirable member of staff, because the selection committee which interviewed him for a quarter of an hour misjudged his personality.

Just because the process is so familiar and taken for granted, it has aroused little scientific curiosity until recently. Dramatists, writers and artists throughout the centuries have excelled in the portrayal of character, but have seldom stopped to ask how they, or we, get to know people, or how accurate is our knowledge. However, the popularity of such unscientific systems as Lavater's physiognomy in the eighteenth century, Gall's phrenology in the nineteenth, and of handwriting interpretations by graphologists, or palm-readings by gipsies, show that people are aware of weaknesses in their judgments and desirous of better methods of diagnosis. It is natural that they should turn to psychology for help, in the belief that psychologists are specialists in 'human nature'.

This belief is hardly justified: for the primary aim of psychology had been to establish the general laws and principles underlying behaviour and thinking, rather than to apply these to concrete problems of the individual person. A great many professional psychologists still regard it as their main function to study the nature of learning, perception and motivation in the abstracted or average human being, or in lower organisms, and consider it premature to put so young a science to practical uses. They would disclaim the possession of any superior skill in judging their fellowmen. Indeed, being more aware of the difficulties than is the non-psychologist, they may be more reluctant to commit themselves to definite predictions or decisions about other people. Nevertheless, to an increasing extent psychologists are moving into educational, occupational, clinical and other applied fields, where they are called upon to use their expertise for such purposes as fitting the education or job to the child or adult, and the person to the job. Thus a considerable proportion of their activities consists of personality assessment.

The success of psychologists in personality assessment has been limited, in comparison with what they have achieved in the fields of abilities and training, with the result that most people continue to rely on unscientific methods of assessment. In recent times there has been a tremendous amount of work on personality tests, and on carefully controlled experimental studies of personality. Investigations of personality by Freudian and other 'depth' psychologists have an even longer history. And yet psychology seems to be no nearer το providing society with practicable techniques which are sufficiently reliable and accurate to win general acceptance. The soundness of the methods of psychologists in the field of personality assessment and the value of their work are under constant fire from other psychologists, and it is far from easy to prove their worth.

The growth of psychology has probably helped responsible members of society to become more aware of the difficulties of assessment. But it is not much use telling employers, educationists and judges how inaccurately they diagnose the personalities with which they have to deal unless techniques of psychologists are sure that they can provide something better. Even when university psychologists themselves appoint a new member of staff, they almost always resort to the traditional assessing the candidates through interviews, past records, and testimonials, and probably make at least as many bad appointments as other employers do. However, a large amount of experimental development of better methods has been carried out since 1940 by groups of psychologists in the Armed Services and in the Civil Service, and by such organizations as the (British) National Institute of Industrial Psychology and the American Institute of Research.

15/ Titan of technology

Gordon Moore is one of the people who gave the world personal computers. Peter Richards spoke to him in 2003.

Gordon Moore is the scientific brain behind Intel, the world's biggest maker of computer chips. Both funny and self-deprecating, he's a shrewd businessman too, but admits to being an 'accidental entrepreneur', happier in the back room trading ideas with techies than out selling the product or chatting up the stockholders. When he applied for a job at Dow Chemical after

gaining his PhD, the company psychologist ruled that 'I was okay technically, but that I'd never manage anything'. This year Intel is set to turn over $28 billion.

When Moore co-founded Intel (short for Integrated Electronics) to develop integrated circuits thirty-five years ago, he provided the motive force in R&D (Research & Development) while his more extrovert partner Robert Noyce became the public face of the company. Intel's ethos was distinctively Californian: laid- back, democratic, polo shirt and chinos. Moore worked in a cubicle like everyone else, never had a designated parking space and flew Economy. None of this implied lack of ambition. Moore and Noyce shared a vision, recognising that success depended just as much on intellectual pizazz as on Intel's ability to deliver a product. Noyce himself received the first patent for an integrated circuit in 1961, while both partners were learning the business of electronics at Fairchild Semiconductor.

Fairchild's success put money in Moore and Noyce's pockets, but they were starved of R&D money. They resigned, frustrated, to found Intel in 1968. 'It was one of those rare periods when money was available,' says Moore. They put in $250,000 each and drummed up another $2.5m of venture capital 'on the strength of a one-page business plan that said essentially nothing'. Ownership was divided 50:50 between founders and backers. Three years later, Intel's first microprocessor was released: the 4004, carrying 2,250 transistors. Progress after that was rapid. By the time the competition realised what was happening, Intel had amassed a seven-year R&D lead that it was never to relinquish.

By the year 2000, Intel's Pentium 4 chip was carrying 42 million transistors. 'Now,' says Moore, 'we put a quarter of a billion transistors on a chip and are looking forward to a billion in the near future.' The performance gains have been phenomenal. The 4004 ran at 108 kilohertz (108,000 hertz), the Pentium at three gigahertz (3 billion hertz). It's calculated that if automobile speed had increased similarly over the same period, you could now drive from New York to San Francisco in six seconds.

Moore's prescience in forecasting this revolution is legendary. In 1965, while still head of the R&D laboratory at Fairchild, he wrote a piece for Electronics magazine observing 'that over the first few years we had essentially doubled the complexity of integrated circuits every year. I blindly extrapolated for the next ten years and said we'd go from about 60 to about 60,000 transistors on a chip. It proved a much more spot-on prediction than I could ever have imagined. Up until then, integrated circuits had been expensive and had had principally military

applications. But I could see that the economics were going to switch dramatically. This was going to become the cheapest way to make electronics.'

The prediction that a chip's transistor-count - and thus its performance - would keep doubling every year soon proved so accurate that Carver Mead, a friend from Caltech, dubbed it 'Moore's Law'. The name has stuck. 'Moore's Law' has become the yardstick by which the exponential growth of the computer industry has been measured ever since. When, in 1975, Moore looked around him again and saw transistor-counts slowing, he predicted that in future chip-performance would double only every two years. But that proved pessimistic. Actual growth since then has split the difference between his two predictions, with performance doubling every 18 months.

And there's a corollary, says Moore. 'If the cost of a given amount of computer power drops 50 per cent every 18 months, each time that happens the market explodes with new applications that hadn't been economical before.' He sees the microprocessor as 'almost infinitely elastic'. As prices fall, new applications keep emerging: smart light bulbs, flashing trainers or greetings cards that sing 'Happy Birthday'. Where will it all stop? Well, it's true, he says, 'that in a few more generations [of chips], the fact that materials are made of atoms starts to be a real problem. Essentially, you can't make things any smaller.' But in practice, the day of reckoning is endlessly postponed as engineers find endlessly more ingenious ways of loading more transistors on a chip. 'I suspect I shared the feelings of everybody else that when we got to the dimensions of a micron [about 1986], we wouldn't be able to continue because we were touching the wavelength of light. But as we got closer, the barriers just melted away.'

When conventional chips finally reach their limits, nanotechnology beckons. Researchers are already working on sci-fi sounding alternatives such as molecular computers, built atom by atom, that theoretically could process hundreds of thousand times more information than today's processors. Quantum computers using the state of electrons as the basis for calculation could operate still faster. On any measure, there looks to be plenty of life left in Moore's Law yet.

16/ How to Run a ….

Publisher and author David Harvey on what makes a good management book

Prior to the Second World War, all the management books ever written could be comfortably stacked on a couple of shelves. Today, you would need a sizeable library, with plenty of room for expansion, to house them. The last few decades have seen the stream of new titles swell into a

flood. In 1975, 771 business books were published. By 2000, the total for the year had risen to 3,203, and the trend continues.

The growth in pubishing activity has followed the rise and rise of management to the point where it constitutes a mini-industry in its own right. In the USA alone, the book market is worth over $1bn. Management consultancies, professional bodies and business schools were part of this new phenomenon, all sharing at least one common need: to get into print. Nor were they the only aspiring authors. Inside stories by and about business leaders balanced the more straight-laced textbooks by academics. How-to books by practising managers and business writers appeared on everything from making a presentation to developing a business strategy. With this upsurge in output, it is not really surprising that the quality is uneven.

Few people are probably in a better position to evaluate the management canon than Carol Kennedy, a business journalist and author of Guide to the Management Gurus, an overview of the world's most influential management thinkers and their works. She is also the books editor of The Director. Of course, it is normally the best of the bunch that are reviewed in the pages of The Director. But from time to time, Kennedy is moved to use The Director's precious column inches to warn readers off certain books. Her recent review of The Leader's Edge summed up her irritation with authors who over-promise and under-deliver. The banality of the treatment of core competencies for leaders, including the 'competency of paying attention', was a conceit too far in the context of a leaden text. 'Somewhere in this book,' she wrote, 'there may be an idea worth reading and taking note of, but my own competency of paying attention ran out on page 31. Her opinion of a good proportion of the other books that never make it to the review pages is even more terse. 'Unreadable' is her verdict.

Simon Caulkin, contributing editor of the Observer's management page and former editor of Management Today, has formed a similar opinion. 'A lot is pretty depressing, unimpressive stuff! Caulkin is philosophical about the inevitability of finding so much dross. Business books, he says, 'range from total drivel to the ambitious stuff. Although the confusing thing is that the really ambitious stuff can sometimes be drivel. Which leaves the question open as to why the subject of management is such a literary wasteland. There are some possible explanations.

Despite the attempts of Frederick Taylor, the early twentieth-century founder of scientific management, to establish a solid, rule-based foundation for the practice, management has come to be seen as just as much an art as a science. Once psychologists like Abraham Maslow,

behaviouralists and social anthropologists persuaded business to look at management from a human perspective, the topic became more multi- dimensional and complex. Add to that the requirement for management to reflect the changing demands of the times, the impact of information technology and other factors, and it is easy to understand why management is in a permanent state of confusion. There is a constant requirement for reinterpretation, innovation and creative thinking: Caulkin's ambitious stuff. For their part, publishers continue to dream about finding the next big management idea, a topic given an airing in Kennedy's book, The Next Big Idea.

Indirectly, it tracks one of the phenomena of the past 20 years or so: the management blockbusters which work wonders for publishers' profits and transform authors' careers. Peters and Waterman's In Search of Excellence: Lessons from America's Best-Run Companies achieved spectacular success. So did Michael Hammer and James Champy's book, Reengineering the Corporation: A Manifesto for Business Revolution. Yet the early euphoria with which such books are greeted tends to wear off as the basis for the claims starts to look less than solid. In the case of In Search of Excellence, it was the rapid reversal of fortunes that turned several of the exemplar companies into basket cases. For Hammer's and Champy's readers, disillusion dawned with the realisation that their slash-and-burn prescription for reviving corporate fortunes caused more problems than it solved.

Yet one of the virtues of these books is that they could be understood. There is a whole class of management texts that fail this basic test. 'Some management books are stuffed with jargon,' says Kennedy. 'Consultants are among the worst offenders.' She believes there is a simple reason for this flight from plain English. 'They all use this jargon because they can't think clearly. It disguises the paucity of thought.'

By contrast, the management thinkers who have stood the test of time articulate their ideas in plain English. Peter Drucker, widely regarded as the doyen of management thinkers, has written a steady stream of influential books over half a century. 'Drucker writes beautiful, clear prose,' says Kennedy, 'and his thoughts come through. He is among the handful of writers whose work, she believes, transcends the specific interests of the management community. Caulkin also agrees that Drucker reaches out to a wider readership. 'What you get is a sense of the larger cultural background,' he says. That's what you miss in so much management writing. Charles Handy,

perhaps the most successful UK business writer to command an international audience, is another rare example of a writer with a message for the wider world.

17/ Stadium Australia

You might ask, why be concerned about the architecture of a stadium? Surely, as long as the action is entertaining and the building is safe and reasonably comfortable, why should the aesthetics matter? This one question has dominated my professional life, and its answer is one I find myself continually rehearsing. If one accepts that sporting endeavour is as important an outlet for human expression as, say, the theatre or cinema, fine art or music, why shouldn't the buildings in which we celebrate this outlet be as grand and as inspirational as those we would expect, and demand, in those other areas of cultural life? Indeed, one could argue that because stadiums are, in many instances, far more popular than theatres or art galleries, we should actually devote more, and not less, attention to their form. Stadiums have frequently been referred to as 'cathedrals'. Football has often been dubbed 'the opera of the people'. What better way, therefore, to raise the general public's awareness and appreciation of quality design than to offer them the very best buildings in the one area of life that seems to touch them most? Could it even be that better stadiums might just make for better citizens?

But then maybe, as my detractors have labelled me in the past, I am a snob. Maybe I should just accept that sport, and its associated accoutrements and products, is an essentially tacky and ephemeral business, while stadium design is all too often driven by pragmatists and penny-pinchers. Certainly, when I first started writing about stadium architecture, one of the first and most uncomfortable truths I had to confront was that some of the most popular stadiums in the world were also amongst the least attractive or innovative in architectural terms. 'Worthy and predictable' has usually won more votes than 'daring and different'. Old Trafford football ground in Manchester, the Yankee Stadium in New York, Ellis Park in Johannesburg. The list is long and is not intended to suggest that these are necessarily poor buildings. Rather, that each has derived its reputation more from the events that it has staged, from its associations, than from the actual form it takes. Equally, those stadiums whose forms have been revered - such as the Maracana in Rio, or the San Siro in Milan have turned out to be rather poorly designed in several respects, once one analyses them not as icons but as functioning public assembly facilities' (to use the current jargon). Finding the balance between beauty and practicality has never been easy.

Homebush Bay was the site of the main Olympic Games complex for the Sydney Olympics of 2000. To put it politely, I am no great admirer of the Olympics as an event, or, rather, of the insane pressures its past bidding procedures have placed upon candidate cities. Nor, as a spectator, do I much enjoy the bloated Games programme and the consequent demands this places upon the designers of stadiums. Yet in my calmer moments it would be churlish to deny that, if approached sensibly and imaginatively, the opportunity to stage the Games can yield enormous benefits in the long term (as well they should, considering the expenditure involved), if not for sport then at least for the cause of urban regeneration. Following in Barcelona's footsteps, Sydney undoubtedly set about its urban regeneration in a wholly impressive way. To an outsider, the 760-hectare site at Homebush Bay, once the home of an abattoir, a racecourse, a brickworks and light industrial units, seemed miles from anywhere - it was actually fifteen kilometres from the centre of Sydney and pretty much in the heart of the city's extensive conurbation. Some £1.3 billion worth of construction and reclamation was commissioned, all of it, crucially, with an eye to post- Olympic usage. Strict guidelines, studiously monitored by Greenpeace, ensured that the 2000 Games would be the most environmentally friendly ever. What's more, much of the work was good-looking, distinctive and lively. 'That's a reflection of the Australian spirit,' I was told.

At the centre of Homebush lay the main venue for the Olympics, Stadium Australia. It was funded by means of a BOOT (Build, Own, Operate and Transfer) contract, which meant that the Stadium Australia consortium, led by the contractors Multiplex and the financiers Hambros, bore the bulk of the construction costs, in return for which it was allowed to operate the facility for thirty years, and thus, it hopes, recoup its outlay, before handing the whole building over to the New South Wales government in the year 2030.

Stadium Australia was the most environmentally friendly Olympic stadium ever built. Every single product and material used had to meet strict guidelines, even if it turned out to be more expensive. All the timber was either recycled or derived from renewable sources. In order to reduce energy costs, the design allowed for natural lighting in as many public areas as possible, supplemented by solar-powered units. Rainwater collected from the roof ran off into storage tanks, where it could be tapped for pitch irrigation. Stormwater run-off was collected for toilet flushing. Wherever possible, passive ventilation was used instead of mechanical air-conditioning. Even the steel and concrete from the two end stands due to be demolished at the

end of the Olympics was to be recycled. Furthermore, no private cars were allowed on the Homebush site. Instead, every spectator was to arrive by public transport, and quite right too. If ever there was a stadium to persuade a sceptic like myself that the Olympic Games do, after all, have a useful function in at least setting design and planning trends, this was the one. I was, and still am, I freely confess, quite knocked out by Stadium Australia.

18/ A Theory of Shopping

For a one-year period I attempted to conduct an ethnography of shopping on and around a street in North London. This was carried out in association with Alison Clarke. I say 'attempted' because, given the absence of community and the intensely private nature of London households, this could not be an ethnography in the conventional sense. Nevertheless, through conversation, being present in the home and accompanying householders during their shopping, I tried to reach an understanding of the nature of shopping through greater or lesser exposure to 76 households.

My part of the ethnography concentrated upon shopping itself. Alison Clarke has since been working with the same households, but focusing upon other forms of provisioning such as the use of catalogues (see Clarke 1997). We generally first met these households together, but most of the material that is used within this particular essay derived from my own subsequent fieldwork. Following the completion of this essay, and a study of some related shopping centres, we hope to write a more general ethnography of provisioning. This will also examine other issues, such as the nature of community and the implications for retail and for the wider political economy. None of this, however, forms part of the present essay, which is primarily concerned with establishing the cosmological foundations of shopping.

To state that a household has been included within the study is to gloss over a wide diversity of degrees of involvement. The minimum requirement is simply that a householder has agreed to be interviewed about their shopping, which would include the local shopping parade, shopping centres and supermarkets. At the other extreme are families that we have come to know well during the course of the year. Interaction would include formal interviews, and a less formal presence within their homes, usually with a cup of tea. It also meant accompanying them on one or several 'events', which might comprise shopping trips or participation in activities associated with the area of Clarke's study, such as the meeting of a group supplying products for the home.

In analysing and writing up the experience of an ethnography of shopping in North London, I am led in two opposed directions. The tradition of anthropological relativism leads to an emphasis upon difference, and there are many ways in which shopping can help us elucidate differences. For example, there are differences in the experience of shopping based on gender, age, ethnicity and class. There are also differences based on the various genres of shopping experience, from a mall to a corner shop. By contrast, there is the tradition of anthropological generalisation about 'peoples' and comparative theory. This leads to the question as to whether there are any fundamental aspects of shopping which suggest a robust normativity that comes through the research and is not entirely dissipated by relativism. In this essay I want to emphasize the latter approach and argue that if not all, then most acts of shopping on this street exhibit a normative form which needs to be addressed. In the later discussion of the discourse of shopping I will defend the possibility that such a heterogenous group of households could be fairly represented by a series of homogenous cultural practices.

The theory that I will propose is certainly at odds with most of the literature on this topic. My premise, unlike that of most studies of consumption, whether they arise from economists, business studies or cultural studies, is that for most households in this street the act of shopping was hardly ever directed towards the person who was doing the shopping. Shopping is therefore not best understood as an individualistic or individualising act related to the subjectivity of the shopper. Rather, the act of buying goods is mainly directed at two forms of 'otherness. The first of these expresses a relationship between the shopper and a particular other individual such as a child or partner, either present in the household, desired or imagined. The second of these is a relationship to a more general goal which transcends any immediate utility and is best understood as cosmological in that it takes the form of neither subject nor object but of the values to which people wish to dedicate themselves.

It never occurred to me at any stage when carrying out the ethnography that I should consider the topic of sacrifice as relevant to this research. In no sense then could the ethnography be regarded as a testing of the ideas presented here. The literature that seemed most relevant in the initial analysis of the London material was that on thrift discussed in chapter 3. The crucial element in opening up the potential of sacrifice for understanding shopping came through reading Bataiile. Bataille, however, was merely the catalyst, since I will argue that it is the classic works on sacrifice and, in particular, the foundation to its modern study by Hubert and Mauss (1964) that

has become the primary grounds for my interpretation. It is important, however, when reading the following account to note that when I use the word 'sacrifice', I only rarely refer to the colloquial sense of the term as used in the concept of the 'self-sacrificial' housewife. Mostly the allusion is to this literature on ancient sacrifice and the detailed analysis of the complex ritual sequence involved in traditional sacrifice. The metaphorical use of the term may have its place within the subsequent discussion but this is secondary to an argument at the level of structure.

19/ Racy telenovelas inspire social change

Brazil's popular soap operas have done more than just entertain people - they have reduced the birth rate by three million and driven up the rate of divorce, a new report has found. Their colourful storylines of glamorous love triangles, paternity mysteries and rags-to-riches successes have long dominated Brazilian airwaves. Now the racy telenovelas that are the mainstays of the country's powerful TV Globo network are being credited with more than just their audience pulling-power.

A study of population data stretching back to 1971 has revealed that Brazil's popular and often fanciful soap operas have had a direct impact on the nation's divorce and birth rates, as the main channel that broadcast them gradually extended its reach across the country. According to the report, prepared for the Inter-American Development Bank, the rate of marriage break-up rose and the number of children born to each woman fell more quickly in areas receiving the TV Globo signal for the first time.

Over the two decades that were studied, an estimated three million fewer Brazilian babies were born than would have been if telenovelas had never been broadcast, and 800,000 more couples separated or divorced. If the effect continued to the present day, the numbers would be even greater. 'Exposure to modern lifestyles as portrayed on television, to emancipated women's roles, and to a critique of traditional values, was associated with increases in the share of separated and divorced woman across Brazil's municipal areas,' the report's authors said.

Every Brazilian knows that what happens on TV Globo can affect the real world. Its schedules dictate kick-off times for football matches, its costumes influence design and fashion and the telenovelas' plotlines have influenced the outcome of elections. However, the revelation that the cult of the telenovela has had such impact on the most intimate aspects of its viewers' lives will startle Brazilians. Maria Immacolata Lopes, the coordinator of the Telenovela Centre at USP, one

of Brazil's leading universities, said it was the first time that research had been undertaken on such a wide scale.

Alberto Chong, one of the study's authors, said the reason for the change was the 'aspirational ethos' of the country's soaps, which, unlike their grittier equivalents in Britain, tend to portray the upper levels of Brazilian society. That generally means characters are whiter, wealthier and better educated than most of Brazil's 190 million people. They have fewer children and are more likely to be separated or divorced. Viewers instantly took to that image. 'If the leading female character of a telenovela was divorced or separated, the divorce rate rose, by an average of 0.1 percentage point', Mr Chong said. 'At the same time, women in areas reached by the Globo signal had 0.6 per cent fewer children than those in areas with no signal.' This may appear to be a small impact, but equates to millions fewer babies born over two decades.

TV Globo reacted with hostility to the study, saying that it underestimated the intelligence of the channel's viewers. A spokesman asserted that the soaps' portrayal of divorce and smaller families reflected the trends of the time, rather than brought them about. 'Our dramas are attuned to the questions being asked in society. While we don't doubt the novelas make people think, we don't believe they actually influence their opinions or choices,' said Luis Erlanger, Globo's communications director. Mr Chong rejected the view, pointing out that the chances of a new-born baby being named after a soap star were significantly higher in areas where the soaps were broadcast.

Other international studies have shown that television can infuence behaviour and transform social mores, especially where the population does not have constant access to mixed media. In India, the arrival of cable television in remote areas caused pregnancy rates to fall and enrolment in education among girls to rise. Inhabitants of Lutsaan, a village in northern India, were passionate fans of the radio drama Tinka Tinka Sukh. The programme is claimed to have promoted gender equality and encouraged renouncement of the local custom of demanding a bridal dowry. Enrolment of girls in the local school rose by 25 per cent. In other parts of the country, soap viewers were more likely to refute the commonly held view that a husband was justified in beating his wife.

A Rwandan radio serial Musekeweya has had an even more notable impact. Devised and broadcast by Radio La Benevolencija, a partner of Oxfam, the story centres on the conflict between two fictional tribes and the doomed romance between two of its characters. The project

has the high hope of mending ethnic tension and encouraging reconciliation. This may be fiction, but the backdrop is very evidently the period just before the horrendous events of 1994.

One of the earliest programmes to have a far-reaching impact on audiences was the Peruvian telenovela Simplemente Maria first aired in the late 1960s. The central character was a rural girl who escaped to the city to find work as a maid. She learnt to read and, more importantly, to sew, enabling her to become a successful fashion designer. The show was so popular that when Maria married her literacy teacher, thousands of avid viewers collected outside the church to bestow gifts on the happy couple. Across the country, increased enrolment in literacy classes coincided with the storyline.

Back in Brazil, although they have lost viewers to the internet, the influence of the novelas remains evident. The increased presence of slender blondes is credited with driving a shift away from what was once a nationwide preference for guitar-shaped brunettes. 'Novelas in Brazil take on a greater importance than a simple drama because they move people,' said Mauro Alencar, the author of several books about the genre. 'But the novela is above all a reflection of society. It feeds off what is exposed in day to day life and recreates a fictional version.'

20/ How to build a tree house

A tree house is a place where you can give free rein to your individual creativity. However, while there are almost as many types of tree house as there are types of tree, some general principles do apply when it comes to tree house construction.

Before you begin your tree house plans, check with your local planning authorities about any restrictions on building tree houses that may exist. In some places, if a structure is below a certain size and not used as a permanent dwelling it will not need planning approval, but there may be restrictions on height or on windows overlooking adjacent properties. Safety is vital during construction. Always use a safety harness, and firmly tie it to a strong branch. Think before you act, and keep a first aid kit handy.

First Steps

First, you need to choose a tree and decide on a position within it for your tree house. Think about what you want from your tree house: Will it be an adult hideaway or children's play area? If you are considering a tree house for children, keep it close to the ground: Consider whether you want your tree house to be hidden or visible, and make sure it will not disturb other people.

Choose a mature, healthy tree with no special protection orders that may affect pruning. When selecting a tree it is best to consult a qualified arborist, and if any pruning is necessary arrange for this to be done professionally. Decide how you want to access your tree house and what materials you want to use. Whatever you decide, it is best to start small and simple.

Every tree is different, so let the tree be your guide. Follow the form of the tree, allow for growth and movement, and keep the structure lightweight. Keep the various positions of the sun in mind when planning small decks. If there is not one ideal tree, then several closely spaced, smaller trees will suffice. Ideally, plan the structure on paper before starting work, allowing for a deck if you want one. Never make the tree house too big for the tree.

Building a Platform

The platform, providing a secure foundation for the rest of the structure, is the key element of almost any tree house. It should be built close to the trunk, with diagonal bracing for extra strength, if it is not supported by branches or posts. Make sure the platform is level, and keep it balanced centrally around the tree to support uneven loads and reduce swaying. When securing the structure, do everything you can to limit damage to the tree. Ideally use rope lashing, but make sure you know the right knots. If necessary, use strong galvanised steel screws, as ungalvanised screws or nails will rust and encourage disease and rot. Avoid cutting the bark all the way round, or constricting it too tightly with rope or wire.

Once the platform is secure, you need to add the floor. For this you might use plywood sheets or conventional floorboards. The walls can either be built in situ in the tree or prefabricated on the ground and then hoisted up into position (for larger tree houses the latter is much easier and safer). To minimise the amount of work done while perched up in the tree, you can even add external wall finishes on the ground and prefix doors and windows. The roof may also be pre-assembled, but if branches are to penetrate it, or if it is an irregular shape, it is generally best to build it in situ. Once in position, the roof should be covered and protected with roofing felt. If desired the roof can be finished with local materials such as palm leaves or recycled shingles.

Windows and Doors

In a tree house, adhering to convention is unnecessary. This is a place to experiment and indulge your design fantasies. Whether your taste leans toward Gothic towers or rustic cottages, the possibilities for windows and doors are endless. The important thing is to keep them in

proportion to the size and design of the tree house. For safety and lightness, use Perspex or Plexiglas instead of glass for windows. Try to use old or recycled items whenever possible.

Deck and Railings

Nothing can beat the experience of sitting outside a tree house, among the leaves and branches, on an outside deck, balcony or veranda. A deck can be part of the tree house platform, or it might be in a separate place nearby, perhaps at a different level and reached by a rope bridge or wooden walkway. Whichever you choose, the deck must be surrounded by safe railings. Functional these may be, but as with doors and windows, you can still give your imagination free rein. For something different, why not make a giant hammock by attaching a strong rope net to the deck? Spread with pillows and cushions it makes a great place to relax.

Tree House Access

Now that you have built your tree house, how will you get up there? A simple wooden or rope ladder is fine if the house is not far from the ground, but steps, ideally with handrails, are better for higher constructions. Spiral steps winding around the trunk are always fun and look more natural than a straight flight. If higher still, it is a good idea to break the journey with a series of landings. Sometimes it is possible to build a bridge or rope walkway from an adjacent tree, building or area of high ground. For really high tree houses, a rope pulley system with a harness or chair may be the most convenient method. A rope pulley with a basket is indispensable for hoisting up provisions, whatever the height your tree house.

After all the effort involved in designing and building a tree house, the last thing you want is for it to fall down. Remember to check the floors, decks and railings frequently for rot or weakness. Inspect any steps, ladders and walkways, and repair damage immediately. Check the tree annually for growth and movement, and adjust or refix attachments to the tree as necessary.

21/ Do animals think?

When an animals knows it is being chased and starts to run, is it obeying some ancient instinct, or does it know to be afraid?

Mammals have brains so they can feel pain and fear and can react in disgust. If a wildebeest did not feel pain, it would continue grazing as lions slowly devoured it. If an antelope did not sense fear, it would not break into a sprint at the first hint of cheetah. If a canine were not disgusted, it would not vomit; it would not be, as the saying goes, sick as a dog.

Pain, fear and disgust are part of a mammal's survival machinery developed over tens of millions of years of evolution. Homo sapiens have, however, only been around for about 200,000 years so all three emotional states owe something to mammal origins. If football hooligans can feel those emotions, then so too do deer, foxes and dogs. The argument is about how 'aware' or 'conscious' non-human mammals might be during these emotional events. When an animal knows it is being chased and starts to run, is it obeying some instinct inherited from ancestors that knew when to flee a danger zone or does it actually 'know' to be afraid?

That might be the wrong question. A human startled by a strange shape in a darkened corridor experiences a pounding heart, lungs gasping for air and a body in recoil. This is the well-known flight or fight reaction. A human appreciates the full force of fear and has already started to counter the danger a fraction of a second before the brain has time to absorb and order the information presented by the menacing figure. This is because mental calculations are too slow to cope with surprise attack. Pain precedes logic. Touch something hot and you withdraw your hand even before you have time to think about doing so. Once again, the wisdom is after the event.

If humans can experience the universal emotions of fear, anger, disgust, happiness, sadness, and surprise, then so can mammals. But does an animal think about its state of fear? Does it have not just a mind but a theory of mind? Does it have a sense of its own identity and that of another being? Can it put itself in another animal's shoes, so to speak?

All animals communicate, but only humans have language. The puzzle remains: do animals think? Can they think about abstractions, about the past or about other animals? Researchers have wrestled with a series of experiments to see whether animals are capable of behaving as if they had the capacity to learn, the will to improvise and the ability to guess what other animals are thinking. Dogs show a remarkable capacity to guess human intentions correctly. Dogs, however, have lived intimately with humans for 15,000 years, so are unlikely to make ideal test subjects.

Primates, humanity's closest relatives, show unexpected abilities. Researchers from St Andrews in 1999 counted 39 different ways in which chimpanzees deal with food. Since these differ according to group and geography, they have used the word 'culture' to describe these differing methods. One female chimpanzee in Kyoto, convinced researchers that she could place Arabic numerals in ascending order one to nine. Monkeys astonished a team at Columbia University in

New York in 1998 by distinguishing groups of objects numbering one to four. Chimpanzees in large captive colonies forge alliances, switch sides and double-cross each other. They have also been seen in the wild systematically searching for leaves that have a medicinal effect. From such observations, a new branch of research has been born. It is called zoo pharmacognosy.

Chimpanzees and humans share a common ancestor, and 98% of their DNA. Do more distant mammal relatives share the capacity for cogitation? Several years ago, Keith Kendrick at the Babraham Institute in Cambridge astonished the world by revealing that sheep could recognise up to 50 other sheep and up to ten human faces for at least two years after first seeing them. If a sheep can tell the difference between its flock members from flash cards and screen pictures, it must surely have a sense of these other creatures even when they are not there. Perhaps this means it also has an idea of 'self'.

More disconcertingly, pigs have demonstrated their own theory of mind. Mike Mendl of Bristol University revealed astonishing evidence at the British Association science festival in 2002. A larger and stronger pig that did not know where food was hidden had learned to follow a weaker, but better informed pig, to the trough. At this point the weaker pig would start to use distracting behaviour to keep the bully pig guessing, and only lunge for the rations when not being watched. It seems the smaller pig could guess what the other was thinking and outsmart it. In a human, this is what we call 'intelligence'.

One of the animal world's highest achievers, however, is not a mammal at all. Betty the crow lives in an Oxford laboratory. She repeatedly picks up a straight piece of wire, bends it into a hook and uses the hook to lift an appetising treat from a tube too deep for her beak. Before achieving this feat for the first time, she had never previously seen a piece of wire. So an animal far removed from humankind could identify a challenge, contemplate a simple matter of physics, identify a tool shape, select a raw material, make a tool and retrieve the reward. Birds are cousins not of mammals but of the dinosaurs. Humans and birds last shared a common ancestor 200 million years ago. Experiments like these confirm, over and over again, that other mammals are more like us than we thought. It becomes increasingly difficult to know just what it is that makes humans different.

22/ Giant Camel Fossil Found in Arctic

Camels are well known for their ability to survive the hot and dry conditions of the desert but research suggests that they once thrived in a colder climate.

The idea that giant camels once roamed the Arctic along with polar bears and walruses is startling. Yet this is the key implication of research published by scientists working on Canada's Ellesmere Island. Lying deep inside the Arctic Circle, opposite Greenland's northern coast, Ellesmere is one of the world's coldest, bleakest spots. However, researchers have also found it was the home of a 3.5 million year old species of camel that later evolved into the creatures that now roam the Sahara and other hot spots. It seems that evolution can still throw up surprises.

However, there is more to the project than merely uncovering the camel's unexpected evolutionary history. The researchers' work has also demonstrated the power of a dramatic new technique for investigating the pre-historic past. It is known as collagen fingerprinting, and many researchers believe it could transform our understanding of life on Earth. 'This is the first time that collagen has been extracted and used to identify a species from such ancient bone fragments' said Dr Mike Buckley of Manchester University's Institute of Biotechnology. This unlocks the huge potential of collagen fingerprinting to better identify extinct species'.

Collagen is a protein that forms the connective tissue that holds bones together in an animal's skeleton, and it was only by analysing scraps of the material, found in the bones on Ellesmere, that scientists were able to identify the remains as those of an ancient camel. Indeed it was not evident at first that the remains were actually fossils. ‘The first time I picked up a piece, I thought that it might be wood' said expedition leader Dr Natalia Rybczynski of the Canadian Museum of Nature. 'It was only back at the field camp that I was able to ascertain that it was not only bone, but also from a fossil mammal larger than anything we had seen so far'.

However, it was the analysis of the collagen attached to the bones that provided proof that these once belonged to the family Paracamelus, from which all modern camels are descended. The results show an almost identical match to the modern-day one- humped camel, the dromedary. A comparison of the chemical makeup of the collagen with the tissue from Ice Age Yukon camels revealed more than similarities – they were found to be closely related, and possibly the same species. In addition, anatomical data suggest the leg bone found on Ellesmere was one third larger than the same bone in a modern camel indicating that this giant creature would likely have stood about 3.5 metres tall at the hump. The findings suggest that mineralisation worked along with cold temperatures to help preserve the proteins in the bones. 'This specimen is spectacular

and provides important clues about how such exceptional preservation may occur' said Dr Buckley.

In the past, scientists have speculated that the camel still bears features that could have evolved to cope with harsh polar winters. Traits found in modern camels, such as their humps which serve as a fat store, would have benefited their ancestors during the deep winters when food was scarce. Other camel characteristics that would have been useful in the frozen conditions include the species' flat feet, which support the animal on soft ground such as loose sand or in the same way that a snowshoe helps a person walk on snow. Their large eyes would also have helped them peer through low light and forage for food during the long, Arctic winter. At that time, annual average temperatures in the area was about -4 degrees C, barely below freezing but still about 18 degrees Celsius warmer than the modern average. The camels that evolved in North America may have then migrated across Asia via a land bridge between Alaska and Russia.

The Ellesmere Island site is about 1200 kilometres further north than any previous camel find. Fossils unearthed at a location about ten kilometres away from the camel find and from rocks of approximately the same age, reveal that the landscape hosted an open forest inhabited by bears, rabbits, beavers and a pony-sized three-toed horse. The findings indicate that these animals were living, even thriving, at latitudes where few mammals can now exist.

The idea is intriguing - but it is only the start. Collagen fingerprinting is several orders of magnitude more effective at establishing links between ancient fossils and modern species compared with DNA fingerprinting, which has been used up to now. Collagen does not break down as speedily as DNA and so it can be used to study animals that are millions of years old and establish links with modern species by studying slight changes in their amino acid structure. As a result, scientists are now focussing on a wide range of species, from angelfish to zebras, to uncover links between ancient and modern animals. 'This is going to provide some startling results', said Dr Buckley.

23/ Cars that can drive themselves

The idea of the self-driving car dates back to before the Second World War. Visitors to General Motors’Futurama' at the 1939 World Fair in New York were shown a vision of the future in

1960, in which radio-controlled automobiles would zip along perfectly safe highways. In the 1950s, General Motors and the Radio Corporation of America began experimenting with such a system, digging radio-transmitting cables into roads at a cost of around $100,000 per mile.

The system worked. In 1958, a Chevrolet impala made it round a special course 'without the driver's hands on the steering wheel' but it joined the list of other expensive automated dreams. The first real breakthroughs for self- driving cars took place in the late 1980s, in the £800m Eureka Promethesus Project, led by Ernst Dickmanns of the Bundeswehr University Munich, a pioneer of computer vision. Using just four black and white cameras, Dickmanns's cars managed two road trips of more than 1,000 kilometres through Europe in 1994 and 1995, driving without human intervention 95% of the time. Automated cars have made huge leaps and bounds in recent years. Starting in 2004, Darpa, the high- tech research wing of the US military, ran a series of competitions for driverless vehicles. The winning team was hired by Google, and for years the technology company ran a fleet of automated cars around the highways of California. So far the cars have clocked up 200,000 miles and have been involved in one minor human-caused accident. Google is not on its own. Other car manufacturers also have some kind of automated car in the works, with research and testing also going on in the UK and Germany.

Most driverless cars share the same 'Velodyne' laser system on their roofs. 64 spinning lasers provide a constant, 3D view of the environment 40 metres around the car, while radars on the bumpers and a rear-view camera also feed in information. The data is sorted by algorithms that distinguish between cars, pedestrians, plastic bags and cats, and tell the car what to do. Automated cars are programmed to be model drivers: they stop when pedestrians step onto the road; they give way when they should; they stay out of other cars' blindspots and nudge forward when other cars should be letting them through.

Across the world, 1.2 million people are killed or injured on the roads each year with human error to blame 90% of the time. 'It's amazing to me that we let humans drive cars,' says Eric Schmidt, the executive director of Google. Paul Newman, a robotics engineer at Oxford University, says it is only a matter of time before we hand over the wheel. 'It's crazy to imagine that in ten to twenty years we'll still have to sit behind a wheel, concentrating hard, not falling asleep and not running over people', he says. Computer-controlled cars offer the benefits of safety, fuel efficiency and speed. Roads full of automated cars, all communicating with one another, will see vehicles going bumper-to- bumper at 70mph, eliminating traffic jams.

In spite of the encouraging pace of development, however, enormous hurdles still remain, notably how to engineer human common sense. 'Imagine a situation where a box falls onto the road in front of you,' says John Leonard, a mechanical engineering professor at the Massachusetts Institute of Technology. 'The system needs to make a split-second decision to either go straight through it or to swerve left or right - which might have worse consequences than just going forward'. Other challenges include recognising the weaknesses of automated cars: how do their sensors respond to glare, poor weather, or damage? However, no matter how good, their guidance systems are, self-driven cars will still have accidents.In which case, who will be responsible- the car manufacturer, the software developer or the human driver – for failing to override the computer at the critical moment? But will the cars even have people on board? One of the attractions, surely, will be in ordering them to come and pick us up: in which case will it be empty car A, or car B with driver, which is to blame for a driving mistake? In whatever form they emerge, automated cars will require the greatest overhaul of the law of the roads since the rise of the automobile in the first half of the 20th century.

It seems unlikely, at least for the time being, that drivers will hand over their car keys. A lot of people actually like to drive and hate being passengers. More likely we will see a continuation of the gradual automation of cars that have been under way for two decades, during which automatic lane-keeping, cruise control and parking aids have been gratefully taken up. A new Volvo, for example, now maintains safe distances in heavy traffic without human intervention, and Nissan is working on software that anticipates a driver's next move, adjusting the car ahead of time. Piece by piece, radars, lasers, car to car communication, and the warning of dangers ahead will be added as well, slowly easing the wheel out of our hands.

24/ Freerunning

Freerunning – or Parkour – is an acrobatic discipline which turns the city into a playground. It has been described as jogging meets gymnastics, as urban-steeplechase aerobics and as acrobatic performance art.

The discipline of Parkour-sport really is not an accurate way of describing it—was developed in the suburbs of Paris in the 1980s when a group of friends began to use the architectural landscape as their playground and gym. Fun was important for these founders, but for them Parkour was not just a leisure activity, it was a way of life. As in martial arts, Parkour involves

mental discipline and self-improvement. It is not concerned solely with the acquisition of physical skills, but also with the improvement of one's mental and spiritual wellbeing. As one runner comments, 'It teaches me not to be scared in life, when new situations come to me, I deal with them calmly, like I would do before a new jump.'

So, freerunning provides a philosophy for life: why walk when you could run, leap, vault and somersault? Why go round obstacles when you could go under, over and through them? Why use steps when there are handrails and sheer drops? The aim of a freerunner, or traceur, is to travel in an uninterrupted flow over the cityscape, incorporating any obstacles into the journey. 'Flow' is a key word here. Using fluid movements, which are both graceful and efficient, you try to flow like water through your surroundings. Freedom is another key aspect - the sense of escaping from the restrictions of your surroundings and routine. In attempting to become 'fluid like water', the traceur tries to use the body as efficiently as possible. At the same time, they have respect for their surroundings and disapprove of anything, such as the grinding and waxing done by skateboarders, which damages them.

This respect was not immediately evident to the people whose buildings they were using. Informal groups of young men testing their skills on public or other people's property, naturally met with disapproval and even hostility and for many traceurs this was the thrill or even the point of doing it. Knowing that it was an underground activity that belonged only to a select portion of urban youth was what made it special, what made it theirs.

The free, accessible nature of freerunning means it has the potential to engage groups of young people who are typically unmoved by traditional sports. Basically anyone can practise, anywhere all you need is a decent pair of trainers, so the financial outlay is negligible. There are no joining fees, no forms to fill in and no rules and regulations. However, there is a shared attitude among the original traceurs, which they feel is being jeopardised by its rapidly increasing popularity.

The TV ads involving the early French founders of the discipline drew attention from all over the world. A British documentary showed the founders running over the rooftops of famous London landmarks, which encouraged many to start to practise themselves. Subsequently the French were joined by a group of English traceurs called Urban Freeflow demonstrating the rapid growth of Parkour.

But it is this growing popularity and the acrobatic and spectacular performances which have attracted so much attention, that may contain the very few elements which some feel will change

the nature of Parkour. The public approval and corporate sponsorship which could popularise the sport could actually destroy it. Yet that is the direction in which even some early traceurs would like it to take-away from the founders' original philosophy.

Media and big business have been attracted to the youthful appeal of the discipline. TV, which has done so much to popularise the activity, demands dramatic, showy visuals, including flips and somersaults. These daring embellishments are known as 'tricking', a term which, while it is an accurate description, might also suggest a false approach to the discipline. While the original traceurs might argue that true Parkour should not involve competition, there are forces pushing it in that direction.

There are participants of course, for whom entertainment and showmanship are the point. Inspired by YouTube clips, young people across Britain are adopting a form of freerunning which includes competing to produce moves which are spectacular. Runners who want to display acrobatics to each other are also more likely to stay in one place, abandoning the physical journey and its random challenges.

The promoters of Parkour call it 'the coolest way for young people to get fit and stay healthy' and 'a fitness regime designed by young people for young people' and there are organisations where the words 'cool' and 'young' spark a great deal of interest. Councils, seeing this growing popularity, have started looking at ways to take the activity into schools or even to create 'freerun parks' and major companies, meanwhile, are keen to have their brands associated with the youthfulness of the activity.

Freerunners on the street seem to be particularly sceptical about commercialisation. 'There are already special Freerunning trainers you can buy' says a young traceur, who like most, wears a simple T-shirt, baggy tracksuit bottoms and unbranded trainers for the sport. Another neatly summed up the contradiction within the notion of this young, rebellious activity becoming mainstream,'I don't think I would do it if it really took off.'

25/ Why does music move us?

How is it that the combination of sound waves that we know as music can have such a moving effect, asks Roger Highóeld.

In the most basic terms, sound is merely a pressure wave that ripples through air. So how does the combination of sound waves that we know as music become, as Tolstoy put it, 'the shorthand of emotion'? Or, to put it another way, how can mechanical vibrations have such a moving effect?

The answer, according to Philip Ball, author of The Music Instinct, lies not in the notes themselves, but in our brains. Recently, I hosted an event with him at the Royal Institution, at which he explained to a packed audience why listening to much current pop music was as demanding as listening to Bach or Beethoven.

Whatever your favourite genre of music your brain has to work hard to make sense of it. Its remarkable skill at pattern detection will take the extraordinary harmonics-crammed richness of a note played on a piano or flute, and magically collapse it in your head, so that it is perceived as a single note rather than a forest of overtones.

My companion explained that we are pattern seekers, and that music helps us to find patterns in sound. We come equipped with all sorts of rules of thumb to make sense of what we hear. Those rules are the brain mechanisms that we use to organise sound and make sense of music.

Medical scanners have shown that this process is not limited to one part of the brain. Different aspects of music activate different areas. We use our temporal lobe to process melody and pitch, our hippocampus to recover musical memories and what we might call 'rhythm-processing circuits' to fire up motor functions. Interestingly, the brain gives out the same signal of confusion when it encounters sentences that do not make sense as it does when the syntax of music sounds wrong and when chords do not complement one another. If you study the way we react to patterns of notes, you find there is something special about a pitch that is double the frequency of another; the interval better known as an octave.

The biggest question, however, is whether this kind of mental circuitry is designed specifically to handle music, or if songs and tunes are just 'auditory cheesecake', as Harvard University's Steven Pinker puts it. He claims that sounds accidentally generate pleasure via neural systems. The ability to hear them in the first place evolved to respond to other kinds of stimuli.

The disappointing truth might be that we simply do not know. We do know, however, that the way we learn to appreciate music is profoundly affected by how we were raised. A few years ago, Philip Ball wrote about the fact that music seems to have a national character, probably as a result of the rhythms and cadences of the different language spoken in each case. The English

tend to vary the pitch of their speech, and the length of their vowels, more than the French, and their composers follow suit in the rhythms and intervals they use. On the latter measure, Elgar is considered by some to be the most 'English' of all composers, perhaps explaining why his music is so frequently the background to important national pageants.

Similarly, concepts of what is harmonious boil down to a matter of convention, not acoustics. The older generation struggle with modern music and complain that it is dissonant - full of horrible jarring notes that are difficult to listen to. However, dissonance has always been in music. Beethoven and Chopin are full of it. It is all a matter of convention. What we regard as consonant now was thought dissonant in the Middle Ages. The augmented fourth was thought sinister back then, when it was dubbed 'diabolus in musica'. We still find it slightly unsettling today, which might explain why it is so popularly used in heavy metal.

Towards the end of my evening with Philip Ball, I asked whether music's effects on the brain can be harnessed for good. It was a perfect set-up for him to examine the so-called ‘Mozart effect' – the belief that playing your children classical music will make them brainier. He cited an experiment conducted in 1996, which concluded that playing babies rock music had a more beneficial effect than did playing them Mozart. The essential factor was not the music per se, but the fact that it put the children in bright spirits.

For Ball, the definition of the 'music instinct' is that we are predisposed to make the world a musical place. Apart from the tiny proportion of the population who really are tone-deaf, it is impossible to say: 'I am not musical,' even if it may seem that way whenever you get dragged along to participate in karaoke.

26/ Rag-pickers: The Bottom Rung in the Waste Trade Ladder

Recycling has existed in one form or another for many years in India and is complicated. Long before the term itself seeped into everyday vocabulary, women separated newspapers and sold them to weekend buyers, who cycled by with a weighing scale and loose change to pay with. Bottles were reused until they broke, and tins were simply never thrown away. As a 13-year-old, I was surrounded by baby food tins from my infancy, storing rice, dals and chutneys. These habits are sadly dying out, superseded by the advent of the non-recyclable, non- reusable sachet and plastic packaging. Now, instead of being stored away for a rainy day, unwanted products are

tossed carelessly into the dustbin. And this is where modern-day recycling begins. In Delhi, for every hundred residents, one person is engaged in recycling.

All recycling in India is undertaken by and via the informal sector. This sector includes rag-pickers, middlemen, transporters, and finally, reprocessors. In terms of human resources this sector is arranged in a table-top pyramid with rag- pickers at the base, forming the backbone of waste collection. At the thinner end of the wedge are the small middlemen, who buy the waste and sell it onto larger middlemen, who usually specialise in particular items and materials. Above them are factory owners, who procure supplies from those beneath through a ubiquitous network of agents.

Delhi is particularly interesting, because it has one of the largest and most vibrant recycling bases in the country. The 100,000 waste-pickers are the base of a huge recycling pyramid, handling something like 15% of the solid waste generated in the city. Since over 7,000 metric tonnes of waste is generated daily, this is a substantial business. A range of material is processed within the sector, including plastics, metals, paper and glass. Studies estimate that this informal labour force saves the three Delhi Municipalities a minimum of Rs. 6 lakhs (approx. 12,000 USD) every day. It has been calculated that a single scrap of material can increase 700% in value before it is even reprocessed, as it moves along the recycling chain.

So, recycling in Delhi is big business but is it a green business, and who does it benefit? Consider, first, the rag-picker, usually a young person, though not a child, with a large woven sack hanging from his or her shoulder. He or she will begin work as early as 4am, or miss the most profitable finds. As locations and routes are territorial, residents may begin to recognise their own rag-picker. By late afternoon, or when the bag is full, the rag-picker hunts down a middleman to sell to. The waste should be separated according to almost 30 different categories, and it must be clean and dry. In secret segregation patches around the city; thousands of the poorest inhabitants sort through waste and wash it from makeshift water sources. Hunched over for hours, the poor undertake what the privileged preach: segregation of waste. If the privileged had done this themselves, the poor would suffer less from backache, allergies and respiratory disorders, and have fewer cuts, burns and dog-bites. The transaction at the selling point is complex and frequently unjust. A rag-picker may be paid less if waste is sub-standard or wet, or if the buyer is temporarily cash strapped. Rag-pickers often take loans from buyers, and soon find themselves working simply to pay back debt.

Rag-pickers generally live either in slums, often the shop or warehouse of a middleman, or outside in alleyways and on footpaths. Some sleep in dustbins. Their access to basic amenities and essential services is virtually non-existent. The police regularly beat them or burn their bags of waste, leaving them with nothing to show for a day's work. Municipal workers charge rag-pickers to be allowed to forage in a bin, and if it is a lucrative bin, the rates gradually increase. Once ensconced, the municipal worker makes them do additional work, sweeping or loading trucks. It is not unknown for the police to pick up rag-pickers and force them to clean the police station.

Sadly and shockingly, this whole process subsidises the consumption of various materials by the city's wealthier citizens. The example of plastics is a good example. According to a report by the Ministry of Environment, the plastics industry is growing at 10% per annum, and almost 52% of this is expected to be used in the packaging sector. Packaging is a short life use and it will be collected and processed as waste by the informal sector. It will be undertaken in a manner which ensures that ecologically, economically and socially, the costs will be internalised by this recycling chain.

In India, the informal sector has an essential role because it is able to undertake recycling, which the municipality cannot. However, although it is critical, especially to the handling of solid waste, the sector is unable to optimise its work. There is a stark lack of awareness and specific skills, as well as very poor working conditions. The services provided by this sector are poorly understood and ultimately free to consumers, so are currently unappealing to the private sector. Recycling, at least for now, must be seen as the flip side of urban middle class consumption.

The state's attitude towards informal recycling is schizophrenic. On the one hand, in conferences and seminars, the sector is praised and rag-pickers complemented for their contribution. On the other hand, the sector is ignored by planners and policy makers, who look to reform municipal systems. The current Third Master Plan for Delhi, though still being drafted in secrecy, has been largely criticised for having 'left out the informal sectors'. This lack of planning perpetuates the image of the sector as an illegal and illegitimate one, which is projected as encroaching upon the city, rather than serving it.

27/ In Praise of Fast Food

The media and a multitude of cookbook writers would have us believe that modern, fast, processed food is a disaster, and that it is a mark of sophistication to bemoan the steel roller mill and sliced white bread while yearning for stone-ground flour and a brick oven. Perhaps, we should call those who scorn industrialised food, culinary Luddites, after the 19th-century English workers who rebelled against the machines that destroyed their way of life. Instead of technology, what these Luddites abhor is commercial sauces and any synthetic aid to flavouring our food.

Culinary Luddism has come to signify more than just taste, however. It presents itself as a moral and political crusade, and it is here that I begin to back off. As a historian, I cannot accept the notion that the sunny, rural days of yesterday is in such contrast to the grey industrial present. I refute the philosophy that so crudely pits fresh and natural against processed and preserved, local against global, slow against fast and additive-free against contaminated. History shows, I believe, that the Luddites have things back to front.

It will come as a shock to many to discover that the notion of food being fresh and natural is actually a rather modern one. For our ancestors, what was natural frequently tasted bad. Fresh meat was rank and tough, fresh fruit inedibly sour, and fresh vegetables horribly bitter. Natural was unreliable. Fresh milk soured, eggs went rotten and everywhere seasons of plenty were followed by seasons of hunger. What's more, natural was usually indigestible. Grains, which supplied 50 to 90 per cent of the calories in most societies, had to be threshed, ground and cooked to be fit for consumption.

So to make food tasty, safe, digestible, and healthy, our forebears bred, ground, soaked, leached, curdled, fermented, and cooked naturally occurring plants and animals until they were nothing at all like their original form. They created sweet oranges and juicy apples and non-bitter legumes, happily abandoning their more natural but less tasty ancestors. They dried their meat and fruit, salted and smoked their fish, curdled and fermented their dairy products, and cheerfully used additives and preservatives like sugar, salt, oil and vinegar to make food edible.

Eating fresh, natural food was regarded with suspicion verging on horror; only the uncivilised, the poor, and the starving resorted to it. The ancient Greeks regarded the consumption of greens and root vegetables as a sign of bad times, and many succeeding civilizations believed the same. Happiness was not a verdant garden abounding in fresh fruits, but a securely locked storehouse jammed with preserved, processed foods.

What about the idea that the best food is handmade in the country? That food comes from the country goes without saying. However, the idea that country people eat better than city dwellers is preposterous. Very few of our ancestors working the land were independent peasants baking their own bread and salting down their own pig. Most were burdened with heavy taxes and rent, often paid directly by the food they produced. Many were ultimately serfs or slaves, who subsisted on what was left over; on watery soup and gritty flatbread.

The dishes we call ethnic and assume to be of peasant origin were invented for the urban, or at least urbane, aristocrats who collected the surplus. This is as true of the lasagna of northern Italy as it is of the chicken korma of Mughal Delhi, the moo shu pork of imperial China, and the pilafs and baklava of the great Ottoman palace in Istanbul. Cities have always enjoyed the best food and have invariably been the focal points of culinary innovation.

Preparing home-cooked breakfast, dinner, and tea for eight to ten people 365 days a year was servitude. Churning butter or skinning and cleaning rabbits, without the option of picking up the phone for a pizza if something went wrong, was unremitting, unforgiving toil. Not long ago, in Mexico, most women could expect to spend five hours a day kneeling at the grindstone preparing the dough for the family's tortillas.

In the first half of the 20th century, Italians embraced factory-made pasta and canned tomatoes. In the second half, Japanese women welcomed factory-made bread because they could sleep a little longer instead of getting up to make rice. As supermarkets appeared in Eastern Europe, people rejoiced at the convenience of ready- made goods. Culinary modernism had proved what was wanted: food that was processed, preservable, industrial, novel, and fast, the food of the elite at a price everyone could afford. Where modern food became available, people grew taller and stronger and lived longer.

So the sunlit past of the culinary Luddites never existed and their ethos is based not on history but on a fairy tale. So what? Certainly no one would deny that an industrialised food supply has its own problems. Perhaps we should eat more fresh, natural, locally- sourced, slow food. Does it matter if the history is not quite right? It matters quite a bit, I believe. If we do not understand that most people had no choice but to devote their lives to growing and cooking food, we are incapable of comprehending that modern food allows us unparalleled choices. If we urge the farmer to stay at his olive press and the housewife to remain at her stove, all so that we may eat traditionally pressed olive oil and home-cooked meals, we are assuming the mantle of the

aristocrats of old. If we fail to understand how scant and monotonous most traditional diets were, we fail to appreciate the 'ethnic foods' we encounter.

If we assume that good food means only old or slow or homemade food, we miss the fact that many industrial foods are better. Certainly no one with a grindstone will ever produce chocolate as sophisticated as that produced by 72 hours in a conching machine. And let us not forget that the current popularity of Italian food owes much to two convenience foods that even purists love, factory pasta and canned tomatoes. Far from fleeing them, we should be clamouring for more high- quality industrial foods.

If we romanticise the past, we may miss the fact that it is the modern, global, industrial economy (not the local resources of the wintry country around New York, Boston, or Chicago) that allows us to savour traditional, fresh, and natural foods. Fresh and natural loom so large because we can take for granted the processed staples - salt, flour, sugar, chocolate, oils, coffee, tea – produced by food corporations.

Culinary Luddites are right, though, about two important things: We need to know how to prepare good food, and we need a culinary ethos. As far as good food goes, they've done us all a service by teaching us how to use the bounty delivered to us by the global economy. Their ethos, though, is another matter. Were we able to turn back the clock, as they urge, most of us would be toiling all day in the fields or the kitchen, and many of us would be starving.

28/ Why does skin wrinkle in water?

Thousands of years after the invention of the bath, scientists have come up with a theory to explain why our fingers and toes wrinkle when steeped in water. Puckered or wrinkled skin gives a better grip and may have helped our ancestors uproot wet plants when foraging for food, or be steadier and more sure-footed in a slippery, wet environment, they say. Writing in Biology Letters, Tom Smulders, an evolutionary neurobiologist at Newcastle University suggests that it may be an evolutionary development, 'Going back in time, this wrinkling could have helped with gathering food from wet vegetation or streams. The analogous effect in the toes could have helped our ancestors get a better footing in the rain,' he says.

The familiar wrinkles on wet fingers and toes may also have benefitted early humans in their first forays into technology. 'It might have helped handling tools in wet conditions,' Smulders added, such as fixing hunting weapons in the rain, or fishing with harpoons.

It is popularly believed that fingertips absorb water and swell up, making the skin ripple with tiny folds. But this was proved to be incorrect by studies that showed the effect disappeared when the nerves in the fingers were damaged. Rather than swelling up, fingertips shrink when they wrinkle because the blood vessels inside them contract. The effect is controlled by the autonomic nervous system, which also governs breathing and heart rate.

Smulders investigated the benefits of wrinkled fingers after reading a paper by Mark Changizi, director of human cognition at 2A1 Labs in Idaho. His report in the journal Brain, Behaviour and Evolution suggested that wrinkles on fingers resemble car treads and the network drainage systems seen on mountains.

In the latest study, Smulders had 20 people move 45 submerged marbles and fishing weights from one container to another. The objects were plucked one at a time, with the forefinger and thumb of the right hand, passed through a hole in a screen separating the containers and into the thumb and forefinger of the left hand. Smulder timed them on the task, once when they had dry and unwrinkled hands before starting, and again after they had soaked their hands in water for half an hour. The task took between 90 and 150 seconds to complete, but those with wrinkled fingers moved the wet objects 15 seconds faster on average, compared with those who began with dry hands. Wrinkles made no difference to the time it took to do the task with dry objects, according to the study reported in Biology Letters. 'It could be working like treads on your car tyres which give you a better grip,' said Smulders.

The findings raise the question of how, and from which species, humans inherited their wrinkling skin. 'My guess is that all primates have pruney fingers, but our only evidence at the moment beyond humans is from macaques,' said Changizi. At his lab in Idaho, Changizi has done a similar, though more rudimentary, experiment and reached the same conclusions as the Newcastle team. 'The obvious application here is biologically inspired rain treads for your shoes,' Changizi said. 'We'd ideally like to have shoe treads with the right wrinkle shapes for our foot topography. And we'd ideally like to have the treads flatten so that the entire shoe grips the ground once the water is squirted out through the channels.'

One question that remains is why fingers are not wrinkled all the time, even when they are not in water. The answer may be that wrinkling comes at a cost: the loss of sensitivity.

29/ Physical Touch Affects Emotional Mood

Sitting in a comfortable chair does put you in a better mood, a new study suggests.

Scientists have discovered that the hardness of a chair directly influences the way someone feels about another person. In an astonishing study, volunteers given wooden seats were less flexible while negotiating the price of a new car than people who sat on a padded cushion. The finding is part of an astonishing series of experiments that reveal the links between our attitudes to other people - and the texture of objects all around us. In one experiment, people given a soft blanket to hold were less likely to judge someone as rigid or strict than those handed a hard wooden block to play with. In another experiment, people who were given heavy clipboards to hold rated job applicants as more serious than people given a lightweight board – even though both groups of job applicants were identical.

The findings suggest that the behaviour of everyone - from high court judges and teachers to job interviewers and politicians - is influenced by something as mundane as the seat they are using, or the feel of the pen in their hand. Researchers who carried out the experiments believe the link between touch and emotion goes right back to early childhood. Physical concepts such as roughness, hardness and warmth are among the first that infants develop – and the study suggests that these are crucial to how people eventually develop ideas about people and relationships such as understanding the meaning of a warm smile or a hard heart. Christopher Nocera, who led the study at Harvard University said, 'Touch remains perhaps the most underappreciated sense in behavioural research. People often assume that exploration of new things occurs primarily through the eyes. While the power of vision is irrefutable, this is not the whole: story. Our work suggests that greetings involving touch, such as handshakes and cheek kisses, may in fact have critical influences on our social interactions in an unconscious fashion'.

The researchers carried out a set of experiments on volunteers to test how objects' weight, texture and hardness unconsciously shape judgements about other people. The results, published in the journal| Science, make fascinating reading. In one experiment, 86 volunteers were invited to a lab, seated in either wooden chairs or soft seats and asked to imagine shopping for a new car at a dealer's. After being told the sticker price of the car they were invited to write down their first offer price and a second price, assuming the dealer rejected the first offer. Those in hard chairs

were less flexible in their haggling skills and were far less willing to drop their prices during the negotiations, the researchers found.

Another study asked 49 volunteers to examine a piece of soft blanket or hard block of wood before looking at a scenario set in a workplace describing a meeting between a boss and employee. The scenario was designed to be ambiguous - and included friendly conversation between the characters as well as an exchange of sharp words. Volunteers who were given the hard block of wood to handle judged the employee to be more rigid and stricter than those who had been given a blanket to hold. In a third experiment, a similar scenario was given to volunteers after they had completed a five piece jigsaw. Half the volunteers were given a smooth puzzle while the others were given one covered with sandpaper. Again, those who were given the rough object rated the relationship between the characters as harsher and more adversarial than those given the smooth jigsaw.

Even the weight of a clipboard can influence someone's attitude, the study found. The researchers asked 54 volunteers to give their impression of a job applicant by reading their CVs. When the CVs were given to the volunteers on heavy clipboards, they were rated as far more serious than when the identical CVs were attached to flimsy, lightweight clipboards. Dr John Bargh of Yale University, who took part in the study said, ‘It is behavioural priming through the seat of the pants. Our minds are deeply and organically linked to our bodies'. Not only is touch an important sense for exploring the world, but it also shapes our understanding of it, reflected in the use of everyday phrases such as 'take the rough with the smooth', 'have a soft spot for someone' or ‘a prickly situation'.

Past studies have shown that people judge strangers to be more generous and caring after they have held a warm cup of coffee, rather than a cold drink., ‘Physical experiences not only shape the foundations of our thoughts and perceptions, but influence our behaviour towards others, sometimes just because we are sitting on a hard instead of a soft chair'.

30/ Owl secrets

It always appeared to fly in the face of logic. But now, the biological secrets that allow owls to rotate their heads without cutting off their blood supply have finally been unravelled. Scientists have discovered four major adaptations in owls designed to prevent injury when the animals rotate their overly large heads by up to 270 degrees.

The study found that the birds' unique bone structures and vascular systems let them move with increased flexibility. Scientists at John Hopkins University School of Medicine in the US studied snowy, barred and great horned owls after their deaths from natural causes. They found that the vertebral artery enters the neck higher than in other birds, creating more slack. Unlike humans, owls were found to have small vessel connections between the carotid and vertebral arteries, allowing the blood to be exchanged between the two blood vessels. This creates an uninterrupted blood flow to the brain, even if one route is blocked during extreme neck rotation.

The adaptation gives the birds a huge range of vision without having to move their bodies and arouse detection by prey. The lack of similar adaptations in humans could explain why humans are more vulnerable to neck injury, the experts concluded. When humans attempt sudden and violent twists of their neck they risk damaging the lining of their blood vessels, which can result in a fatal blockage or stroke. Study senior investigator Doctor Philippe Gailloud, said: ‘Until now, brain imaging specialists like me who deal with human injuries caused by trauma to arteries in the head and neck have always been puzzled as to why rapid, twisting neck movements did not leave thousands of owls lying dead on the forest floor from stroke. 'The carotid and vertebral arteries in the neck of most animals - including owls and humans - are very fragile and highly susceptible to even minor tears of the vessel lining.'

To solve the puzzle, the researchers studied the bone and blood vessel structures in the heads and necks of the birds. An injectable contrast dye was used to highlight the birds' blood vessels, which were then dissected, drawn and scanned to allow detailed analysis.

The most striking finding came after researchers injected dye into the owls' arteries, mimicking blood flow, and manually turned the animals’ heads. They found that when they turned the heads, the blood vessels below the jaw bone expanded as more dye entered, creating pools of blood capable of maintaining the energy supply to the brain and eyes. They showed that the big carotid arteries, instead of being on the side of the neck as in humans, are carried close to the centre of rotation just in front of the spine. As a consequence, these arteries experience much less twisting and turning. The potential for damage is therefore greatly reduced. This contrasted starkly with human anatomical ability, where arteries generally tend to get smaller and smaller, and do not balloon out as they branch out. This creates the risk of clotting after sudden neck movements such as whiplash.

Researchers say these contractile blood reservoirs act as a trade-off, allowing birds to pool blood to meet the energy needs of their large brains and eyes, while they rotate their heads. The supporting vascular network, with its many interconnections and adaptations, helps minimise any interruption in blood flow. The study results demonstrate what physical properties are needed to allow such extreme head movements, and explain why injuries sustained from treatments that involve manipulating bones with the hands such as chiropractic therapy can have such serious consequences for humans. Dr Gailloud added: 'Our new study results show precisely what morphological adaptations are needed to handle such head gyrations and why humans are so vulnerable to bone injury from chiropractic therapy. Extreme manipulations of the human head are really dangerous because we lack so many of the vessel-protecting features seen in owls.' Medical illustrator Fabian de Kok-Mercado said: 'In humans, the vertebral artery really hugs the hollow cavities in the neck. But this is not the case in owls, whose structures are specially adapted to allow for greater arterial flexibility and movement.' It is a powerful adaptive trait, but it is not unique. Plenty of birds have a similar ability to look behind them. Red tailed hawks for example are almost as flexible as their nocturnal cousins. 'There are lots of advantages to being able to look over your shoulder and see something coming - if you're trying to avoid predators or detect prey', he added. The team's findings were published in the journal Science.

31/ The Soul of Irish Writers

The wind swept clouds into inky puddles across the sky. A few swollen drops of rain fell on the windshield of our rental car as my friend and I sat at a service station. A red-haired lad with a spattering of freckles across his face pumped our gas. He craned his head upward. 'Ah, the weather is desperate today,' he said.

Desperate. The word clung to me. How had he found the most poetic and perfect word to describe the weather that day? Although this trip was many years ago, I still recall that young man, as well as the cadence and lilt of the words that greeted us in the shops and pubs at which we stopped to ask directions. As a writer, I was inspired and intrigued by the Irish and their wonderful facility for language and poetic prose.

While Ireland is a small island - you can drive from the east coast to the west coast, or north to the south in little more than four hours - this green and fertile land has produced more writers per square inch than any other country. And it has done so for centuries, from James Joyce to

Nobel-Prize winning poet Seamus Heaney. But how? What organic ingredients have created a recipe for such talent? Could it be the mythical landscape itself?

During that trip, I still remember how the green, undulating mountains that opened up to vistas of the ocean, cliffs and ruined castles seemed to be permeated with an ancient wisdom and mysterious energy that seeped from the earth into my very spirit. Is it this that has made such prolific writers of the Irish and blessed them with their gift for the lyrical word?

Perhaps so, but I believe it is also about the Irish soul, which is so entwined with storytelling. Much like the primeval land that was carved over centuries, the Irish seem to allow for the flow of space and time. They are present to the rhythm of their lives and allow the creative process to speak to their souls. One of my favourite authors, the late John O'Donohue in his book Anam Cara, spoke of the power of simple presence which takes us ultimately where we need to be, as people and as creative writers.

'It is far more creative to work with the idea of mindfulness rather than with the idea of will. Too often people try to change their lives by using the will as a kind of hammer to beat their lives into shape. If you work with a different rhythm, you will come easily and naturally home to yourself. Your soul knows the geography of your destiny. Your soul alone has the map of your future, therefore, you can trust this indirect, oblique side of yourself. If you do, it will take you where you need to go.'

The Irish are also well-known storytellers. In fact the Seanachie (pronounced shawn-a-key) or storyteller is still an honoured profession in Ireland as it has been for centuries. Sean O Suilleabhain in Storytelling in Irish Tradition, writes: 'The good storyteller, who had a large repertoire stored in his memory, seated at his own fireside, in an honoured place in the house of a neighbour or at a wake, was assured of an attentive audience on winter nights. Nor was it only adults who wished to hear tales. My father described to me how himself and other children of eight years of age would spend hours, night after night, listening to an old woman storyteller in South Kerry, and an old man in the same area told me that, as a youth, he and his companions used to do all the household chores for an elderly neighbour each winter evening in order that he might be free to spend the night telling them long folktales ...'

The desire to tell stories, to weave narratives, is still central to the Irish people, as their works of literature demonstrate. James Joyce, W.B. Yeats, C.S. Lewis, Frank McCourt, Maeve Binchy,

Niall Williams, and countless other writers have not only given us moving stories but told them, often times, in words that resonate to the rhythm of our soul.

At the end of that trip, we found time to visit the site of Yeats' grave in County Sligo. The weather that day was more than desperate, as a biting wind whipped leaves around the Drumcliffe cemetery. I took a quick snapshot of his grave, and stood there, part of his poem When You are Old and Gray wafting through my thoughts.

I thanked him for sharing his gift of words with the world and asked him to help me do the same. Weeks later after we had returned home, I had the photos developed (there were no digital cameras back then) and was amazed at what I saw. There, above his grave, floated a form, a shape - a hazy gauze of white that I could not explain. I like to think his Irish soul was wishing me well as a writer.

32/ Marriage works – and it's the answer to the misery of loneliness

This week the Office for National Statistics (ONS) confirmed that more of us than ever are living alone. This won't trouble the author Colm Tóibín, who once eulogised the freedom that living alone gives him, likening his solitary existence to that of 'a cloistered nun'. This is a terrifying image, surely, and not a metaphor for a life most of us would seek to inhabit. Certainly not my friend Helen: successful, well-off, homeowner; but tired of her single life, of the near-constant awareness that she's running out of time to have children, as fast as she's running out of the energy to embark on another round of futile first dates. Nor my friend Mark, divorced dad, active in his daughter's life - but who still, at the end of the weekend, returns the child to her mother, before driving back to his re-emptied house, where he spends the evenings with PlayStation and Sky Sports.

In discussing solitary lives, we should ignore the Colm Tóibíns financially independent people who realise that, for them, living alone brings more advantages than otherwise. Most people of my generation had such a stage in their lives - between university, and settling down - but we didn't want it to last forever. In any case, with property prices as they are, such self-selected solitude is not an option for much of the succeeding generation. Set aside, too, those figures pertaining to the very elderly; not because there aren't real problems faced by those (usually female) 'survivors', but because their existence is a function of the uneven impact of medical advances and lifestyle changes on the longevity of each of the genders.

It's not the relatively young, or the very old, who are the main drivers of this demographic change. As the ONS makes clear, the largest increase in solitary living is down to the 45-64 age group. Almost two and a half million Britons in that age category have no one with whom to share their home, an increase of more than 800,000 households since the mid-Nineties. Even allowing for the increase in total population size, that's still a noticeable change, and they don't all enjoy the experience. I suspect there are more divorced parents, like my friend Mark, poking about their fridges for a pre-packed meal for one, than there are cloistered Irish novelists.

This would all be fine, were this phenomenon merely to affect matters as concrete as housing. But evidence suggests a link between solitariness and poorer health outcomes (mirroring, bleakly, the evidence about the outcomes for children raised in single-parent households). One paper I read showed a significant increase in the prescription of antidepressants to the solitary, compared with cohabiting couples. Correlation doesn't prove a sociological theory, of course, but it's hard to ignore the link between living alone, and other detrimental life choices.

The issue demands a political response: marriage is the most important institution to act as a bulwark against loneliness, and the British Government should promote it. Instead, the government is unwinding its insidious 'couples penalty': a finan- cial punishment for initially setting up home with a partner, and then after divorce, (probably the result of the stress brought on by all the expense), a further charge for a change to living conditions. The Centre for Social Justice discovered that the people most penalised for living together are - surprise - among the poorest. This must be fixed. What's more, couples who arrange to 'live apart together' shouldn't be demonised for rationally navigating the snares of the benefits system.

But if we acknowledge that a financial penalty can cause the poorest to avoid marriage, why assume that monetary considerations don't affect the better- off? First, because politicians are scared to reward marriage in the tax system, and second, because our divorce laws so scar those who endure them that, I suspect, we've produced a generation with the motto 'once bitten, twice shy'. The changes to child benefit for the well-off hardly help either.

Not very long ago, the then Home Secretary, Michael Howard deployed a powerful phrase in defence of his criminal justice policy: 'prison works'. It's time we used a similar phrase, in defence of social justice: marriage 'works' too. It works for most people and definitely for civic society, yet we find it hard to say this, and shy away from its political implications. What started as a desire not to judge 'lifestyle choices' has bred a generation living in lonely, quiet despair.

Loneliness is a much harder political issue to tackle than, say, house- building, but - if we believe in society at all – hardly one of lesser significance.

33/ How human language could have evolved from birdsong

Linguistics and biology researchers propose a new theory on the deep roots of human speech.

'The sounds uttered by birds offer in several respects the nearest analogy to language,' Charles Darwin wrote in The Descent of Man (1871), while contemplating how humans learned to speak. Language, he speculated, might have had its origins in singing, which 'might have given rise to words expressive of various complex emotions.'

Now researchers from MIT, along with a scholar from the University of Tokyo, say that Darwin was on the right path. The balance of evidence, they believe, suggests that human language is a grafting of two communication forms found elsewhere in the animal kingdom: first, the elaborate songs of birds, and second, the more utilitarian, information bearing types of expression seen in a diversity of other animals. 'It's this adventitious combination that triggered human language,' says Shigeru Miyagawa, a professor of linguistics in MIT's Department of Linguistics and Philosophy, and co-author of a new paper published in the journal Frontiers in Psychology.

The idea builds upon Miyagawa's conclusion, detailed in his previous work, that there are two 'layers' in all human languages: an 'expression' layer, which involves the changeable organisation of sentences, and a 'lexical' layer, which relates to the core content of a sentence. His conclusion is based on earlier work by linguists including Noam Chomsky, Kenneth Hale and Samuel Jay Keyser. Based on an analysis of animal communication, and using Miyagawa's framework, the authors say that birdsong closely resembles the expression layer of human sentences, whereas the communicative waggles of bees or the short, audible messages of primates are more like the lexical layer. At some point, between 50,000 and 80,000 years ago, humans may have merged these two types of expression into a uniquely sophisticated form of language.

'There were these two pre-existing systems,' Miyagawa says, 'like apples and oranges that just happened to be put together.' These kinds of adaptations of existing structures are common in natural history, notes Robert Berwick, a co-author of the paper, who is a professor of computational linguistics in MIT's Laboratory for Information and Decision Systems, in the Department of Electrical Engineering and Computer Science. 'When something new evolves, it is often built out of old parts,' he says. 'We see this over and over again in evolution. Old structures can change just a little bit, and acquire radically new functions.'

The new paper, 'The Emergence of Hierarchical Structure in Human Language,' was co-written by Miyagawa, Berwick and Kazuo Okanoya, a bio-psychologist and expert on animal communication. To consider the difference between the expression layer and the lexical layer, take a simple sentence: 'Todd saw a condor.' We can easily create variations of this, such as, 'When did Todd see a condor?' This rearranging of elements takes place in the expression layer and allows us to add complexity and ask questions. But the lexical layer remains the same, since it involves the same core elements: the subject, 'Todd,' the verb, 'to see,' and the object, 'condor.'

Birdsong lacks a lexical structure. Instead, birds sing learned melodies with what Berwick calls a 'holistic' structure; the entire song has one meaning, whether about mating, territory or other things. The Bengalese finch, as the authors note, can loop back to parts of previous melodies, allowing for greater variation and communication of more things; a nightingale may be able to recite from 100 to 200 different melodies.

By contrast, other types of animals have bare-bones modes of expression without the same melodic capacity. Bees communicate visually, using precise waggles to indicate sources of foods to their peers; other primates can make a range of sounds, comprising warnings about predators and other messages.

Humans, according to Miyagawa, Berwick and Okanoya, fruitfully combined these systems. We can communicate essential information, like bees or primates, but like birds, we also have a melodic capacity and an ability to recombine parts of our uttered language. For this reason, our finite vocabularies can generate seemingly infinite string of words. Indeed, the researchers suggest that humans first had the ability to sing, as Darwin conjectured, and then managed to integrate specific lexical elements into those songs. 'It's not a very long step to say that what got joined together was the ability to construct these complex patterns, like a song, but with words,' Berwick says.

As they note in the paper, some of the 'striking parallels' between language acquisition in birds and humans include the phase of life when each is best at picking up languages, and the part of the brain used for language. Another similarity as Berwick puts it is that 'all human languages have a finite number of stress patterns, a certain number of beat patterns. Well, in birdsong, there is also this limited number of beat patterns.'

Norbert Hornstein, a professor of linguistics at the University of Maryland, says the paper has been 'very well received' among linguists, and 'perhaps will be the standard go-to paper for

language-birdsong comparison for the next five years.' He adds that he would like to see further comparison of birdsong and sound production in human language, as well as more neuroscientific research, pertaining to both birds and humans, to see how brains are structured for making sounds.

The researchers acknowledge that further empirical studies on the subject would be desirable. 'It's just a hypothesis,' Berwick says. 'But it's a way to make explicit what Darwin was talking about very vaguely, because we know more about language now.' Miyagawa, for his part, asserts it is a viable idea in part because it could be subject to more scrutiny, as the communication patterns of other species are examined in further detail. 'If this is right, then human language has a precursor in nature, in evolution, that we can actually test today,' he says, adding that bees, birds and other primates could all be sources of further research insight.

MIT-based research in linguistics has largely been characterised by the search for universal aspects of all human languages. With this paper, Miyagawa, Berwick and Okanoya hope to spur others to think of the universality of language in evolutionary terms. It is not just a random cultural construct, they say, but based in part on capacities humans share with other species. At the same time, Miyagawa notes, human language is unique, in that two independent systems in nature merged, in our species, to allow us to generate unbounded linguistic possibilities, albeit within a constrained system. 'Human language is not just freeform, it's rule-based,' Miyagawa says. 'If we are right, human language has a very heavy constraint on what it can and cannot do, based on its antecedents in nature.'

34/ The end of email?

More than 107 trillion emails are sent every year but its grip on our lives is loosening….

For several years students of the internet have noticed that young people are abandoning email in favour of alternative electronic ways of staying in touch. A leading US internet research firm, ComScore, recently reported a 59% decline in the use of internet-based email services by 12 to 17 year-olds, an 18% decline among 25 to 35 year-olds, and an 8% fall among 35 to 44 year-olds. There are even signs that email is beginning to lose favour in the workplace too.

Europe's largest IT company, Atos Origin, intends to scrap internal emails altogether. Its staff will still use email to correspond with clients and other businesses but to talk among themselves they will adopt a variety of newer services such as instant messaging services and older methods

– namely talking face to face. The company's chairman prompted headlines around the world when he mentioned he had not sent an email in more than three years. But in fact a number of companies have been quietly moving away from using email as the primary way of communicating within the company. Intel, for example, has been experimenting with 'no-email Fridays' encouraging its engineers to solve problems by phone or face to face instead.

The move, in part reflects the preferences of its workers, many of whom are under the age of 30. However, it is also happening because the volume of email is becoming unsustainable. Employees who usually get 200 emails a day, spend between five and 20 hours a week just clearing their inboxes. The distraction and time-wasting of email have been a regular part of office life for more than a decade. More than 107 trillion are now sent each year, of which half are spam. The rest are a mix of round robins, personal messages and badly written memos that pile up in archives and do little to boost productivity. Research shows that it takes 64 seconds to regain concentration after reading an email and when you consider that US office workers have been measured checking their emails and swapping windows on their computer screens an average of 37 times an hour, that adds up to major distraction.

Employees will be expected to use collaboration and social media tools instead of email to communicate with co-workers. In English, that means newer types of electronic messaging services. One such service is instant messaging. Devised in the 1990s by people playing games on the net, instant messaging or IM is much simpler and more responsive than email. IM users can see when colleagues are online and then communicate in small, continuous trails of dialogues on their screens, much more like a phone call. These messages tend to be deleted as they go, thus avoiding clogged up email inboxes and archives. Less formal than email, they are also a far more efficient way of, for example, trying to arrange a meeting. IM or 'chat' facilities often form part of larger social networks, such as Facebook and Twitter.

The immediacy of these synchronous messaging systems enable people to stay in touch and broadcast information to each other - their location, activities, plans and daily schedules without the need for constant emailing. 'Status updates' in which users post a simple message that can be read by all their contacts, enable people to see and share information that might not be worth an email but can be useful nonetheless. All such ‘easy chat' services were born of an engagement with the internet that just didn't exist when email overtook the world of communication in the early 1990s.

Until about a decade ago, most neuroscientists thought the brain stopped developing after childhood. But the constant distraction and torrent of information that we subject ourselves to – via email, surfing the web, TV, multi-tasking – is now thought to alter the way we think. The new technology is, in effect, rewiring our brains. Scientists have drawn parallels between the use of electronic communication and addiction to food stimulants that release small amounts of dopamine in the brain. We feel a buzz of excitement when a message arrives, which then fades, leaving us feeling flat and bored until the next one comes. But whether this makes us less productive is open to question. Research has found that people work better in bursts of concentration interrupted by breaks – even for pointless emails – than long sustained spells.

There is still an estimated three billion email accounts in the world, a figure that dwarfs any other form of communication. Email also retains several distinguishing qualities. Unlike the galaxy of social networks and IM services on the internet - all requiring different accounts and often their own software - email systems are all fundamentally compatible. It doesn't matter which programme you send it from. And even its annoyances contain advantages: email archives have proved to be hugely valuable, and because it is an asynchronous medium (the recipients choose when to open their messages) this means we can try and preserve some control over our time. This is not the end of email - it will remain a bedrock of businesses for some time to come. It's simply the end of its monopoly.

35/ Colour on the brain

A scientific study reveals the different effects that colours have on the brain.

Paint your room red if you want attention to detail and paint it blue to prompt creative thinking. This is the conclusion of a study into how colour is likely to affect the human mind. Scientists who monitored the performance of more than 600 people as they underwent a series of psychological tests found that red stimulated a person's attentiveness whereas blue stimulated the imagination and inspired more of a risk-taking attitude.

The researchers found that the volunteers were unaware of the effect that colour had on their thinking and suggest that the findings could be used for anything from choosing the interior decoration of a school or university to the marketing of products and services. Previous research produced contradictory conclusions in terms of the benefit or otherwise of exposing people to a background colour of red or blue while asking them to carry out a thinking task, according to

Juliet Zhu of the University of British Columbia in Vancouver, who carried out the study published in the journal Science. 'Prior research found conflicting results in terms of which colour - red or blue - leads to better performance', said Dr Zhu. 'We show that if the task requires detailed attention, red will help more, but if the task is creative in nature, blue will be more beneficial. It really depends on the nature of the task'.

Humans, like other primates, have trichromatic, three colour vision, which evolutionists believe came about as a result of the need to distinguish easily between ripe and unripe fruit in a forest. But the influence of red and blue on our modern way of thinking is probably a learnt behaviour rather than being innate, Dr Zhu said. We think the difference between red and blue is due to learnt associations, she said. That's why I expect that if in another culture red is often associated with other meanings, we might not be able to replicate the results of this study. Thanks to stop signs, emergency vehicles and teacher's red pens, we associate red with danger, mistakes and caution. The avoidance motivation, or heightened state, that red activates makes us vigilant and so helps us to perform tasks where careful attention is required to produce a right or wrong answer.

Blue meanwhile, is associated with a clear sky or an open ocean, and as such it is the colour that encourages us to think 'outside the box' and to be creative. It is also the colour of calmness and tranquillity. Dr Zhu explained, 'Through associations with the sky, the ocean and water, most people associate blue with openness, peace and tranquillity. The benign cues make people feel safe without being creative and exploratory not surprisingly, it is people's favourite colour. Six different psychological tests were carried out on the volunteers. One involved a memory task; recalling 36 words within a two-minute period. People did better when the background colour on the computer screen was red, whereas blue led to more false recalls. Another challenged people to think of as many different uses for a pile of bricks as they could. Red or blue did not affect the total number of ideas, but blue did result in a significantly higher score in terms of the creative content of the idea.

Several of the tests investigated how colour affects a person's attitude to an advertising campaign. A red background stimulated a person's attention to the detailed technological capabilities of a camera, whereas a blue background was more likely to stimulate ideas about what the camera could be used for. Similarly, an advertisement for a fictional brand of toothpaste was found to have a greater impact for a negative message, such as ‘cavity prevention,' if red was

used as the background colour. But blue had a greater impact for a positive message, such as 'tooth whitening'. Dr Zhu said that the background colour used in advertisements could have subtly different effects on a potential consumer. When the background colour of ads was red, people formed more favourable evaluations of products featuring specific product details as opposed to evocative or creative messaging.

However, blue produced the opposite effect. Dr Zhu said, ‘If we are setting up educational facilities that intend to enhance performance on detail-oriented tasks, such as memory and proofreading, or if we want people to remember important side-effects of medications, then the colour red should be more appropriate. However, if we want to set up a brain-storming session for a new product-development process or coming up with innovative ideas, then go with blue'. 'Blue if you want to be creative, red if you want to be diligent'.

36/ The Strange Sad Fate of the honey bee

The world is losing the honey bee at an alarming rate a trend that could have implications for us all...

Thousands of American beehives were recently found to be almost empty and devoid of bees. They were thought to be victims of a malady called Colony Collapse Disorder (CCD). The problem has not been limited to America. Over the past few years, large numbers of colonies have been wiped out in Canada, South America, Asia and Europe.

The malady occurs when most of the bees suddenly disappear from the hive leaving it with only queens, eggs or pupae ('the brood') and a few immature workers still remaining. The vanished bees strangely never found are thought to die singly far from home. The phenomenon is odd for various reasons. Firstly, bees never usually abandon a hive until the brood has hatched; their sophisticated in-built navigation system allows them to forage up to three miles from the hive and return safely. Secondly, when a colony dies, the honey left behind is usually raided by bees from other hives, yet these bees avoid the hives completely. And lastly, the incidence of the malady is very erratic. Some beekeepers report heavy losses while their neighbours maintain healthy hives.

If honey bee populations continue to decline, it will, of course hit honey supplies. But far more disturbing is the effect it could have on flora. Most flowers rely on animals to pollinate them, and the honey bee is nature's premier pollinator, with a body perfectly designed to collect and spread

pollen and a work ethic to match: one big colony containing up to 60,000 worker bees, can pollinate millions of flowers in a day. In a spiral of decline, as bee numbers drop, the remaining islands of wild flowers may not be pollinated and some could simply die out. Especially at risk are rare varieties and the insect and animal species that depend on them.

Scientists remain puzzled by the decline in bee populations. However, they believe that there has been widespread damage to the bees' immune system. In America, bees are hauled around the country to pollinate crops. Their environment is altered to keep them working, by moving them to warmer spots in winter so that the queen keeps laying and producing more workers. One theory is that the bees' immune systems get damaged in the process. Another sees the cause in the disruptive effects of climate change, while others again trace it to one of two well-known bee diseases. When honey bees are kept as a business (for honey production or hired out to fruit farmers as pollinators) their colonies are kept close together. This allows disease to spread easily despite them being treated with antibiotics to keep them producing. In stressed conditions bees may more easily fall victim to viruses that normally would do them little harm. More fancifully, some even blame mobile phones, which are said to interfere with bees' navigation systems. The impact of all such factors (except the last) is exacerbated by the shrinking size of the gene pool - most beekeepers having filled their apiaries with just one type of bee from Italy, renowned for its honey and gentleness.

Bees have also suffered from pesticides sprayed on crops and in open spaces such as parks. The pesticides attack the nervous system and disorientate them, interfering with the bees, vital communication skills in particular the 'waggle dance' they use to tell other workers where nectar and pollen can be found. One such pesticide was banned in France following heavy winter bee deaths.

The first recorded case of disappearing bees was in America 150 years ago, and, ever since, large numbers have vanished at regular intervals throughout North America, Europe and Australia. These losses have been given many different names: disappearing disease, spring dwindle, May disease or autumn collapse. In America, there were 5.9 million maintained colonies in 1947; today there are only 2.44 million. If bees keep disappearing at this rate, it is estimated that there will be none left in America by 2035.

'If the bee disappeared off the surface of the globe' the mathematician Albert Einstein is reputed to have said, 'then man would only have four years of life left'. This may be an exaggeration but

scientists believe that if the honey bee did disappear, farming as we know it would collapse. More than 90 commercial crops - from apples, peaches and citrus fruits to strawberries and blackberries, to nuts, carrots, broccoli and onions are pollinated by bees. So is cotton and much livestock fodder, such as clover. A study by Cornell University found that bees helped produce around 60 billion dollars worth of food around the world - fifteen billion dollars in the US alone, where many commercial beekeepers take their hives on a five month tour of the country, pollinating California's lucrative almond trees, for instance, then Florida's citrus trees and Maine's blueberries. Without bees, wind-pollinated grasses would continue to grow, but flowers and vegetable beds would be devastated, and there would be far less food for birds and mammals to eat. It has been calculated that the 'service' that bees provide is essential for the production of one in three of our mouthfuls of food. In southern Sichuan in China, where honey bees have been wiped out, pear trees have to be pollinated by hand - an extremely labour intensive business.

37/ In Praise of Amateurs

Despite the specialisation of scientific research, amateurs still have an important role to play

During the scientific revolution of the 17th century, scientists were largely men of private means who pursued their interest in natural philosophy for their own edification. Only in the past century or two has it become possible to make a living from investigating the workings of nature. Modern science was, in other words, built on the work of amateurs. Today, science is an increasingly specialised and compartmentalised subject, the domain of experts who know more and more about less and less. Perhaps surprisingly, however, amateurs - even those without private means – are still important.

A recent poll carried out at a meeting of the American Association for the Advancement of Science by astronomer Dr Richard Fienberg found that, in addition to his field of astronomy, amateurs are actively involved in such fields as acoustics, horticulture, ornithology, meteorology, hydrology and palaeontology. Far from being crackpots, amateur scientists are often in close touch with professionals, some of whom rely heavily on their co-operation.

Admittedly, some fields are more open to amateurs than others. Anything that requires expensive equipment is clearly a no-go area. And some kinds of research can be dangerous; most amateur chemists, jokes Dr Fienberg, are either locked up or have blown themselves to bits. But amateurs

can make valuable contributions in fields from rocketry to palaeontology and the rise of the Internet has made it easier than ever before to collect data and distribute results.

Exactly which field of study has benefited most from the contributions of amateurs is a matter of some dispute. Dr Fienberg makes a strong case for astronomy. There is, he points out, a long tradition of collaboration between amateur and professional sky watchers. Numerous comets, asteroids and even the planet Uranus were discovered by amateurs. Today, in addition to comet and asteroid spotting, amateurs continue to do valuable work observing the brightness of variable stars and detecting novae 'new' stars in the Milky Way and supernovae in other galaxies. Amateur observers are helpful, says Dr Fienberg, because there are so many of them (they far outnumber professionals) and because they are distributed all over the world. This makes special kinds of observations possible: if several observers around the world accurately record the time when a star is eclipsed by an asteroid, for example, it is possible to derive useful information about the asteroid's shape.

Another field in which amateurs have traditionally played an important role is palaeontology. Adrian Hunt, a palaeontologist at Mesa Technical College in New Mexico, insists that his is the field in which amateurs have made the biggest contribution. Despite the development of high-tech equipment, he says, the best sensors for finding fossils are human eyes - lots of them. Finding volunteers to look for fossils is not difficult, he says, because of the near-universal interest in anything to do with dinosaurs. As well as helping with this research, volunteers learn about science, a process he calls 'recreational education'.

Rick Bonney of the Cornell Laboratory of Ornithology in Ithaca, New York, contends that amateurs have contributed the most in his field. There are, he notes, thought to be as many as 60 million birdwatchers in America alone. Given their huge numbers and the wide geographical coverage they provide, Mr Bonney has enlisted thousands of amateurs in a number of research projects. Over the past few years their observations have uncovered previously unknown trends and cycles in bird migrations and revealed declines in the breeding populations of several species of migratory birds, prompting a habitat conservation programme.

Despite the successes and whatever the field of study, collaboration between amateurs and professionals is not without its difficulties. Not everyone, for example is happy with the term ‘amateur'. Mr Bonney has coined the term 'citizen scientist' because he felt that other words, such as 'volunteer' sounded disparaging. A more serious problem is the question of how professionals

can best acknowledge the contributions made by amateurs. Dr Fienberg says that some amateur astronomers are happy to provide their observations but grumble about not being reimbursed for out-of-pocket expenses. Others feel let down when their observations are used in scientific papers, but they are not listed as co-authors. Dr Hunt says some amateur palaeontologists are disappointed when told that they cannot take finds home with them.

These are legitimate concerns but none seems insurmountable. Provided amateurs and professionals agree the terms on which they will work together beforehand, there is no reason why co-operation between the two groups should not flourish. Last year Dr S. Carlson, founder of the Society for Amateur Scientists won an award worth $290,000 for his work in promoting such co-operation. He says that one of the main benefits of the prize is the endorsement it has given to the contributions of amateur scientists, which has done much to silence critics among those professionals who believe science should remain their exclusive preserve.

At the moment, says Dr Carlson, the society is involved in several schemes including an innovative rocket-design project and the setting up of a network of observers who will search for evidence of a link between low-frequency radiation and earthquakes. The amateurs, he says, provide enthusiasm and talent, while the professionals provide guidance 'so that anything they do discover will be taken seriously'. Having laid the foundations of science, amateurs will have much to contribute to its ever-expanding edifice.

38/ Reading the screen

Are the electronic media exacerbating illiteracy and making our children stupid? On the contrary, says Colin McCabe, they have the potential to make us truly literate.

The debate surrounding literacy is one of the most charged in education. On the one hand there is an army of people convinced that traditional skills of reading and writing are declining. On the other, a host of progressives protest that literacy is much more complicated than a simple technical mastery of reading and writing. This second position is supported by most of the relevant academic work over the past 20 years. These studies argue that literacy can only be understood in its social and technical context. In Renaissance England, for example, many more people could read than could write, and within reading there was a distinction between those who could read print and those who could manage the more difficult task of reading manuscript. An understanding of these earlier periods helps us understand today's 'crisis in literacy' debate.

There does seem to be evidence that there has been an overall decline in some aspects of reading and writing - you only need to compare the tabloid newspapers of today with those of 50 years ago to see a clear decrease in vocabulary and simplification of syntax. But the picture is not uniform and doesn't readily demonstrate the simple distinction between literate and illiterate which had been considered adequate since the middle of the 19th century.

While reading a certain amount of writing is as crucial as it has ever been in industrial societies, it is doubtful whether a fully extended grasp of either is as necessary as it was 30 or 40 years ago. While print retains much of its authority as a source of topical information, television has increasingly usurped this role. The ability to write fluent letters has been undermined by the telephone and research suggests that for many people the only use for writing, outside formal education, is the compilation of shopping lists.

The decision of some car manufacturers to issue their instructions to mechanics as a video pack rather than as a handbook might be taken to spell the end of any automatic link between industrialisation and literacy. On the other hand, it is also the case that ever-increasing numbers of people make their living out of writing, which is better rewarded than ever before. Schools are generally seen as institutions where the book rules – film, television and recorded sound have almost no place; but it is not clear that this opposition is appropriate. While you may not need to read and write to watch television, you certainly need to be able to read and write in order to make programmes.

Those who work in the new media are anything but illiterate. The traditional oppositions between old and new media are inadequate for understanding the world which a young child now encounters. The computer has re-established a central place for the written word on the screen, which used to be entirely devoted to the image. There is even anecdotal evidence that children are mastering reading and writing in order to get on to the Internet. There is no reason why the new and old media cannot be integrated in schools to provide the skills to become economically productive and politically enfranchised.

Nevertheless, there is a crisis in literacy and it would be foolish to ignore it. To understand that literacy may be declining because it is less central to some aspects of everyday life is not the same as acquiescing in this state of affairs. The production of school work with the new technologies could be a significant stimulus to literacy. How should these new technologies be introduced into the schools? It isn't enough to call for computers, camcorders and edit suites in

every classroom; unless they are properly integrated into the educational culture, they will stand unused. Evidence suggests that this is the fate of most information technology used in the classroom. Similarly, although media studies are now part of the national curriculum, and more and more students are now clamouring to take these course, teachers remain uncertain about both methods and aims in this area.

This is not the fault of the teachers. The entertainment and information industries must be drawn into a debate with the educational institutions to determine how best to blend these new technologies into the classroom.

Many people in our era are drawn to the pessimistic view that the new media are destroying old skills and eroding critical judgement. It may be true that past generations were more literate but - taking the pre-19th century meaning of the term - this was true of only a small section of the population. The word literacy is a 19th-century coinage to describe the divorce of reading and writing from a full knowledge of literature. The education reforms of the 19th century produced reading and writing as skills separable from full participation in the cultural heritage.

The new media now point not only to a futuristic cyber-economy, they also make our cultural past available to the whole nation. Most children's access to these treasures is initially through television. It is doubtful whether our literary heritage has ever been available to or sought out by more than about 5 per cent of the population; it has certainly not been available to more than 10 per cent. But the new media joined to the old, through the public service tradition of British broadcasting, now makes our literary tradition available to all.

39/ The Revolutionary Bridges of Robert Maillart

Swiss engineer Robert Maillart built some of the greatest bridges of the 20th century. His designs elegantly solved a basic engineering problem: how to support enormous weights using a slender arch

Just as railway bridges were the great structural symbols of the 19th century, highway bridges became the engineering emblems of the 20th century. The invention of the automobile created an irresistible demand for paved roads and vehicular bridges throughout the developed world. The type of bridge needed for cars and trucks, however, is fundamentally different from that needed for locomotives. Most highway bridges carry lighter loads than railway bridges do, and their roadways can be sharply curved or steeply sloping. To meet these needs, many

turn-of-the-century bridge designers began working with a new building material: reinforced concrete, which has steel bars embedded in it. And the master of this new material was Swiss structural engineer, Robert Maillart.

Early in his career, Maillart developed a unique method for designing bridges, buildings and other concrete structures. He rejected the complex mathematical analysis of loads and stresses that was being enthusiastically adopted by most of his contemporaries. At the same time, he also eschewed the decorative approach taken by many bridge builders of his time. He resisted imitating architectural styles and adding design elements solely for ornamentation. Maillart's method was a form of creative intuition. He had a knack for conceiving new shapes to solve classic engineering problems.] And because he worked in a highly competitive field, one of his goals was economy - he won design and construction contracts because his structures were reasonably priced, often less costly than all his rivals' proposals.

Maillart's first important bridge was built in the small Swiss town of Zuoz. The local officials had initially wanted a steel bridge to span the 30-metre wide Inn River, but Maillart argued that he could build a more elegant bridge made of reinforced concrete for about the same cost. His crucial innovation was incorporating the bridge's arch and roadway into a form called the hollow-box arch, which would substantially reduce the bridge's expense by minimising the amount of concrete needed. In a conventional arch bridge the weight of the roadway is transferred by columns to the arch, which must be relatively thick. In Maillart's design, though, the roadway and arch were connected by three vertical walls, forming two hollow boxes running under the roadway (see diagram). The big advantage of this design was that because the arch would not have to bear the load alone. it could be much thinner - as little as one-third as thick as the arch in the conventional bridge.

His first masterpiece, however, was the 1905 Tavanasa Bridge over the Rhine river in the Swiss Alps. In this design, Maillart removed the parts of the vertical walls which were not essential because they carried no load. This produced a slender, lighter-looking form, which perfectly met the bridge's structural requirements. But the Tavanasa Bridge gained little favourable publicity in Switzerland; on the contrary, it aroused strong aesthetic objections from public officials who were more comfortable with old-fashioned stone-faced bridges. Maillart, who had founded his own construction firm in 1902, was unable to win any more bridge projects, so he shifted his

focus to designing buildings, water tanks and other structures made of reinforced concrete and did not resume his work on concrete bridges until the early 1920s.

His most important breakthrough during this period was the development of the deck-stiffened arch, the first example of which was the Flienglibach Bridge, built in 1923. An arch bridge is somewhat like an inverted cable. A cable curves downward when a weight is hung from it, an arch bridge curves upward to support the roadway and the compression in the arch balances the dead load of the traffic. For aesthetic reasons, Maillart wanted a thinner arch and his solution was to connect the arch to the roadway with transverse walls. In this way, Maillart justified making the arch as thin as he could reasonably build it. His analysis accurately predicted the behaviour of the bridge but the leading authorities of Swiss engineering would argue against his methods for the next quarter of a century.

Over the next 10 years, Maillart concentrated on refining the visual appearance of the deck-stiffened arch. His best-known structure is the Salginatobel Bridge, completed in 1930. He won the competition for the contract because his design was the least expensive of the 19 submitted - the bridge and road were built for only 700,000 Swiss francs, equivalent to some $3.5 million today. Salginatobel was also Maillart's longest span, at 90 metres and it had the most dramatic setting of all his structures, vaulting 80 metres above the ravine of the Salgina brook. In 1991 it became the first concrete bridge to be designated an international historic landmark.

Before his death in 1940, Maillart completed other remarkable bridges and continued to refine his designs. However, architects often recognised the high quality of Maillart's structures before his fellow engineers did and in 1947 the architectural section of the Museum of Modern Art in New York City devoted a major exhibition entirely to his works. In contrast, very few American structural engineers at that time had even heard of Maillart. In the following years, however, engineers realised that Maillart's bridges were more than just aesthetically pleasing - they were technically unsurpassed. Maillart's hollow-box arch became the dominant design form for medium and long- span concrete bridges in the US. In Switzerland, professors finally began to teach Maillart's ideas, which then influenced a new generation of designers.

40/ Tackling Obesity in the Western World

Obesity is a huge problem in many Western countries and one which now attracts considerable medical interest as researchers take up the challenge to find a 'cure' for the common condition of

being seriously overweight. However, rather than take responsibility for their weight, obese people have often sought solace in the excuse that they have a slow metabolism, a genetic hiccup which sentences more than half the Australian population (63% of men and 47% of women) to a life of battling with their weight. The argument goes like this: it doesn't matter how little they eat, they gain weight because their bodies break down food and turn it into energy more slowly than those with a so-called normal metabolic rate.

'This is nonsense,' says Dr Susan Jebb from the Dunn Nutrition Unit at Cambridge in England. Despite the persistence of this metabolism myth, science has known for several years that the exact opposite is in fact true. Fat people have faster metabolisms than thin people. 'What is very clear,' says Dr Jebb, 'is that overweight people actually burn off more energy. They have more cells, bigger hearts, bigger lungs and they all need more energy just to keep going."

It took only one night, spent in a sealed room at the Dunn Unit to disabuse one of their patients of the beliefs of a lifetime: her metabolism was fast, not slow. By sealing the room and measuring the exact amount of oxygen she used, researchers were able to show her that her metabolism was not the culprit. It wasn't the answer she expected and probably not the one she wanted but she took the news philosophically.

Although the metabolism myth has been completely disproved, science has far from discounted our genes as responsible for making us whatever weight we are, fat or thin. One of the world's leading obesity researchers, geneticist Professor Stephen O'Rahilly, goes so far as to say we are on the threshold of a complete change in the way we view not only morbid obesity, but also everyday overweight. Prof. O'Rahilly's groundbreaking work in Cambridge has proven that obesity can be caused by our genes. 'These people are not weak- willed, slothful or lazy,' says Prof. O'Rahilly, 'They have a medical condition due to a genetic defect and that causes them to be obese.'

In Australia, the University of Sydney's Professor lan Caterson says while major genetic defects may be rare, many people probably have minor genetic variations that combine to dictate weight and are responsible for things such as how much we eat, the amount of exercise we do and the amount of energy we need. When you add up, all these little variations, the result is that some people are genetically predisposed to putting on weight. He says while the fast/slow metabolism debate may have been settled, that doesn't mean some other subtle change in the metabolism gene won't be found in overweight people. He is confident that science will, eventually, be able

to 'cure' some forms of obesity but the only effective way for the vast majority of overweight and obese people to lose weight is a change of diet and an increase in exercise.

Despite the $500 million a year Australians spend trying to lose weight and the $830 million it costs the community in health care, obesity is at epidemic proportions here, as it is in all Western nations. Until recently, research and treatment for obesity had concentrated on behaviour modification, drugs to decrease appetite and surgery. How the drugs worked was often not understood and many caused severe side effects and even death in some patients. Surgery for obesity has also claimed many lives.

It has long been known that a part of the brain called the hypothalamus is responsible for regulating hunger, among other things. But it wasn't until 1994 that Professor Jeffery Friedman from Rockerfeller University in the US sent science in a new direction by studying an obese mouse. Prof. Friedman found that unlike its thin brothers, the fat mouse did not produce a hitherto unknown hormone called leptin. Manufactured by the fat cells, leptin acts as a messenger, sending signals to the hypothalamus to turn off the appetite. Previously, the fat cells were thought to be responsible simply for storing fat. Prof. Friedman gave the fat mouse leptin and it lost 30% of its body weight in two weeks.

On the other side of the Atlantic, Prof. O'Rahilly read about this research with great excitement. For many months two blood samples had lain in the bottom of his freezer, taken from two extremely obese young cousins. He hired a doctor to develop a test for leptin in human blood, which eventually resulted in the discovery that neither of the children's blood contained the hormone. When one cousin was given leptin, she lost a stone in weight and Prof. O'Rahilly made medical history. Here was the first proof that a genetic defect could cause obesity in humans. But leptin deficiency turned out to be an extremely rare condition and there is a lot more research to be done before the 'magic' cure for obesity is ever found.

41/ Wheel of Fortune

Emma Duncan discusses the potential effects on the entertainment industry of the digital revolution

Since moving pictures were invented a century ago, a new way of distributing entertainment to consumers has emerged about once every generation. Each such innovation has changed the industry irreversibly; each has been accompanied by a period of fear mixed with exhilaration.

The arrival of digital technology, which translates music, pictures and text into the zeros and ones of computer language, marks one of those periods.

This may sound familiar, because the digital revolution, and the explosion of choice that would go with it, has been heralded for some time. In 1992, John Malone, chief executive of TCI, an American cable giant, welcomed the '500-channel universe'. Digital television was about to deliver everything except pizzas to people's living rooms. When the entertainment companies tried out the technology, it worked fine - but not at a price that people were prepared to pay.

Those 500 channels eventually arrived but via the Internet and the PC rather than through television. The digital revolution was starting to affect the entertainment business in unexpected ways. Eventually it will change every aspect of it, from the way cartoons are made to the way films are screened to the way people buy music. That much is clear. What nobody is sure of is how it will affect the economics of the business.

New technologies always contain within them both threats and opportunities. They have the potential both to make the companies in the business a great deal richer, and to sweep them away. Old companies always fear new technology. Hollywood was hostile to television, television terrified by the VCR. Go back far enough, points out Hal Varian, an economist at the University of California at Berkeley, and you find publishers complaining that 'circulating libraries' would cannibalise their sales. Yet whenever a new technology has come in, it has made more money for existing entertainment companies. The proliferation of the means of distribution results, gratifyingly, in the proliferation of dollars, pounds, pesetas and the rest to pay for it.

All the same, there is something in the old companies' fears. New technologies may not threaten their lives, but they usually change their role. Once television became widespread, film and radio stopped being the staple form of entertainment. Cable television has undermined the power of the broadcasters. And as power has shifted the movie studios, the radio companies and the television broadcasters have been swallowed up. These days, the grand old names of entertainment have more resonance than power. Paramount is part of Viacom, a cable company; Universal, part of Seagram, a drinks-and-entertainment company; MGM, once the roaring lion of Hollywood, has been reduced to a whisper because it is not part of one of the giants. And RCA, once the most important broadcasting company in the world, is now a recording label belonging to Bertelsmann, a large German entertainment company.

Part of the reason why incumbents got pushed aside was that they did not see what was coming. But they also faced a tighter regulatory environment than the present one. In America, laws preventing television broadcasters from owning programme companies were repealed earlier this decade, allowing the creation of vertically integrated businesses. Greater freedom, combined with a sense of history, prompted the smarter companies in the entertainment business to re-invent themselves. They saw what happened to those of their predecessors who were stuck with one form of distribution. So, these days, the powers in the entertainment business are no longer movie studios, or television broadcasters, or publishers; all those businesses have become part of bigger businesses still,

companies that can both create content and distribute it in a range of different ways.

Out of all this, seven huge entertainment companies have emerged - Time Warner, Walt Disney, Bertelsmann, Viacom, News Corp, Seagram and Sony. They cover pretty well every bit of the entertainment business except pornography. Three are American, one is Australian, one Canadian, one German and one Japanese. 'What you are seeing', says Christopher Dixon, managing director of media research at PaineWebber, a stockbroker, 'is the creation of a global oligopoly. It happened to the oil and automotive businesses earlier this century; now it is happening to the entertainment business.' It remains to be seen whether the latest technology will weaken those great companies, or make them stronger than ever.

42/ What do we mean by being 'talented' or 'gifted'? The most obvious way is to look at the work someone does and if they are capable of significant success, label them as talented. The purely quantitative route 'percentage definition' - looks not at individuals, but at simple percentages, such as the top five per cent of the population, and labels them by

definition as gifted. This definition has fallen from favour, eclipsed by the advent of IQ tests, favoured by luminaries such as Professor Hans Eysenck, where a series of written or verbal tests of general intelligence leads to a score of intelligence.

The IQ test has been eclipsed in turn. Most people studying intelligence and creativity in the new millennium now prefer a broader definition, using a multifaceted approach where talents in many areas are recognised rather than purely concentrating on academic achievement. If we are therefore assuming that talented, creative or gifted individuals may need to be assessed across a range of abilities, does this mean intelligence can run in families as a genetic or inherited

tendency? Mental dysfunction - such as schizophrenia – can, so is an efficient mental capacity passed on from parent to child?

Animal experiments throw some light on this question, and on the whole area of whether it is genetics, the environment or a combination of the two that allows for intelligence and creative ability. Different strains of rats show great differences in intelligence or 'rat reasoning'. If these are brought up in normal conditions and then run through a maze to reach a food goal, the 'bright' strain make far fewer wrong turns that the 'dull' ones. But if the environment is made dull and boring the number of errors becomes equal. Return the rats to an exciting maze and the discrepancy returns as before - but is much smaller. In other words, a dull rat in a stimulating environment will almost do as well as a bright rat who is bored in a normal one. This principle applies to humans too – someone may be born with innate intelligence, but their environment probably has the final say over whether they become creative or even a genius.

Evidence now exists that most young children, if given enough opportunities and encouragement, are able to achieve significant and sustainable levels of academic or sporting prowess. Bright or creative children are often physically very active at the same time, and so may receive more parental attention as a result – almost by default in order to ensure their safety. They may also talk earlier, and this, in turn, breeds parental interest. This can sometimes cause problems with other siblings who may feel jealous even though they themselves may be bright. Their creative talents may be undervalued and so never come to fruition. Two themes seem to run through famously creative families as a result. The first is that the parents were able to identify the talents of each child, and nurture and encourage these accordingly but in an even-handed manner. Individual differences were encouraged, and friendly sibling rivalry was not seen as a particular problem. If the father is, say, a famous actor, there is no undue pressure for his children to follow him onto the boards, but instead their chosen interests are encouraged. There need not even by any obvious talent in such a family since there always needs to be someone who sets the family career in motion, as in the case of the Sheen acting dynasty.

Martin Sheen was the seventh of ten children born to a Spanish immigrant father and an Irish mother. Despite intense parental disapproval he turned his back on entrance exams to university and borrowed cash from a local priest to start a fledgling acting career. His acting successes in films such as Badlands and Apocalypse Now made him one of the most highly-regarded actors

of the 1970s. Three sons Emilio Estevez, Ramon Estevez and Charlie Sheen have followed him into the profession as a consequence of being inspired by his motivation and enthusiasm.

A stream seems to run through creative families. Such children are not necessarily smothered with love by their parents. They feel loved and wanted, and are secure in their home, but are often more surrounded by an atmosphere of work and where following a calling appears to be important. They may see from their parents that it takes time and dedication to be master of a craft, and so are in less of a hurry to achieve for themselves once they start to work.

The generation of creativity is complex: it is a mixture of genetics, the environment, parental teaching and luck that determines how successful or talented family members are. This last point - luck - is often not mentioned where talent is concerned but plays an undoubted part. Mozart, considered by many to be the finest composer of all time, was lucky to be living in an age that encouraged the writing of music. He was brought up surrounded by it, his father was a musician who encouraged him to the point of giving up his job to promote his child genius, and he learnt musical composition with frightening speed - the speed of a genius. Mozart himself simply wanted to create the finest music ever written but did not necessarily view himself as a genius - he could write sublime music at will, and so often preferred to lead a hedonistic lifestyle that he found more exciting than writing music to order.

Albert Einstein and Bill Gates are two more examples of people whose talents have blossomed by virtue of the times they were living in. Einstein was a solitary, somewhat slow child who had affection at home but whose phenomenal intelligence emerged without any obvious parental input. This may have been partly due to the fact that at the start of the 20th Century a lot of the Newtonian laws of physics were being questioned, leaving a fertile ground for ideas such as his to be developed. Bill Gates may have had the creative vision to develop Microsoft, but without the new computer age dawning at the same time he may never have achieved the position on the world stage he now occupies.

43/ Indoor pollution

Since the early eighties we have been only too aware of the devastating effects of large-scale environmental pollution. Such pollution is generally the result of poor government planning in many developing nations or the short-sighted, selfish policies of the already industrialised

countries which encourage a minority of the world's population to squander the majority of its natural resources.

While events such as the deforestation of the Amazon jungle or the nuclear disaster in Chernobyl continue to receive high media exposure, as do acts of environmental sabotage, it must be remembered that not all pollution is on this grand scale. A large proportion of the world's pollution has its source much closer to home. The recent spillage of crude oil from an oil tanker accidentally discharging its cargo straight into Sydney Harbour not only caused serious damage to the harbour foreshores but also created severely toxic fumes which hung over the suburbs for days and left the angry residents wondering how such a disaster could have been allowed to happen.

Avoiding pollution can be a full- time job. Try not to inhale traffic fumes; keep away from chemical plants and building-sites; wear a mask when cycling. It is enough to make you want to stay at home. But that, according to a growing body of scientific evidence, would also be a bad idea. Research shows that levels of pollutants such as hazardous gases, particulate matter and other chemical 'nasties' are usually higher indoors than out, even in the most polluted cities. Since the average American spends 18 hours indoors for every hour outside, it looks as though many environmentalists may be attacking the wrong target.

The latest study, conducted by two environmental engineers, Richard Corsi and Cynthia Howard-Reed, of the University of Texas in Austin, and published in Environmental Science and Technology, suggests that it is the process of keeping clean that may be making indoor pollution worse. The researchers found that baths, showers, dishwashers and washing machines can all be significant sources of indoor pollution, because they extract trace amounts of chemicals from the water that they use and transfer them to the air.

Nearly all public water supplies contain very low concentrations of toxic chemicals, most of them left over from the otherwise beneficial process of chlorination. Dr. Corsi wondered whether they stay there when water is used, or whether they end up in the air that people breathe. The team conducted a series of experiments in which known quantities of five such chemicals were mixed with water and passed through a dishwasher, a washing machine, a shower head inside a shower stall or a tap in a bath, all inside a specially designed chamber. The levels of chemicals in the effluent water and in the air extracted from the chamber were then measured to see how much of each chemical had been transferred from the water into the air.

The degree to which the most volatile elements could be removed from the water, a process known as chemical stripping, depended on a wide range of factors, including the volatility of the chemical, the temperature of the water and the surface area available for transfer. Dishwashers were found to be particularly effective: the high-temperature spray, splashing against the crockery and cutlery, results in a nasty plume of toxic chemicals that escapes when the door is opened at the end of the cycle.

In fact, in many cases, the degree of exposure to toxic chemicals in tap water by inhalation is comparable to the exposure that would result from drinking the stuff. This is significant because many people are so concerned about water-borne pollutants that they drink only bottled water, worldwide sales of which are forecast to reach $72 billion by next year. D. Corsi's results suggest that they are being exposed to such pollutants anyway simply by breathing at home.

The aim of such research is not, however, to encourage the use of gas masks when unloading the washing. Instead, it is to bring a sense of perspective to the debate about pollution. According to Dr Corsi, disproportionate effort is wasted campaigning against certain forms of outdoor pollution, when there is as much or more cause for concern indoors, right under people's noses.

Using gas cookers or burning candles, for example, both result in indoor levels of carbon monoxide and particulate matter that are just as high as those to be found outside, amid heavy traffic. Overcrowded classrooms whose ventilation systems were designed for smaller numbers of children frequently contain levels of carbon dioxide that would be regarded as unacceptable on board a submarine. 'New car smell' is the result of high levels of toxic chemicals, not cleanliness. Laser printers, computers, carpets and paints all contribute to the noxious indoor mix.

The implications of indoor pollution for health are unclear. But before worrying about the problems caused by large-scale industry, it makes sense to consider the small-scale pollution at home and welcome international debate about this. Scientists investigating indoor pollution will gather next month in Edinburgh at the Indoor Air conference to discuss the problem. Perhaps unwisely, the meeting is being held indoors.

44/ Robots

Since the dawn of human ingenuity, people have devised ever more cunning tools to cope with work that is dangerous, boring, onerous, or just plain nasty. That compulsion has culminated in robotics – the science of conferring various human capabilities on machines

The modern world is increasingly populated by quasi-intelligent gizmos whose presence we barely notice but whose creeping ubiquity has removed much human drudgery. Our factories hum to the rhythm of robot assembly arms. Our banking is done at automated teller terminals that thank us with rote politeness for the transaction. Our subway trains are controlled by tireless robotic drivers. Our mine shafts are dug by automated moles, and our nuclear accidents - such as those at Three Mile Island and Chernobyl - are cleaned up by robotic muckers fit to withstand radiation.

Such is the scope of uses envisioned by Karel Capek, the Czech playwright who coined the term 'robot' in 1920 (the word 'robota' means 'forced labor' in Czech). As progress accelerates, the experimental becomes the exploitable at record pace.

Other innovations promise to extend the abilities of human operators. Thanks to the incessant miniaturisation of electronics and micro- mechanics, there are already robot systems that can perform some kinds of brain and bone surgery with submillimeter accuracy - far greater precision than highly skilled physicians can achieve with their hands alone. At the same time, techniques of long-distance control will keep people even farther from hazard. In 1994 a ten-foot-tall NASA robotic explorer called Dante, with video-camera eyes and with spiderlike legs, scrambled over the menacing rim of an Alaskan volcano while technicians 2,000 miles away in California watched the scene by satellite and controlled Dante's descent.

But if robots are to reach the next stage of labour-saving utility, they will have to operate with less human supervision and be able to make at least a few decisions for themselves - goals that pose a formidable challenge. 'While we know how to tell a robot to handle a specific error,' says one expert, 'we can't yet give a robot enough common sense to reliably interact with a dynamic world.' Indeed the quest for true artificial intelligence (AI) has produced very mixed results. Despite a spasm of initial optimism in the 1960s and 1970s, when it appeared that transistor circuits and microprocessors might be able to perform in the same way as the human brain by the 21st century, researchers lately have extended their forecasts by decades if not centuries.

What they found, in attempting to model thought, is that the human brain's roughly one hundred billion neurons are much more talented and human perception far more complicated than

previously imagined. They have built robots that can recognise the misalignment of a machine panel by a fraction of a millimeter in a controlled factory environment. But the human mind can glimpse a rapidly changing scene and immediately disregard the 98 per cent that is irrelevant, instantaneously focusing on the woodchuck at the side of a winding forest road or the single suspicious face in a tumultuous crowd. The most advanced computer systems on Earth can't approach that kind of ability, and neuroscientists still don't know quite how we do it.

Nonetheless, as information theorists, neuroscientists, and computer experts pool their talents, they are finding ways to get some lifelike intelligence from robots. One method renounces the linear, logical structure of conventional electronic circuits in favour of the messy, ad hoc arrangement of a real brain's neurons. These 'neural networks' do not have to be programmed. They can 'teach' themselves by a system of feedback signals that reinforce electrical pathways that produced correct responses and, conversely, wipe out connections that produced errors. Eventually the net wires itself into a system that can pronounce certain words or distinguish certain shapes.

In other areas researchers are struggling to fashion a more natural relationship between people and robots in the expectation that some day machines will take on some tasks now done by humans in, say, nursing homes. This is particularly important in Japan, where the percentage of elderly citizens is rapidly increasing. So experiments at the Science University of Tokyo have created a 'face robot' - a life-size, soft plastic model of a female head with a video camera imbedded in the left eye - as a prototype. The researchers' goal is to create robots that people feel comfortable around. They are concentrating on the face because they believe facial expressions are the most important way to transfer emotional messages. We read those messages by interpreting expressions to decide whether a person is happy, frightened, angry, or nervous. Thus the Japanese robot is designed to detect emotions in the person it is 'looking at' by sensing changes in the spatial arrangement of the person's eyes, nose, eyebrows, and mouth. It compares those configurations with a database of standard facial expressions and guesses the emotion. The robot then uses an ensemble of tiny pressure pads to adjust its plastic face into an appropriate emotional response.

Other labs are taking a different approach, one that doesn't try to mimic human intelligence or emotions. Just as computer design has moved away from one central mainframe in favour of myriad individual workstations and single processors have been replaced by arrays of smaller

units that break a big problem into parts that are solved simultaneously - many experts are now investigating whether swarms of semi-smart robots can generate a collective intelligence that is greater than the sum of its parts. That's what beehives and ant colonies do, and several teams are betting that legions of mini-critters working together like an ant colony could be sent to explore the climate of planets or to inspect pipes in dangerous industrial situations.

45/ Saving language

For the first time, linguists have put a price on language. To save a language from extinction isn't cheap – but more and more people are arguing that the alternative is the death of communities

There is nothing unusual about a single language dying. Communities have come and gone throughout history, and with them their language. But what is happening today is extraordinary, judged by the standards of the past. It is language extinction on a massive scale. According to the best estimates, there are some 6,000 languages in the world. Of these, about half are going to die out in the course of the next century: that's 3,000 languages in 1,200 months. On average, there is a language dying out somewhere in the world every two weeks or so.

How do we know? In the course of the past two or three decades, linguists all over the world have been gathering comparative data. If they find a language with just a few speakers left, and nobody is bothering to pass the language on to the children, they conclude that language is bound to die out soon. And we have to draw the same conclusion if a language has less than 100 speakers. It is not likely to last very long. A 1999 survey shows that 97 per cent of the world's languages are spoken by just four per cent of the people.

It is too late to do anything to help many languages, where the speakers are too few or too old, and where the community is too busy just trying to survive to care about their language. But many languages are not in such a serious position. Often, where languages are seriously endangered, there are things that can be done to give new life to them. It is called revitalisation.

Once a community realises that its language is in danger, it can start to introduce measures which can genuinely revitalise. The community itself must want to save its language. The culture of which it is a part must need to have a respect for minority languages. There needs to be funding, to support courses, materials, and teachers. And there need to be linguists, to get on with the basic task of putting the language down on paper. That's the bottom line: getting the language

documented – recorded, analysed, written down. People must be able to read and write if they and their language are to have a future in an increasingly computer- literate civilisation.

But can we save a few thousand languages, just like that? Yes, if the will and funding were available. It is not cheap, getting linguists into the field, training local analysts, supporting the community with language resources and teachers, compiling grammars and dictionaries, writing materials for use in schools. It takes time, lots of it, to revitalise an endangered language. Conditions vary so much that it is difficult to generalise, but a figure of $100,000 a year per language cannot be far from the truth. If we devoted that amount of effort over three years for each of 3,000 languages, we would be talking about some $900 million.

There are some famous cases which illustrate what can be done. Welsh, alone among the Celtic languages, is not only stopping its steady decline towards extinction but showing signs of real growth. Two Language Acts protect the status of Welsh now, and its presence is increasingly in evidence wherever you travel in Wales.

On the other side of the world, Maori in New Zealand has been maintained by a system of so-called 'language nests', first introduced in 1982. These are organisations which provide children under five with a domestic setting in which they are intensively exposed to the language. The staff are all Maori speakers from the local community. The hope is that the children will keep their Maori skills alive after leaving the nests, and that as they grow older they will in turn become role models to a new generation of young children. There are cases like this all over the world. And when the reviving language is associated with a degree of political autonomy, the growth can be especially striking, as shown by Faroese, spoken in the Faroe Islands, after the islanders received a measure of autonomy from Denmark.

In Switzerland, Romansch was facing a difficult situation, spoken in five very different dialects, with small and diminishing numbers, as young people left their community for work in the German-speaking cities. The solution here was the creation in the 1980s of a unified written language for all these dialects. Romansch Grischun, as it is now called, has official status in parts of Switzerland, and is being increasingly used in spoken form on radio and television.

A language can be brought back from the very brink of extinction. The Ainu language of Japan, after many years of neglect and repression, had reached a stage where there were only eight fluent speakers left, all elderly. However, new government policies brought fresh attitudes and a positive interest in survival. Several 'semi- speakers' – people who had become unwilling to

speak Ainu because of the negative attitudes by Japanese speakers - were prompted to become active speakers again. There is fresh interest now and the language is more publicly available than it has been for years.

If good descriptions and materials are available, even extinct languages can be resurrected. Kaurna, from South Australia, is an example. This language had been extinct for about a century, but had been quite well documented. So, when a strong movement grew for its revival, it was possible to reconstruct it. The revised language is not the same as the original, of course. It lacks the range that the original had, and much of the old vocabulary. But it can nonetheless act as a badge of present-day identity for its people. And as long as people continue to value it as a true marker of their identity, and are prepared to keep using it, it will develop new functions and new vocabulary, as any other living language would do.

It is too soon to predict the future of these revived languages, but in some parts of the world they are attracting precisely the range of positive attitudes and grass roots support which are the preconditions for language survival. In such unexpected but heart-warming ways might we see the grand total of languages in the world minimally increased.

46/ The Great Australian Fence

A war has been going on for almost a hundred years between the sheep farmers of Australia and the dingo, Australia's wild dog. To protect their livelihood, the farmers built a wire fence, 3,307 miles of continuous wire mesh, reaching from the coast of South Australia all the way to the cotton fields of eastern Queensland, just short of the Pacific Ocean.

The Fence is Australia's version of the Great Wall of China, but even longer, erected to keep out hostile invaders, in this case hordes of yellow dogs. The empire it preserves is that of the woolgrowers, sovereigns of the world's second largest sheep flock, after China's – some 123 million head – and keepers of a wool export business worth four billion dollars. Never mind that more and more people - conservationists, politicians, taxpayers and animal lovers – say that such a barrier would never be allowed today on ecological grounds. With sections of it almost a hundred years old, the dog fence has become, as conservationist Lindsay Fairweather ruefully admits, 'an icon of Australian frontier ingenuity'.

To appreciate this unusual outback monument and to meet the people whose livelihoods depend on it, I spent part of an Australian autumn travelling the wire. It's known by different names in

different states: the Dog Fence in South Australia, the Border Fence in New South Wales and the Barrier Fence in Queensland. I would call it simply the Fence.

For most of its prodigious length, this epic fence winds like a river across a landscape that, unless a big rain has fallen, scarcely has rivers. The eccentric route, prescribed mostly by property lines, provides a sampler of outback topography: the Fence goes over sand dunes, past salt lakes, up and down rock-strewn hills, through dense scrub and across barren plains.

The Fence stays away from towns. Where it passes near a town, it has actually become a tourist attraction visited on bus tours. It marks the traditional dividing line between cattle and sheep. Inside, where the dingoes are legally classified as vermin, they are shot, poisoned and trapped. Sheep and dingoes do not mix and the Fence sends that message mile after mile.

What is this creature that by itself threatens an entire industry, inflicting several millions of dollars of damage a year despite the presence of the world's most obsessive fence? Cousin to the coyote and the jackal, descended from the Asian wolf, Canis lupus dingo is an introduced species of wild dog. Skeletal remains indicate that the dingo was introduced to Australia more than 3,500 years ago probably with Asian seafarers who landed on the north coast. The adaptable dingo spread rapidly and in a short time became the top predator, killing off all its marsupial competitors. The dingo looks like a small wolf with a long nose, short pointed ears and a bushy tail. Dingoes rarely bark; they yelp and howl. Standing about 22 inches at the shoulder – slightly taller than a coyote - the dingo is Australia's largest land carnivore.

The woolgrowers' war against dingoes, which is similar to the sheep ranchers' rage against coyotes in the US, started not long. after the first European settlers disembarked in 1788, bringing with them a cargo of sheep. Dingoes officially became outlaws in 1830 when governments placed a bounty on their heads. Today bounties for problem dogs killing sheep inside the Fence can reach $500. As pioneers penetrated the interior with their flocks of sheep, fences replaced shepherds until, by the end of the 19th century, thousands of miles of barrier fencing crisscrossed the vast grazing lands.

'The dingo started out as a quiet observer,' writes Roland Breckwoldt, in A Very Elegant Animal: The Dingo, 'but soon came to represent everything that was dark and dangerous on the continent.' It is estimated that since sheep arrived in Australia, dingo numbers have increased a hundredfold. Though dingoes have been eradicated from parts of Australia, an educated guess puts the population at more than a million.

Eventually government officials and graziers agreed that one well-maintained fence, placed on the outer rim of sheep country and paid for by taxes levied on woolgrowers, should supplant the maze of private netting. By 1960, three states joined their barriers to form a single dog fence.

The intense private battles between woolgrowers and dingoes have usually served to define the Fence only in economic terms. It marks the difference between profit and loss. Yet the Fence casts a much broader ecological shadow for it has become a kind of terrestrial dam, deflecting the flow of animals inside and out. The ecological side effects appear most vividly at Sturt National Park. In 1845, explorer Charles Sturt led an expedition through these parts on a futile search for an inland sea. For Sturt and other early explorers, it was a rare event to see a kangaroo. Now they are ubiquitous for without a native predator the kangaroo population has exploded inside the Fence. Kangaroos are now cursed more than dingoes. They have become the rivals of sheep, competing for water and grass. In response state governments cull* more than three million kangaroos a year to keep Australia's national symbol from overrunning the pastoral lands. Park officials, who recognise that the fence is to blame, respond to the excess of kangaroos by saying 'The fence is there, and we have to live with it.'

47/ It's Ecological

Planning an eco-friendly holiday can be a minefield for the well-meaning traveller, says Steve Watkins. But help is now at hand.

If there were awards for tourism phrases that have been hijacked, diluted and misused then 'ecotourism' would earn top prize. The term first surfaced in the early 1980s reflecting a surge in environmental awareness and a realisation by tour operators that many travellers wanted to believe their presence abroad would not have a negative impact. It rapidly became the hottest marketing tag a holiday could carry.

These days the ecotourism label is used to cover anything from a two-week tour living with remote Indonesian tribes, to a one-hour motorboat trip through an Australian gorge. In fact, any tour that involves cultural interaction, natural beauty spots, wildlife or a dash of soft adventure is likely to be included in the overflowing ecotourism folder. There is no doubt the original motives behind the movement were honourable attempts to provide a way for those who cared to make informed choices, but the lack of regulations and a standard industry definition left many travellers lost in an ecotourism jungle.

It is easier to understand why the ecotourism market has become so overcrowded when we look at its wider role in the world economy. According to World Tourism Organisation figures, ecotourism is worth US$20 billion a year and makes up one-fifth of all international tourism. Add to this an annual growth rate of around five per cent and the pressure for many operators, both in developed and developing countries, to jump on the accelerating bandwagon is compelling. Without any widely recognised accreditation system, the consumer has been left to investigate the credentials of an operator themselves. This is a time-consuming process and many travellers usually take an operator's claims at face value, only adding to the proliferation of fake ecotours.

However, there are several simple questions that will provide qualifying evidence of a company's commitment to minimise its impact on the environment and maximise the benefits to the tourism area's local community. For example, does the company use recycled or sustainable, locally harvested materials to build its tourist properties? Do they pay fair wages to all employees? Do they offer training to employees? It is common for city entrepreneurs to own tour companies in country areas, which can mean the money you pay ends up in the city rather than in the community being visited. By taking a little extra time to investigate the ecotourism options, it is not only possible to guide your custom to worthy operators but you will often find that the experience they offer is far more rewarding.

The ecotourism business is still very much in need of a shake-up and a standardised approach. There are a few organisations that have sprung up in the last ten years or so that endeavour to educate travellers and operators about the benefits of responsible ecotourism. Founded in 1990, the Ecotourism Society (TES) is a non-profit organisation of travel industry, conservation and ecological professionals, which aims to make ecotourism a genuine tool for conservation and sustainable development. Helping to create inherent economic value in wilderness environments and threatened cultures has undoubtedly been one of the ecotourism movement's most notable achievements. TES organises annual initiative to further aid development of the ecotourism industry. This year it is launching 'Your Travel Choice Makes a Difference', an educational campaign aimed at helping consumers understand the potential positive and negative impacts of their travel decisions. TES also offers guidance on the choice of ecotour and has established a register of approved ecotourism operators around the world.

A leading ecotourism operator in the United Kingdom is Tribes, which won the 1999 Tourism Concern and Independent Traveller's World Award for Most Responsible Tour Operator'. Amanda Marks, owner and director of Tribes, believes that the ecotourism industry still has some way to go to get its house in order. Until now, no ecotourism accreditation scheme has really worked, principally because there has been no systematic way of checking that accredited companies actually comply with the code of practice. Amanda believes that the most promising system is the recently re-launched Green Globe 21 scheme. The Green Globe 21 award is based on the sustainable development standards contained in Agenda 21 from the 1992 Earth Summit and was originally coordinated by the World Travel & Tourism Council (WTTC). The scheme is now an independent concern, though the WTTC still supports it. Until recently, tour companies became affiliates and could use the Green Globe logo merely on payment of an annual fee, hardly a suitable qualifying standard. However, in November 1999 Green Globe 21 introduced an annual, independent check on operators wishing to use the logo.

Miriam Cain, from the Green Globe 21 marketing development, explains that current and new affiliates will now have one year to ensure that their operations comply with Agenda 21 standards. If they fail the first inspection, they can only reapply once. The inspection process is not a cheap option, especially for large companies, but the benefits of having Green Globe status and the potential operational cost savings that complying with the standards can bring should be significant. 'We have joint ventures with organisations around the world, including Australia and the Caribbean, that will allow us to effectively check all affiliate operators,' says Miriam. The scheme also allows destination communities to become Green Globe 21 approved.

For a relatively new industry it is not surprising that ecotourism has undergone teething pains. However, there are signs that things are changing for the better. With a committed and unified approach by the travel industry, local communities, travellers and environmental experts could make ecotourism a tag to be proud of and trusted.

48/ Striking the right note

Is perfect pitch a rare talent possessed solely by the likes of Beethoven? Kathryn Brown discusses this much sought-after musical ability

The uncanny, if sometimes distracting, ability to name a solitary note out of the blue, without any other notes for reference, is a prized musical talent – and a scientific mystery. Musicians with

perfect pitch - or, as many researchers prefer to call it, absolute pitch – can often play pieces by ear, and many can transcribe music brilliantly. That's because they perceive the position of a note in the musical stave – its pitch – as clearly as the fact that they heard it. Hearing and naming the pitch go hand in hand.

By contrast, most musicians follow not the notes, but the relationship between them. They may easily recognise two notes as being a certain number of tones apart, but could name the higher note as an E only if they are told the lower one is a C, for example. This is relative pitch. Useful, but much less mysterious.

For centuries, absolute pitch has been thought of as the preserve of the musical elite. Some estimates suggest that maybe fewer than 1 in 2,000 people possess it. But a growing number of studies, from speech experiments to brain scans, are now suggesting that a knack for absolute pitch may be far more common, and more varied, than previously thought. 'Absolute pitch is not an all or nothing feature,' says Marvin, a music theorist at the University of Rochester in New York state. Some researchers even claim that we could all develop the skill, regardless of our musical talent. And their work may finally settle a decades-old debate about whether absolute pitch depends on melodious genes or early music lessons.

Music psychologist Diana Deutsch at the University of California in San Diego is the leading voice. Last month at the Acoustical Society of America meeting in Columbus, Ohio, Deutsch reported a study that suggests we all have the potential to acquire absolute pitch – and that speakers of tone languages use it every day. A third of the world's population - chiefly people in Asia and Africa speak tone languages, in which a word's meaning can vary depending on the pitch a speaker uses.

Deutsch and her colleagues asked seven native Vietnamese speakers and 15 native Mandarin speakers to read out lists of words on different days. The chosen words spanned a range of pitches, to force the speakers to raise and lower their voices considerably. By recording these recited lists and taking the average pitch for each whole word, the researchers compared the pitches used by each person to say each word on different days.

Both groups showed strikingly consistent pitch for any given word – often less than a quarter-tone difference between days. 'The similarity,' Deutsch says, ‘is mind-boggling.' It's also, she says, a real example of absolute pitch. As babies, the speakers learnt to associate certain pitches with meaningful words – just as a musician labels one tone A and another B and they

demonstrate this precise use of pitch regardless of whether or not they have had any musical training, she adds.

Deutsch isn't the only researcher turning up everyday evidence of absolute pitch. At least three other experiments have found that people can launch into familiar songs at or very near the correct pitches. Some researchers have nicknamed this ability ‘absolute memory', and they say it pops up on other senses, too. Given studies like these, the real mystery is why we don't all have absolute pitch, says cognitive psychologist Daniel Levitin of McGill University in Montreal.

Over the past decade, researchers have confirmed that absolute pitch often runs in families. Nelson Freimer of the University of California in San Francisco, for example, is just completing a study that he says strongly suggests the right genes help create this brand of musical genius. Freimer gave tone tests to people with absolute pitch and to their relatives. He also tested several hundred other people who had taken early music lessons. He found that relatives of people with absolute pitch were far more likely to develop the skill than people who simply had the music lessons. 'There is clearly a familial aggregation of absolute pitch,' Freimer says.

Freimer says some children are probably genetically predisposed toward absolute pitch - and this innate inclination blossoms during childhood music lessons. Indeed, many researchers now point to this harmony of nature and nurture to explain why musicians with absolute pitch show different levels of the talent.

Indeed, researchers are finding more and more evidence suggesting music lessons are critical to the development of absolute pitch. In a survey of 2,700 students in American music conservatories and college programmes, New York University geneticist Peter Gregersen and his colleagues found that a whopping 32 per cent of the Asian students reported having absolute pitch, compared with just 7 per cent of non-Asian students. While that might suggest a genetic tendency towards absolute pitch in the Asian population, Gregersen says that the type and timing of music lessons probably explains much of the difference.

For one thing, those with absolute pitch started lessons, on average, when they were five years old, while those without absolute pitch started around the age of eight. Moreover, adds Gregersen, the type of music lessons favoured in Asia, and by many of the Asian families in his study, such as the Suzuki method, often focus on playing by ear and learning the names of musical notes, while those more commonly used in the US tend to emphasise learning scales in a relative pitch way. In Japanese pre-school music programmes, he says, children often have to

listen to notes played on a piano and hold up a coloured flag to signal the pitch. 'There's a distinct cultural difference,' he says.

Deutsch predicts that further studies will reveal absolute pitch in its imperfect, latent form - inside all of us. The Western emphasis on relative pitch simply obscures it, she contends. 'It's very likely that scientists will end up concluding that we're all born with the potential to acquire very fine-grained absolute pitch. It's really just a matter of life getting in the way."

49/ Twist in the Tale

Fears that television and computers would kill children's desire to read couldn't have been more wrong. With sales roaring, a new generation of authors are publishing newest and unlikeliest literary stars.

Less than three years ago, doom merchants were predicting that the growth in video games and the rise of the Internet would sound the death knell for children's literature. But contrary to popular myth, children are reading more books than ever. A recent survey by Books Marketing found that children up to the age of 11 read on average for four hours a week, particularly girls.

Moreover, the children's book market, which traditionally was seen as a poor cousin to the more lucrative and successful adult market, has come into its own. Publishing houses are now making considerable profits on the back of new children's books and children's authors can now command significant advances. 'Children's books are going through an incredibly fertile period,' says Wendy Cooling, a children's literature consultant. 'There's a real buzz around them. Book clubs are happening, sales are good, and people are much more willing to listen to children's authors.' The main growth area has been the market for eight to fourteen-year-olds, and there is little doubt that the boom has been fuelled by the bespectacled apprentice, Harry Potter. So influential has J. K. Rowling's series of books been that they have helped to make reading fashionable for pre-teens. 'Harry made it OK to be seen on a bus reading a book,' says Cooling. 'To a child, that is important.' The current buzz around the publication of the fourth Harry Potter beats anything in the world of adult literature.

'People still tell me, "Children don't read nowadays", says David Almond, the award-winning author of children's books such as Skellig. The truth is that they are skilled, creative readers. When I do classroom visits, they ask me very sophisticated questions about use of language, story structure, chapters and dialogue.' No one is denying that books are competing with other

forms of entertainment for children's attention but it seems as though children find a special kind of mental nourishment within the printed page.

'A few years ago, publishers lost confidence and wanted to make books more like television, the medium that frightened them most,' says children's book critic Julia Eccleshare. 'But books aren't TV, and you will find that children always say that the good thing about books is that you can see them in your head. Children are demanding readers,' she says. 'If they don't get it in two pages, they'll drop it.'

No more are children's authors considered mere sentimentalists or failed adult writers. Some feted adult writers would kill for the sales,' says Almond, who sold 42,392 copies of Skellig in 1999 alone. And advances seem to be growing too: UK publishing outfit Orion recently negotiated a six-figure sum from US company Scholastic for The Seeing Stone, a children's novel by Kevin Crossley-Holland, the majority of which will go to the author.

It helps that once smitten, children are loyal and even fanatical consumers. Author Jacqueline Wilson says that children spread news of her books like a bushfire. ‘My average reader is a girl of ten,' she explains. "They're sociable and acquisitive. They collect. They have parties - where books are a good present. If they like something, they have to pass it on.' After Rowling, Wilson is currently the best-selling children's writer, and her sales have boomed over the past three years. She has sold more than three million books, but remains virtually invisible to adults, although most ten- year-old girls know about her.

Children's books are surprisingly relevant to contemporary life. Provided they are handled with care, few topics are considered off-limits for children. One senses that children's writers relish the chance to discuss the whole area of topics and language. But Anne Fine, author of many award- winning children's books is concerned that the British literati still ignore children's culture. 'It's considered worthy but boring,' she says.

'I think there's still a way to go,' says Almond, who wishes that children's books were taken more seriously as literature. Nonetheless, he derives great satisfaction from his child readers. 'They have a powerful literary culture,' he says. 'It feels as if you're able to step into the store of mythology and ancient stories that run through all societies and encounter the great themes: love and loss and death and redemption.'

At the moment, the race is on to find the next Harry Potter. The bidding for new books at Bologna this year - the children's equivalent of the Frankfurt Book Fair – was as fierce as

anything anyone has ever seen. All of which bodes well for the long-term future of the market - and for children's authors, who have traditionally suffered the lowest profile in literature, despite the responsibility of their role.

50/ Fun for the Masses

Americans worry that the distribution of income is increasingly unequal. Examining leisure spending, changes that picture.

Are you better off than you used to be? Even after six years of sustained economic growth, Americans worry about that question. Economists who plumb government income statistics agree that Americans' incomes, as measured in inflation-adjusted dollars, have risen more slowly in the past two decades than in earlier times, and that some workers' real incomes have actually fallen. They also agree that by almost any measure, income is distributed less equally than it used to be. Neither of those claims, however, sheds much light on whether living standards are rising or falling. This is because 'living standard' is a highly amorphous concept. Measuring how much people earn is relatively easy, at least compared with measuring how well they live.

A recent paper by Dora Costa, an economist at the Massachusetts Institute of Technology, looks at the living-standards debate from an unusual direction. Rather than worrying about cash incomes, Ms Costa investigates Americans' recreational habits over the past century. She finds that people of all income levels have steadily increased the amount of time and money they devote to having fun. The distribution of dollar incomes may have become more skewed in recent years, but leisure is more evenly spread than ever.

Ms Costa bases her research on consumption surveys dating back as far as 1888. The industrial workers surveyed in that year spent, on average, three-quarters of their incomes on food, shelter and clothing. Less than 2% of the average family's income was spent on leisure but that average hid large disparities. The share of a family's budget that was spent on having fun rose sharply with its income: the lowest-income families in this working-class sample spent barely 1% of their budgets on recreation, while higher earners spent more than 3%. Only the latter group could afford such extravagances as theatre and concert performances, which were relatively much more expensive than they are today.

Since those days, leisure has steadily become less of a luxury. By 1991, the average household needed to devote only 38% of its income to the basic necessities, and was able to spend 6% on

recreation. Moreover, Ms Costa finds that the share of the family budget spent on leisure now rises much less sharply with income than it used to. At the beginning of this century a family's recreational spending tended to rise by 20% for every 10% rise in income. By 1972-73, a 10% income gain led to roughly a 15% rise in recreational spending, and the increase fell to only 13% in 1991. What this implies is that Americans of all income levels are now able to spend much more of their money on having fun.

One obvious cause is that real income overall has risen. If Americans in general are richer, their consumption of entertainment goods is less likely to be affected by changes in their income. But Ms Costa reckons that rising incomes are responsible for, at most, half of the changing structure of leisure spending. Much of the rest may be due to the fact that poorer Americans have more time off than they used to. In earlier years, low-wage workers faced extremely long hours and enjoyed few days off. But since the 1940s, the less skilled (and lower paid) have worked ever-fewer hours, giving them more time to enjoy leisure pursuits.

Conveniently, Americans have had an increasing number of recreational possibilities to choose from. Public investment in sports complexes, parks and golf courses has made leisure cheaper and more accessible. So too has technological innovation. Where listening to music used to imply paying for concert tickets or owning a piano, the invention of the radio made music accessible to everyone and virtually free. Compact discs, videos and other paraphernalia have widened the choice even further.

At a time when many economists are pointing accusing fingers at technology for causing a widening inequality in the wages of skilled and unskilled workers, Ms Costa's research gives it a much more egalitarian face. High earners have always been able to afford amusement. By lowering the price of entertainment, technology has improved the standard of living of those in the lower end of the income distribution. The implication of her results is that once recreation is taken into account, the differences in Americans' living standards may not have widened so much after all.

These findings are not water-tight. Ms Costa's results depend heavily upon what exactly is classed as a recreational expenditure. Reading is an example. This was the most popular leisure activity for working men in 1888, accounting for one-quarter of all recreational spending. In 1991, reading took only 16% of the entertainment dollar. But the American Department of Labour's expenditure surveys do not distinguish between the purchase of a mathematics tome

and that of a best-selling novel. Both are classified as recreational expenses. If more money is being spent on textbooks and professional books now than in earlier years, this could make 'recreational' spending appear stronger than it really is.

Although Ms Costa tries to address this problem by showing that her results still hold even when tricky categories, such as books, are removed from the sample, the difficulty is not entirely eliminated. Nonetheless, her broad conclusion seems fair. Recreation is more available to all and less dependent on income. On this measure at least, inequality of living standards has fallen.

51/ The art of healing

As with so much, the medicine of the Tang dynasty left its European counterpart in the shade. It boasted its own ‘national health service’, and left behind the teachings of the incomparable Sun Simiao

If no further evidence was available of the sophistication of China in the Tang era, then a look at Chinese medicine would be sufficient. At the Western end of the Eurasian continent the Roman empire had vanished, and there was nowhere new to claim the status of the cultural and political centre of the world. In fact, for a few centuries, this centre happened to be the capital of the Tang empire, and Chinese medicine under the Tang was far ahead of its European counterpart. The organisational context of health and healing was structured to a degree that had no precedence in Chinese history and found no parallel elsewhere.

An Imperial Medical Office had been inherited from previous dynasties: it was immediately restructured and staffed with directors and deputy directors, chief and assistant medical directors, pharmacists and curators of medicinal herb gardens and further personnel. Within the first two decades after consolidating its rule, the Tang administration set up one central and several provincial medical colleges with professors, lecturers, clinical practitioners and pharmacists to train students in one or all of the four departments of medicine, acupuncture, physical therapy and exorcism.

Physicians were given positions in governmental medical service only after passing qualifying examinations. They were remunerated in accordance with the number of cures they had effected during the past year.

In 723 Emperor Xuanzong personally composed a general formulary of prescriptions recommended to him by one of his imperial pharmacists and sent it to all the provincial medical

schools. An Arabic traveller, who visited China in 851, noted with surprise that prescriptions from the emperor's formulary were publicised on notice boards at crossroads to enhance the welfare of the population.

The government took care to protect the general populace from potentially harmful medical practice. The Tang legal code was the first in China to include laws concerned with harmful and heterodox medical practices. For example, to treat patients for money without adhering to standard procedures was defined as fraud combined with theft and had to be tried in accordance with the legal statutes on theft. If such therapies resulted in the death of a patient, the healer was to be banished for two and a half years. In case a physician purposely failed to practice according to the standards, he was to be tried in accordance with the statutes on premeditated homicide. Even if no harm resulted, he was to be sentenced to sixty strokes with a heavy cane.

In fact, physicians practising during the Tang era had access to a wealth of pharmaceutical and medical texts, their contents ranging from purely pragmatic advice to highly sophisticated theoretical considerations. Concise descriptions of the position, morphology, and functions of the organs of the human body stood side by side in libraries with books enabling readers to calculate the daily, seasonal and annual climatic conditions of cycles of sixty years and to understand and predict their effects on health.

Several Tang authors wrote large collections of prescriptions, continuing a literary tradition documented since the 2nd century BC. The two most outstanding works to be named here were those by Sun Simiao (581-682?) and Wang Tao (c.670-755). The latter was a librarian who copied more than six thousand formulas, categorised in 1,104 sections, from sixty-five older works and published them under the title Waitai miyao. Twenty-four sections, for example, were devoted to ophthalmology. They reflect the Indian origin of much Chinese knowledge on ailments of the eye and, in particular, of cataract surgery.

Sun Simiao was the most eminent physician and author not only of the Tang dynasty, but of the entire first millennium AD. He was a broadly educated intellectual and physician; his world view integrated notions of all three of the major currents competing at his time - Confucianism, Daoism and Buddhism. Sun Simiao gained fame during his lifetime as a clinician (he was summoned to the imperial court at least once) and as author of the Prescriptions Worth Thousands in Gold (Qianjinfang) and its sequel. In contrast to developments in the 12th century, physicians relied on prescriptions and single substances to treat their patients' illnesses. The

theories of systematic correspondences, characteristic of the acupuncture tradition, had not been extended to cover pharmacology yet.

Sun Simiao rose to the pantheon of Chinese popular Buddhism in about the 13th century. He was revered as paramount Medicine God. He gained this extraordinary position in Chinese collective memory not only because he was an outstanding clinician and writer, but also for his ethical concerns. Sun Simiao was the first Chinese author known to compose an elaborate medical ethical code. Even though based on Buddhist and Confucian values, his deontology is comparable to the Hippocratic Oath. It initiated a debate on the task of medicine, its professional obligations, social position and moral justification that continued until the arrival of Western medicine in the 19th century.

Despite or - more likely - because of its long- lasting affluence and political stability, the Tang dynasty did not add any significantly new ideas to the interpretation of illness, health and healing. Medical thought reflects human anxieties; changes in medical thought always occur in the context of new existential fears or of fundamentally changed social circumstances. Nevertheless, medicine was a most fascinating ingredient of Tang civilisation and it left a rich legacy to subsequent centuries.

52/ Snow makers

Skiing is big business nowadays. But what can ski resort owners do if the snow doesn’t come?

In the early to mid twentieth century, with the growing popularity of skiing, ski slopes became extremely profitable businesses. But ski resort owners were completely dependent on the weather; if it didn't snow, or didn't snow enough, they had to close everything down. Fortunately, a device called the snow gun can now provide snow whenever it is needed. These days such machines are standard equipment in the vast majority of ski resorts around the world, making it possible for many resorts to stay open four months or more a year.

Snow formed by natural weather systems comes from water vapour in the atmosphere. The water vapour condenses into droplets, forming clouds. If the temperature is sufficiently low, the water droplets freeze into tiny ice crystals. More water particles then condense onto the crystal and join with it to form a snowflake. As the snowflake grows heavier, it falls towards the Earth.

The snow gun works very differently from a natural weather system, but it accomplishes exactly the same thing. The device basically works by combining water and air. Two different hoses are

attached to the gun, one leading from a water pumping station which pumps water up from a lake or reservoir, and the other leading from an air compressor. When the compressed air passes through the hose into the gun, it atomises the water - that is, it disrupts the stream so that the water splits up into tiny droplets. The droplets are then blown out of the gun and if the outside temperature is below 0°C, ice crystals will form, and will then make snowflakes in the same way as natural snow.

Snow-makers often talk about dry snow and wet snow. Dry snow has a relatively low amount of water, so it is very light and powdery. This type of snow is excellent for skiing because skis glide over it easily without getting stuck in wet slush. One of the advantages of using a snow-maker is that this powdery snow can be produced to give the ski slopes a level surface. However, on slopes which receive heavy use, resort owners also use denser, wet snow underneath the dry snow. Many resorts build up the snow depth this way once or twice a year, and then regularly coat the trails with a layer of dry snow throughout the winter.

The wetness of snow is dependent on the temperature and humidity outside, as well as the size of the water droplets launched by the gun. Snow-makers have to adjust the proportions of water and air in their snow guns to get the perfect snow consistency for the outdoor weather conditions. Many ski slopes now do this with a central computer system that is connected to weather-reading stations all over the slope.

But man-made snow makes heavy demands on the environment. It takes about 275,000 litres of water to create a blanket of snow covering a 60 x 60 metre area. Most resorts pump water from one or more reservoirs located in low-lying areas. The run-off water from the slopes feeds back into these reservoirs, so the resort can actually use the same water over and over again. However, considerable amounts of energy are needed to run the large air-compressing pumps, and the diesel engines which run them also cause air pollution.

Because of the expense of making snow, ski resorts have to balance the cost of running the machines with the benefits of extending the ski season, making sure they only make snow when it is really needed, and when it will bring the maximum amount of profit in return for the investment. But man-made snow has a number of other uses as well. A layer of snow keeps a lot of the Earth's heat from escaping into the atmosphere, so farmers often use man-made snow to provide insulation for winter crops. Snow-making machines have played a big part in many movie productions. Movie producers often take several months to shoot scenes that cover just a

few days. If the movie takes place in a snowy setting, the set decorators have to get the right amount of snow for each day of shooting either by adding man-made snow or melting natural snow. And another important application of man-made snow is its use in the tests that aircraft must undergo in order to ensure that they can function safely in extreme conditions.

53/ Why are so few tigers man-eaters?

As you leave the Bandhavgarh National Park in central India, there is a notice which shows a huge, placid tiger. The notice says, 'You may not have seen me, but I have seen you." There are more than a billion people in India and Indian tigers probably see humans every single day of their lives. Tigers can and do kill almost anything they meet in the jungle - they will even attack elephants and rhino. Surely, then, it is a little strange that attacks or humans are not more frequent.

Some people might argue that these attacks were in fact common in the past. British writers of adventure stories, such as Jim Corbett, gave the impression that village life in India in the early years of the twentieth century involved a state of constant siege by man-cating tigers. But they may have overstated the terror spread by tigers. There were also far more tigers around in those days (probably 60,000 in the subcontinent, compared to just 3000 today). So in proportion, attacks appear to have been as rare then as they are today.

It is widely assumed that the constraint is fear: but what exactly are tigers afraid of? Can they really know that we may be even better armed than they are? Surely not. Has the species programmed the experiences of all tigers with humans into its genes to be inherited as instinct? Perhaps. But I think the explanation may be more simple and, in a way, more intriguing.

Since the growth of ethology' in the 1950s. we have tried to understand animal behaviour from the animal's point of view. Until the first elegant experiments by pioneers in the field, such as Konrad Lorenz, naturalists wrote about animals as if they were slightly less intelligent humans. Jim Corbett's breathless accounts of his duels with man-eaters in truth tell us more about Jim Corbett than they do about the animals. The principle of ethology, on the other hand, requires us to attempt to think in the same way as the animal we are studying thinks, and to observe every tiny detail of its behaviour without imposing our own human significances on its actions.

I suspect that a tiger's fear of humans lies not in some preprogrammed ancestral logic but in the way he actually perceives us visually. If you try to think like a tiger, a human in a car might

appear just to be part of the car, and because tigers don't eat cars the human is safe unless the car is menacing the tiger or its cubs, in which case a brave or enraged tiger may charge. A human on foot is a different sort of puzzle. Imagine a tiger sees a man who is 1.8m tall. A tiger is less than Im tall but he may be up to 3m long from head to tail. So when a tiger sees the man face on, it might not be unreasonable for him to assume that the man is 6m long. If he met a deer of this size, he might attack the animal by leaping on its back, but when he looks behind the man. he can't see a back. From the front the man is huge, but looked at from the side he all but disappears. This must be very disconcerting. A hunter has to be confident that it can tackle its prey, and no one is confident when they are disconcerted. This is especially true of a solitary hunter such as the tiger and may explain why lions-particularly young lionesses who tend to encourage one another to take risks are more dangerous than tigers.

If the theory that a tiger is disconcerted to find that a standing human is both very big and yet somehow invisible is correct, the opposite should be true of a squatting human. A squatting human is half the size and presents twice the spread of back, and more closely resembles a medium-sized deer. If tigers were simply frightened of all humans, then a squatting person would be no more attractive as a target than a standing one. This, however, appears not to be the case. Many incidents of attacks on people involve villagers squatting or bending over to cut grass for fodder or building material.

The fact that humans stand upright may therefore not just be something that distinguishes them from nearly all other species, but also a factor that helped them to survive in a dangerous and unpredictable environment.

54/ Keep taking the tablets

The history of aspirin is a product of a rollercoaster ride through time, of accidental discoveries, intuitive reasoning and intense corporate rivalry

In the opening pages of Aspirin: The Remarkable Story of a Wonder Drug, Diarmuid Jeffreys describes this little white pill as one of the most amazing creations in medical history, a drug so astonishingly versatile that it can relieve headache, case your aching limbs, lower your temperature and treat some of the deadliest human diseases'.

Its properties have been known for thousands of years. Ancient Egyptian physicians used extracts from the willow tree as an analgesic, or pain killer. Centuries later the Greek physician

Hippocrates recommended the bark of the willow tree as a remedy for the pains of childbirth and as a fever reducer. But it wasn't until the eighteenth and nineteenth centuries that salicylates - the chemical found in the willow tree- became the subject of serious scientific investigation. The race was on to identify the active ingredient and to replicate it synthetically. At the end of the nineteenth century a German company, Friedrich Bayer & Co. succeeded in creating a relatively safe and very effective chemical compound, acetylsalicylic acid, which was renamed aspirin.

The late nineteenth century was a fertile period for experimentation, partly because of the hunger among scientists to answer some of the great scientific questions, but also because those questions were within their means to answer. One scientist in a laboratory with some chemicals and a test tube could make significant breakthroughs- whereas today, in order to map the human genome for instance, one needs an army of researchers, a bank of computers and millions and millions of dollars'.

But an understanding of the nature of science and scientific inquiry is not enough on its own to explain how society innovates. In the nineteenth century, scientific advance was closely linked to the industrial revolution. This was a period when people frequently had the means, motive and determination to take an idea and turn it into reality. In the case of aspirin that happened piecemeal - a series of minor, often unrelated advances, fertilised by the century's broader economic, medical and scientific developments, that led to one big final breakthrough.

The link between big money and pharmaceutical innovation is also a significant one. Aspirin's continued shelf life was ensured because for the first 70 years of its life, huge amounts of money were put into promoting it as an ordinary everyday analgesic. In the 1970s other analgesics, such as ibuprofen and paracetamol, were entering the market, and the pharmaceutical companies then focused on publicising these new drugs. But just at the same time, discoveries were made regarding the beneficial role of aspirin in preventing heart attacks, strokes and other afflictions. Had it not been for these findings, this pharmaceutical marvel may well have disappeared.

So the relationship between big money and drugs is an odd one. Commercial markets are necessary for developing new products and ensuring that they remain around long enough for scientists to carry out research on them. But the commercial markets are just as likely to kill off certain products when something more attractive comes along. In the case of aspirin, a potential 'wonder drug' was around for over 70 years without anybody investigating the way in which it achieved its effects, because they were making more than enough money out of it as it was. If

ibuprofen or paracetamol had entered the market just a decade earlier, aspirin might then not be here today. It would be just another forgotten drug that people hadn't bothered to explore.

None of the recent discoveries of aspirin's benefits were made by the big pharmaceutical companies; they were made by scientists working in the public sector. The reason for that is very simple and straightforward, Jeffreys says in his book. 'Drug companies will only pursue research that is going to deliver financial benefits. There's no profit in aspirin any more. It is incredibly inexpensive with tiny profit margins and it has no patent any more, so anyone can produce it.' In fact, there's almost a disincentive for drug companies to further boost the drug, he argues, as it could possibly put them out of business by stopping them from selling their more expensive brands.

So what is the solution to a lack of commercial interest in further exploring the therapeutic benefits of aspirin? More public money going into clinical trials, says Jeffreys. 'If I were the Department of Health, I would say "this is a very inexpensive drug. There may be a lot of other things we could do with it." We should put a lot more money into trying to find out."

Jeffreys' book-which not only tells the tale of a 'wonder drug' but also explores the nature of innovation and the role of big business, public money and regulation - reminds us why such research is so important.

55/ Why risks can go wrong

Human intuition is a bad guide to handling risk

People make terrible decisions about the future. The evidence is all around, from their investments in the stock markets to the way they run their businesses. In fact, people are consistently bad at dealing with uncertainty, underestimating some kinds of risk and overestimating others. Surely there must be a better way than using intuition?

In the 1960s a young American research psychologist, Daniel Kahneman, became interested in people's inability to make logical decisions. That launched him on a career to show just how irrationally people behave in practice. When Kahneman and his colleagues first started work, the idea of applying psychological insights to economics and business decisions was seen as rather bizarre. But in the past decade the fields of behavioural finance and behavioural economics have blossomed, and in 2002 Kahneman shared a Nobel Prize in economics for his work. Today he is in demand by business organisations and international banking companies. But, he says, there are

plenty of institutions that still fail to understand the roots of their poor decisions. He claims that, far from being random, these mistakes are systematic and predictable.

One common cause of problems in decision- making is over-optimism. Ask most people about the future, and they will see too much blue sky ahead, even if past experience suggests otherwise. Surveys have shown that people's forecasts of future stock market movements are far more optimistic than past long-term returns would justify. The same goes for their hopes of ever-rising prices for their homes or doing well in games of chance. Such optimism can be useful for managers or sportsmen, and sometimes turns into a self-fulfilling prophecy. But most of the time it results in wasted effort and dashed hopes. Kahneman's work points to three types of over-confidence. First, people tend to exaggerate their own skill and prowess; in polls, far fewer than half the respondents admit to having below-average skills in, say, driving. Second, they overestimate the amount of control they have over the future, forgetting about luck and chalking up success solely to skill. And third, in competitive pursuits such as dealing on shares, they forget that they have to judge their skills against those of the competition.

Another source of wrong decisions is related to the decisive effect of the initial meeting, particularly in negotiations over money. This is referred to as the "anchor effect. Once a figure has been mentioned, it takes a strange hold over the human mind. The asking price quoted in a house sale, for example, tends to become accepted by all parties as the anchor' around which negotiations take place. Much the same goes for salary negotiations or mergers and acquisitions. If nobody has much information to go on, a figure can provide comfort - even though it may lead to a terrible mistake.

In addition, mistakes may arise due to stubbornness. No one likes to abandon a cherished belief, and the earlier a decision has been taken, the harder it is to abandon it. Drug companies must decide early to cancel a failing research project to avoid wasting money, but may find it difficult to admit they have made a mistake. In the same way, analysts may have become wedded early to a single explanation that coloured their perception. A fresh eye always helps.

People also tend to put a lot of emphasis on things they have seen and experienced themselves, which may not be the best guide to decision-making. For example, somebody may buy an overvalued share because a relative has made thousands on it, only to get his fingers burned. In finance, too much emphasis on information close at hand helps to explain the tendency by most investors to invest only within the country they live in. Even though they know that

diversification is good for their portfolio, a large majority of both Americans and Europeans invest far too heavily in the shares of their home countries. They would be much better off spreading their risks more widely.

More information is helpful in making any decision but, says Kahneman, people spend proportionally too much time on small decisions and not enough on big ones. They need to adjust the balance. During the boom years, some companies put as much effort into planning their office party as into considering strategic mergers.

Finally, crying over spilled milk is not just a waste of time; it also often colours people's perceptions of the future. Some stock market investors trade far too frequently because they are chasing the returns on shares they wish they had bought earlier.

Kahneman reckons that some types of businesses are much better than others at dealing with risk. Pharmaceutical companies, which are accustomed to many failures and a few big successes in their drug-discovery programmes, are fairly rational about their risk-taking. But banks, he says, have a long way to go. They may take big risks on a few huge loans, but are extremely cautious about their much more numerous loans to small businesses, many of which may be less risky than the big ones. And the research has implications for governments too. They face a whole range of sometimes conflicting political pressures, which means they are even more likely to take irrational decisions.

56/ There has always been a sense in which America and Europe owned film. They invented it at the end of the nineteenth century in unfashionable places like New Jersey, Leeds and the suburbs of Lyons. At first, they saw their clumsy new camera-projectors merely as more profitable versions of Victorian lantern shows, mechanical curiosities which might have a use as a sideshow at a funfair. Then the best of the pioneers looked beyond the fairground properties of their invention. A few directors, now mostly forgotten, saw that the flickering new medium was more than just a diversion. This crass commercial invention gradually began to evolve as an art. DW Griffith in California glimpsed its grace, German directors used it as an analogue to the human mind and the modernising city, Soviets emphasised its agitational and intellectual properties, and the Italians reconfigured it on an operatic scale.

So heady were these first decades of cinema that America and Europe can be forgiven for assuming that they were the only game in town. In less than twenty years western cinema had

grown out of all recognition; its unknowns became the most famous people in the world; it made millions. It never occurred to its financial backers that another continent might borrow their magic box and make it its own. But film industries were emerging in Shanghai, Bombay and Tokyo, some of which would outgrow those in the west.

Between 1930 and 1935, China produced more than 500 films, mostly conventionally made in studios in Shanghai, without soundtracks. China's best directors Bu Wancang and Yuan Muzhi introduced elements of realism to their stories.

The Peach Girl (1931) and Street Angel (1937) are regularly voted among the best ever made in the country.

India followed a different course. In the west, the arrival of talkies gave birth to a new genre - the musical - but in India, every one of the 5000 films made between 1931 and the mid-1950s had musical interludes. The films were stylistically more wide- ranging than the western musical, encompassing realism and escapist dance within individual sequences, and they were often three hours long rather than Hollywood's 90 minutes. The cost of such productions resulted in a distinctive national style of cinema. They were often made in Bombay. the centre of what is now known as 'Bollywood". Performed in Hindi (rather than any of the numerous regional languages), they addressed social and peasant themes in an optimistic and romantic way and found markets in the Middle East, Africa and the Soviet Union.

In Japan, the film industry did not rival India's in size but was unusual in other ways. Whereas in Hollywood the producer was the central figure, in Tokyo the director chose the stories and hired the producer and actors. The model was that of an artist and his studio of apprentices. Employed by a studio as an assistant, a future director worked with senior figures, learned his craft, gained authority. until promoted to director with the power to select screenplays and performers. In the 1930s and 40s, this freedom of the director led to the production of some of Asia's finest films.

The films of Kenji Mizoguchi were among the greatest of these. Mizoguchi's films were usually set in the nineteenth century and analysed the way in which the lives of the female characters whom he chose as his focus were constrained by the society of the time. From Osaka Elegy (1936) to Ugetsu Monogatari (1953) and beyond, he evolved a sinuous way of moving his camera in and around a scene, advancing towards significant details but often retreating at moments of confrontation or strong feeling. No one had used the camera with such finesse before.

Even more important for film history, however, is the work of the great Ozu. Where Hollywood. cranked up drama, Ozu avoided it. His camera seldom moved. It nestled at seated height, framing people square on, listening quietly to their words. Ozu rejected the conventions of editing, cutting not on action, as is usually done in the west, but for visual balance. Even more strikingly, Ozu regularly cut away from his action to a shot of a tree or a kettle or clouds, not to establish a new location but as a moment of repose. Many historians now compare such pillow shots' to the Buddhist idea that mu - empty space or nothing is itself an element of composition.

As the art form most swayed by money and market, cinema would appear to be too busy to bother with questions of philosophy. The Asian nations proved and are still proving that this is not the case. Just as deep ideas about individual freedom have led to the aspirational cinema of Hollywood, so it is the beliefs which underlie cultures such as those of China and Japan that explain the distinctiveness of Asian cinema at its best. Yes, these films are visually striking, but it is their different sense of what a person is, and what space and action are, which makes them new to western eyes.

57/ Quiet roads ahead

The roar of passing vehicles could soon be a thing of the past

The noise produced by busy roads is a growing problem. While vehicle designers have worked hard to quieten engines, they have been less successful elsewhere. The sound created by the tyres on the surface of the road now accounts for more than half the noise that vehicles create, and as road building and car sales continue to boom-particularly in Asia and the US-this is turning into a global issue.

According to the World Health Organization. exposure to noise from road traffic over long periods can lead to stress-related health problems. And where traffic noise exceeds a certain threshold, road builders have to spend money erecting sound barriers and installing double glazing in blighted homes. Houses become harder to sell where environmental noise is high, and people are not as efficient or productive at work.

Already, researchers in the Netherlands - one of the most densely populated countries in the world - are working to develop techniques for silencing the roads. In the next five years the Dutch government aims to have reduced noise levels from the country's road surfaces by six decibels overall. Dutch mechanical engineer Ard Kuijpers has come up with one of the most

promising, and radical, ideas. He set out to tackle the three most important factors: surface texture, hardness and ability to absorb sound.

The rougher the surface, the more likely it is that a tyre will vibrate and create noise. Road builders usually eliminate bumps on freshly laid asphalt with heavy rollers, but Kuijpers has developed a method of road building that he thinks can create the ultimate quiet road. His secret is a special mould 3 metres wide and 50 metres long. Hot asphalt, mixed with small stones, is spread into the mould by a rail- mounted machine which flattens the asphalt mix with a roller. When it sets, the 10-millimetre- thick sheet has a surface smoother than anything that can be achieved by conventional methods.

To optimise the performance of his road surface - to make it hard wearing yet soft enough to snuff out vibrations he then adds another layer below the asphalt. This consists of a 30-millimetre-thick layer of rubber, mixed with stones which are larger than those in the layer above. 'It's like a giant mouse mat, making the road softer,' says Kuijpers.

The size of the stones used in the two layers is important, since they create pores of a specific size in the road surface. Those used in the top layer are just 4 or 5 millimetres across, while the ones below are approximately twice that size - about 9 millimetres. Kuijpers says the surface can absorb any air that is passing through a tyre's tread', damping oscillations that would otherwise create noise. And in addition they make it easier for the water to drain away, which can make the road safer in wet weather.

Compared with the complex manufacturing process, laying the surface is quite simple. It emerges from the factory rolled, like a carpet. onto a drum 1.5 metres in diameter. On site, it is unrolled and stuck onto its foundation with bitumen. Even the white lines are applied in the factory.

The foundation itself uses an even more sophisticated technique to reduce noise further. It consists of a sound-absorbing concrete base containing flask-shaped slots up to 10 millimetres wide and 30 millimetres deep that are open at the top and sealed at the lower end. These cavities act like Helmholtz resonators - when sound waves of specific frequencies enter the top of a flask, they set up resonances inside and the energy of the sound dissipates into the concrete as heat. The cavities play another important role: they help to drain water that seeps through from the upper surface. This flow will help flush out waste material and keep the pores in the outer layers clear.

Kuijpers can even control the sounds that his resonators absorb, simply by altering their dimensions. This could prove especially useful since different vehicles produce noise at different frequencies. Car tyres peak at around 1000 hertz, for example, but trucks generate lower-frequency noise at around 600 hertz. By varying the size of the Kuijpers resonators, it is possible to control which frequencies the concrete absorbs. On large highways, trucks tend to use the inside lane, so resonators here could be tuned to absorb sounds at around 600 hertz while those in other lanes could deal with higher frequency noise from cars.

Kuijpers believes he can cut noise by five decibels compared to the quietest of today's roads. He has already tested a 100-metre- long section of his road on a motorway near Apeldoorn, and Dutch construction company Heijmans is discussing the location of the next roll-out road with the country's government. The success of Kuijpers' design will depend on how much it eventually costs. But for those affected by traffic noise there is hope of quieter times ahead.

58/ A song on the brain

Some songs just won’t leave you alone. But this may give us clues about how our brain works

Everyone knows the situation where you can't get a song out of your head. You hear a pop song on the radio- or even just read the song's title - and it haunts you for hours, playing over and over in your mind until you're heartily sick of it. The condition now even has a medical name 'song-in-head syndrome".

But why does the mind annoy us like this? No one knows for sure, but it's probably because the brain is better at holding onto information than it is at knowing what information is important. Roger Chaffin, a psychologist at the University of Connecticut says, 'It's a manifestation of an aspect of memory which is normally an asset to us, but in this instance it can be a nuisance.

This eager acquisitiveness of the brain may have helped our ancestors remember important information in the past. Today, students use it to learn new material, and musicians rely on it to memorise complicated pieces. But when this useful function goes awry it can get you stuck on a tune. Unfortunately, superficial, repetitive pop tunes are, by their very nature, more likely to stick than something more inventive.

The annoying playback probably originates in the auditory cortex. Located at the front of the brain, this region handles both listening and playback of music and other sounds. Neuroscientist Robert Zatorre of McGill University in Montreal proved this some years ago when he asked

volunteers to replay the theme from the TV show Dallas in their heads. Brain imaging studies showed that this activated the same region of the auditory cortex as when the people actually heard the song.

Not every stored musical memory emerges into consciousness, however. The frontal lobe of the brain gets to decide which thoughts become conscious and which ones are simply stored away. But it can become fatigued or depressed, which is when people most commonly suffer from song-in-head syndrome and other intrusive thoughts, says Susan Ball, a clinical psychologist at Indiana University School of Medicine in Indianapolis. And once the unwanted song surfaces, it's hard to stuff it back down into the subconscious. 'The more you try to suppress a thought, the more you get it,' says Ball. We call this the pink elephant phenomenon. Tell the brain not to think about pink elephants, and it's guaranteed to do so," she says.

For those not severely afflicted, simply avoiding certain kinds of music can help. I know certain pieces that are kind of "sticky" to me, so I will not play them in the early morning for fear that they will run around in my head all day,' says Steven Brown, who trained as a classical pianist but is now a neuroscientist at the University of Texas Health Science Center at San Antonio. He says he always has a song in his head and, even more annoying, his mind never seems to make it all the way through. 'It tends to involve short fragments between, say, 5 or 15 seconds. They seem to get looped, for hours sometimes," he says.

Brown's experience of repeated musical loops may represent a phenomenon called 'chunking", in which people remember musical phrases as a single unit of memory, says Caroline Palmer, a psychologist at Ohio State University in Columbus. Most listeners have little choice about what chunks they remember. Particular chunks may be especially 'sticky' if you hear them often or if they follow certain predictable patterns, such as the chord progression of rock 'n' roll music. Palmer's research shows that the more a piece of music conforms to these patterns, the easier it is to remember. That's why you're more likely to be haunted by the tunes of pop music than by those of a classical composer such as J. S. Bach.

But this ability can be used for good as well as annoyance. Teachers can tap into memory reinforcement by setting their lessons to music. For example, in one experiment students who heard a history text set as the lyrics to a catchy song remembered the words better than those who simply read them, says Sandra Calvert, a psychologist at Georgetown University in Washington DC.

This sort of memory enhancement may even explain the origin of music. Before the written word could be used to record history, people memorised it in songs, says Leon James, a psychologist at the University of Hawaii. And music may have had an even more important role. 'All music has a message,' he says. "This message functions to unite society and to standardise the thought processes of people in society."

59/ Wordly Wealth

Can the future population of the world enjoy a comfortable lifestyle, with possessions, space and mobility, without crippling the environment?

The world's population is expected to stabilize a around nine billion. Will it be possible for nine billion people to have the lifestyle enjoyed today only by the wealthy? One school of thought says no: not only should the majority of the world's people resign themselves to poverty forever, but rich nations must also revert to simpler lifestyles in order to save the planet.

Admittedly, there may be political or social barriers to achieving a rich world. But in fact there seems to be no insuperable physical or ecological reason why nine billion people should not achieve a comfortable lifestyle, using technology only slightly more advanced than that which we now possess. In thinking about the future of civilization. we ought to start by asking what people want. The evidence demonstrates that as people get richer they want a greater range of personal technology, they want lots of room (preferably near or in natural surroundings) and they want greater speed in travel. More possessions, more space, more mobility.

In the developed world, the personal technologies of the wealthy, including telephones, washing machines and cars, have become necessities within a generation or two. Increasing productivity that results in decreasing costs for such goods has been responsible for the greatest gains in the standard of living, and there is every reason to believe that this will continue.

As affluence grows, the amount of energy and raw materials used for production of machinery will therefore escalate. But this need not mean an end to the machine age. Rather than being thrown away, materials from old machinery can be recycled by manufacturers. And long before all fossil fuels are exhausted, their rising prices may compel industrial society not only to become more energy efficient but also to find alternative energy sources sufficient for the demands of an advanced technological civilization - nuclear fission, nuclear fusion, solar energy, chemical photosynthesis, geothermal. biomass or some yet unknown source of energy.

The growth of cities and suburbs is often seen as a threat to the environment. However, in fact th increasing amount of land consumed by agriculture is a far greater danger than urban sprawl. Stopping the growth of farms is the best way to preserve many of the world's remaining wild areas. Bu is a dramatic downsizing of farmland possible! Thanks to the growth of agricultural productivity reforestation and 're-wilding' has been under way in the industrial countries for generations. Since 1950 more land in the US has been set aside in parks than has been occupied by urban and suburban growth. And much of what was farmland in the nineteenth century is now forest again. Taking the best Iowa maize growers as the norm for world food productivity, it has been calculated that less than a tenth of present cropland could support a population of 10 billion. In The Environment Game, a vision of a utopia that would be at once high-tech and environmentalist. Nigel Calder suggested that nourishing but unpalatable primary food produced by industrial techniques - like yeast from petroleum - may be fed to animals, so that we can continue to eat our customary meat, eggs, milk, butter, and cheese - and so that people in underdeveloped countries can have adequate supplies of animal protein for the first time."

In the long run, tissue-cloning techniques could be used to grow desired portions of meat by themselves. Once their DNA has been extracted to create cowless steaks and chickenless drumsticks, domesticated species of livestock, bred for millennia to be stupid or to have grotesquely enhanced traits, should be allowed to become extinct, except for a few specimens in zoos. However, game such as wild deer, rabbits and wild ducks will be ever more abundant as farms revert to wilderness, so this could supplement the laboratory-grown meat in the diets of tomorrow's affluent.

With rising personal incomes come rising expectations of mobility. This is another luxury of today's rich that could become a necessity of tomorrow's global population particularly if its members choose to live widely dispersed in a post-agrarian wilderness. In his recent book Free Flight, James Fallows, a pilot as well as a writer. describes serious attempts by both state and private entrepreneurs in the USA to promote an "air taxi' system within the price range of today's middle class and perhaps tomorrow's global population. Two of the chief obstacles to the science fiction fantasy of the personal plane or hover car are price and danger. While technological improvements are driving prices down, piloting an aircraft in three dimensions is still more difficult than driving a car in two, and pilot error causes more fatalities than driver error. But before long our aircraft and cars will be piloted by computers which are never tired or stressed.

So perhaps there are some grounds for optimism when viewing the future of civilization. With the help of technology, and without putting serious strains on the global environment, possessions, space and mobility can be achieved for all the projected population of the world.

60/ Space: The final archaeological frontier

Space travel may still have a long way to go, but the notion of archaeological research and heritage management in space is already concerning scientists and environmentalists.

In 1993, University of Hawaii's anthropologist Ben Finney, who for much of his career has studied the technology once used by Polynesians to colonize islands in the Pacific, suggested that it would not be premature to begin thinking about the archaeology of Russian and American aerospace sites on the Moon and Mars. Finney pointed out that just as today's scholars use archaeological records to investigate how Polynesians diverged culturally as they explored the Pacific, archaeologists will someday study off-Earth sites to trace the development of humans in space. He realized that it was unlikely anyone would be able to conduct fieldwork in the near future, but he was convinced that one day such work would be done.

There is a growing awareness, however, that it won't be long before both corporate adventurers and space tourists reach the Moon and Mars. There is a wealth of important archaeological sites from the history of space exploration on the Moon and Mars and measures need to be taken to protect these sites. In addition to the threat from profit- seeking corporations, scholars cite other potentially destructive forces such as souvenir hunting and unmonitored scientific sampling, as has already occurred in explorations of remote polar regions. Already in 1999 one company was proposing a robotic lunar rover mission beginning at the site of Tranquility Base and rumbling across the Moon from one archaeological site to another, from the wreck of the Ranger 8 probe to Apollo 17's landing site. The mission, which would leave vehicle tyre- marks all over some of the most famous sites on the Moon, was promoted as a form of theme-park entertainment.

According to the vaguely worded United Nations Outer Space Treaty of 1967, what it terms 'space junk remains the property of the country that sent the craft or probe into space. But the treaty doesn't explicitly address protection of sites like Tranquility Base, and equating the remains of human exploration of the heavens with 'space junk' leaves them vulnerable to scavengers. Another problem arises through other international treaties proclaiming that land in space cannot be owned by any country or individual. This presents some interesting dilemmas

for the aspiring manager of extraterrestrial cultural resources. Does the US own Neil Armstrong's famous first footprints on the Moon but not the lunar dust in which they were recorded? Surely those footprints are as important in the story of human development as those left by hominids at Laetoli, Tanzania. But unlike the Laetoli prints, which have survived for 3.5 million years encased in cement-like ash, those at Tranquility Base could be swept away with a casual brush of a space tourist's hand. To deal with problems like these, it may be time to look to innovative international administrative structures for the preservation of historic remains on the new frontier.

The Moon, with its wealth of sites, will surely be the first destination of archaeologists trained to work in space. But any young scholars hoping to claim the mantle of history's first lunar archaeologist will be disappointed. That distinction is already taken.

On November 19, 1969, astronauts Charles Conrad and Alan Bean made a difficult manual landing of the Apollo 12 lunar module in the Moon's Ocean of Storms, just a few hundred feet from an unmanned probe, Surveyor 3, that had landed in a crater on April 19, 1967. Unrecognized at the time, this was an important moment in the history of science. Bean and Conrad were about to conduct the first archaeological studies on the Moon.

After the obligatory planting of the American flag and some geological sampling, Conrad and Bean made their way to Surveyor 3. They observed that the probe had bounced after touchdown and carefully photographed the impressions made by its footpads. The whole spacecraft was covered in dust, perhaps kicked up by the landing.

The astronaut-archaeologists carefully removed the probe's television camera, remote sampling arm, and pieces of tubing. They bagged and labelled these artefacts, and stowed them on board their lunar module. On their return to Earth, they passed them on to the Daveson Space Center in Houston, Texas, and the Hughes Air and Space Corporation in El Segundo, California. There, scientists analyzed the changes in these aerospace artefacts.

One result of the analysis astonished them. A fragment of the television camera revealed evidence of the bacteria Streptococcus mitis. For a moment it was thought Conrad and Bean had discovered evidence for life on the Moon, but after further research the real explanation became apparent. While the camera was being installed in the probe prior to the launch, someone sneezed on it. The resulting bacteria had travelled to the Moon, remained in an alternating

freezing/boiling vacuum for more than two years, and returned promptly to life upon reaching the safety of a laboratory back on Earth.

The finding that not even the vastness of space can stop humans from spreading a sore throat was an unexpected spin-off. But the artefacts brought back by Bean and Conrad have a broader significance. Simple as they may seem, they provide the first example of extraterrestrial archaeology and - perhaps more significant for the history of the discipline formational archaeology, the study of environmental and cultural forces upon the life history of human artefacts in space.

61/ Green virtues of green sand

Revolution in glass recycling could help keep water clean

For the past 100 years special high grade white sand, dug from the ground at Leighton Buzzard in the UK, has been used to filter tap water to remove bacteria and impurities - but this may no longer be necessary. A new factory that turns used wine bottles into green sand could revolutionise the recycling industry and help to filter Britain's drinking water. Backed by $1.6m from the European Union and the Department for Environment, Food and Rural Affairs (Defra), a company based in Scotland is building the factory, which will turn beverage bottles back into the sand from which they were made in the first place. The green sand has already been successfully tested by water companies and is being used in 50 swimming pools in Scotland to keep the water clean.

The idea is not only to avoid using up an increasingly scarce natural resource, sand, but also to solve a crisis in the recycling industry. Britain uses 5.5m tonnes of glass a year, but recycles only 750,000 tonnes of it. The problem is that half the green bottle glass in Britain is originally from imported wine and beer bottles. Because there is so much of it, and it is used less in domestic production than other types, green glass is worth only $25 a tonne. Clear glass, which is melted down and used for whisky bottles, mainly for export, is worth double that amount.

Howard Dryden, a scientist and managing director of the company, Dryden Aqua, of Bonnyrigg, near Edinburgh, has spent six years working on the product he calls Active Filtration Media, or AFM. He concedes that he has given what is basically recycled glass a 'fancy name' to remove the stigma of what most people would regard as an inferior product. He says he needs bottles that have already contained drinkable liquids to be sure that drinking water filtered through the AFM

would not be contaminated. Crushed down beverage glass has fewer impurities than real sand and it performed better in trials. The fact is that tests show that AFM does the job better than sand, it is easier to clean and reuse and has all sorts of properties that make it ideal for other applications, he claimed.

The factory is designed to produce 100 tonnes of AFM a day, although Mr Dryden regards this as a large-scale pilot project rather than full production. Current estimates of the UK market for this glass for filtering drinking water. sewage, industrial water, swimming pools and fish farming are between 175,000 to 217,000 tonnes a year, which will use up most of the glass available near the factory. So he intends to build five or six factories in cities where there are large quantities of bottles, in order to cut down on transport costs.

The current factory will be completed this month and is expected to go into full production on January 14th next year. Once it is providing a 'regular' product, the government's drinking water inspectorate will be asked to perform tests and approve it for widespread use by water companies. A Defra spokesman said it was hoped that AFM could meet approval within six months. The only problem that they could foresee was possible contamination if some glass came from sources other than beverage bottles.

Among those who have tested the glass already is Caroline Fitzpatrick of the civil and environmental engineering department of University College London. 'We have looked at a number of batches and it appears to do the job,' she said. "Basically, sand is made of glass and Mr Dryden is turning bottles back into sand. It seems a straightforward idea and there is no reason we can think of why it would not work. Since glass from wine bottles and other beverages has no impurities and clearly did not leach any substances into the contents of the bottles, there was no reason to believe there would be a problem,' Dr Fitzpatrick added.

Mr Dryden has set up a network of agents round the world to sell AFM. It is already in use in central America to filter water on banana plantations where the fruit has to be washed before being despatched to European markets. It is also in use in sewage works to filter water before it is returned to rivers, something which is becoming legally necessary across the European Union because of tighter regulations on sewage works. So there are a great number of applications involving cleaning up water. Currently, however, AFM costs $670 a tonne, about four times as much as good quality sand. 'But that is because we haven't got large-scale production. Obviously, when we get going it will cost a lot less, and be competitive with sand in price as well," Mr

Dryden said. 'I believe it performs better and lasts longer than sand, so it is going to be better value too."

If AFM takes off as a product it will be a big boost for the government agency which is charged with finding a market for recycled products. Crushed glass is already being used in road surfacing and in making tiles and bricks. Similarly, AFM could prove to have a widespread use and give green glass a cash value.

62/ Natural choice: Coffee and chocolate

What's the connection between your morning coffee, wintering North American birds and the cool shade of a tree? Actually, quite a lot, says Simon Birch.

When scientists from London's Natural History Museum descended on the coffee farms of the tiny Central American republic of El Salvador, they were astonished to find such diversity of insec and plant species. During 18 months' work on 12 farms, they found a third more species of parasitic wasp than are known to exist in the whole country of Costa Rica. They described four new species and are aware of a fifth. On 24 farms they found nearly 300 species of tree when they had expected to find about 100.

El Salvador has lost much of its natural forest, with coffee farms covering nearly 10% of the country. Most of them use the 'shade-grown' method of production, which utilises a semi-natural forest ecosystem. Alex Munro, the museum's botanist on the expedition, says: "Our findings amazed our insect specialist. There's a very sophisticated food web present. The wasps, for instance, may depend on specific species of tree.'

It's the same the world over. Species diversity is much higher where coffee is grown in shade conditions. In addition, coffee (and chocolate) is usually grown in tropical rainforest regions that are biodiversity hotspots. These habitats support up to 70% of the planet's plant and animal species, and so the production methods of cocoa and coffee can have a hugely significant impact," explains Dr Paul Donald of the Royal Society for the Protection of Birds.

So what does 'shade-grown' mean, and why is it good for wildlife? Most of the world's coffee is produced by poor farmers in the developing world. Traditionally they have grown coffee (and cocoa) under the shade of selectively thinned tracts of rain forest in a genuinely sustainable form of farming. Leaf fall from the canopy provides a supply of nutrients and acts as a mulch that

suppresses weeds. The insects that live in the canopy pollinate the cocoa and coffee and prey on pests. The trees also provide farmers with fruit and wood for fuel.

'Bird diversity in shade-grown coffee plantations rivals that found in natural forests in the same region,' says Robert Rice from the Smithsonian Migratory Bird Center. In Ghana, West Africa, - one of the world's biggest producers of cocoa 90% of the cocoa is grown under shade, and these forest plantations are a vital habitat for wintering European migrant birds. In the same way, the coffee forests of Central and South America are a refuge for wintering North American migrants.

More recently, a combination of the collapse in the world market for coffee and cocoa and a drive to increase yields by producer countries has led to huge swathes of shade-grown coffee and cocoa being cleared to make way for a highly intensive, monoculture pattern of production known as 'full sun'. But this system not only reduces the diversity of flora and fauna, it also requires huge amounts of pesticides and fertilisers. In Côte d'Ivoire, which produces more than half the world's cocoa, more than a third of the crop is now grown in full-sun conditions.

The loggers have been busy in the Americas too, where nearly 70% of all Colombian coffee is now produced using full-sun production. One study carried out in Colombia and Mexico found that, compared with shade coffee, full-sun plantations have 95% fewer species of birds.

In El Salvador, Alex Munro says shade-coffee farms have a cultural as well as ecological significance and people are not happy to see them go. But the financial pressures are great, and few of these coffee farms make much money. One farm we studied, a cooperative of 100 families, made just $10,000 a year $100 per family- and that's not taking labour costs into account."

The loss of shade-coffee forests has so alarmed a number of North American wildlife organisations that they're now harnessing consumer power to help save these threatened habitats. They are promoting a 'certification' system that can indicate to consumers that the beans have been grown on shade plantations. Bird-friendly coffee, for instance, is marketed by the Smithsonian Migratory Bird Center. The idea is that the small extra cost is passed directly on to the coffee farmers as a financial incentive to maintain their shade-coffee farms.

Not all conservationists agree with such measures, however. Some say certification could be leading to the loss - not preservation of natural forests. John Rappole of the Smithsonian Conservation and Research Center, for example, argues that shade- grown marketing provides an

incentive to convert existing areas of primary forest that are too remote or steep to be converted profitably to other forms of cultivation into shade-coffee plantations'.

Other conservationists, such as Stacey Philpott and colleagues, argue the case for shade coffee. But there are different types of shade growing. Those used by subsistence farmers are virtually identical to natural forest (and have a corresponding diversity), while systems that use coffee plants as the understorey and cacao or citrus trees as the overstorey may be no more diverse than full-sun farms. Certification procedures need to distinguish between the two, and Ms Philpott argues that as long as the process is rigorous and offers financial gains to the producers, shade growing does benefit the environment.

63/ Painters of time

“The world’s fascination with the mystique of Australian Aboriginal art.”

The works of Aboriginal artists are now much in demand throughout the world, and not just in Australia, where they are already fully recognised: the National Museum of Australia, which opened in Canberra in 2001 designated 40% of its exhibition space to works by Aborigines. In Europe their art is being exhibited at a museum in Lyon, France while the future Quai Branly museum in Paris - which will be devoted to arts and civilisations of Africa, Asia, Oceania and the Americas - plans to commission frescoes by artists from Australia.

Their artistic movement began about 30 years ago, but its roots go back to time immemorial. All the works refer to the founding myth of the Aboriginal culture, 'the Dreaming'. That internal geography, which is rendered with a brush and colours, is also the expression of the Aborigines' long quest to regain the land which was stolen from them when Europeans arrived in the nineteenth century. 'Painting is nothing without history,' says one such artist, Michael Nelson Tjakamarra.

There are now fewer than 400,000 Aborigines living in Australia. They have been swamped by the country's 17.5 million immigrants. These original 'natives' have been living in Australia for 50,000 years, but they were undoubtedly maltreated by the newcomers. Driven back to the most barren lands or crammed into slums on the outskirts of cities, the Aborigines were subjected to a policy of assimilation', which involved kidnapping children to make them better 'integrated' into European society, and herding the nomadic Aborigines by force into settled communities.

It was in one such community, Papunya, near Alice Springs, in the central desert, that Aboriginal painting first came into its own. In 1971, a white schoolteacher, Geoffrey Bardon, suggested to a group of Aborigines that they should decorate the school walls with ritual motifs, so as to pass on to the younger generation the myths that were starting to fade from their collective memory. He gave them brushes, colours and surfaces to paint on - cardboard and canvases. He was astounded by the result. But their art did not come like a bolt from the blue: for thousands of years Aborigines had been painting' on the ground using sands of different colours, and on rock faces. They had also been decorating their bodies for ceremonial purposes. So there existed a formal vocabulary.

This had already been noted by Europeans. In the early twentieth century. Aboriginal communities brought together by missionaries in northern Australia had been encouraged to reproduce on tree bark the motifs found on rock faces. Artists turned out a steady stream of works, supported by the churches, which helped to sell them to the public, and between 1950 and 1960 Aboriginal paintings began to reach overseas museums. Painting on bark persisted in the north, whereas the communities in the central desert increasingly used acrylic paint, and elsewhere in Western Australia women explored the possibilities of wax painting and dyeing processes, known as 'batik.

What Aborigines depict are always elements of the Dreaming, the collective history that each community is both part of and guardian of. The Dreaming is the story of their origins, of their 'Great Ancestors', who passed on their knowledge, their art and their skills (hunting, medicine, painting, music and dance) to man. The Dreaming is not synonymous with the moment when the world was created," says Stephane Jacob, one of the organisers of the Lyon exhibition. 'For Aborigines, that moment has never ceased to exist. It is perpetuated by the cycle of the seasons and the religious ceremonies which the Aborigines organise. Indeed the aim of those ceremonies is also to ensure the permanence of that golden age. The central function of Aboriginal painting, even in its contemporary manifestations, is to guarantee the survival of this world. The Dreaming is both past, present and future."

Each work is created individually, with a form peculiar to each artist, but it is created within and on behalf of a community who must approve it. An artist cannot use a 'dream' that does not belong to his or her community, since each community is the owner of its dreams, just as it is

anchored to a territory marked out by its ancestors, so each painting can be interpreted as a kind of spiritual road map for that community.

Nowadays, each community is organised as a cooperative and draws on the services of an art adviser, a government-employed agent who provides the artists with materials, deals with galleries and museums and redistributes the proceeds from sales among the artists.

Today, Aboriginal painting has become a great success. Some works sell for more than $25,000, and exceptional items may fetch as much as $180,000 in Australia.

By exporting their paintings as though they were surfaces of their territory, by accompanying them to the temples of western art, the Aborigines have redrawn the map of their country, into whose depths they were exiled,' says Yves Le Fur, of the Quai Branly museum. 'Masterpieces have been created. Their undeniable power prompts a dialogue that has proved all too rare in the history of contacts between the two cultures'.

64/ Sustainable architecture – lessons from the ant

Termite mounds were the inspiration for an innovative design in sustainable living

Africa owes its termite mounds a lot. Trees and shrubs take root in them. Prospectors mine them, looking for specks of gold carried up by termites from hundreds of metres below. And of course, they are a special treat to aardvarks and other insectivores.

Now, Africa is paying an offbeat tribute to these towers of mud. The extraordinary Eastgate Building in Harare, Zimbabwe's capital city, is said to be the only one in the world to use the same cooling and heating principles as the termite mound.

Termites in Zimbabwe build gigantic mounds inside which they farm a fungus that is their primary food source. This must be kept at exactly 30.5°C, while the temperatures on the African veld outside can range from 1.5°C at night-only just above freezing -to a baking hot 40°C during the day. The termites achieve this remarkable feat by building a system of vents in the mound. Those at the base lead down into chambers cooled by wet mud carried up from water tables far below, and others lead up through a flue to the peak of the mound. By constantly opening and closing these heating and cooling vents over the course of the day the termites succeed in keeping the temperature constant in spite of the wide fluctuations outside.

Architect Mick Pearce used precisely the same strategy when designing the Eastgate Building, which has no air conditioning and virtually no heating. The building the country's largest

commercial and shopping complex - uses less than 10% of the energy of a conventional building its size. These efficiencies translated directly to the bottom line: the Eastgate's owners saved $3.5 million on a $36 million building because an air- conditioning plant didn't have to be imported. These savings were also passed on to tenants: rents are 20% lower than in a new building next door.

The complex is actually two buildings linked by bridges across a shady, glass-roofed atrium open to the breezes. Fans suck fresh air in from the atrium, blow it upstairs through hollow spaces under the floors and from there into each office through baseboard vents. As it rises and warms, it is drawn out via ceiling vents and finally exits through forty- eight brick chimneys.

To keep the harsh, high veld sun from heating the interior, no more than 25% of the outside is glass, and all the windows are screened by cement arches that jut out more than a metre.

During summer's cool nights, big fans flush air through the building seven times an hour to chill the hollow floors. By day, smaller fans blow two changes of air an hour through the building, to circulate the air which has been in contact with the cool floors. For winter days, there are small heaters in the vents.

This is all possible only because Harare is 1600 feet above sea level, has cloudless skies, little humidity and rapid temperature swings days as warm as 31°C commonly drop to 14°C at night. 'You couldn't do this in New York, with its fantastically hot summers and fantastically cold winters,' Pearce said. But then his eyes lit up at the challenge. 'Perhaps you could store the summer's heat in water somehow.....

The engineering firm of Ove Arup & Partners, which worked with him on the design, monitors daily temperatures outside, under the floors and at knee, desk and ceiling level. Ove Arup's graphs show that the temperature of the building has generally stayed between 23°C and 25°C, with the exception of the annual hot spell just before the summer rains in October, and three days in November, when a janitor accidentally switched off the fans at night. The atrium, which funnels the winds through, can be much cooler. And the air is fresh - far more so than in air-conditioned buildings, where up to 30% of the air is recycled.

Pearce, disdaining smooth glass skins as igloos in the Sahara, calls his building, with its exposed girders and pipes, 'spiky'. The design of the entrances is based on the porcupine-quill headdresses of the local Shona tribe. Elevators are designed to look like the mineshaft cages used in

Zimbabwe's diamond mines. The shape of the fan covers, and the stone used in their construction, are echoes of Great Zimbabwe, the ruins that give the country its name.

Standing on a roof catwalk, peering down inside at people as small as termites below, Pearce said he hoped plants would grow wild in the atrium and pigeons and bats would move into it, like that termite fungus, further extending the whole 'organic machine metaphor. The architecture, he says, is a regionalised style that responds to the biosphere, to the ancient traditional stone architecture of Zimbabwe's past, and to local human resources.

65/ Inside the mind of the consumer

Could brain-scanning technology provide an accurate way to assess the appeal of new products and the effectiveness of advertising?

MARKETING people are no longer prepared to take your word for it that you favour one product over another. They want to scan your brain to see which one you really prefer. Using the tools of neuroscientists, such as electroencephalogram (EEG) mapping and functional magnetic-resonance imaging (fMRI), they are trying to learn more about the mental processes behind purchasing decisions. The resulting fusion of neuroscience and marketing is, inevitably, being called 'neuromarketing".

The first person to apply brain-imaging technology in this way was Gerry Zaltman of Harvard University, in the late 1990s. The idea remained in obscurity until 2001, when BrightHouse, a marketing consultancy based in Atlanta, Georgia, set up a dedicated neuromarketing arm, BrightHouse Neurostrategies Group. (BrightHouse lists Coca- Cola, Delta Airlines and Home Depot among its clients.) But the company's name may itself simply be an example of clever marketing. BrightHouse does not scan people while showing them specific products or campaign ideas, but bases its work on the results of more general fMRI-based research into consumer preferences and decision-making carried out at Emory University in Atlanta.

Can brain scanning really be applied to marketing? The basic principle is not that different from focus groups and other traditional forms of market research. A volunteer lies in an fMRI machine and is shown images or video clips. In place of an interview or questionnaire, the subject's response is evaluated by monitoring brain activity. fMRI provides real-time images of brain activity, in which different areas light up' depending on the level of blood flow. This provides clues to the subject's subconscious thought patterns. Neuroscientists know, for example, that the

sense of self is associated with an area of the brain known as the medial prefrontal cortex. A flow of blood to that area while the subject is looking at a particular logo suggests that he or she identifies with that brand.

At first, it seemed that only companies in Europe were prepared to admit that they used neuromarketing. Two carmakers, DaimlerChrysler in Germany and Ford's European arm, ran pilot studies in 2003. But more recently, American companies have become more open about their use of neuromarketing. Lieberman Research Worldwide, a marketing firm based in Los Angeles, is collaborating with the California Institute of Technology (Caltech) to enable movie studios to market-test film trailers. More controversially, the New York Times recently reported that a political consultancy, FKF Research, has been studying the effectiveness of campaign commercials using neuromarketing techniques.

Whether all this is any more than a modern-day version of phrenology, the Victorian obsession with linking lumps and bumps in the skull to personality traits, is unclear. There have been no large-scale studies, so scans of a handful of subjects may not be a reliable guide to consumer behaviour in general. Of course, focus groups and surveys are flawed too: strong personalities can steer the outcomes of focus groups, and some people may be untruthful in their responses to opinion pollsters. And even honest people cannot always explain their preferences.

That is perhaps where neuromarketing has the most potential. When asked about cola drinks, most people claim to have a favourite brand, but cannot say why they prefer that brand's taste. An unpublished study of attitudes towards two well- known cola drinks, Brand A and Brand B. carried out last year in a college of medicine in the US found that most subjects preferred Brand B in a blind tasting-fMRI scanning showed that drinking Brand B lit up a region called the ventral putamen, which is one of the brain's 'reward centres', far more brightly than Brand A. But when told which drink was which, most subjects said they preferred Brand A, which suggests that its stronger brand outweighs the more pleasant taste of the other drink.

'People form many unconscious attitudes that are obviously beyond traditional methods that utilise introspection, says Steven Quartz, a neuroscientist at Caltech who is collaborating with Lieberman Research. With over $100 billion spent each year on marketing in America alone, any firm that can more accurately analyse how customers respond to brands could make a fortune.

Consumer advocates are wary. Gary Ruskin of Commercial Alert, a lobby group, thinks existing marketing techniques are powerful enough. 'Already, marketing is deeply implicated in many

serious pathologies,' he says. "That is especially true of children, who are suffering from an epidemic of marketing-related diseases, including obesity and type-2 diabetes. Neuromarketing is a tool to amplify these trends."

Dr Quartz counters that neuromarketing techniques could equally be used for benign purposes. 'There are ways to utilise these technologies to create more responsible advertising,' he says. Brain- scanning could, for example, be used to determine when people are capable of making free choices, to ensure that advertising falls within those bounds.

Another worry is that brain-scanning is an invasion of privacy and that information on the preferences of specific individuals will be misused. But neuromarketing studies rely on small numbers of volunteer subjects, so that seems implausible. Critics also object to the use of medical equipment for frivolous rather than medical purposes. But as Tim Ambler, a neuromarketing researcher at the London Business School, says: A tool is a tool, and if the owner of the tool gets a decent rent for hiring it out, then that subsidises the cost of the equipment, and everybody wins. Perhaps more brain-scanning will some day explain why some people like the idea of neuromarketing, but others do not.

66/ The accidental rainforest

According to ecological theory, rainforests are supposed to develop slowly over millions of years. But new ecologists are being forced to reconsider their ideas.

When Peter Osbeck, a Swedish priest, stopped off at the mid-Atlantic island of Ascension in 1752 on his way home from China, he wrote of a heap of ruinous rocks' with a bare, white mountain in the middle. All it boasted was a couple of dozen species of plant, most of them ferns and some of them unique to the island.

And so it might have remained. But in 1843 British plant collector Joseph Hooker made a brief call on his return from Antarctica. Surveying the bare earth. he concluded that the island had suffered some natural calamity that had denuded it of vegetation and triggered a decline in rainfall that was turning the place into a desert. The British Navy, which by then maintained a garrison on the island, was keen to improve the place and asked Hooker's advice. He suggested an ambitious scheme for planting trees and shrubs that would revive rainfall and stimulate a wider ecological recovery. And, perhaps lacking anything else to do, the sailors set to with a will.

In 1845, a naval transport ship from Argentina delivered a batch of seedlings. In the following years, more than 200 species of plant arrived from South Africa. From England came 700 packets of seeds, including those of two species that especially liked the place: bamboo and prickly pear. With sailors planting several thousand trees a year, the bare white mountain was soon cloaked in green and renamed Green Mountain, and by the early twentieth century the mountain's slopes were covered with a variety of trees and shrubs from all over the world.

Modern ecologists throw up their hands in horror at what they see as Hooker's environmental anarchy. The exotic species wrecked the indigenous ecosystem, squeezing out the island's endemic plants. In fact, Hooker knew well enough what might happen. However, he saw greater benefit in improving rainfall and encouraging more prolific vegetation on the island.

But there is a much deeper issue here than the relative benefits of sparse endemic species versus luxuriant imported ones. And as botanist Davic Wilkinson of Liverpool John Moores University in the UK pointed out after a recent visit to the island. it goes to the heart of some of the most dearly held tenets of ecology. Conservationists understandable concern for the fate of Ascension's handful of unique species has, he says, blinded them to something quite astonishing the fact that the introduced species have been a roaring success.

Today's Green Mountain, says Wilkinson, is 'a fully functioning man-made tropical cloud forest" that has grown from scratch from a ragbag of species collected more or less at random from all over the planet. But how could it have happened? Conventional ecological theory says that complex ecosystems such as cloud forests can emerge only through evolutionary processes in which each organism develops in concert with others to fill particular niches. Plants co-evolve with their pollinators and seed dispersers, while microbes in the soil evolve to deal with the leaf litter.

But that's not what happened on Green Mountain. And the experience suggests that perhaps natural rainforests are constructed far more by chance than by evolution. Species, say some ecologists, don't so much evolve to create ecosystems as make the best of what they have. The Green Mountain system is a man-made system that has produced a tropical rainforest without any co-evolution between its constituent species,' says Wilkinson.

Not everyone agrees. Alan Gray, an ecologist at the University of Edinburgh in the UK, argues that the surviving endemic species on Green Mountain, though small in number, may still form

the framework of the new ecosystem. The new arrivals may just be an adornment, with little structural importance for the ecosystem.

But to Wilkinson this sounds like clutching at straws. And the idea of the instant formation of rainforests sounds increasingly plausible as research reveals that supposedly pristine tropical rainforests from the Amazon to south-east Asia may in places be little more than the overgrown gardens of past rainforest civilisations.

The most surprising thing of all is that no ecologists have thought to conduct proper research into this human-made rainforest ecosystem. A survey of the island's flora conducted six years ago by the University of Edinburgh was concerned only with endemic species. They characterised everything else as a threat. And the Ascension authorities are currently turning Green Mountain into a national park where introduced species, at least the invasive ones, are earmarked for culling rather than conservation.

Conservationists have understandable concerns, Wilkinson says. At least four endemic species have gone extinct on Ascension since the exotics started arriving. But in their urgency to protect endemics, ecologists are missing out on the study of a great enigma.

'As you walk through the forest, you see lots of leaves that have had chunks taken out of them by various insects. There are caterpillars and beetles around,' says Wilkinson. 'But where did they come from? Are they endemic or alien? If alien, did they come with the plant on which they feed or discover it on arrival?' Such questions go to the heart of how rainforests happen.

The Green Mountain forest holds many secrets. And the irony is that the most artificial rainforest in the world could tell us more about rainforest ecology than any number of natural forests.

67/ Astronaut ice cream, everyone?

Freeze-drying is a technique that can help to provide food for astronauts. But it also has other applications nearer home.

Freeze-drying is like suspended animation for food; you can store a freeze-dried meal for years, and then, when you're finally ready to eat it, you can completely revitalise it with a little hot water. Even after several years, the original foodstuff will be virtually unchanged.

The technique basically involves completely removing the water from some material, such as food, while leaving the rest of the material virtually intact. The main reason for doing this is either to preserve the food or to reduce its weight. Removing the water from food keeps it from

spoiling, because the microorganisms such as bacteria that cause spoiling cannot survive without it. Similarly, the enzymes which occur naturally in food cannot cause ripening without water, so removing water from food will also stop the ripening process.

Freeze-drying significantly reduces the total weight of the food because most food is largely made up of water; for example, many fruits are more than 80- 90% water. Removing this makes the food much lighter and therefore makes transportation less difficult. The military and camping-supply companies freeze- dry foods to make them easier for an individual to carry and NASA has also freeze-dried foods for the cramped quarters on board spacecraft.

The process is also used to preserve other sorts of material, such as pharmaceuticals. Chemists can greatly extend pharmaceutical shelf life by freeze-drying the material and storing it in a container free of oxygen and water. Similarly, research scientists may use freeze-drying to preserve biological samples for long periods of time. Even valuable manuscripts that had been water damaged have been saved by using this process.

Freeze-drying is different from simple drying because it is able to remove almost all the water from materials, whereas simple drying techniques can only remove 90-95%. This means that the damage caused by bacteria and enzymes can virtually be stopped, rather than just slowed down. In addition, the composition and structure of the material is not significantly changed, so materials can be revitalised without compromising the quality of the original.

This is possible because in freeze-drying, solid water ice is converted directly into water vapour, missing out the liquid phase entirely. This is called 'sublimation', the shift from a solid directly into a gas. Just like evaporation, sublimation occurs when a molecule gains enough energy to break free from the molecules around it. Water will sublime from a solid (ice) to a gas (vapour) when the molecules have enough energy to break free but the conditions aren't right for a liquid to form. These conditions are determined by heat and atmospheric pressure. When the temperature is above freezing point, so that ice can thaw, but the atmospheric pressure is too low for a liquid to form (below 0.06 atmospheres (ATM)) then it becomes a gas.

This is the principle on which a freeze-drying machine is based. The material to be preserved is placed in a freeze-drying chamber which is connected to a freezing coil and refrigerator compressor. When the chamber is sealed the compressor lowers the temperature inside it. The material is frozen solid, which separates the water from everything around it on a molecular level, even though the water is still present. Next, a vacuum pump forces air out of the chamber,

lowering the atmospheric pressure below to 0.06 ATM. The heating units apply a small amount of heat to the shelves in the chamber, causing the ice to change phase. Since the pressure in the chamber is so low, the ice turns directly into water vapour, which leaves the freeze-drying chamber, and flows past the freezing coil. The water vapour condenses onto the freezing coil in the form of solid ice, in the same way that water condenses as frost on a cold day.

The process continues for many hours (even days) while the material gradually dries out. This time is necessary to avoid overheating, which might affect the structure of the material. Once it has dried sufficiently, it is sealed in a moisture- free package. As long as the package is secure, the material can sit on a shelf for years and years without degrading, until it is restored to its original form with a little hot water. If everything works correctly, the material will go through the entire process almost completely unscathed.

In fact, freeze-drying, as a general concept, is not new but has been around for centuries. The ancient Incas of Peru used mountain peaks along the Andes as natural food preservers. The extremely cold temperatures and low pressure at those high altitudes prevented food from spoiling in the same basic way as a modern freeze-drying machine and a freezer.

68/ The Wild Side of Town

The countryside is no longer the place to see wildlife, according to Chris Barnes. These days you are more likely to find impressive numbers of skylarks, dragonflies, and toads in your own back garden.

The past half century has seen an interesting reversal in the fortunes of much of Britain's wildlife. Whilst the rural countryside has become poorer and poorer, wildlife habitat in towns has burgeoned. Now, if you want to hear a deafening dawn chorus of birds or familiarise yourself with foxes, you can head for the urban forest.

Whilst species that depend on wide open spaces such as the hare, the eagle and the red deer may still be restricted to remote rural landscapes, many of our wild plants and animals find the urban ecosystem ideal. This really should be no surprise, since it is the fragmentation and agrochemical pollution in the farming lowlands that has led to the catastrophic decline of so many species.

By contrast, most urban open spaces have escaped the worst of the pesticide revolution, and they are an intimate mosaic of interconnected habitats. Over the years, the cutting down of hedgerows on farmland has contributed to habitat isolation and species loss. In towns, the tangle of canals,

railway embankments, road verges and boundary hedges lace the landscape together, providing first-class ecological corridors for species such as hedgehogs, kingfishers and dragonflies.

Urban parks and formal recreation grounds are valuable for some species, and many of them are increasingly managed with wildlife in mind. But in many places their significance is eclipsed by the huge legacy of post-industrial land- demolished factories, waste tips, quarries, redundant railway yards and other so-called 'brownfield' sites. In Merseyside, South Yorkshire and the West Midlands, much of this has been spectacularly colonised with birch and willow woodland, herb-rich grassland and shallow wetlands. As a consequence, there are song birds and predators in abundance over these once-industrial landscapes. There are fifteen million domestic gardens in the UK, and whilst some are still managed as lifeless chemical war zones, most benefit the local wildlife, either through benign neglect or positive encouragement. Those that do best tend to be woodland species, and the garden lawns and flower borders, climber-covered fences, shrubberies and fruit trees are a plausible alternative. Indeed, in some respects gardens are rather better than the real thing, especially with exotic flowers extending the nectar season. Birdfeeders can also supplement the natural seed supply, and only the millions of domestic cats may spoil the scene.

As Britain's gardeners have embraced the idea of 'gardening with nature', wildlife's response has been spectacular. Between 1990 and the year 2000, the number of different bird species seen at artificial feeders in gardens increased from 17 to an amazing 81. The BUGS project (Biodiversity in Urban Gardens in Sheffield) calculates that there are 25,000 garden ponds and 100,000 nest boxes in that one city alone. We are at last acknowledging that the wildlife habitat in towns provides a valuable life support system. The canopy of the urban forest is filtering air pollution, and intercepting rainstorms, allowing the water to drip more gradually to the ground. Sustainable urban drainage relies on ponds and wetlands to contain storm water runoff, thus reducing the risk of flooding, whilst reed beds and other wetland wildlife communities also help to clean up the water. We now have scientific proof that contact with wildlife close to home can help to reduce stress and anger. Hospital patients with a view of natural green space make a more rapid recovery and suffer less pain.

Traditionally, nature conservation in the UK has been seen as marginal and largely rural. Now we are beginning to place it at the heart of urban environmental and economic policy. There are now dozens of schemes to create new habitats and restore old ones in and around our big cities.

Biodiversity is big in parts of London, thanks to schemes such as the London Wetland Centre in the southwest of the city. This is a unique scheme masterminded by the Wildfowl and Wetlands Trust to create a wildlife reserve out of a redundant Victorian reservoir. Within five years of its creation the Centre has been hailed as one of the top sites for nature in England and made a Site of Special Scientific Interest. It consists of a 105-acre wetland site, which is made up of different wetland habitats of shallow, open water and grazing marsh. The site attracts more than 104 species of bird, including nationally important rarities like the bittern.

We need to remember that if we work with wildlife, then wildlife will work for us and this is the very essence of sustainable development.

69/ Running on empty

A revolutionary new theory in sports physiology.

For almost a century, scientists have presumed, not unreasonably, that fatigue or exhaustion-in athletes originates in the muscles. Precise explanations have varied, but all have been based on the 'limitations theory'. In other words, muscles tire because they hit a physical limit: they either run out of fuel or oxygen or they drown in toxic by-products.

In the past few years, however, Timothy Noakes and Alan St Clair Gibson from the University of Cape Town, South Africa, have examined this standard theory. The deeper they dig, the more convinced they have become that physical fatigue simply isn't the same as a car running out of petrol. Fatigue, they argue, is caused not by distress signals springing from overtaxed muscles, but is an emotional response which begins in the brain. The essence of their new theory is that the brain, using a mix of physiological, subconscious and conscious cues, paces the muscles to keep them well back from the brink of exhaustion. When the brain decides it's time to quit, it creates the distressing sensations we interpret as unbearable muscle fatigue. This 'central governor' theory remains controversial, but it does explain many puzzling aspects of athletic performance.

A recent discovery that Noakes calls the 'lactic acid paradox' made him start researching this area seriously. Lactic acid is a by-product of exercise. and its accumulation is often cited as a cause of fatigue. But when research subjects exercise in conditions simulating high altitude, they become fatigued even though lactic acid levels remain low. Nor has the oxygen content of their blood

fallen too low for them to keep going. Obviously. Noakes deduced, something else was making them tire before they hit either of these physiological limits.

Probing further, Noakes conducted an experiment with seven cyclists who had sensors taped to their legs to measure the nerve impulses travelling through their muscles. It has long been known that during exercise, the body never uses 100% of the available muscle fibres in a single contraction. The amount used varies, but in endurance tasks such as this cycling test the body calls on about 30%.

Noakes reasoned that if the limitations theory was correct and fatigue was due to muscle fibres hitting some limit, the number of fibres used for each pedal stroke should increase as the fibres tired and the cyclist's body attempted to compensate by recruiting an ever-larger proportion of the total. But his team found exactly the opposite. As fatigue set in, the electrical activity in the cyclists' legs declined - even during sprinting, when they were striving to cycle as fast as they could.

To Noakes, this was strong evidence that the old theory was wrong. 'The cyclists may have felt completely exhausted,' he says, 'but their bodies actually had considerable reserves that they could theoretically tap by using a greater proportion of the resting fibres.' This, he believes, is proof that the brain is regulating the pace of the workout to hold the cyclists well back from the point of catastrophic exhaustion.

More evidence comes from the fact that fatigued muscles don't actually run out of anything critical. Levels of glycogen, which is the muscles' primary fuel, and ATP, the chemical they use for temporary energy storage, decline with exercise but never bottom out. Even at the end of a marathon, ATP levels are 80-90% of the resting norm, and glycogen levels never get to zero.

Further support for the central regulator comes from the fact that top athletes usually manage to go their fastest at the end of a race, even though, theoretically, that's when their muscles should be closest to exhaustion. But Noakes believes the end spurt makes no sense if fatigue is caused by muscles poisoning themselves with lactic acid, as this would cause racers to slow down rather than enable them to sprint for the finish line. In the new theory, the explanation is obvious. Knowing the end is near, the brain slightly relaxes its vigil, allowing the athlete to tap some of the body's carefully hoarded reserves.

But the central governor theory does not mean that what's happening in the muscles is irrelevant. The governor constantly monitors physiological signals from the muscles, along with other

information, to set the level of fatigue. A large number of signals are probably involved, but, unlike the limitations theory, the central governor theory suggests that these physiological factors are not the direct determinants of fatigue, but simply information to take into account.

Conscious factors can also intervene. Noakes believes that the central regulator evaluates the planned workout, and sets a pacing strategy accordingly. Experienced runners know that if they set out on a 10-kilometre run, the first kilometre feels easier than the first kilometre of a 5-kilometre run, even though there should be no difference. That, Noakes says, is because the central governor knows you have farther to go in the longer run and has programmed itself to dole out fatigue symptoms accordingly.

St Clair Gibson believes there is a good reason why our bodies are designed to keep something back. That way, there's always something left in the tank for an emergency. In ancient times, and still today, life would be too dangerous if our bodies allowed us to become so tired that we couldn't move quickly when faced with an unexpected need.

70/ Reducing electricity consumption on the isle of Eigg

Background

The Isle of Eigg is situated off the West Coast of Scotland, and is reached by ferry from the mainland. For the island community of about a hundred residents, it has always been expensive to import products, materials and skilled labour from the mainland, and this has encouraged a culture of self-sufficiency and careful use of resources. Today, although the island now has most modern conveniences, CO2 emissions per household are 20 percent lower than the UK average, and electricity use is 50 percent lower.

When Eigg designed its electricity grid, which was switched on in February 2008, it quickly became apparent that in order to keep the capital building costs down, it would be necessary to manage demand. This would also allow the island to generate most of its electricity from renewable sources, mainly water, wind and solar power. This goal was overseen by the Eigg Heritage Trust (EHT).

The technology

Eigg manages electricity demand mainly by capping the instantaneous power that can be used to five kilowatts (kW) for a household and ten kW for a business. If usage goes over the limit, the electricity supply is cut off and the maintenance team must be called to come and switch it back

on again. All households and businesses have energy monitors, which display current and cumulative electricity usage, and sound an alarm when consumption reaches a user-defined level, usually set a few hundred watts below the actual limit. The result is that Eigg residents have a keen sense of how much power different electrical appliances use, and are careful to minimise energy consumption.

Demand is also managed by warning the entire island when renewable energy generation is lower than demand, and diesel generators are operating to back it up – a so-called 'red light day', as opposed to 'green light days' when there is sufficient renewable energy. Residents then take steps to temporarily reduce electricity demand further still, or postpone demand until renewable energy generation has increased.

Energy use on the island has also been reduced through improved wall and loft insulation in homes, new boilers, solar water heating, car-sharing and various small, energy-saving measures in households. New energy supplies are being developed, including sustainably harvested forests to supply wood for heating.

Eigg Heritage Trust has installed insulation in all of its own properties at no cost to the tenants, while private properties have paid for their own insulation to be installed. The same applies for installations of solar water heating, although not all Trust properties have received this as yet. The Trust also operates a Green Grants scheme, where residents can claim 50 percent of the cost of equipment to reduce carbon emissions, up to a limit of £300. Purchases included bikes, solar water heating, secondary glazing, thicker curtains, and greenhouses to grow food locally, rather than importing it.

Environmental benefits

Prior to the installation of the new electricity grid and renewable energy generation, most households on Eigg used diesel generators to supply electricity, resulting in significant carbon emissions. Homes were also poorly insulated and had old, inefficient oil-burning boilers, or used coal for heating.

The work by the Eigg Heritage Trust to reduce energy use has resulted in significant reductions in carbon emissions from the island's households and businesses. The average annual electricity use per household is just 2,160 kilowatt hours (kWh), compared to a UK average in 2008 of 4,198 kWh. Domestic carbon emissions have fallen by 47 percent, from 8.4 to 4.45 tonnes per year. This compares to average UK household emissions of 5.5 to 6 tonnes per year. The

emissions should fall even further over the next few years as the supply of wood for heating increases.

Social benefits

The completion of Eigg's electricity grid has made a significant difference to the island's residents, freeing them from dependence on diesel generators and providing them with a stable and affordable power supply. A reliable electricity supply has brought improvements in other areas, for example, better treatment of drinking water in some houses, and the elimination of the constant noise of diesel generators. Improved home insulation and heating has also yielded benefits, making it more affordable to keep homes at a comfortable temperature. One of the incentives for capping electricity use, rather than charging different amounts according to usage, was to make access to energy equitable. Every household has the same five kW cap, irrespective of income, so distributing the available resources equally across the island's population.

Economic and employment benefits

Eigg's electricity grid supports four part-time maintenance jobs on the island, and residents have also been employed for building work to improve Trust-owned houses and other buildings. Likewise, the start of organised harvesting of wood for heating has created several forestry jobs for residents. A part-time 'green project manager' post has also been created. A wider economic impact has come from having a reliable and affordable electricity supply, which has enabled several new businesses to start up, including restaurants, shops, guest houses and self-catering accommodation. As Eigg has become known for cutting carbon emissions and protecting the environment, an increasing number of visitors have come to the island to learn about its work, bringing a further economic benefit to the residents.

71/ Change in business organisations

The forces that operate to bring about change in organisations can be thought of as winds which are many and varied – from small summer breezes that merely disturb a few papers, to mighty howling gales which cause devastation to structures and operations, causing consequent reorientation of purpose and rebuilding. Sometimes, however, the winds die down to give periods of relative calm, periods of relative organizational stability. Such a period was the agricultural age, which Goodman (1995) maintains prevailed in Europe and western societies as a whole until the early 1700s. During this period, wealth was created in the context of an

agriculturally based society influenced mainly by local markets (both customer and labour) and factors outside people's control, such as the weather. During this time, people could fairly well predict the cycle of activities required to maintain life, even if that life might be at little more than subsistence level.

To maintain the meteorological metaphor, stronger winds of change blew to bring in the Industrial Revolution and the industrial age. Again, according to Goodman, this lasted for a long time, until around 1945. It was characterised by a series of inventions and innovations that reduced the number of people needed to work the land and, in turn, provided the means of production of hitherto rarely obtainable goods; for organisations, supplying these in ever increasing numbers became the aim. To a large extent, demand and supply were predictable, enabling companies to structure their organisations along what Burns and Stalker (1966) described as mechanistic lines, that is as systems of strict hierarchical structures and firm means of control.

This situation prevailed for some time, with demand still coming mainly from the domestic market and organisations striving to fill the 'supply gap'. Thus the most disturbing environmental influence on organisations of this time was the demand for products, which outstripped supply. The saying attributed to Henry Ford that 'You can have any colour of car so long as it is black', gives a flavour of the supply-led state of the market. Apart from any technical difficulties of producing different colours of car, Ford did not have to worry about customers' colour preferences: he could sell all that he made. Organisations of this period can be regarded as 'task-oriented', with effort being put into increasing production through more effective and efficient production processes.

As time passed, this favourable period for organisations began to decline. In the neo-industrial age, people became more discriminating in the goods and services they wished to buy and, as technological advancements brought about increased productivity, supply overtook demand. Companies began, increasingly, to look abroad for additional markets.

At the same time, organisations faced more intensive competition from abroad for their own products and services. In the West, this development was accompanied by a shift in focus from manufacturing to service, whether this merely added value to manufactured products, or whether it was service in its own right. In the neo-industrial age of western countries, the emphasis

moved towards adding value to goods and services – what Goodman calls the value-oriented time, as contrasted with the taskoriented and products/services-oriented timesof the past.

Today, in the post-industrial age, most people agree that organisational life is becoming ever more uncertain, as the pace of change quickens and the future becomes less predictable. Writing in 1999, Nadler and Tushman, two US academics, said: 'Poised on the eve of the next century, we are witnessing a profound transformation in the very nature of our business organisations. Historic forces have converged to fundamentally reshape the scope, strategies, and structures of large enterprises.' At a less general level of analysis, Graeme Leach, Chief Economist at the British Institute of Directors, claimed in the Guardian newspaper (2000) that: 'By 2020, the nine-to-five rat race will be extinct and present levels of self-employment, commuting and technology use, as well as age and sex gaps, will have changed beyond recognition.' According to the article, Leach anticipates that: 'In 20 years time, 20-25 percent of the workforce will be temporary workers and many more will be flexible,… 25 percent of people will no longer work in a traditional office and… 50 percent will work from home in some form.' Continuing to use the 'winds of change' metaphor, the expectation is of damaging gale-force winds bringing the need for rebuilding that takes the opportunity to incorporate new ideas and ways of doing things.

Whether all this will happen is arguable. Forecasting the future is always fraught with difficulties. For instance, Mannermann (1998) sees future studies as part art and part science and notes: 'The future is full of surprises, uncertainty, trends and trend breaks, irrationality and rationality, and it is changing and escaping from our hands as time goes by. It is also the result of actions made by innumerable more or less powerful forces.' What seems certain is that the organisational world is changing at a fast rate - even if the direction of change is not always predictable. Consequently, it is crucial that organisational managers and decision makers are aware of, and able to analyse the factors which trigger organisational change.

72/ The creation of lasting memories

Many studies of the brain processes underlying the creation of memory consolidation (lasting memories) have involved giving various human and animal subjects treatment, while training them to perform a task. These have contributed greatly to our understanding.

In pioneering studies using goldfish, Bernard Agranoff found that protein synthesis inhibitors injected after training caused the goldfish to forget what they had learned. In other experiments,

he administered protein synthesis inhibitors immediately before the fish were trained. The remarkable finding was that the fish learned the task completely normally, but forgot it within a few hours - that is, the protein synthesis inhibitors blocked memory consolidation, but did not influence short-term memory.

There is now extensive evidence that short-term memory is spared by many kinds of treatments, including electro-convulsive therapy (ECT), that block memory consolidation. On the other hand, and equally importantly, neuroscientist Ivan Izquierdo found that many drug treatments can block short-term memory without blocking memory consolidation. Contrary to the hypothesis put forward by Canadian psychologist Donald Hebb, in 1949, long-term memory does not require short-term memory, and vice versa.

Such findings suggest that our experiences create parallel, and possibly independent stages of memory, each with a different life span. All of this evidence from clinical and experimental studies strongly indicates that the brain handles recent and remote memory in different ways; but why does it do that?

We obviously need to have memory that is created rapidly: reacting to an ever and rapidly changing environment requires that. For example, most current building codes require that the heights of all steps in a staircase be equal. After taking a couple of steps, up or down, we implicitly remember the heights of the steps and assume that the others will be the same. If they are not the same, we are very likely to trip and fall. Lack of this kind of rapidly created implicit memory would be bad for us and for insurance companies, but perhaps good for lawyers. It would be of little value to us if we remembered the heights of the steps only after a delay of many hours, when the memory becomes consolidated.

The hypothesis that lasting memory consolidates slowly over time is supported primarily by clinical and experimental evidence that the formation of long-term memory is influenced by treatments and disorders affecting brain functioning. There are also other kinds of evidence indicating more directly that the memories consolidate over time after learning. Avi Kami and Dov Sagi reported that the performance of human subjects trained in a visual skill did not improve until eight hours after the training was completed, and that improvement was even greater the following day. Furthermore, the skill was retained for several years.

Studies using human brain imaging to study changes in neural activity induced by learning have also reported that the changes continue to develop for hours after learning. In an innovative study

using functional imaging of the brain, Reza Shadmehr and Henry Holcomb examined brain activity in several brain regions shortly after human subjects was trained in a motor learning task requiring arm and hand movements. They found that while the performance of the subjects remained stable for several hours after completion of the training, their brain activity did not; different regions of the brain were predominantly active at different times over of period of several hours after the training. The activity shifted from the prefrontal cortex to two areas known to be involved in controlling movements, the motor cortex and cerebellar cortex. Consolidation of the motor skill appeared to involve activation of different neural systems that increased the stability of the brain processes underlying the skill.

There is also evidence that learning-induced changes in the activity of neurons in the cerebral cortex continue to increase for many days after the training. In an extensive series of studies using rats with electrodes implanted in the auditory cortex, Norman Weinberger reported that, after a tone of specific frequency was paired a few times with footshock, neurons in the rats' auditory cortex responded more to that specific tone and less to other tones of other frequencies. Even more interestingly, the selectivity of the neurons' response to the specific tone used in training continued to increase for several days after the training was terminated.

It is not intuitively obvious why our lasting memories consolidate slowly. Certainly, one can wonder why we have a form of memory that we have to rely on for many hours, days or a lifetime, that is so susceptible to disruption shortly after it is initiated. Perhaps the brain system that consolidates long-term memory over time was a late development in vertebrate evolution. Moreover, maybe we consolidate memories slowly because our mammalian brains are large and enormously complex. We can readily reject these ideas. All species of animals studied to date have both short and long-term memory; and all are susceptible to retrograde amnesia. Like humans, birds, bees, and molluscs, as well as fish and rats, make long-term memory slowly. Consolidation of memory clearly emerged early in evolution, and was conserved.

Although there seems to be no compelling reason to conclude that a biological system such as a brain could not quickly make a lasting memory, the fact is that animal brains do not. Thus, memory consolidation must serve some very important adaptive function or functions. There is considerable evidence suggesting that the slow consolidation is adaptive because it enables neurobiological processes occurring shortly after learning to influence the strength of memory

for experiences. The extensive evidence that memory can be enhanced, as well as impaired, by treatments administered shortly after training, provides intriguing support for this hypothesis.

73/ Sport science in Australia

The professional career paths available to graduates from courses relating to human movement and sport science are as diverse as the graduate's imagination. However, undergraduate courses with this type of content, in Australia as well as in most other Western countries, were originally designed as preparation programmes for Physical Education (PE) teachers.

The initial programmes commenced soon after the conclusion of World War II in the mid-1940s. One of the primary motives for these initiatives was the fact that, during the war effort, so many of the men who were assessed for military duty had been declared unfit. The government saw the solution in the providing of Physical Education programmes in schools, delivered by better prepared and specifically educated PE teachers.

Later, in the 1970s and early 1980s, the surplus of Australians graduating with a PE degree obliged institutions delivering this qualification to identify new employment opportunities for their graduates, resulting in the first appearance of degrees catering for recreation professionals. In many instances, this diversity of programme delivery merely led to degrees, delivered by physical educators, as a sideline activity to the production of PE teachers.

Whilst the need to produce Physical Education teachers remains a significant social need, and most developed societies demand the availability of quality leisure programmes for their citizens, the career options of graduates within this domain are still developing. The two most evident growth domains are in the area of the professional delivery of sport, and the role of a physical lifestyle for community health.

The sports industry is developing at an unprecedented rate of growth. From a business perspective, sport is now seen as an area with the potential for high returns. It is quite significant that the businessman Rupert Murdoch broadened his business base from media to sport, having purchased an American baseball team and an Australian Rugby League competition, as well as seeking opportunities to invest in an English football club. No business person of such international stature would see fit to invest in sport unless he was satisfied that this was a sound business venture with ideal revenue-generating opportunities.

These developments have confirmed sport as a business with professional management structures, marketing processes, and development strategies in place. They have indicated new and developing career paths for graduates of human movement science, sport science, exercise science and related degrees. Graduates can now visualise career paths extending into such diverse domains as sport management, sport marketing, event and facility management, government policy development pertaining to sport, sport journalism, sport psychology, and sport or athletic coaching.

Business leaders will only continue their enthusiasm for sport if they receive returns for their money. Such returns will only be forthcoming if astute, enthusiastic and properly educated professionals are delivering the programs that earn appropriate financial returns. The successful universities of the 21st century will be those that have responded to this challenge by delivering such degrees.

A second professional growth area for this group of graduates is associated with community health. The increasing demand for government expenditure within health budgets is reaching the stage where most governments are simply unable to function in a manner that is satisfying their constituents. One of the primary reasons for this problem is the unhelpful emphasis on treatment in medical care programmes. Governments have traditionally given their senior health official the title of ‘Minister for Health’, when in fact this officer has functioned as ‘Minister for Sickness and the Construction of Hospitals’. Government focus simply has to change. If the change is not brought about for philosophical reasons, it will occur naturally, because insufficient funding will be available to address the ever-increasing costs of medical support.

Graduates of human movement, exercise science and sport science have the potential to become major players in this shift in policy focus. It is these graduates who already have the skills, knowledge and understanding to initiate community health education programmes to reduce cardio-vascular disease, to reduce medical dependency upon diabetes, to improve workplace health leading to increased productivity, to initiate and promote programmes of activity for the elderly that reduce medical dependency, and to maintain an active lifestyle for the unemployed and disadvantaged groups in society. This is the graduate that governments will be calling upon to shift the community focus from medical dependency to healthy lifestyles in the decades ahead.

The career paths of these graduates are developing at a pace that is not evident in other professions. The contribution that these graduates can make to society, and the recognition of this contribution is at an unprecedented high, and all indications are that it will continue to grow.

74/ An assessment of micro-wind turbines

In terms of micro-renewable energy sources suitable for private use, a 15-kilowatt (kW) turbine is at the biggest end of the spectrum. With a nine metre diameter and a pole as high as a four-storey house, this is the most efficient form of wind microturbine, and the sort of thing you could install only if you had plenty of space and money. According to one estimate, a 15-kW micro-turbine (that's one with the maximum output), costing £41,000 to purchase and a further £9,000 to install, is capable of delivering 25,000 kilowatt-hours (kWh) of electricity each year if placed on a suitably windy site.

I don't know of any credible studies of the greenhouse gas emissions involved in producing and installing turbines, so my estimates here are going to be even more broad than usual. However, it is worth trying. If turbine manufacture is about as carbon intensive per pound sterling if product as other generators and electrical motors, which seems a reasonable assumption, the carbon intensity of manufacture will be around 640 kilograms (kg) per £1,000 of value. Installation is probably about as carbon intensive as typical construction, at around 380 kg per £1,000. That makes the carbon footprint (the total amount of greenhouse gases that installing a turbine creates) 30 tonnes.

The carbon savings from wind-powered electricity generation depend on the carbon intensity of the electricity that you're replacing. Let's assume that your generation replaces the coal-fuelled part of the country's energy mix. In other words, if you live in the UK, let's say that rather than replacing typical grid electricity, which comes from a mix of coal, gas, oil and renewable energy sources, the effect of your turbine is to reduce the use of coal-fired power stations. That's reasonable, because coal is the least preferable source in the electricity mix. In this case the carbon saving is roughly one kilogram per kWh, so you save 25 tonnes per year and pay back the embodied carbon in just 14 months – a great start.

The UK government has recently introduced a subsidy for renewable energy that pays individual producers 24p per energy unit on top of all the money they save on their own fuel bill, and on selling surplus electricity back to the grid at approximately 5p per unit. With all this taken into

account, individuals would get back £7,250 per year on their investment. That pays back the costs in about six years. It makes good financial sense and, for people who care about the carbon savings for their own sake, it looks like a fantastic move. The carbon investment pays back in just over a year, and every year after that is a 25-tonne carbon saving. (It's important to remember that all these sums rely on a wind turbine having a favourable location.)

So, at face value, the turbine looks like a great idea environmentally, and a fairly good long-term investment economically for the person installing it. However, there is a crucial perspective missing from the analysis so far. Has the government spent its money wisely? It has invested 24p per unit into each micro-turbine. That works out at a massive £250 per tonne of carbon saved. My calculations tell me that had the government invested its money in offshore wind farm, instead of subsidising smaller domestic turbines, they would have broken even after eight years. In other words, the micro-turbine works out as a good investment for individuals, but only because the government spends, and arguably wastes, so much money subsidising it. Carbon savings are far lower too.

Nevertheless, although the micro-wind turbine subsidy doesn't look like the best way of spending government resources on climate change mitigation we are talking about investing only about 0.075 percent per year of the nation's GDP to get a one percent reduction in carbon emissions, which is a worthwhile benefit. In other words, it could be much better, but it could be worse. In addition, such investment helps to promote and sustain developing technology.

There is one extra favourable way of looking at the micro-wind turbine, even if it is not the single best way of investing money in cutting carbon. Input-output modelling has told us that it is actually quite difficult to spend money without having a negative carbon impact. So if the subsidy encourages people to spend their money on a carbon-reducing technology such as a wind turbine, rather than on carbon-producing goods like cars, and services such as overseas holidays, then the reductions in emissions will be greater than my simple sums above have suggested.

75/ Pottery production in ancient Akrotiri

Excavations at the site of prehistoric Akrotiri, on the coast of the Aegean Sea, have revealed much about the technical aspects of pottery manufacture, indisputably one the basic industries of this Greek city. However, considerably less is known about the socio-economic context and the way production was organised.

The bulk of pottery found at Akrotiri is locally made, and dates from the late fifteenth century BC. It clearly fulfilled a vast range of the settlement's requirements: more than fifty different types of pots can be distinguished. The pottery found includes a wide variety of functional types like storage jars, smaller containers, pouring vessels, cooking pots, drinking vessels and so on, which all relate to specific activities and which would have been made and distributed with those activities in mind. Given the large number of shapes produced and the relatively high degree of standardisation, it has generally been assumed that most, if not all, of Akrotiri pottery was produced by specialised craftsmen in a non-domestic context. Unfortunately neither the potters' workshops nor kilns have been found within the excavated area. The reason may be that the ceramic workshops were located on the periphery of the site which has not yet been excavated. In any event, the ubiquity of the pottery, and the consistent repetition of the same types in different sizes, suggests production on an industrial scale.

The Akrotirian potters seem to have responded to pressures beyond their households, namely to the increasing complexity of regional distribution and exchange systems. We can imagine them as full-time craftsmen working permanently in a high production-rate craft such as pottery manufacture, and supporting themselves entirely from the proceeds of their crafts. In view of the above, one can begin to speak in terms of mass-produced pottery and the existence of organised workshops of craftsmen during the period 1550-1500 BC. Yet, how pottery production was organised at Akrotiri remains an open question, as there is no real documentary evidence. Our entire knowledge comes from the ceramic material itself, and the tentative conclusions which can be drawn from it.

The invention of units of quantity and of a numerical system to count them was of capital importance for an exchange-geared society such as that of Akrotiri. In spite of the absence of any written records, the archaeological evidence reveals that concepts of measurements, both of weight and number, had been formulated. Standard measures may already have been in operation, such as those evidenced by a graduated series of lead weights – made in disc form – found at the site. The existence of units of capacity in Late Bronze Age times is also evidenced, by the notation of units of a liquid measure for wine n excavated containers.

It must be recognised that the function of pottery vessels plays a very important role in determining their characteristics. The intended function affects the choice of clay, the production technique, and the shape and the size of the pots. For example, large storage jars (pithoi) would

be needed to store commodities, whereas smaller containers would be used for transport. In fact, the length of a man's arm limits the size of a smaller pot to a capacity of about twenty litres; that is also the maximum a man can comfortably carry.

The various sizes of container would thus represent standard quantities of a commodity, which is a fundamental element in the function of exchange. Akrotirian merchants handling a commodity such as wine would have been able to determine easily the amount of wine they were transporting from the number of containers they carried in their ships, since the capacity of each container was known to be 14-18 litres. (We could draw a parallel here with the current practice in Greece of selling oil in l7 kilogram tins.)

We may therefore assume that the shape, capacity, and, sometimes decoration of vessels are indicative of the commodity contained by them. Since individual transactions would normally involve different quantities of a given commodity, a range of 'standardised' types of vessel would be needed to meet traders' requirements.

In trying to reconstruct systems of capacity by measuring the volume of excavated pottery, a rather generous range of tolerances must be allowed. It seems possible that the potters of that time had specific sizes of vessel in mind, and tried to reproduce them using a specific type and amount of clay. However, it would be quite difficult for them to achieve the exact size required every time, without any mechanical means of regulating symmetry and wall thickness, and some potters would be more skilled than others. In addition, variations in the repetition of types and size may also occur because of unforeseen circumstances during the throwing process. For instance, instead of destroying the entire pot if the clay in the rim contained a piece of grit, a potter might produce a smaller pot by simply cutting off the rim. Even where there is no noticeable external difference between pots meant to contain the same quantity of a commodity, differences in their capacity can actually reach one or two litres. In one case the deviation from the required size appears to be as much as 10-20 percent.

The establishment of regular trade routes within the Aegean led to increased movement of goods; consequently a regular exchange of local, luxury and surplus goods, including metals, would have become feasible as a result of the advances in transport technology. The increased demand for standardised exchanges, inextricably linked to commercial transactions, might have been one of the main factors which led to the standardisation of pottery production. Thus, the whole

network of ceramic production and exchange would have depended on specific regional economic conditions, and would reflect the socio-economic structure of prehistoric Akrotiri.

76/ The Rufous Hare-Wallaby

The Rufous Hare-Wallaby is a species of Australian kangaroo, usually known by its Aboriginal name, ‘mala’. At one time, there may have been as many as ten million of these little animals across the arid and semi-arid landscape of Australia, but their populations, like those of so many other small endemic species, were devastated when cats and foxes were introduced - indeed, during the 1950s it was thought that the mala was extinct. But in 1964, a small colony was found 450 miles northwest of Alice Springs in the Tanami Desert. And 12 years later, a second small colony was found nearby. Very extensive surveys were made throughout historical mala range - but no other traces were found.

Throughout the 1970s and 1980s, scientists from the Parks and Wildlife Commission of the Northern Territory monitored these two populations. At first it seemed that they were holding their own. Then in late 1987, every one of the individuals of the second and smaller of the wild colonies was killed. From examination of the tracks in the sand, it seemed that just one single fox had been responsible. And then, in October 1991, a wild-fire destroyed the entire area occupied by the remaining colony. Thus the mala was finally pronounced extinct in the wild.

Fortunately, ten years earlier, seven individuals had been captured, and had become the founders of a captive breeding programme at the Arid Zone Research Institute in Alice Springs; and that group had thrived. Part of this success is due to the fact that the female can breed when she is just five months old and can produce up to three young a year. Like other kangaroo species, the mother carries her young - known as a joey - in her pouch for about 15 weeks, and she can have more than one joey at the same time.

In the early 1980s, there were enough mala in the captive population to make it feasible to start a reintroduction programme. But first it was necessary to discuss this with the leaders of the Yapa people. Traditionally, the mala had been an important animal in their culture, with strong medicinal powers for old people. It had also been an important food source, and there were concerns that any mala returned to the wild would be killed for the pot. And so, in 1980, a group of key Yapa men was invited to visit the proposed reintroduction area. The skills and knowledge of the Yapa would play a significant and enduring role in this and all other mala projects.

With the help of the local Yapa, an electric fence was erected around 250 acres of suitable habitat, about 300 miles northwest of Alice Springs so that the mala could adapt while protected from predators. By 1992, there were about 150 mala in their enclosure, which became known as the Mala Paddock. However, all attempts to reintroduce mala from the paddocks into the unfenced wild were unsuccessful, so in the end the reintroduction programme was abandoned. The team now faced a situation where mala could be bred, but not released into the wild again.

Thus, in 1993, a Mala Recovery Team was established to boost mala numbers, and goals for a new programme were set: the team concentrated on finding suitable predator-free or predator-controlled conservation sites within the mala's known range. Finally, in March 1999, twelve adult females, eight adult males, and eight joeys were transferred from the Mala Paddock to Dryandra Woodland in Western Australia. Then, a few months later, a second group was transferred to Trimouille, an island off the coast of western Australia. First, it had been necessary to rid the island of rats and cats - a task that had taken two years of hard work.

Six weeks after their release into this conservation site, a team returned to the island to find out how things were going. Each of the malas had been fitted with a radio collar that transmits for about 14 months, after which it falls off. The team was able to locate 29 out of the 30 transmitters – only one came from the collar of a mala that had died of unknown causes. So far the recovery programme had gone even better than expected.

Today, there are many signs suggesting that the mala population on the island is continuing to do well.

77/ Measures to combat infectious disease in Tsarist Russia

In the second half of the seventeenth century, Russian authorities began implementing controls at the borders of their empire to prevent the importation of plague, a highly infectious and dangerous disease. Information on disease outbreak occurring abroad was regularly reported to the tsar's court through various means, including commercial channels (travelling merchants), military personnel deployed abroad, undercover agents, the network of Imperial Foreign Office embassies and representations abroad, and the customs offices. For instance, the heads of customs offices were instructed to question foreigners entering Russia about possible epidemics of dangerous diseases in their respective countries.

If news of an outbreak came from abroad, relations with the affected country were suspended. For instance, foreign vessels were not allowed to dock in Russian ports if there was credible information about the existence of epidemics in countries from whence they had departed. In addition, all foreigners entering Russia from those countries had to undergo quarantine. In 1665, after receiving news about a plague epidemic in England, Tsar Alexei wrote a letter to King Charles II in which he announced the cessation of Russian trade relations with England and other foreign states. These protective measures appeared to have been effective, as the country did not record any cases of plague during that year and in the next three decades. It was not until 1692 that another plague outbreak was recorded in the Russian province of Astrakhan. This epidemic continued for five months and killed 10,383 people, or about 65 percent of the city's population. By the end of the seventeenth century, preventative measures had been widely introduced in Russia, including the isolation of persons ill with plague, the imposition of quarantines, and the distribution of explanatory public health notices about plague outbreaks.

During the eighteenth century, although none of the occurrences was of the same scale as in the past, plague appeared in Russia several times. For instance, from 1703 to 1705, a plague outbreak that had ravaged Istanbul spread to the Podolsk and Kiev provinces in Russia, and then to Poland and Hungary. After defeating the Swedes in the battle of Poltava in 1709, Tsar Peter I (Peter the Great) dispatched part of his army to Poland, where plague had been raging for two years. Despite preventive measures, the disease spread among the Russian troops. In 1710, the plague reached Riga (then part of Sweden, now the capital of Latvia), where it was active until 1711 and claimed 60,000 lives. During this period, the Russians besieged Riga and, after the Swedes had surrendered the city in 1710, the Russian army lost 9,800 soldiers to the plague. Russian military chronicles of the time note that more soldiers died of the disease after the capture of Riga than from enemy fire during the siege of that city.

Tsar Peter I imposed strict measures to prevent the spread of plague during these conflicts. Soldiers suspected of being infected were isolated and taken to areas far from military camps. In addition, camps were designed to separate divisions, detachments, and smaller units of soldiers. When plague reached Narva (located in present-day Estonia) and threatened to spread to St. Petersburg, the newly built capital of Russia, Tsar Peter I ordered the army to cordon off the entire boundary along the Luga River, including temporarily halting all activity on the river. In order to prevent the movement of people and goods from Narva to St Petersburg and Novgorod,

roadblocks and checkpoints were set up on all roads. The tsar's orders were rigorously enforced, and those who disobeyed were hung.

However, although the Russian authorities applied such methods to contain the spread of the disease and limit the number of victims, all of the measures had a provisional character: they were intended to respond to a specific outbreak, and were not designed as a coherent set of measures to be implemented systematically at the first sign of plague. The advent of such a standard response system came a few years later.

The first attempts to organise procedures and carry out proactive steps to control plague date to the aftermath of the 1727- 1728 epidemic in Astrakhan. In response to this, the Russian imperial authorities issued several decrees aimed at controlling the future spread of plague. Among these decrees, the 'Instructions for Governors and Heads of Townships' required that all governors immediately inform the Senate – a government body created by Tsar Peter I in 1711 to advise the monarch – if plague cases were detected in their respective provinces. Furthermore, the decree required that governors ensure the physical examination of all persons suspected of carrying the disease and their subsequent isolation. In addition, it was ordered that sites where plague victims were found had to be encircled by checkpoints and isolated for the duration of the outbreak. These checkpoints were to remain operational for at least six weeks. The houses of infected persons were to be burned along with all of the personal property they contained, including farm animals and cattle. The governors were instructed to inform the neighbouring provinces and cities about every plague case occurring on their territories. Finally, letters brought by couriers were heated above a fire before being copied.

The implementation by the authorities of these combined measures demonstrates their intuitive understanding of the importance of the timely isolation of infected people to limit the spread of plague.

78/ Recovering a damaged reputation

In 2009, it was revealed that some of the information published by the University of East Anglia's Climatic Research Unit (CRU) in the UK, concerning climate change, had been inaccurate. Furthermore, it was alleged that some of the relevant statistics had been withheld from publication. The ensuing controversy affected the reputation not only of that institution, but also of the Intergovernmental Panel on Climate Change (IPCC), with which the CRU is closely

involved, and of climate scientists in general. Even if the claims of misconduct and incompetence were eventually proven to be largely untrue, or confined to a few individuals, the damage was done. The perceived wrongdoings of a few people had raised doubts about the many.

The response of most climate scientists was to cross their fingers and hope for the best, and they kept a low profile. Many no doubt hoped that subsequent independent inquiries into the IPCC and CRU would draw a line under their problems. However, although these were likely to help, they were unlikely to undo the harm caused by months of hostile news reports and attacks by critics.

The damage that has been done should not be underestimated. As Ralph Cicerone, the President of the US National Academy of Sciences, wrote in an editorial in the journal Science: 'Public opinion has moved toward the view that scientists often try to suppress alternative hypotheses and ideas and that scientists will withhold data and try to manipulate some aspects of peer review to prevent dissent.' He concluded that 'the perceived misbehavior of even a few scientists can diminish the credibility of science as a whole.'

An opinion poll taken at the beginning of 2010 found that the proportion of people in the US who trust scientists as a source of information about global warming had dropped from 83 percent, in 2008, to 74 percent. Another survey carried out by the British Broadcasting Corporation in February 2010 found that Just 26 percent of British people now believe that climate change is confirmed as being largely human-made, down from 41 percent in November 2009.

Regaining the confidence and trust of the public is never easy. Hunkering down and hoping for the beest – climate science's current strategy - makes it almost impossible. It is much better to learn from the successes and failures of organisations that have dealt with similar blows to their public standing.

In fact, climate science needs professional help to rebuild its reputation. It could do worse than follow the advice given by Leslie Gaines-Ross, a 'reputation strategist' at Public Relations (PR) company Weber Shandwick, in her recent book Corporate Reputation: 12 Steps to Safeguarding and Recovering Reputation. Gaines-Ross's strategy is based on her analysis of how various organisations responded to crises, such as desktop-printer firm Xerox, whose business

plummeted during the 1990s and the USA's National Aeronautics and Space Administration (NASA) after the Columbia shuttle disaster in 2003.

The first step she suggests is to 'take the heat - leader first'. In many cases, chief executives who publicly accept responsibility for corporate failings can begin to reverse the freefall of their company's reputations, but not always. If the leader is held at least partly responsible for the fall from grace, it can be almost impossible to convince critics that a new direction can be charted with that same person at the helm.

This is the dilemma facing the heads of the IPCC and CRU. Both have been blamed for their organisations' problems, not least for the way in which they have dealt with critics, and both have been subjected to public calls for their removal. Yet both organisations appear to believe they can repair their reputations without a change of leadership.

The second step outlined by Gaines-Ross is to 'communicate tirelessly'. Yet many climate researchers have avoided the media and the public, at least until the official enquiries have concluded their reports. This reaction may be understandable, but it has backfired. Journalists following the story have often been unable to find spokespeople willing to defend climate science. In this case, 'no comment' is commonly interpreted as an admission of silent, collective guilt.

Remaining visible is only a start, though; climate scientists also need to be careful what they say. They must realise that they face doubts not just about their published results, but also about their conduct and honesty. It simply won't work for scientists to continue to appeal to the weight of the evidence, while refusing to discuss the integrity of their profession. The harm has been increased by a perceived reluctance to admit even the possibility of mistakes or wrongdoing.

The third step put forward by Gaines-Ross is 'don't underestimate your critics and competitors'. This means not only recognising the skill with which the opponents of climate research have executed their campaigns through Internet blogs and other media, but also acknowledging the validity of some of their criticisms. It is clear, for instance, that climate scientists need better standards of transparency, to allow for scrutiny not just by their peers, but also by critics from outside the world of research.

It is also important to engage with those critics. That doesn't mean conceding to unfounded arguments which are based on prejudice rather than evidence, but there is an obligation to help

the public understand the causes of climate change, as well as the options for avoiding and dealing with the consequences.

To begin the process of rebuilding trust in their profession, climate scientists need to follow these three steps. But that is just the start. Gaines-Ross estimates that it typically takes four years for a company to rescue and restore a broken reputation.

Winning back public confidence is a marathon, not a sprint, but you can't win at all if you don't step up to the starting line.

79/ Geoff Brash

Geoff Brash, who died in 2010, was a gregarious Australian businessman and philanthropist who encouraged the young to reach their potential.

Born in Melbourne to Elsa and Alfred Brash, he was educated at Scotch College. His sister, Barbara, became a renowned artist and printmaker. His father, Alfred, ran the Brash retail music business that had been founded in 1862 by his grandfather, the German immigrant Marcus Brasch, specialising in pianos. It carried the slogan 'A home is not a home without a piano.'

In his young days, Brash enjoyed the good life, playing golf and sailing, and spending some months travelling through Europe, having a leisurely holiday. He worked for a time at Myer department stores before joining the family business in 1949, where he quickly began to put his stamp on things. In one of his first management decisions, he diverged from his father's sense of frugal aesthetics by re-carpeting the old man's office while he was away. After initially complaining of his extravagance, his father grew to accept the change and gave his son increasing responsibility in the business.

After World War II (1939-1945), Brash's had begun to focus on white goods, such as washing machines and refrigerators, as the consumer boom took hold. However, while his father was content with the business he had built, the younger Brash viewed expansion as vital. When Geoff Brash took over as managing director in l957, the company had two stores, but after floating it on the stock exchange the following year, he expanded rapidly and opened suburban stores, as well as buying into familiar music industry names such as Allans, Palings and Suttons. Eventually, 170 stores traded across the continent under the Brash's banner.

Geoff Brash learned from his father's focus on customer service. Alfred Brash had also been a pioneer in introducing a share scheme for his staff, and his son retained and expanded the plan following the float.

Geoff Brash was optimistic and outward looking. As a result, he was a pioneer in both accessing and selling new technology, and developing overseas relationships. He sourced and sold electric guitars, organs, and a range of other modern instruments, as well as state-of-the-art audio and video equipment. He developed a relationship with Taro Kakehashi, the founder of Japan's Roland group, which led to a joint venture that brought electronic musical devices to Australia.

In 1965, Brash and his wife attended a trade fair in Guangzhou, the first of its kind in China; they were one of the first Western business people allowed into the country following Mao Zedong's Cultural Revolution. He returned there many times, helping advise the Chinese in establishing a high quality piano factory in Beijing; he became the factory's agent in Australia. Brash also took leading jazz musicians Don Burrows and James Morrison to China, on a trip that reintroduced jazz to many Chinese musicians.

He stood down as Executive Chairman of Brash's in 1988, but under the new management debt became a problem, and in 1994 the banks called in administrators. The company was sold to Singaporean interests and continued to trade until 1998, when it again went into administration. The Brash name then disappeared from the retail world. Brash was greatly disappointed by the collapse and the eventual disappearance of the company he had run for so long. But it was not long before he invested in a restructured Allan's music business.

Brash was a committed philanthropist who, in the mid-1980s, established the Brash Foundation, which eventually morphed, with other partners, into the Soundhouse Music Alliance. This was a not-for-profit organisation overseeing and promoting multimedia music making and education for teachers and students. The Soundhouse offers teachers and young people the opportunity to get exposure to the latest music technology, and to use this to compose and record their own music, either alone or in collaboration. The organisation has now also established branches in New Zealand, South Africa and Ireland, as well as numerous sites around Australia.

80/ Early occupations around the river Thames

In her pioneering survey, Sources of London English, Laura Wright has listed the variety of medieval workers who took their livings from the river Thames. The baillies of Queenhithe and Billingsgate acted as customs officers. There were conservators, who were responsible for

maintaining the embankments and the weirs, and there were the garthmen who worked in the fish garths (enclosures). Then there were galleymen and lightermen and shoutmen, called after the names of their boats, and there were hookers who were named after the manner in which they caught their fish. The searcher patrolled the Thames in search of illegal fish weirs, and the tideman worked on its banks and foreshores whenever the tide permitted him to do so.

All of these occupations persisted for many centuries, as did those jobs that depended upon the trade of the river. Yet, it was not easy work for any of the workers. They carried most goods upon their backs, since the rough surfaces of the quays and nearby streets were not suitable for wagons or large carts; the merchandise characteristically arrived in barrels which could be rolled from the ship along each quay. If the burden was too great to be carried by a single man, then the goods were slung on poles resting on the shoulders of two men. It was a slow and expensive method of business.

However, up to the eighteenth century, river work was seen in a generally favourable light. For Langland, writing in the fourteenth century, the labourers working on river merchandise were relatively prosperous. And the porters of the seventeenth and early eighteenth centuries were, if anything, aristocrats of labour, enjoying high status. However, in the years from the late eighteenth to the early nineteenth century, there was a marked change in attitude. This was in part because the working river was within the region of the East End of London, which in this period acquired an unenviable reputation. By now, dockside labour was considered to be the most disreputable, and certainly the least desirable form of work.

It could be said that the first industrial community in England grew up around the Thames. With the host of river workers themselves, as well as the vast assembly of ancillary trades such as tavern-keepers and laundresses, food-sellers and street-hawkers, shopkeepers and marine store dealers – there was a workforce of many thousands congregated in a relatively small area. There were more varieties of business to be observed by the riverside than in any other part of the city. As a result, with the possible exception of the area known as Seven Dials, the East End was also the most intensively inhabited region of London.

It was a world apart, with its own language and its own laws. From the sailors in the opium dens of Limehouse to the smugglers on the malarial flats of the estuary, the workers of the river were not part of any civilised society. The alien world of the river had entered them. That alienation was also expressed in the slang of the docks, which essentially amounted to backslang, or the

reversal of ordinary words. This backslang also helped in the formulation of Cockney rhyming slang1, so that the vocabulary of Londoners was directly affected by the life of the Thames.

The reports in the nineteenth-century press reveal a heterogeneous world of dock labour, in which the crowds of casuals waiting for work at the dock gates at 7.45 a.m. include penniless refugees, bankrupts, old soldiers, broken-down gentlemen, discharged servants, and ex-convicts. There were some 400-500 permanent workers who earned a regular wage and who were considered to be the patricians of dockside labour. However, there were some 2,500 casual workers who were hired by the shift. The work for which they competed fiercely had become ever more unpleasant. Steam power could not be used for the cranes, for example, because of the danger of fire. So the cranes were powered by treadmills. Six to eight men entered a wooden cylinder and, laying hold of ropes, would tread the wheel round. They could lift nearly 20 tonnes to an average height of 27 feet (8.2 metres), forty times in an hour. This was part of the life of the river unknown to those who were intent upon its more picturesque aspects.

81/ Video game research

Although video games were first developed for adults, they are no longer exclusively reserved for the grown-ups in the home. In 2006, Rideout and Hamel reported that as many as 29 percent of preschool children (children between two and six years old) in the United States had played console video games, and 18 percent had played hand-held ones. Given young children's insatiable eagerness to learn, coupled with the fact that they are clearly surrounded by these media, we predict that preschoolers will both continue and increasingly begin to adopt video games for personal enjoyment. Although the majority of gaming equipment is still designed for a much older target audience, once a game system enters the household it is potentially available for all family members, including the youngest. Portable systems have done a particularly good job of penetrating the younger market.

Research in the video game market is typically done at two stages: some time close to the end of the product cycle, in order to get feedback from consumers, so that a marketing strategy can be deve1oped; and at the very end of the product cycle to 'fix bugs' in the game. While both of those types of research are important, and may be appropriate for dealing with adult consumers, neither of them aids in designing better games, especially when it comes to designing for an audience that may have particular needs, such as preschoolers or senior citizens. Instead,

exploratory and formative research has to be undertaken in order to truly understand those audiences, their abilities, their perspective, and their needs. In the spring of 2007, our preschool-game production team at Nickelodeon had a hunch that the Nintendo DS – with its new features, such as the microphone, small size and portability, and its relatively low price point was a ripe gaming platform for preschoolers. There were a few games on the market at the time which had characters that appealed to the younger set, but our game producers did not think that the game mechanics or design were appropriate for preschoolers. What exactly preschoolers could do with the system, however, was a bit of a mystery. So we set about doing a study to answer the query: What could we expect preschoolers to be capable of in the context of hand-held game play, and how might the child development literature inform us as we proceeded with the creation of a new outlet for this age group?

Our context in this case was the United States, although the games that resulted were also released in other regions, due to the broad international reach of the characters. In order to design the best possible DS product for a preschool audience we were fully committed to the ideals of a 'user-centered approach', which assumes that users will be at least considered, but ideally consulted during the development process. After all, when it comes to introducing a new interactive product to the child market, and particularly such a young age group within it, we believe it is crucial to assess the range of physical and cognitive abilities associated with their specific developmental stage.

Revelle and Medoff (2002) review some of the basic reasons why home entertainment systems, computers, and other electronic gaming devices, are often difficult for preschoolers to use. In addition to their still developing motor skills (which make manipulating a controller with small buttons difficult), many of the major stumbling blocks are cognitive. Though preschoolers are learning to think symbolically, and understand that pictures can stand for real-life objects, the vast majority are still unable to read and write. Thus, using text-based menu selections is not viable. Mapping is yet another obstacle since preschoolers may be unable to understand that there is a direct link between how the controller is used and the activities that appear before them on screen. Though this aspect is changing, in traditional mapping systems real life movements do not usually translate into game-based activity.

Over the course of our study, we gained many insights into how preschoolers interact with various platforms, including the DS. For instance, all instructions for preschoolers need to be in

voiceover, and include visual representations, and this has been one of the most difficult areas for us to negotiate with respect to game design on the DS. Because the game cartridges have very limited memory capacity, particularly in comparison to console or computer games, the ability to capture large amounts of voiceover data via sound files or visual representations of instructions becomes limited. Text instructions take up minimal memory, so they are preferable from a technological perspective. Figuring out ways to maximize sound and graphics files, while retaining the clear visual and verbal cues that we know are critical for our youngest players, is a constant give and take. Another of our findings indicated that preschoolers may use either a stylus, or their fingers, or both although they are not very accurate with either. One of the very interesting aspects of the DS is that the interface, which is designed to respond to stylus interactions, can also effectively be used with the tip of the finger. This is particularly noteworthy in the context of preschoolers for two reasons. Firstly, as they have trouble with fine motor skills and their hand-eye coordination is still in development, they are less exact with their stylus movements; and secondly, their fingers are so small that they mimic the stylus very effectively, and therefore by using their fingers they can often be more accurate in their game interactions.

82/ The economic importance of coral reefs

A lot of people around the world are dependent, or partly dependent, on coral reefs for their livelihoods. They often live adjacent to the reef, and their livelihood revolves around the direct extraction, processing and sale of reef resources such as shell fish and seaweeds. In addition, their homes are sheltered by the reef from wave action.

Reef flats and shallow reef lagoons are accessible on foot, without the need for a boat, and so allow women, children and the elderly to engage directly in manual harvesting, or ‘reef-gleaning’. This is a significant factor distinguishing reef-based fisheries from nearshore sea fisheries. Near-shore fisheries are typically the domain of adult males, in particular where they involve the use of boats, with women and children restricted mainly to shore-based activities. However, in a coral-reef fishery the physical accessibility of the reef opens up opportunities for direct participation by women, and consequently increases their independence and the importance of their role in the community. It also provides a place for children to play, and to acquire important skills and knowledge for later in life. For example, in the South West Island of

Tobi, in the Pacific Ocean, young boys use simple hand lines with a loop and bait at the end to develop the art of fishing on the reef. Similarly, in the Surin Islands of Thailand, young Moken boys spend much of their time playing, swimming and diving in shallow reef lagoons, and in doing so build crucial skills for their future daily subsistence.

Secondary occupations, such as fish processing and marketing activities, are often dominated by women, and offer an important survival strategy for households with access to few other physical assets (such as boats and gear), for elderly women, widows, or the wives of infirm men. On Ulithi Atoll in the western Pacific, women have a distinct role and rights in the distribution of fish catches. This is because the canoes, made from mahogany logs from nearby Yap Island, are obtained through the exchange of cloth made by the women of Ulithi. Small-scale reef fisheries support the involvement of local women traders and their involvement can give them greater control over the household income, and in negotiating for loans or credit. Thus their role is not only important in providing income for their families, it also underpins the economy of the local village.

Poor people with little access to land, labour and financial resources are particularly reliant on exploiting natural resources, and consequently they are vulnerable to seasonal changes in availability of those resources. The diversity of coral reef fisheries, combined with their physical accessibility and the protection they provide against bad weather, make them relatively stable compared with other fisheries, or land-based agricultural production.

In many places, the reef may even act as a resource bank, used as a means of saving food for future times of need. In Manus, Papua New Guinea, giant clams are collected and held in walled enclosures on the reef, until they are needed during periods of rough weather. In Palau, sea cucumbers are seldom eaten during good weather in an effort to conserve their populations for months during which rough weather prohibits good fishing.

Coral reef resources also act as a buffer against seasonal lows in other sectors, particularly agriculture. For example, in coastal communities in northern Mozambique, reef harvests provide key sources of food and cash when agricultural production is low, with the peak in fisheries production coinciding with the period of lowest agricultural stocks. In Papua New Guinea, while agriculture is the primary means of food production, a large proportion of the coastal population engage in sporadic subsistence fishing.

In many coral-reef areas, tourism is one of the main industries bringing employment, and in many cases is promoted to provide alternatives to fisheries-based livelihoods, and to ensure that local reef resources are conserved. In the Caribbean alone, tours based on scuba-diving have attracted 20 million people in one year. The upgrading of roads and communications associated with the expansion of tourism may also bring benefits to local communities. However, plans for development must be considered carefully. The ability of the poorer members of the community to access the benefits of tourism is far from guaranteed, and requires development guided by social, cultural and environmental principles. There is growing recognition that sustainability is a key requirement, as encompassed in small-scale eco-tourism activities, for instance.

When tourism development has not been carefully planned, and the needs and priorities of the local community have not been properly recognized, conflict has sometimes arisen between tourism and local, small-scale fishers.

83/ Acquiring the principles of mathematics and sciences

It has been painted out that learning mathematics and science is not so much learning facts as learning ways of thinking. It has also been emphasised that in order to learn science, people often have to change the way they think in ordinary situations. For example, in order to understand even simple concepts such as heat and temperature, ways of thinking of temperature as a measure of heat must be abandoned and a distinction between ‘temperature’ and ‘heat’ must be learned. These changes in ways of thinking are often referred to as conceptual changes. But how do conceptual changes happen? How do young people change their ways of thinking as they develop and as they learn in school?

Traditional instruction based on telling students how modern scientists think does not seem to be very successful. Students may learn the definitions, the formulae, the terminology, and yet still maintain their previous conceptions. This difficulty has been illustrated many times, for example, when instructed students are interviewed about heat and temperature. It is often identified by teachers as a difficulty in applying the concepts learned in the classroom; students may be able to repeat a formula but fail to use the concept represented by the formula when they explain observed events.

The psychologist Piaget suggested an interesting hypothesis relating to the process of cognitive change in children. Cognitive change was expected to result from the pupils’ own intellectual

activity. When confronted with a result that challenges their thinking – that is, when faced with conflict – pupils realise that they need to think again about their own ways of solving problems, regardless of whether the problem is one in mathematics or in science. He hypothesised that conflict brings about disequilibrium, and then triggers equilibration processes that ultimately produce cognitive change. For this reason, according to Piaget and his colleagues, in order for pupils to progress in their thinking they need to be actively engaged in solving problems that will challenge their current mode of reasoning. However, Piaget also pointed out that young children do not always discard their ideas in the face of contradictory evidence. They may actually discard the evidence and keep their theory.

Piaget's hypothesis about how cognitive change occurs was later translated into an educational approach which is now termed 'discovery learning'. Discovery learning initially took what is now considered the 'lone learner' route. The role of the teacher was to select situations that challenged the pupils' reasoning; and the pupils' peers had no real role in this process. However, it was subsequently proposed that interpersonal conflict, especially with peers, might play an important role in promoting cognitive change. This hypothesis, originally advanced by Perret-Clermont (1980) and Doise and Mugny (1984), has been investigated in many recent studies of science teaching and learning.

Christine Howe and her colleagues, for example, have compared children's progress in understanding several types of science concepts when they are given the opportunity to observe relevant events. In one study, Howe compared the progress of 8 to 12-year-old children in understanding what influences motion down a slope. In order to ascertain the role of conflict in group work, they created two kinds of groups according to a pre-test: one in which the children had dissimilar views, and a second in which the children had similar views. They found support for the idea that children in the groups with dissimilar views progressed more after their training sessions than those who had been placed in groups with similar views. However, they found no evidence to support the idea that the children worked out their new conceptions during their group discussions, because progress was not actually observed in a post-test immediately after the sessions of group work, but rather in a second test given around four weeks after the group work.

In another study, Howe set out to investigate whether the progress obtained through pair work could be a function of the exchange of ideas. They investigated the progress made by

12-15-year-old pupils in understanding the path of falling objects, a topic that usually involves conceptual difficulties. In order to create pairs of pupils with varying levels of dissimilarity in their initial conceptions, the pupils' predictions and explanations of the path of falling objects were assessed before they were engaged in pair work. The work sessions involved solving computer-presented problems, again about predicting and explaining the paths of falling objects. A post-test, given to individuals, assessed the progress made by pupils in their conceptions of what influenced the path of falling objects.

84/ Learning lessons from the past

Many past societies collapsed or vanished, leaving behind monumental rums such as those that the poet Shelley imagined in his sonnet, Ozymandias. By collapse, I mean a drastic decrease in human population size and/or political/economic/social complexity, over a considerable area, for an extended time. By those standards, most people would consider the following past societies to have been famous victims of full-fledged collapses rather than of just minor declines: the Anasazi and Cahokia within the boundaries of the modern US, the Maya cities in Central America, Moche and Tiwanaku societies in South America, Norse Greenland, Mycenean Greece and Minoan Crete in Europe, Great Zimbabwe in Africa, Angkor Wat and the Harappan Indus Valley cities in Asia, and Easter Island in the Pacific Ocean.

The monumental ruins left behind by those past societies hold a fascination for all of us. We marvel at them when as children we first learn of them through pictures. When we grow up, many of us plan vacations in order to experience them at first hand. We feel drawn to their often spectacular and haunting beauty, and also to the mysteries that they pose. The scales of the ruins testify to the former wealth and power of their builders. Yet these builders vanished, abandoning the great structures that they had created at such effort. How could a society that was once so mighty end up collapsing?

It has long been suspected that many of those mysterious abandonments were at least partly triggered by ecological problems: people inadvertently destroying the environmental resources on which their societies depended. This suspicion of unintended ecological suicide (ecocide) has been confirmed by discoveries made in recent decades by archaeologists, climatologists, historians, paleontologists, and palynologists (pollen scientists). The processes through which past societies have undermined themselves by damaging their environments fall into eight

categories, whose relative importance differs from case to case: deforestation and habitat destruction, soil problems, water management problems, overhunting, overfishing, effects of introduced species on native species, human population growth, and increased impact of people.

Those past collapses tended to follow somewhat similar courses constituting variations on a theme. Writers find it tempting to draw analogies between the course of human societies and the course of individual human lives – to talk of a society's birth, growth, peak, old age and eventual death. But that metaphor proves erroneous for many past societies: they declined rapidly after reaching peak numbers and power, and those rapid declines must have come as a surprise and shock to their citizens. Obviously, too, this trajectory is not one that all past societies followed unvaryingly to completion: different societies collapsed to different degrees and in somewhat different ways, while many societies did not collapse at all.

Today many people feel that environmental problems overshadow all the other threats to global civilisation. These environmental problems include the same eight that undermined past societies, plus four new ones: human-caused climate change, buildup of toxic chemicals in the environment, energy shortages, and full human utilisation of the Earth's photosynthetic capacity. But the seriousness of these current environmental problems is vigorously debated. Are the risks greatly exaggerated, or conversely are they underestimated? Will modern technology solve our problems, or is it creating new problems faster than it solves old ones? When we deplete one resource (e.g. wood, oil, or ocean fish), can we count on being able to substitute some new resource (e.g. plastics, wind and solar energy, or farmed fish)? Isn't the rate of human population growth declining, such that we're already on course for the world's population to level off at some manageable number of people?

Questions like this illustrate why those famous collapses of past civilisations have taken on more meaning than just that of a romantic mystery. Perhaps there are some practical lessons that we could learn from all those past collapses. But there are also differences between the modern world and its problems, and those past societies and their problems. We shouldn't be so naive as to think that study of the past will yield simple solutions, directly transferable to our societies today. We differ from past societies in some respects that put us at lower risk than them; some of those respects often mentioned include our powerful technology (i.e. its beneficial effects), globalisation, modern medicine, and greater knowledge of past societies and of distant modern societies. We also differ from past societies in some respects that put us at greater risk than them:

again, our potent technology (i.e., its unintended destructive effects), globalisation (such that now a problem in one part of the world affects all the rest), the dependence of millions of us on modern medicine for our survival, and our much larger human population. Perhaps we can still learn from the past, but only if we think carefully about its lessons.

85/ Trends in the Indian fashion and textile industries

During the 1950s, the Indian fashion scene was exciting, stylish and very graceful. There were no celebrity designers or models, nor were there any labels that were widely recognised. The value of a garment was judged by its style and fabric rather than by who made it. It was regarded as perfectly acceptable, even for high-society women, to approach an unknown tailor who could make a garment for a few rupees, providing the perfect fit, finish and style. They were proud of getting a bargain, and of giving their own name to the end result.

The 1960s was an era full of mischievousness and celebration in the arts, music and cinema. The period was characterised by freedom from restrictions and, in the fashion world, an acceptance of innovative types of material such as plastic and coated polyester. Tight-fitting kurtas1 and churidars2 and high coiffures were a trend among women.

The following decade witnessed an increase in the export of traditional materials, and the arrival in India of international fashion. Synthetics became trendy, and the disco culture affected the fashion scene.

It was in the early 80s when the first fashion store 'Ravissant' opened in Mumbai. At that time garments were retailed for a fourfigure price tag. American designers like Calvin Klein became popular. In India too, contours became more masculine, and even the salwar kameez3 was designed with shoulder pads.

With the evolution of designer stores came the culture of designer fashion, along with its hefty price tags. Whatever a garment was like, consumers were convinced that a higher price tag signified elegant designer fashion, so garments were sold at unbelievable prices. Meanwhile, designers decided to get themselves noticed by making showy outfits and associating with the right celebrities. Soon, fashion shows became competitive, each designer attempting to out-do the other in theme, guest list and media coverage.

In the last decade of the millennium, the market shrank and ethnic wear made a comeback. During the recession, there was a push to sell at any cost. With fierce competition the inevitable

occurred: the once hefty price tags began their downward journey, and the fashion-show industry followed suit. However, the liveliness of the Indian fashion scene had not ended – it had merely reached a stable level.

At the beginning of the 21st century, with new designers and models, and more sensible designs, the fashion industry accelerated once again. As far as the global fashion industry is concerned, Indian ethnic designs and materials are currently in demand from fashion houses and garment manufactures. Indian is the third largest producer of cotton, the second largest producer of silk, and the fifth largest producer of man-made fibres in the world.

The Indian garment and fabric industries have many fundamental advantages, in terms of a cheaper, skilled work force, costeffective production, raw materials, flexibility, and a wide range of designs with sequins, beadwork, and embroidery. In addition, that Indian provides garments to international fashion houses at competitive prices, with a shorter lead time, and an effective monopoly on certain designs, is accepted the whole world over. India has always been regarded as the default source in the embroidered garments segment, but changes in the rate of exchange between the rupee and the dollar has further depressed prices, thereby attracting more buyers. So the international fashion houses walk away with customised goods, and craftwork is sold at very low rates.

As far as the fabric market is concerned, the range available in India can attract as well as confuse the buyer. Much of the production takes place in the small town of Chapa in the eastern state of Bihar, a name one might never have heard of. Here fabric-making is a family industry; the range and quality of raw silks churned out here belie the crude production methods and equipment. Surat in Gujarat is the supplier of an amazing set of jacquards, moss crepes and georgette sheers – all fabrics in high demand. Another Indian fabric design that has been adopted by the fashion industry is the ‘Madras check’, originally utilised for the universal lungi, a simple lower-body wrap worn in southern India. This design has now found its way on to bandannas, blouses, home furnishings and almost anything one can think of.

Ethnic Indian designs with batik and hand-embroidered motifs have also become popular across the world. Decorative bead work is another product in demand in the international market. Beads are used to prepare accessory items like belts and bags, and beadwork is now available for haute couture evening wear too.

86/ Sustainable growth at Didcot: the outline of a report by south Oxfordshire District Council

The UK Government's South East Plan proposes additional housing growth in the town of Didcot, which has been a designated growth area since 1979. We in South Oxfordshire District Council consider that, although Didcot does have potential for further growth, such development should be sustainable, well-planned, and supported by adequate infrastructure and community services.

Recent experience in Didcot has demonstrated that large greenfield developments cannot resource all the necessary infrastructure and low-cost housing requirements. The ensuing compromises create a legacy of local transport, infrastructure and community services deficits, with no obvious means of correction. We wish to ensure that there is greater recognition of the cost attached to housing growth, and that a means is found to resource the establishment of sustainable communities in growth areas.

Until the 1950s, the development of job opportunities in the railway industry, and in a large, military ordnance depot, was the spur to Didcot's expansion. Development at that time was geared to providing homes for the railway and depot workers, with limited investment in shopping and other services for the local population. Didcot failed to develop Broadway as a compact town centre, and achieved only a strip of shops along one Side of the main street hemmed in by low density housing and service trade uses.

From the 1970s, strategic planning policies directed significant new housing development to Didcot. Planners recognised Didcot's potential, with rapid growth in local job opportunities and good rail connections for those choosing to work farther afield. However, the town is bisected by the east-west railway, and people living in Ladygrove, the urban extension to the north which has been built since the 1980s, felt, and still feel, cut off from the town and its community.

Population growth in the new housing areas failed to Spark adequate private-sector investment in town centre uses, and the limited investment which did take place – Didcot Market Place development in 1982, for instance – did not succeed in delivering the number and range of town centre uses needed by the growing population. In 1990, public-sector finance was used to buy the land required for the Orchard Centre development, comprising a superstore, parking and a new street of stores running parallel to Broadway. The development took 13 years to complete.

The idea that, by obliging developers of new housing to contribute to the cost of infrastructure and service requirements, all the necessary finance could be raised, has proved unachievable. Substantial public finance was still needed to deliver major projects such as the new link road to the A34 on the outskirts of the town at Milton, the improved railway crossing at Marsh Bridge and new schools. Such projects were delayed due to difficulties in securing public finance. The same problem also held back expansion of health and social services in the town.

In recent years, government policy, in particular the requirement for developers that forty percent of the units in a new housing development should be low cost homes, has had a major impact on the economics of such development, as it has limited the developers' contribution to the costs of infrastructure. The planning authorities are facing difficult choices in prioritising the items of infrastructure which must be funded by development, and this, in turn, means that from now on public finance will need to provide a greater proportion of infrastructure project costs.

The Government's Sustainable Communities Plan seeks a holistic approach to new urban development in which housing, employment, services and infrastructure of all kinds are delivered in a way which avoids the infrastructure deficits that have occurred in places like Didcot in the past. This report, therefore, is structured around the individual components of a sustainable community, and shows the baseline position for each component.

Didcot has been identified as one of the towns with which the Government is working to evaluate whether additional growth will strengthen the economic potential of the town, deliver the necessary infrastructure and improve environmental standards. A programme of work, including discussions with the local community about their aspirations for the town as well as other stakeholders, will be undertaken over the coming months, and will lead to the development of a strategic master plan. The challenge will be in optimizing scarce resources to achieve maximum benefits for the town.

87/ Language diversity

One of the most influential ideas in the study of languages is that of universal grammar (UG). Put forward by Noam Chomsky in the 1960s, it is widely interpreted as meaning that all languages are basically the same, and that the human brain is born language-ready, with an in-built programme that is able to interpret the common rules underlying any mother tongue. For five decades this idea prevailed, and influenced work in linguistics, psychology and cognitive

science. To understand language, it implied, you must sweep aside the huge diversity of languages, and find their common human core.

Since the theory of UG was proposed, linguists have identified many universal language rules. However, there are almost always exceptions. It was once believed, for example, that if a language had syllables that begin with a vowel and end with a consonant (VC), it would also have syllables that begin with a consonant and end with a vowel (CV). This universal lasted until 1999, when linguists showed that Arrernte, spoken by Indigenous Australians from the area around Alice Springs in the Northern Territory, has VC syllables but no CV syllables.

Other non-universal universals describe the basic rules of putting words together. Take the rule that every language contains four basic word classes: nouns, verbs, adjectives and adverbs. Work in the past two decades has shown that several languages lack an open adverb class, which means that new adverbs cannot be readily formed, unlike in English where you can turn any adjective into an adverb, for example ‘soft‘ into ‘softly’. Others, such as Lao, spoken in Laos, have no adjectives at all. More controversially, some linguists argue that a few languages, such as Straits Salish, spoken by indigenous people from north-western regions of North America, do not even have distinct nouns or verbs. Instead they have a single class of words to include events, objects and qualities.

Even apparently indisputable universals have been found lacking. This includes recursion, or the ability to infinitely place one grammatical unit inside a similar unit, such as ‘Jack thinks that Mary thinks that the bus will be on time’. It is widely considered to be the most essential characteristic of human language, one that sets it apart from the communications of all other animals. Yet Dan Everett at Illinois State University recently published controversial work showing that Amazonian Piraha does not have this quality.

But what if the very diversity of languages is the key to understanding human communication? Linguists Nicholas Evans of the Australian National University in Canberra, and Stephen Levinson of the Max Planck Institute for Psycholinguistics in Nijmegen, the Netherlands, believe that languages do not share a common set of rules. Instead, they say, their sheer variety is a defining feature of human communication – something not seen in other animals. While there is no doubt that human thinking influences the form that language takes, if Evans and Levinson are correct, language in turn shapes our brains. This suggests that humans are more diverse than we thought, with our brains having differences depending on the language environment in which we

grew up. And that leads to a disturbing conclusion: every time a language becomes extinct, humanity loses an important piece of diversity.

If languages do not obey a single set of shared rules, then how are they created? ‘Instead of universals, you get standard engineering solutions that languages adopt again and again, and then you get outliers,’ says Evans. He and Levinson argue that this is because any given language is a complex system shaped by many factors, including culture, genetics and history. There are no absolutely universal traits of language, they say, only tendencies. And it is a mix of strong and weak tendencies that characterises the ‘bio-cultural’ mix that we call language.

According to the two linguists, the strong tendencies explain why many languages display common patterns. A variety of factors tend to push language in a similar direction, such as the structure of the brain, the biology of speech, and the efficiencies of communication. Widely shared linguistic elements may also be ones that build on a particularly human kind of reasoning. For example, the fact that before we learn to speak we perceive the world as a place full of things causing actions (agents) and things having actions done to them (patients) explains why most languages deploy these grammatical categories.

Weak tendencies, in contrast, are explained by the idiosyncrasies of different languages. Evans and Levinson argue that many aspects of the particular natural history of a population may affect its language. For instance, Andy Butcher at Flinders University in Adelaide, South Australia, has observed that indigenous Australian children have by far the highest incidence of chronic middle-ear infection of any population on the planet, and that most indigenous Australian languages lack many sounds that are common in other languages, but which are hard to hear with a middle-ear infection. Whether this condition has shaped the sound systems of these languages is unknown, says Evans, but it is important to consider the idea.

Levinson and Evans are not the first to question the theory of universal grammar, but no one has summarised these ideas quite as persuasively, and given them as much reach. As a result, their arguments have generated widespread enthusiasm, particularly among those linguists who are tired of trying to squeeze their findings into the straitjacket of ‘absolute universals’. To some, it is the final nail in UG’s coffin. Michael Tomasello, co-director of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, has been a long-standing critic of the idea that all languages conform to a set of rules. ‘Universal grammar is dead,’ he says.

88/ Space

Is humanity running out of space or will we find new frontiers? As populations grow, people have to look for more innovative ways to provide space.

The world has changed dramatically since Thomas Malthus's work An Essay on the Principle of Population, first published in 1798, argued that by the mid 1800s the unrestricted expansion of the human population would outgrow the agricultural land available to supply humanity with food. Over 150 years have passed since this theoretical milestone, but mankind, admittedly somewhat more cramped, is still expanding and will continue to do so.

The impact of unfettered population growth is clear for all to see. Urbanization is now a more evident worldwide phenomenon than previously as even greater numbers of people drift from rural areas to vast cities all over the world like Tokyo, Mexico City and Mumbai (26.4 million, 18.4 million and 18.1 million inhabitants in 2000 respectively) in their quest for a better life. These mega-cities, i.e., conurbations with an estimated population of more than 10 million people, are springing up in every continent. Now teeming with humanity, they are hungry for one increasingly valuable resource: land.

While developments in agricultural technology ensure humanity may be able, by and large, to feed the people flocking to these great metropolises, the expansion of the human race is fuelling an unprecedented appetite for real estate. Space, whether it be for personal or public use, corporate or national, human or flora/fauna, is now at a premium as we move into a new century. Not only is more land required for accommodation, but also for a wide range of infrastructure facilities. Transport systems including roads within and between cities need to be constructed or upgraded to create motorways; green fields are turned into airports; virgin forest is stripped to provide food and firewood. In poorer regions, this newly exposed land becomes desert, completing the cycle of destruction.

Hitherto, the most common practice for the utilization of expensive space for living and working has been to build upwards; hence, the demand for ever higher buildings, both apartment and commercial, in major cities like New York, Shanghai and Singapore all vying with each other for the tallest buildings. There has also been a tradition for building underground, not just for transport systems, but for the storage of waste, depositories for books etc. as in London, where The British Library housing millions of books has been built largely underground. Recent years have seen more novel construction developments around the world. In the past, in many

countries, Holland and the UK included, marshes and flood plains have been reclaimed from the sea. Like the city of Venice in Italy, housing complexes and even airports have now been constructed off-shore to amazing effect. In Japan, Kansai International Airport has been built off-shore on a man-made island at vast expense and in Dubai a very imaginative and expensive housing complex in the shape of a palm tree is being built just off the coast on land created by a construction company. However, these and other developments are at risk from rising sea levels as a consequence of global warming.

But where will the human race go when planet earth is full? There have been many theories put forward about the human population moving to outer space. Marshall Savage (1992, 1994), for example, has projected that the human population will reach five quintillion throughout the solar system by the year 3000, with the majority living in the asteroid belt. Arthur C Clarke, a fervent supporter of Savage, now argues that by the year 2057 there will be humans on the Moon, Mars, Europa, Ganymede, Titan and in orbit around Venus, Neptune and Pluto. Feeman Dyson (1999) favours the Kuiper belt as the future home of humanity, suggesting this could happen within a few centuries.

Habitation in outer space in huge stations is no longer just a dream, but a reality. A permanent international space station now orbits the earth. The first commercial tourist recently went into outer space with more trips planned for the near future. This is only a beginning, but the development of space hotels is not far-off. There is no knowing where mankind may end up. But the ideas about off-world habitation are not fanciful and I am sure I am not alone in fantasizing about summer holidays spent watching the moons rising in some far-flung planet or on a floating hotel somewhere on the Andromeda nebula.

89/ The History of Salt

Salt is so simple and plentiful that we almost take it for granted. In chemical terms, salt is the combination of a sodium ion with a chloride ion, making it one of the most basic molecules on earth. It is also one of the most plentiful: it has been estimated that salt deposits under the state of Kansas alone could supply the entire world's needs for the next 250,000 years.

But salt is also an essential element. Without it, life itself would be impossible since the human body requires the mineral in order to function properly. The concentration of sodium ions in the blood is directly related to the regulation of safe body fluid levels. And while we are all familiar

with its many uses in cooking, we may not be aware that this element is used in some 14,000 commercial applications. From manufacturing pulp and paper to setting dyes in textiles and fabric, from producing soaps and detergents to making our roads safe in winter, salt plays an essential part in our daily lives.

Salt has a long and influential role in world history. From the dawn of civilization, it has been a key factor in economic, religious, social and political development. In every corner of the world, it has been the subject of superstition, folklore, and warfare, and has ever been used currency.

As a precious and portable commodity, salt has long been a cornerstone of economies throughout history. In fact, researcher M.R. Bloch conjectured that civilization began along the edges of the desert because of the natural surface deposits of salt found there. Bloch also believed that the first war — likely fought near the ancient city of Essalt on the Jordan River — could have been fought over the city's precious supplies of the mineral.

In 2200 BC, the Chinese emperor Hsia Yu levied one of the first known taxes. He taxed salt. In Tibet, Marco Polo noted that tiny cakes of salt were pressed with images of the Grand Khan to be used as coins and to this day among the nomads of Ethiopia's Danakil Plains it is still used as money. Greek slave traders often bartered it for slaves, giving rise to the expression that someone was "not worth his salt." Roman legionnaires were paid in salt — a salarium, the Latin origin of the word "salary."

Merchants in 12th-century Timbuktu — the gateway to the Sahara Desert and the seat of scholars — valued this mineral as highly as books and gold. In France, Charles of Anjou levied the "gabelle," a salt tax, in 1259 to finance his conquest of the Kingdom of Naples. Outrage over the gabelle fueled the French Revolution. Though the revolutionaries eliminated the tax shortly after Louis XVI, the Republic of France re-established the gabelle in the early 19th Century; only in 1946 was it removed from the books.

The Erie Canal, an engineering marvel that connected the Great Lakes to New York's Hudson River in 1825, was called "the ditch that salt built." Salt tax revenues paid for half the cost of construction of the canal. The British monarchy supported itself with high salt taxes, leading to a bustling black market for the white crystal. In 1785, the earl of Dundonald wrote that every year in England, 10,000 people were arrested for salt smuggling. And protesting against British rule in 1930, Mahatma Gandhi led a 200-mile march to the Arabian Ocean to collect untaxed salt for India's poor.

In religion and culture, salt long held an important place with Greek worshippers consecrating it in their rituals. Further, in Buddhist tradition, salt repels evil spirits, which is why it is customary to throw it over your shoulder before entering your house after a funeral: it scares off any evil spirits that may be clinging to your back. Shinto religion also uses it to purify an area. Before sumo wrestlers enter the ring for a match — which is in reality an elaborate Shinto rite — a handful is thrown into the center to drive off malevolent spirits.

In the Southwest of the United States, the Pueblo worship the Salt Mother. Other native tribes had significant restrictions on who was permitted to eat salt. Hopi legend holds that the angry Warrior Twins punished mankind by placing valuable salt deposits far from civilization, requiring hard work and bravery to harvest the precious mineral. In 1933, the Dalai Lama was buried sitting up in a bed of salt. Today, a gift of salt endures in India as a potent symbol of good luck and a reference to Mahatma Gandhi's liberation of India.

The effects of salt deficiency are highlighted in times of war, when human bodies and national economies are strained to their limits. Thousands of Napoleon's troops died during the French retreat from Moscow due to inadequate wound healing and lowered resistance to disease — the results of salt deficiency.

90/ Volunteering: enriching others and helping oneself

Volunteering, some might mistakenly think, embraces a plethora of people from all walks of life as well as activities, but data from the other side of the world suggest otherwise. A 2001 survey on who participated in volunteering by the Office for National Statistics (ONS) in the United Kingdom (UK) revealed that people in higher income households are more likely than others to volunteer. In England and Wales, 57 per cent of adults with gross annual household incomes of £75,000 or more, have volunteered formally (such as raising or handling money for a charity or being a member of a committee) in the 12 months prior to the survey date. They were almost twice as likely to have done so than those living in households with an annual income under £10,000.

As well as having high household incomes, volunteers also tend to have higher academic qualifications, be in higher socio-economic groups and be in employment. Among people with a degree or postgraduate qualification, 79 per cent had volunteered informally and 57 per cent had

volunteered formally in the previous 12 months. For people with no qualifications the corresponding proportions were 52 per cent and 23 per cent. But voluntary work is certainly not the exclusive preserve of the rich, nor should it be. Does the answer not lie perhaps in the fact that the rich tend to have money to allow them the time to become involved in voluntary work compared to less well-off people?

A breakdown in the year 2000 of the range of volunteering activities taken from The Australian Bureau of Statistics gives an idea of the scale of activities in which people are typically involved. Eleven sectors are given ranging from Community and Welfare, which accounted for just over a quarter of the total hours volunteered in Australia, to Law/justice/politics with 1.2 percent at the other end of the scale. Other fields included sport/recreation, religious activities and education, following at 21.2 per cent, 16.9 and 14.3 per cent respectively. Foreign/international volunteer work accounted for 2.4 per cent of the total hours. The data here also seem to point to a cohort of volunteers with expertise and experience.

The knock-on effect of volunteering on the lives of individuals can be profound. Voluntary work helps foster independence and imparts the ability to deal with different situations, often simultaneously, thus teaching people how to work their way through different systems. It therefore brings people into touch with the real world; and, hence, equips them for the future.

Initially, young adults in their late teens might not seem to have the expertise or knowledge to impart to others that say a teacher or agriculturalist or nurse would have, but they do have many skills that can help others. And in the absence of any particular talent, their energy and enthusiasm can be harnessed for the benefit of their fellow human beings, and ultimately themselves. From all this, the gain to any community no matter how many volunteers are involved is immeasurable.

Employers will generally look favourably on people who have shown an ability to work as part of a team. It demonstrates a willingness to learn and an independent spirit, which would be desirable qualities in any employee. So to satisfy employers' demands for experience when applying for work, volunteering can act as a means of gaining experience that might otherwise elude would-be workers and can ultimately lead to paid employment in the desired field.

But what are the prerequisites for becoming a volunteer? One might immediately think of attributes like kindness, selflessness, strength of character, ability to deal with others, determination, adaptability and flexibility and a capacity to comprehend the ways of other

people. While offering oneself selflessly, working as a volunteer makes further demands on the individual. It requires a strength of will, a sense of moral responsibility for one's fellow human beings, and an ability to fit into the ethos of an organization or community. But it also requires something which in no way detracts from the valuable work done by volunteers and which may seem at first glance both contradictory and surprising: self-interest.

Organizations involved in any voluntary work have to be realistic about this. If someone, whatever the age, is going to volunteer and devote their time without money, they do need to receive something from it for themselves. People who are unemployed can use volunteer work as a stepping-stone to employment or as a means of finding out whether they really like the field they plan to enter or as a way to help them find themselves.

It is tempting to use some form of community work as an alternative to national service or as punishment for petty criminals by making the latter for example clean up parks, wash away graffiti, work with victims of their own or of other people. This may be acceptable, but it does not constitute volunteer work, two cardinal rules of which are the willingness to volunteer without coercion and working unpaid.

91/ Seaweed for human consumption

Seaweeds are algae that live in the sea or in brackish water. Scientists often call them 'benthic marine algae', which just means 'attached algae that live in the sea'. Seaweeds come in three basic colours: red, green, and brown: dulse is the red seaweed; sea lettuce is amongst the green algae; and the brown is a wrack. Red and brown algae are almost exclusively marine, whilst green algae are also common in freshwater and in terrestrial situations. Many of these algae are very ancient organisms, and although lumped together as 'algae' are not actually closely related, having representatives in four of the five kingdoms of organisms. There are about 10,500 species of seaweeds, of which 6,500 are red algae (Rhodophyta).

The trend today is to refer to marine algae used as food as 'sea-vegetables'. The main species used in Ireland at present are dulse, carrageen moss, and various kelps and wracks. Dulse — also known as dillisk in a number of areas — is a red alga that is eaten on both sides of the North Atlantic. Generally only eaten in Ireland after it has been dried, it is frequently sold in small packets, most commonly in the west and north. About 16 tonnes are used in Ireland at present;

the species is also eaten in Canada, Iceland, Norway, France and Scotland. About 53 tonnes of carrageen moss were gathered in Ireland in 1994.

Whilst dulse and carrageen moss are worthy sea-vegetables with a history of utilisation and a small but proven market, other species also show considerable promise. Our kelp resources are considerably under-utilised. All of the kelp species are edible but Laminaria saccharina is probably the most palatable as it has a somewhat sweet taste, probably due to its high levels of mannitol, and it also cooks better.

Two other brown algae with potential as food are currently under investigation by us: Himanthalia elongata, known in some places as thongweed, and Alaria esculenta, also known as dabberlocks or murlins. Himanthalia is eaten in France after drying or pickling ('Spaghettis de mer'), and plants are sold in Ireland dried. After soaking in water it makes a surprisingly fine accompaniment to a mixed salad; it does not have the strong seaweedy taste that some dislike. With the aid of a basic research grant from Forbairt, the Irish research and development body, we are examining the growth and life cycle of populations of this species on the west coast. Plants are easy to collect but must be dried quickly and packaged well to preserve their excellent taste and mouth feel.

Alaria is a large, kelp-like brown alga that grows on exposed shores. In Ireland, plants grow to considerable sizes, being found up to 6m in length in some areas, but these are dwarfed by some Pacific species that may grow to 18m in length and to 2m in width. With Marine Research Measure funding, a study of the possibility of developing fast-growing hybrids of this species by crossing species from the Atlantic and Pacific is being carried out. We have growing in culture isolates of A. esculenta from Ireland, Scotland, France, Norway, and Atlantic Canada and other species from British Columbia and Japan. Species of this genus are ideal for cross-breeding studies as the males and females are tiny filamentous plants that are relatively easy to grow and propagate in culture under red light which stimulates reproduction in our growth rooms. Male and female reproductive structures occur on different plants so that we can put plants from one country in with those from another to see if they are sexually compatible.

To date, we have obtained interesting results with A. praelonga, a large species from Japan that co-operates sexually with A. esculenta from the Aran Islands and other Irish sites. The resulting Irish/Japanese progeny are grown initially in sample bottles agitated on a small shaker and their growth rates compared with plants that have resulted from self crosses. Preliminary results are

very encouraging, with hybrid plants showing relatively high growth rates. We hope by this method to obtain sterile hybrids that will not reproduce in the wild so that we can introduce foreign genetic material without the fear that some sort of a tryffid will be introduced that will take over the west coast of Ireland.

While studies of these two food species are very promising, we must bear in mind that the market for such sea-vegetables is very small and needs development and investment. Nutritionally, sea-vegetables are as good as any land-vegetable and are superior in their vitamin, trace element and even protein content. The increase in catholic food tastes in Europe should see greater utilisation of sea-vegetables in the next 20 years.

92/ Designing and shipping after the Restriction of Hazardous Substances (RoHS) directive

Almost two months after the European Union's ban on the use of six environmentally unfriendly materials went into effect, designers have clear evidence that failure to meet the Restriction of Hazardous Substances (RoHS) directive means lost sales. Palm Inc. recently announced that its Treo 650 smart phone is no longer being shipped to Europe, since it doesn't meet RoHS requirements. And several Apple Computer Inc. products will not be sold in Europe for the same reason.

The EU directive, which took effect on 1st July, covers lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and

polybrominated diphenyl ethers. Electronics vendors worldwide are working to eliminate those substances from nearly all new products developed for the European market, while also adapting their manufacturing processes to a lead (Pb)-free environment.

But that is only the beginning. Other countries, including China, Taiwan and South Korea, and certain U.S. states are creating their own "green" or RoHS-like legislation. That means RoHS compliance must become an integral part of a designer's development process, with RoHS checks at each step: concept, development, prototype, first builds and volume production.

Major companies will run the gamut from finding component databases of qualified green components to taking due care to prove compliance and developing processes that allow for the higher-temperature requirements of Pb-free manufacturing. And for designers, those are just the tip of the iceberg. A host of technical and reliability issues remain to be sorted out in Pb-free board processing and soldering.

What it comes down to is what Ken Stanvick, senior vice president at Design Chain Associates, calls a lack of 'tribal knowledge' on design RoHS- compliant systems. 'We had a great tribal knowledge when it came to dealing with leaded systems, but we haven't built up that same amount of knowledge for Pb-free,' he said. 'Every problem will be blamed on Pb-free until it's been worked out. We need to figure out tests that replicate more of the environment and different stresses that we're going to see in this new system.'

Manny Marcano, president and CEO of EMA Design Automation Inc. (Rochester, N.Y.), cited the impact of parts obsolescence, including the need to redesign older products and the resultant emphasis on component engineering at the expense of conceptual design. A key challenge is identifying RoHS design specifications as early as possible in the design process, he said.

But even before they get to that point, designers must understand whether they are designing a fully compliant product or one that's subject to some exemptions, said Robert Chinn, director for consultant firm PRTM (Mountain View, Calif.). 'This affects their design parameters,' he said. 'Previously, they looked at components based on size, performance, electrical parameters, features and functionality. Now they have to add on a new constraint, revolving around environmental compliance: Is it RoHS 6-compliant or is it RoHS 5-compliant?' (RoHS 6 components eliminate all six of the banned substances, while RoHS 5 models, because of exemptions, still contain lead.)

If designers do not take RoHS seriously, any country that can prove a product does not comply can levy fines against the vendor. That can cost market share, Marcano said, since noncompliant companies become non- competitive. And then, not being prepared can mean belatedly diverting resources to RoHS compliance, causing missed market opportunities. But many industry observers believe smaller and medium-size companies will continue to be complacent about the RoHS transition until some major company is cited for non-compliance. 'When that happens, there will be an earthquake throughout the industry, and it will wake up every design engineer,' said Steve Schultz, director of strategic planning and communications at Avnet Logistics and program manager for the distributor's compliance efforts for RoHS in the Americas.

'The product developer's RoHS concerns center on the fear of lost revenue - from a product ban, a customer who demands a RoHS-compliant product that the company doesn't have, or competition', said Harvey Stone, managing director for consultancy GoodBye Chain Group

(Colorado Springs, Colo.). 'With price, quality and service being relatively equal, a savvy customer is going to choose a RoHS-compliant product,' he said.

Meanwhile, designers are looking over their shoulders at several other — and potentially stricter - environmental regulations in the pipeline. These include the EU's Registration, Evaluation and Authorization of Chemicals legislation, which could restrict the use of thousands of chemicals, and its Energy- using Products (EuP) directive, which will initially target energy-efficiency requirements.

93/ Seeing the future in with video-conferencing

Video-conferencing (or Video tele- conferencing-VTC) as a means of communication intra- and inter-business has essentially been possible since the dawn of television. But the early systems, first demonstrated in 1968, were in fact so prohibitively expensive and of such poor picture quality that they were not viable applications for general public use.

However, in the 1980s, digital telephone networks like ISDN began to proliferate, so that by the 1990s the decrease in cost brought the equipment necessary for video-conferencing within the reach of the masses. The 1990s also saw the arrival of IP (Internet Protocol) based video-conferencing with more efficient video compression technologies being introduced, thus permitting desktop, or personal computer (PC)-based video- conferencing. VTC had come on the scene in a big way as free services, web plugins and software, such as NetMeeting, and MSN Messenger, Skype and others brought cheap, albeit low- quality, VTC to the public at large.

Video-conferencing has been disparaged for the lack of eye-contact that can affect the efficacy of the medium and for the fact that participants can be camera conscious. But these obstacles are not insurmountable. The size of modern televisions along with the vast improvement in picture quality as a result of the arrival of the digital age has enhanced the potential of the latest video-conferencing equipment, going somewhat towards solving the former problem. Early studies by Alphonse Chapanis found that the addition of video hindered rather than improved communication. However, as with video and sound recording of meetings, interviews etc, awareness of the presence of the techology diminishes with time to the point that its presence is not felt. A further drawback common to all technology is the ever present possibility of technical hitches. But in the end video-conferencing is no different from any electronic device like a PC or a telephone and so in time, any problems will be ironed out.

Conferencing by video has enhanced the performance of different organizations through its efficiency and effectiveness, saving both time and money for businesses and, in this carbon-conscious age, by the reduction in the environmental cost of business travel from one corner of the world to another. These apart, video-conferencing has an immediacy that is difficult to challenge. It is now essential in any work situation where organizations with employees on different sites or in different parts of the globe can contact each other rapidly. Like a telephone line permanently connected it is easy to dial up a colleague in seconds anywhere in the world.

And what about the equipment? The equipment for video-conferencing is relatively straightforward to use. It has, in fact, been commonplace in the news media for a number of years as corporations have broadcast live from the back of a truck or van in news hotspots around the world. Two ISDN lines are needed at each location: one for video output and the other for video input; a high quality camera with omnidirectional microphones which can be hand-held, clipped on or central are required; and for data transfer a LAN is also needed. And, of course, a televison screen at each end is essential.

The potential use of video-conferencing in the educational field has yet to be fully exploited. In this day and age when academic institutions are supposed to be more revenue conscious and much more flexible, video-conferencing could be employed to bring business into the educational field and vice versa. The system can also be used to take expertise anywhere in the world. It is no longer necessary for experts to travel vast

distances for conferences or to teach. In certain areas, say remote islands like the Outer Hebrides in Scotland or the Cape Verde Islands off West Africa, where it may be difficult to find teachers in specialist subjects like languages, video- conferencing is a perfect way to bring education within the reach of everyone. Video-conferencing is certainly not a panacea for every problem, not an end in itself, but a useful tool that can complement rather than supplant existing teaching methods.

Like the electronic or smart whiteboard, whose introduction in the classroom has met with resistance, video-conferencing may take some time to become mainstream, if ever. But, perhaps with the mounting concern about our carbon footprint, the environment will ultimately be the biggest spur. A sobering thought is whether classrooms and offices of the future will consist solely of TV screens.

94/ Caves

Caves are natural underground spaces, commonly those into which man can enter. There are three major types: the most widespread and extensive are those developed in soluble rocks, usually limestone or marble, by underground movement of water; on the coast are those formed in cliffs generally by the concentrated pounding of waves along joints and zones of crushed rock; and a few caves are formed in lava flows, where the solidified outer crust is left after the molten core has drained away to form rough tunnels, like those on the small basalt volcanoes of Auckland.

Limestone of all ages, ranging from geologically recent times to more than 450 million years ago, is found in many parts of New Zealand, although it is not all cavernous. Many caves have been discovered, but hundreds still remain to be explored. The most notable limestone areas for caves are the many hundreds of square kilometres of Te Kuiti Group (Oligocene) rocks from Port Waikato south to Mokau and from the coast inland to the Waipa Valley - especially in the Waitomo district; and the Mount Arthur Marble (upper Ordovician) of the mountains of north-west Nelson (fringed by thin bands of Oligocene limestone in the valleys and near the coast).

Sedimentary rocks (including limestone) are usually laid down in almost horizontal layers or beds which may be of any thickness, but most commonly of 5-7.5 cm. These beds may accumulate to a total thickness of about a hundred metres. Pure limestone is brittle, and folding due to earth movements causes cracks along the partings, and joints at angles to them. Rain water percolates down through the soil and the fractures in the underlying rocks to the water table, below which all cavities and pores are filled with water. This water, which is usually acidic, dissolves the limestone along the joints and, once a passage is opened, it is enlarged by the abrasive action of sand and pebbles carried by streams. Extensive solution takes place between the seasonal limits of the water table. Erosion may continue to cut down into the floor, or silt and pebbles may build up floors and divert stream courses. Most caves still carry the stream that formed them.

Caves in the softer, well-bedded Oligocene limestones are typically horizontal in development, often with passages on several levels, and frequently of considerable length. Gardner's Gut, Waitomo, has two main levels and more than seven kilometres of passages. Plans of caves show prominent features, such as long, narrow, straight passages following joint patterns as in Ruakuri, Waitomo, or a number of parallel straights oriented in one or more directions like Te Anaroa,

Rockville. Vertical cross sections of cave passages may be tall and narrow following joints, as in Burr Cave, Waitomo; large and ragged in collapse chambers, like Hollow Hill, Waitomo (233m long, 59.4m wide, and 30.48m high); low and wide along bedding planes, as in Luckie Strike, Waitomo; or high vertical water-worn shafts, like Rangitaawa Shaft (91m). Waitomo Caves in the harder, massive Mount Arthur Marble (a metamorphosed limestone) are mainly vertical in development, many reaching several hundred metres, the deepest known being Harwood Hole, Takaka (370m).

The unique beauty of caves lies in the variety of mineral encrustations which are found sometimes completely covering walls, ceiling, and floor. Stalactites (Gk. stalaktos, dripping) are pendent growths of crystalline calcium carbonate (calcite) formed from solution by the deposition of minute quantities of calcite from percolating ground water. They are usually white to yellow in colour, but occasionally are brown or red. Where water evaporates faster than it drips, long thin straws are formed which may reach the floor or thicken into columns. If the source of water moves across the ceiling, a thin drape, very like a stage curtain, is formed. Helictites are stalactites that branch or curl. Stalagmites (Gk. stalagmos, that which dripped) are conical or gnarled floor growths formed by splashing, if the water drips faster than it evaporates. These may grow toward the ceiling to form columns of massive proportions. Where calcite is deposited by water spreading thinly over the walls or floor, flowstone is formed and pools of water may build up their edges to form narrow walls of rimstone. Gypsum (calcium sulphate) is a white cave deposit of many crystal habits which are probably dependent on humidity. The most beautiful form is the gypsum flower which extrudes from a point on the cave wall in curling and diverging bundles of fibres like a lily or orchid.

95/ Left- or right-handed bath water? This seems a silly question, but it was the subject of a serious scientific investigation sponsored by the Daily Mail in 1965. The investigation showed that the direction water swirls down the plug-hole vortex depends on which side of the Equator you are.

As for homo sapiens, between 5 and 30% of the population are estimated to be left-handed, with more males than females, although in one test, 95% of foetuses were found to suck their right thumb in the womb. The general consensus of opinion is that left-handedness is determined by a dominant right cerebral hemisphere controlling the left side of the body, and vice versa. Hereditary factors have been ruled out. So too have earlier theories concerning the need for soldiers to shield their hearts, and the desirability of learning to use Stone Age tools and implements with the hand they were designed for, as well as Plato's idea that it all boiled down to which arm a baby was cradled with. However, the almost universal human preference for dextrality, or right-handedness, remains a mystery.

Prejudice against the left hand dates back to ancient times and is so entwined with religious beliefs and superstitions that it still exists today in everyday speech. Sinister, the Latin for left hand, means 'suggestive of evil' in English, while the French gauche is awkward, or clumsy. Left itself derives from Anglo Saxon lef (weak and fragile). The non- judgmental term southpaw, by contrast, originates from the Chicago baseball stadium where pitchers faced west, so the pitching arm of a left- hander is to the South.

Other negative terms include pen pushers, while a left-handed compliment is actually an insult. Thomas Carlyle, who described right-handedness as the oldest institution in the world, introduced the political concept of 'left' in his work on the French Revolution - in the 1789 Paris Assembly the nobles sat on the right, opposite the radicals.

Associations with luck also go back to early history. The ancient Greek and Roman augurs foretold the future from bird-flight. While the former faced North, with the propitious sunrise side to their right, the latter, before changing later, when sinister took on its ominous meaning, looked southward, so the left was for good omens.

Superstitions world-wide reflect this bias. In Morocco, as in many countries, an itchy left palm means losing money, and a twitching left. eyelid denotes the death of. a relative or sorrow, whereas the right side has felicitous indications. We throw salt over our left shoulder to thwart the demons creeping up on us, but bless with the right hand. One pours wine with this hand and passes it round the table clockwise, the direction of the sun.

Our relatives, the primates, appear to be ambidextrous, or able to use both hands, although gorillas have heavier left arms seemingly due to greater utilization. Aristotle observed that crabs and lobsters had larger right claws. Rats are 80% dextral, yet polar bears are believed to be

left-pawed. Flat fish provide interesting data: in northern seas plaice and sole have their eyes and colour on the right side, but tropical halibut are the other way round. If this is to do with light and sun rotation, it may explain why Indian Ocean sole are reversed, but not why northern halibut are just as sinistral as their southern cousins. In the plant kingdom, honeysuckle is a rare example of a left-handed climber that twines anti- clockwise, or widdershins!

Although we live in a more tolerant age, not so long ago in the UK youngsters were forced to use their right hand, 'to learn the value of conformity' (A. N. Palmer), often resulting in the stuttering speech defects common in 'switched sinistrals' like George VI. In the 1950s the American psychiatrist Abram Blau accused left-handed children of infantile perversity and a stubborn refusal to accept dextrality. Not all experts were so anti- sinistral, however. The 17th century Norfolk scholar Sir Thomas Browne wrote of the prejudices against left- handedness, but accepted that a small proportion of people would always be so and saw no reason to prevent them. Apart from being considered difficult, anti-social troublemakers, left-handers have also been thought to be artistic, creative and gifted.

Famous lefties include Leonardo da Vinci, Michelangelo, Benjamin Franklin, Bill Clinton, Joan of Arc, Lewis Carroll, Paul McCartney, Jimi Hendrix,! Jean Genet, Beethoven and many others. Finally, in defence of all sinistrals, if the left side of the body is really controlled by the right hemisphere of the brain, then left-handers are the only people in their right minds!

96/ Physician, rule thyself!

Professions and self-regulation

When is an occupation a profession? There appears to be no absolute definition, but only different ways of looking at the issue, from historical, cultural, sociological, moral, political, ethical or philosophical viewpoints. It is often said that professions are elites who undertake specialized, selfless work, in accordance with ethical codes, and that their work is guaranteed by examination and a licence to practise. In return, however, they request exclusive control over a body of knowledge, freedom to practise, special rewards and higher financial and economic status.

The public needs experts to offer them specialist advice, but because this advice is specialized they are not in a position to know what advice they need: this has to be defined in conversation with the professional. Professional judgement could be at odds with client satisfaction since the

latter cannot then be "the chief measure of whether the professional has acted in a trustworthy fashion." Professional elites have negative potential: to exploit their power and prestige for economic goals; to allow the search for the necessary theoretical or scientific knowledge to become an end in itself; to lose sight of client well-being in the continuing fragmentation of specialist knowledge.

Professions in different cultures are subject to different levels of state intervention, and are shaped by this. In England our relatively weak state and the organic growth of professional groups, many of them licensed by Royal Charter, means that regulation became an arrangement among elites. Similarly, in the US, where liberal market principles have had a free rein, academic institutions have had more influence than the state in the development of the professions. By contrast, in many European countries the state has defined and controlled the market for the professions since the late eighteenth and early nineteenth centuries. In all cases, the activities of the professions affect public interest, and so the state has a legitimate interest in them.

In general, the higher the social status of a profession the greater the degree of public trust in it, and the more freedom to operate it enjoys. There are, however, certain features which appear to be common to most, if not all, professions. In addition to a specialised knowledge base, it appears that there is an agreed set of qualifications and experience which constitutes a licence to practise. There is also frequently an agreed title or form of address, coupled with a particular, often conservative, public image, and an accepted mode of dress. Standards are maintained mainly through self-regulatory bodies. Also, financial rewards may be increased through private practice.

Within different cultures, and at different times, the relative status of different professions may vary. For example, in Western Europe, the status of politicians has been in long-term decline since the middle of the twentieth century. Teachers would appear to have higher status in France and Italy than in the UK, where medicine and the law have traditionally been the 'elite professions'.

The higher a profession's social status the more freedom it enjoys. Therefore, an occupation wanting to maintain or improve its status will try to retain as much control as possible over its own affairs. As in so many other areas, socio-cultural change has affected the professions considerably in recent years. Market forces and social pressures have forced professionals to be more open about their modes of practice. In addition, information technology has enabled the

public to become much better informed, and therefore more demanding. Moreover, developments in professional knowledge itself have forced a greater degree of specialisation on experts, who constantly have to retrain and do research to maintain their position.

Self-regulation then becomes an even more important thing for a profession to maintain or extend. But in whose interests? Is self-regulation used to enable a profession to properly practise without undue interference, or is it used to maintain the status of the profession for its own ends? Is it used to enable those with appropriate education and training to join the profession? Another question that needs to be answered is whether self-regulation restricts access so that the profession retains its social and economic privileges? Or again is it used to protect clients by appropriately disciplining those who have transgressed professional norms, or to protect the public image of the profession by concealing allegations that would damage it?

These are all questions which the medical profession in the UK has recently had to address, and which remain the subject of continuing debate. One thing is clear, however: the higher a profession's status, the better equipped it is to meet these challenges.

97/ English Heritage Blue Plaques Scheme 2

The blue plaques scheme has been running for over 140 years and is one of the oldest of its kind in the world. The idea of erecting 'memorial tablets was first proposed by William Ewart MP in the House of Commons in 1863. It had an immediate impact on the public imagination, and in 1866 the Society of Arts (later Royal Society of Arts) founded an official plaques scheme. The Society erected its first plaque - to the poet Lord Byron - in 1867. In all, the Society of Arts erected 35 plaques; today, less than half of them survive, the earliest of which commemorates Napoleon III (1867). In 1901, the plaques scheme was taken over by London County Council (LCC), which erected nearly 250 plaques over the next 64 years and gave the scheme its popular appeal. It was under the LCC that the blue plaque design as we know it today was adopted, and the selection criteria were formalised. On the abolition of the LCC in 1965, the plaques scheme passed to the Greater London Council (GLC). The scheme changed little, but the GLC was keen to broaden the range of people commemorated. The 262 plaques erected by the GLC include those to figures such as Sylvia Pankhurst, campaigner for women's rights; Samuel Coleridge-Taylor, composer of the Song of Hiawatha; and Mary Seacole, the Jamaican nurse and

heroine of the Crimean War. Since 1986, English Heritage has managed the blue plaques scheme. So far, English Heritage has erected nearly 300 plaques, bringing the total number to over 800.

English Heritage receives about 100 suggestions for blue plaques each year, almost all of which come from members of the public. The background of each case is very different. Each nominated person has to meet basic selection criteria before they can be considered. Most importantly, they must have been dead for 20 years or have passed the centenary of their birth, whichever is the earlier. This delay allows a person's reputation to mature and ensures that their fame is long-lasting.

English Heritage's Blue Plaques Panel - representatives of various disciplines from across the country - considers all the suggestions which meet the basic criteria; on average, around 1 in 3 proposals are accepted. If a figure is rejected, proposers must wait a further 10 years before their suggestion can be considered again. Detailed research is carried out into the surviving addresses of shortlisted candidates, using sources such as autobiographies, electoral registers and post office directories.

As only one plaque is allowed per person, the house to be commemorated has to be chosen very carefully. Factors which are considered include length of residence and the accomplishments of a candidate during the relevant years. A significant place of work can also be considered.

Before a plaque can be erected, the owners and tenants of the building in question have to give their consent. Where listed buildings are involved, Listed Building Consent is sought from the relevant local authority. If such consents are granted, the plaque is designed, and then produced by a specialist manufacturer. It is normally ready within about two months. Plaques are set into the fabric of the building, flush with the wall face. The cost of plaque manufacture and installation are borne entirely by English Heritage. In all, it can take between 2 and 5 years from the initial suggestion to the erection of a plaque.

The exact form of the blue plaque, as we see it now, was a relatively late development, though certain guiding principles had been in place from the outset. The earliest plaques, erected in 1867, were blue. Their format, a circle with the name of the Society of Arts worked into a pattern around the edge, was used consistently by the Society over its 35 years of management.

Manufacture of each plaque is undertaken by the mixing and pouring of a thick clay slip into a casting mould. When sufficiently dry, the cast is removed and the outline of the inscription and border is piped onto the face of the plaque and filled with white glaze. Blue glaze is then applied

to the background before firing. This process produces gently raised characters and border, a unique feature of English Heritage plaques. After firing, plaques usually have a thickness of 2 inches (50mm) and a final diameter of 19.5 inches (495mm), although smaller diameter plaques are sometimes used to meet special circumstances.

Plaques have been found to be extremely durable and have an almost indefinite life expectancy. Similar plaques erected by the Society of Arts have lasted, perfectly legible, for over one hundred years. Due to the slightly domed design, they are self-cleansing and require virtually no maintenance.

98/ The software tools of research are typically more abundant than hardware tools in the social sciences. Software is usually thought of as meaning computer programs that te the hardware what to do, but any to not related to a physical device can be considered software. Included in this category are published tests and questionnaires.

Often researchers want to gather information related to a general area such as personality or intelligence. For these instances, the use of a standardized test may be the best choice. With already published tests you can be sure of both validity and reliability and can save a lot of time that might otherwise be spent on test construction. Standardized tests can be classified into five main categories: achievement, aptitude, interest, personality, and intelligence.

Achievement tests are designed specifically to measure an individual's previously learned knowledge or ability. They are available for many topic areas related to psychology, education, business, and other fields. Achievement tests require that prior learning take place and that this learning be demonstrated in order to pass.

Aptitude tests attempt to predict an individual's performance in some activity at some point in the future. They do not require any specific prior learning although basic knowledge related to reading and writing is usually required and some preparation, such as studying up on math formulas or sentence structure, can be helpful. A well-known example of this type is the Scholastic Achievement Test (SAT) designed to predict future college performance.

Interest inventories also require only general knowledge but no preparation is needed. These tests look at an individual's subjective interests in orde to make predictions about some future behavior or activity. Perhaps the most used interest inventory is the Strong Interest Inventory, which compares interests related to specific careers in order to help guide an individual's career

path. Endorsed interests are compared with the interests of successful individuals in various fields and predictions are made regarding the test-taker's fit with the various career fields.

Typically designed to assess and diagnose personality and mental health related disorders, personality tests are used extensively by psychologists in clinical, educational, and business related settings. By far the most widely used test of this type is the Minnesota Multiphasic Personality Inventory, Second Edition (MMPI-2), which compares an individual's responses on a series of true-false items to those suffering from various mental disorders such as depression, schizophrenia, and anxiety. The theory behind the test argues that if you endorse items similar to the items endorsed by those with depression, for example, then the chances that you are also depressed increases.

Intelligence tests could be classified as aptitude tests since they are sometimes used to predict future performance. They could also be classified as personality tests since they can be used to diagnose disorders such as learning disabilities and mental retardation. However, because of their limited scope, we will place them in their own category. The purpose of an intelligence test is to attain a summary score or intelligence quotient (IQ) of an individual's intellectual ability. Scores are compared to each other and can be broken down into different subcategories depending on the intelligence test used. The most commonly used tests of this type are the Wechsler Scales, including the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC), and the Wechsler Preschool and Primary Scale of Intelligence (WPPSI).

HSelf-response questionnaires are a great way to gather large amounts of information in a relatively short amount of time. A questionnaire, similar to a survey you might see on a web page, allows subjects to respond to questions, rate responses, or offer opinions. Their responses can then be used to place them in specific categories or groups or can be compared to other subjects for data analysis. A concern with self- report, however, is the accuracy of the responses. Unlike direct observation, there is no way of knowing if the subject has told the truth or whether or not the question was understood as intended. There are several different methods for gathering information on a questionnaire or survey, including a Likert scale, the Thurstone technique, and the semantic differential. The Likert scale is a popular method used in surveys because it allows the researcher to quantify opinion based items. Questions are typically grouped together and rated or responded to based on a five-point scale. This scale typically ranges in order from one extreme to the other, such as (1) very interested; (2) somewhat interested; (3) unsure; (4) not very

interested; and (5) not interested at all. Items that might be rated with this scale representing the subject's level of interest could include a list of careers or academic majors, for example.

99/ Much ado about nothing

The public outcry over genetically modified foods offers several lessons for those working and investing in nanotechnology.

"THE time for discussion of the rights and wrongs of GM crops has passed. Intense and consistent economic sabotage and intimidation are what will make the commercialisation of GM crops an unattractive option."

Words like these, from an article in the current edition of Earth First!, a radical environmental journal, send shivers down the spines of those involved in commercialising biotechnology. The strength of public disapproval of genetically modified organisms (GMOs) was a shock and a surprise to most of those involved. Now, some people are wondering whether nanotechnology - a term that covers the manipulation of matter at scales of a millionth of a millimetre - could be in for similar treatment and, if so, whether there are lessons that its protagonists can learn from the public backlash against biotechnology.

Profit of doom

In a neglected corner, amid thousands of participants at a Nanotech conference held in Boston last week, Jeffrey Matsuura, a law professor at the University of Dayton, in Ohio, stood next to his unprepossessing poster of his work. His warning, however, was pertinent to everyone there - especially the investors who were scouring the conference for opportunities. And this is that several of the factors that created a public backlash against biotechnology are already at work within nanotechnology. Dr Matsuura says that biotechnologists assumed that the public would quickly recognise and appreciate biotech's potential for improving the quality of life. Instead, the risks captured the attention of the media and much of the general public. Well-fed European consumers met the suggestion of cheaper food, in particular, with scepticism. Many felt that the gains would accrue to the companies which had developed GMOs, while the risks of growing and consuming the crops would be taken on by the public.

Dr Matsuura believes that public perception of nanotechnology is developing along a similar track. Like those of biotechnology, the first applications of nanotechnology will bring little obvious benefit to consumers. Better, cheaper materials, and hidden manufacturing efficiencies

that benefit producers first, are redolent of the 'advantages' of biotech namely reduced applications of agricultural chemicals, which help to keep the cost down while raising yields. Obvious consumer benefits, such as improvements in medicine, are further away.

This should not matter - consumers do benefit eventually, even from cost savings. And yet, in alliance with a feeling that there are hazards involved, an absence of immediate benefits could turn public opinion against nanotech quite rapidly. And potential hazards there are. Concerns over out-of-control, self- replicating 'nanobots' that would eventually consume and transform the entire planet into a 'grey goo' are absurd. And yet, it is true that novel 'nanoparticles' might have real toxicological risks.

Nanoparticles are so small that, if inhaled, they could become lodged in the lungs. In theory, they are small enough to enter living cells and accumulate there. And in January Ken Donaldson, a professor of respiratory toxicology at the University of Edinburgh, told a Royal Institution seminar in London that, once inhaled, ultrafine carbon particles can move to the brain and blood.

There are already several products that use nanoparticles already on the market, such as sunscreen and car parts. Though all this may sound alarming, people are already exposed to nanoparticles of many different kinds, and have been throughout history. Soot, for example, is composed of carbon nanoparticles. Nevertheless, nanoparticles from sources such as diesel soot, welding fumes and photocopier toner are already associated with ill-health. The prospect of more such particles is likely to worry many. No wonder that several people at the conference in Boston mentioned the need to address public fears over nanotechnology "aggressively".

One of these was Clayton Teague, the director of America's National Nanotechnology Co-ordination Office. He says the American government is as sensitive to any indication of true health risk as any member of the public. Several large and well-funded studies on the environmental and health risks of nanotechnology are now under way.

Dr Teague adds that any decisions about nanotechnology will be made carefully and based on solid scientific data. But even if science gives the go-ahead, another one of Dr Matsuura's lessons is that this might not necessarily win the day, and that fear over potential abuses and accidents may dominate the debate.

One piece of advice Dr Matsuura gives is that everyone involved should have a consistent message. If investors are told a technology will change the world, someone who is concerned about the risks cannot then be told that the same technology is no big deal. It strikes a false note

to say that something can be both revolutionary and nothing to worry about, he says. Such inconsistencies will breed public mistrust and fear.

Product placement

Donald Reed is a senior consultant with Ecos, a business-advisory firm based in Sydney, Australia, that acts as an intermediary between corporations and activists. Mr Reed goes as far as to recommend that companies think about the early products they choose to pursue – in particular, whether they can demonstrate the "societal value" of these products. For example, it might be worth emphasising that one of the early products of nanotechnology could be cheap and efficient photovoltaic materials, which are used to generate electricity from sunlight.

100/ A silent force

There is a legend that St Augustine in the fourth century AD was the first individual to be seen reading silently rather than aloud, or semi-aloud, as had been the practice hitherto. Reading has come a long way since Augustine's day. There was a time when it was a menial job of scribes and priests, not the mark of civilization it became in Europe during the Renaissance when it was seen as one of the attributes of the civilized individual.

Modern nations are now seriously affected by their levels of literacy. While the Western world has seen a noticeable decline in these areas, other less developed countries have advanced and, in some cases, overtaken the West. India, for example, now has a large pool of educated workers. So European countries can no longer rest on their laurels as they have done for far too long; otherwise, they are in danger of falling even further behind economically.

It is difficult in the modern world to do anything other than a basic job without being able to read. Reading as a skill is the key to an educated workforce, which in turn is the bedrock of economic advancement, particularly in the present technological age. Studies have shown that by increasing the literacy and numeracy skills of primary school children in the UK, the benefit to the economy generally is in billions of pounds. The skill of reading is now no more just an intellectual or leisure activity, but rather a fully-fledged economic force.

Part of the problem with reading is that it is a skill which is not appreciated in most developed societies. This is an attitude that has condemned large swathes of the population in most Western nations to illiteracy. It might surprise people in countries outside the West to learn that in the

United Kingdom, and indeed in some other European countries, the literacy rate has fallen to below that of so-called less developed countries.

There are also forces conspiring against reading in our modern society. It is not seen as cool among a younger generation more at home with computer screens or a Walkman. The solitude of reading is not very appealing. Students at school, college or university who read a lot are called bookworms. The term indicates the contempt in which reading and learning are held in certain circles or subcultures. It is a criticism, like all such attacks, driven by the insecurity of those who are not literate or are semi- literate. Criticism is also a means, like all bullying, of keeping peers in place so that t they do not step out of line. Peer pressure among young people is so powerful that it often kills any attempts to change attitudes to habits like reading.

But the negative connotations apart, is modern Western society standing Canute-like against an uncontrollable spiral of decline? I think not.

How should people be encouraged to read more? It can easily be done by increasing basic reading skills at an early age and encouraging young people to borrow books from schools. Some schools have classroom libraries as well as school libraries. It is no good waiting until pupils are in their secondary school to encourage an interest in books; it needs to be pushed at an early age. Reading comics, magazines and low brow publications like Mills and Boon is frowned upon. But surely what people, whether they be adults or children, read is of little import. What is significant is the fact that they are reading. Someone who reads a comic today may have the courage to pick up a more substantial tome later on.

But perhaps the best idea would be to stop the negative attitudes to reading from forming in the first place. Taking children to local libraries brings them into contact with an environment where they can become relaxed among books. If primary school children were also taken in groups into bookshops, this might also entice them to want their own books. A local bookshop, like some local libraries, could perhaps arrange book readings for children which, being away from the classroom, would make the reading activity more of an adventure. On a more general note, most countries have writers of national importance. By increasing the standing of national writers in the eyes of the public, through local and national writing competitions, people would be drawn more to the printed word. Catch them young and, perhaps, they just might then all become bookworms.

101/ Adam's wine

Water is the giver and, at the same time, the taker of life. It covers most of the surface of the planet we live on and features large in the development of the human race. On present predictions, it is an element that is set to assume even greater significance.

Throughout history, water has had a huge impact on our lives. Humankind has always had a rather ambiguous relationship with water, on the one hand receiving enormous benefit from it, not just as a drinking source, but as a provider of food and a means whereby to travel and to trade. But forced to live close to water in order to survive and to develop, the relationship has not always been peaceful or beneficial. In fact, it has been quite the contrary. What has essentially been a necessity for survival has turned out in many instances to have a very destructive and life-threatening side. Through the ages, great floods alternated with long periods of drought have assaulted people and their environment, hampering their fragile fight for survival. The dramatic changes to the environment that are now a feature of our daily news are not exactly new: fields that were once lush and fertile are now barren; lakes and rivers that were once teeming with life are now long gone; savannah has been turned to desert. What perhaps is new is our naïve wonder when faced with the forces of nature.

Today, we are more aware of climatic changes around the world. Floods in far-flung places are instant news for the whole world. Perhaps these events make us feel better as we face the destruction of our own property by floods and other natural disasters.

In 2002, many parts of Europe suffered severe flood damage running into billions of euros. Properties across the continent collapsed into the sea as waves pounded the coastline wreaking havoc with sea defences. But it was not just the seas. Rivers swollen by heavy rains and by the effects of deforestation carried large volumes of water that wrecked many communities.

Building stronger and more sophisticated river defences against flooding is the expensive short-term answer. There are simpler ways. Planting trees in highland areas, not just in Europe but in places like the Himalayas, to protect people living in low-lying regions like the Ganges Delta, is a cheaper and more attractive solution. Progress is already being made in convincing countries that the emission of carbon dioxide and other greenhouse gases is causing considerable damage to the environment. But more effort is needed in this direction.

And the future? If we are to believe the forecasts, it is predicted that two- thirds of the world population will be without fresh water by 2025. But for a growing number of regions of the world the future is already with us. While some areas are devastated by flooding, scarcity of water in many other places is causing conflict. The state of Texas in the United States of America is suffering a shortage of water with the Rio Grande failing to reach the Gulf of Mexico for the first time in 50 years in the spring of 2002, pitting region against region as they vie for water sources. With many parts of the globe running dry through drought and increased water consumption, there is now talk of water being the new oil.

Other doom-laden estimates suggest that, while tropical areas will become drier and uninhabitable, coastal regions and some low-lying islands will in all probability be submerged by the sea as the polar ice caps melt. Popular no-go exotic destinations now visited by countless tourists will become areas. Today's holiday hotspots of southern Europe and elsewhere will literally become hotspots - too hot to live in or visit. With the current erratic behaviour of the weather, it is difficult not to subscribe to such despair. Some might say that this despondency is ill-founded, but we have had ample proof that there is something not quite right with the climate. Many parts of the world have experienced devastating flooding. As the seasons revolve, the focus of the destruction moves from one continent to another. The impact on the environment is alarming and the cost to life depressing. It is a picture to which we will need to become accustomed.

102/ Is it any wonder that there are teacher shortages? Daily, the press carries reports of schools going on four-day weeks simply because they cannot recruit enough teachers. But why? There is no straightforward answer. For a start, fewer students are entering teacher-training courses when they leave school. But can you blame young people after the barracking faced by the teaching profession in the UK. over the last decade? The attack, relentless in the extreme, has been on several fronts. Government inspectors, by accident or design, have been feeding the media au constant stream of negative information about the teaching establishments in this country. Teachers also come in for a lot of flak from politicians. And the government wonders why there are problems in schools.

The government's obvious contempt for the teaching profession was recently revealed by one of the most powerful people in government when she referred to schools as 'bog standard

comprehensives. Hardly the sort of comment to inspire parents or careers advisers seeking to direct young people's future. Would you want to spend your working life in a dead-end profession? The government doesn't seem to want you to either. On the administrative side, most teachers are weighed down by an increasing flow of bureaucracy. Cynicism would have me believe that this stops teachers from fomenting dissent as they are worn out by useless administrative exercises. Most teachers must then also be cynics!

Teacher bashing has, unfortunately, spread to youngsters in schools as the recent catalogue of physical attacks on teachers will testify. If grown-ups have no respect for the teaching profession, young people can hardly be expected to think any differently. The circle is then squared when, as well as experienced, competent teachers being driven out of the profession by the increased pressure and stress, fewer students are applying for teacher-training courses.

Increased salaries are certainly welcome, but they are not the complete answer to a sector in crisis. Addressing the standing of the profession in the eyes of the public is crucial to encourage experienced teachers to remain in the classroom and to make it an attractive career option for potential teachers once again. It might also be a good idea for the relevant ministers to go on a fact-finding mission and find out from teachers in schools, rather than relying overmuch on advisers, as to what changes could be brought about to improve the quality of the education service. Initiatives in the educational field surprisingly come from either politicians who know little about classroom practice or educational theorists who know even less, but are more dangerous because they work in the rarefied air of universities largely ignorant of classroom practice.

Making sure that nobody without recent classroom experience is employed as a teacher-trainer at any tertiary institution would further enhance the teaching profession. If someone does not have practical experience in the classroom, they cannot in all seriousness propound theories about it. Instead of being given sabbaticals to write books or papers, lecturers in teacher-training establishments should be made to spend a year at the blackboard or, these days, the whiteboard. This would give them practical insights into current classroom practice. Student teachers could then be given the chance to come and watch the specialists in the classroom: a much more worthwhile experience than the latter sitting thinking up ideas far removed governmentfrom the classroom. Then we would have fewer initiatives like the recent proposal to teach thinking in school. Prima facie, this is a laudable recommendation. But, as any practising teacher will tell y

this is done in every class. Perhaps someone needs to point out to the academic who thought up the scheme that the wheel has been around for some time.

In the educational field, there is surprisingly constant tension between the educational theorists and government officials on the one hand, who would like to see teachers marching in unison to some greater Utopian abstraction and, on the other, practising teachers. Any experienced classroom practitioner knows that the series of initiatives on teaching and learning that successive governments have tried to foist on schools and colleges do not work.

103/ Eva Hesse

In one corner of the room is a mass of tangled rope suspended from the ceiling with some sections dangling to the floor; the first of three encountered pieces of work that have a resounding impact on the viewing public. It stops one in one's tracks: how dare it be there - this mess of nothing! It is like arranged chaos: that is, the confused mixture of varying sizes of rope, dipped in latex, looks as though it might collapse in a heap on the floor at any moment. At the same time, it is held up and in place by a series of fine wires and hooks, giving it a strange sense of... order. A deliberate challenge to the forces of gravity. It is a shambles. It makes one laugh. It is play. It is drawing in the air! Maybe it can move or dance about! Yet, it is hardly there, like something imagined. The materials are cheap and disposable. Impermanent, like... the people looking at it. But it is very definitely present! It has a presence. You can see that people want to walk into it and become a part of it - but alas! The gallery guard is hovering nearby.

To the left of this piece, running along the wall, in two rows on top of each other, is a long series of lid-less boxes. They are mounted at average nose height and are made of fibreglass which gives them a shiny, almost moist, appearance. They are the colour of murky water, absorbing the gallery light with an opacity similar to that of mucus or tree gum. They look as though they might be soft and malleable to touch, with their irregular edges and non-norw conforming sides. This gives the overall impression that they could fall in on themselves or slide down the wall. The structure is puzzlingly familiar, similar to things in the world, and yet it is not like anything in particular.

In the adjacent corner is the third piece, consisting of a collection of nine cylindrical open-ended objects, slit part way from end to end. They give the appearance of being randomly placed - some lying, some leaning on the wall or on each other – all seeming somehow to be related. Like

the boxes, they are a multiple of each other. Made of fibreglass with a shiny surface they look almost like abandoned pods that had once been alive. The associations seem to jump around in one's head, running between sensations of delight and pleasure, violence and discomfort.

One has to bend down to be with them more. Driven by the desire to physically interact, one is almost forced to stoop further so that one can touch, or indeed taste, this intriguing surface; but no, the guard is there.

The visual language apparent in these artworks is unfamiliar, as is the artist, Eva of Hesse. Her work is as exciting as it is disturbing. For many, Hesse's sculpture prol refers essentially to the body. This, perhaps, does not seem surprising when it is in relation to the body that women are generally assessed. Hesse died of a brain tumour in 1970 at the age of 34. It must be an inescapable inevitability, therefore, that her work was read in the context of its time where it has, until recently, been largely abandoned.

Given the influence of feminism on our cultural consciousness since that period, it seems paramount that we avoid, or at the very least attempt to avoid, those dramatic facts about her life and family history. We may then be freed from a limited and narrow translation of her art.

Hesse's work is much more ambiguous and funny than some rather literal readings would have us believe. Perhaps it is precisely because her use of metaphor in her work is so subtle that it escapes the one-line definitions we so love to employ.

We are now, more than ever, hungry for the cult of 'personality'. While Hesse and others before and since can more than fill that demand, we seem in danger of focusing on the life of the artist and not on the life of the art.

When looking at Hesse's sculpture, drawings and paintings, the most interesting and challenging aspects lie just there - within the work. And this must be the starting point for any interpretation, not her complex life or untimely death.

104/ The instruments of the western orchestra are conventionally divided into four sections: woodwind, brass, percussion and strings. However, a much more comprehensive system for classifying musical instruments - ancient and modern, eastern and western, orchestral and folk- is also available. This alternative system, based on the work of Erich von Hornbostel and Curt Sachs, provides for the classification of musical instruments of all shapes and sizes according to

how their sounds are produced. It begins by dividing instruments into four broad groups-aerophones, chordophones, idiophones and membranophones.

The first group, aerophones, contains any instrument that makes a mal sound when the air within or around it is made to vibrate. Further classification within the group is made according to how the air is m set into vibration. Simplest are the so-called free aerophones (bull- roarers and buzzers), which consist of a flat disc twirled through the air on a string.

More typically, aerophones have a hollow tube or vessel body into which air is introduced by blowing. Sub-groups include instruments with a blow hole (most flutes) or a whistle mouthpiece (whistles and whistle flutes), in which the air vibrates after being blown against a sharp edge. In instruments with a cup mouthpiece, such as trumpets and horns, it is the action of the player's lips that causes the air to vibrate. Vibrations within a tube may also be produced by a reed taken into the musician's mouth. Such reeds may be single (clarinets) or double (oboes). Instruments classified as free reed aerophones, such as mouth organs and concertinas, have vibrating reeds within the body of the instrument. Organs and bagpipes are hybrid forms, each with pipes of different kinds.

The name chordophones is used for instruments with strings that produce a sound when caused to vibrate. Further classification is based on body shape and on how vibrations are induced. There are five basic types: bows, lyres, harps, lutes and zithers. The simplest musical bows have a single string attached to each end of a flexible stick; others have resonators to amplify the sound. Lyres, common in ancient times, have a four-sided frame consisting of a soundbox, two arms and a crossbar. The plucked strings run from the front of the soundbox to the crossbar. Harps are basically triangular in shape, with strings attached to a soundbox and the instrument's 'neck'.

Classified as lutes are all instruments with strings that run from the base of a resonating 'belly' up and along the full length of an attached neck. This sub-group is further divided into plucked lutes (round- or flat-backed), and bowed lutes (including folk fiddles and violins). The fifth type, zithers, have strings running the entire length of the body and are subdivided into simple zithers (stick, raft, tube or trough-shaped), long zithers (from the Far East), plucked zithers (such as the psaltery and harpsichord), and struck zithers (including the dulcimer and piano).

The third main group, idiophones, contains instruments made of naturally sonorous sticks simply struck one against another, to tuned instruments like the orchestral glockenspiel. Idiophones are

further classified according to the method of sound production plucked (Jew's harps), concussion (when two sonorous parts are struck together, for example into eight sub-groups: stamped, stamping, scraped, friction, shaken (bells and rattles), cymbals) and percussion (when a non-sonorous beater is used for striking). Percussion idiophones are further subdivided by shape into bars (metallophones, lithophones, xylophones), vessels (slit drums and steel drums), gongs and two types of bell (struck and clapper).

Hornbostel and Sachs termed their final broad group membranophones. In these instruments sound is produced by the vibration of a membrane or skin. Most drums fall into this category, being further classified by shape as frame, vessel and tubular drums, and by sounding method as friction drums. Tubular drums are further subdivided into long, footed, goblet, waisted, barrel, conical and cylindrical types. Much less important than drums are membranophones with an internal membrane vibrated by blowing, such as the kazoo. The classification system of Hornbostel and Sachs, published in 1909, came before the burgeoning of electronic music in the second half of the twentieth century. The addition of a fifth group, to take in instruments that produce sound electronically (guitars, organs, synthesizers) would bring their system neatly up to date.

105/ Waterside: a study in suburban development

Since the 1950s there has been an increasing trend for extended housing and commercial expansion to take the form of rapid suburban rather than urban growth. There are several factors influencing the location and spread of such development, but an increase in economic activity is the trigger.

The area to the west of Southampton Water, now known as Waterside, exemplifies several factors impacting on the shape and nature of recent development. Up until the early 1950s this area, occupying a narrow strip of predominantly rural land approximately twenty kilometres long by five kilometres wide between Southampton Water and the New Forest, was relatively sparsely populated. There were a number of small villages, including Hythe, Fawley, Holbury, Dibden and Marchwood; communications were poor, and farming and associated industries were the main sources of employment.

The main town in the region, Southampton, was and still is one of the major UK ports. In the early part of the twentieth century, Southampton boomed as the growth in passenger numbers on

transatlantic liners reached its peak. The main waterway leading to Southampton, Southampton Water, enjoys a long stretch of deep water channel suitable for large ocean-going vessels, and also benefits from an extended period of high tide because of its position in relation to the Isle of Wight. Existing settlement on the east side of the waterway made further expansion problematic, so a site was chosen on the west side to build a large oil refinery capable of handling the crude oil imported in the cargo holds of the enormous oil tankers then being built. The new oil refinery was built in the mid 1950s between Fawley and the coastal hamlet of Calshot.

The effects on the Waterside area were dramatic. Firstly, a major road was built linking the new Fawley refinery to the road network around Southampton. Also, a number of ancillary chemicals and plastics industries developed, dependent on by-products of the refining process. Work opportunities expanded and the population began to grow rapidly as workers and their families moved into the area. House-building took off.

The first areas to expand were around Fawley village, close to the refinery, and Hythe, the largest of the existing villages, with a ferry link to Southampton. However, although expansion in house-building was rapid, the development of a new commercial centre with a range of services and the provision of an expanded range of educational and health services or entertainment and sporting facilities did not initially take place. Partly, this was due to the proximity of Southampton, with its large range of facilities, now easily accessible through improved road links.

But there was another constraint on growth: the limited availability of land. Bordered on the east by Southampton Water, on the south by the sea, and limited to the north by the large village of Totton, almost a suburb of Southampton, there was only one direction expansion could go - westwards.

There were, however, limits here too. West of Southampton Water lies the New Forest, an area of ancient woodland and open heath, soon to be designated a National Park. Although it occupies a relatively small area, about 160 square kilometres, the New Forest is a complex and diverse ecosystem supporting a wide variety of plants and animals, many of which are found only in this area or are under threat in other parts of the country. There are stringent planning restrictions on all new building or WVID TO construction of any kind. Moreover, these restrictions are supported by the local population living within the Forest, who are determined to preserve the unspoilt character of their villages and whose income is increasingly dependent on providing

services for the growing tourist industry exploiting the Forest as a leisure resource. In short, development was channelled along a relatively narrow corridor parallel to le Southampton Water. The space between existing villages was progressively filled with housing until they coalesced. Little farming land now exists between Dibden and Fawley; housing estates have taken almost all the land. The area around Marchwood, further from Fawley, remains more rural, but some development has taken place here too. Nor has any nucleated commercial centre emerged, though the existing village centres now have more shops, offices and a greater range of public facilities.

There is little room for further residential expansion in Waterside except in the area around Dibden Bay. Pressure for new housing development is now less, economic expansion has slowed considerably, and residents in the area are keen to preserve the bay area as a green open space with pleasant waterside views. But there is now a threat from another quarter. While passenger numbers using Southampton have declined, freight container traffic has continued to expand. The port area of Southampton has reached capacity. So the port authority are looking with speculative eyes at the one as yet undeveloped shoreline of Southampton Water with relatively easy access to deep water for large container ships - Dibden Bay.

106/ One finds oneself rebelling against a very controlled approach to education with its restrictions of centralization and, at the same time, against the liberal chaos that can at times prevail. There is a constant struggle between both camps of the educational divide, a struggle which invariably creates a jumbled mixture of educational provision. This is not to say that what is provided is totally unacceptable. Far from it.

In the educational world, picking and choosing from different theories, i.e. eclecticism, as is no doubt the case in many other fields, is frowned upon by the theoretical purist, irrespective of which of the two above camps they belong to. The pragmatists, i.e. practical classroom teachers, know that they have to jump from one teaching method to another, trying out new ones and discarding the old. But they frequently return again to tried and trusted techniques, sometimes with a fresh insight. Experienced teachers know that essentially there is not just one method, but that people learn in many different ways.

Some learners use a single method, but the most sophisticated employ an array of different techniques, instinctively or subconsciously, picking and even adapting any approach to suit their

needs, while the not-so effective learners stick to a limited repertoire or even one method. The practicalities of the real world demand, however, that students and trainers in every field be eclectic.

Having a larger repertoire of strategies for learning, the sophisticated student advances at an exponential rate, as the different strategies he or she uses cross-fertilize and help each other. It is dangerous to exclude one particular technique in teaching or to follow one orthodoxy, as the one-size-fits-all principle does not, from a common sense point of view, work. It may deprive a weaker student of the only tool he or she may be able to use and deny the more effective learner an extra mechanism.

Take rote-learning, a much maligned learning process. There are certain aspects of any subject area, whether it be language or the arts or science, where a student is required to learn huge amounts of facts. These may be learnt by experience, but developing memory skills gives students an advantage in this area. Antipathy to certain methods like memory-based learning has condemned many students to a second-rate education, compounded by the fact that their teachers have been damaged by similar attitudes. It has been said that students are damned by the limitations of their teachers, just as the teachers themselves were damned.

This is not to say that rote-learning is the best approach to learning, yet it has its place as part of a wider programme. Where rote-learning proves inadequate is that it is not suitable for every learner. Not everyone is blessed with a good memory and learners should not be humiliated by not being able to learn things by heart. Other strategies need then be harnessed to compensate for this.

Electronic learning

The search for ever more different novel learning styles goes on. Electronic-learning, or e-learning, is now very much the flavour of the month. The upside is that students may access the training whenever they want and they can learn at their own pace unhindered by fellow students. Again, whilst it has its place, e-learning lacks some essential ingredients, like the motivation of human contact in the classroom. Such training is, in fact, inherently flawed as it is impossible to devise an exhaustive programme to accommodate every individual. Learners have individual needs that may not be catered for by distance-learning delivered on the Internet. Frustrated by their lack of development, they will not develop to their full potential. One solution has been to build into any e-learning programme an element of human contact with on-line help via e-mail,

but increasingly, as video-conferencing facilities become more advanced, designers are able to incorporate real-time video links. While this is a considerable advance, it still falls far short of the human contact that learning requires.

E-learning is here to stay, so what needs to be done is to give it a human face. Not, might I add, a computerized one, but a real one. Students should be able, if necessary, to access a tutor by telephone or, even better, face to face. Periodic tutorials could be built into any programme. These can be individual, group and seminar or a mixture of all three.

Distance learning, such as e-learning, comes with an oft unheeded caveat. It is seen by the unwary as a cheap option and as a way of curbing costs. Set up on a wave of innovation and excitement, the initial wave of enthusiasm soon wanes. Few take on board the warning: any self-access material that needs to be developed requires huge amounts of input time. It has been estimated that, for every student hour, materials writers have to put in 70 hours of preparation. Those unfamiliar with the workings of materials production expect others to live through the consequences of their inexperience in this field. The wrong people, i.e. the materials producers, get the blame for any shortcomings: frequently, the quality and volume of material. There is one further point here that is worth mentioning. Once in place, the material requires constant updating and research: an added cost.

107/ Worms put new life into derelict site

Poisoned soil at an old steelwork is being cleansed by thousands of worms, write Miml Chakraborty.

Thousands of deep-burrowing earthworms are to help turn the long derelict site of a steelwork woodland and a renewable energy park. As part of a pioneering low-cost plan to reclaim the site of the former Hanside steelworks at Gambuslang near Glasgow, worms are being used to accelerate the process of soil regeneration and to transform the land, over time, into an attractive and financially productive site.

Hallside's closure in 1979 put an end to more than 100 years of steel production. The surrounding land had become heavily compacted and was too contaminated with heavy metals such as chromium, cadmium and lead to support any kind of brick and mortar development.

The site's 30 hectares were left abandoned until 1990, when a rescue plan put together by local landscaping and earthmoving company, HL Banks, and the regional developer, Scottish Greenbelt, was approved by local authorities.

Now the site has been covered by a two-metre layer of partially treated sewage material which has been mixed with colliery waste. This will be converted into usable soil by about 21,000 Lubricus terrestris (garden lobworms) and Aporrectodea longa (black-headed worms) that have been let loose on the site.

The specialty raised hermaphrodites, which are self-impregnating, will spend the next five to ten years chewing their way through the topping layer to create a soil structure able to sustain long-term plant growth. Without them, the process could take up to 60 years.

Researchers at Bell College of Technology in nearby Hamilton examined the use of earthworms In land regrading, and found that even in the hostile mixture of coal-tip waste and partially treated sewage, earthworms were able to speed up the process of soil recomposition.

They selected different varieties of deeper-borrowing earthworm species, whose bulk feeding and casting actions, as well as their ability to improve the mineral content of soil, would increase the rate of reformulation much faster than the natural processes.

Sean Ince, of Bell's department of biology, says: 'The idea is that earthworms will contribute in a cumulative way to further soil binding, and that they will aerate and add nitrogen to the soil covering the Hallside site.'

At the same time, Scottish Greenbelt has begun planting the area with 250,000 trees - including willow and alder - specially selected for their ability to grow on degraded land.

These will have the dual function of extracting contaminants from the soil through their root systems, and being harvested for wood burning or chipboard manufacture.

By using the cash raised from wood harvesting, David Craven, director of Scottish Greenbelt, says he expects Hallside to be self-financing.

'The first tranche of trees was planted in April and they are now over six feet tall, despite dry weather through the summer,' he says. 'The fields are being planted on a four-year rotation basis and will be used to help us meet our costs: Craven says the cost of land bio-remediation - the labour-intensive process of removing soil for chemical and bacterial cleansing - could have been more than £30m.

At Bell College, Ince says: 'There's a whole legacy of toxic soil contamination going hack many years. There is physical degradation of the soil as well as contamination from metals, including lead, chromium and arsenic.'

Sampling of the soil at regular intervals over the next few years will give an indication of the level of contaminants. Within less than 20 years the land could be re-integrated into the community.

Hopes of a successful outcome at Hallside have paved the way for similar regeneration plans for the nearby Gartoosh steelworks and at Glengarnock in Ayrshire.

108/ Day-dreaming: an art or a waste of time?

Day-dreaming is generally viewed as an impractical. wasteful activity: one should be doing something useful. not just sitting or walking around with 'one'. head in the clouds'. But rather than being of little worth. the capacity to fantasize is a priceless skill. a thoroughly useful tool, a tool for all seasons.

Day-dreaming is an essential ingredient In moat. If not all. creative processes. In the pursuit of innovation and development. many organizations have been trying over recent years 'to capture the day-dreaming process' by formalizing and institutionalising the process in creative seminars. Workshops where employees sit around 'brainstorming' and 'being creative' are now mushrooming. But do they work? To a certain extent they can, but not always. There are instances of outside consultants setting up brainstorming aessions for orwhere the chairperson ar director gives his or her ideas Brat. In doing so, they set the parameters as no one wants to contradict or overrule the boss. True brainstorming, like true day-dreaming. however, knows no boundaries, no hierarchies and no tears, The intention is not to disparage such activities but they are too over-controlled and do not even mimic the environment needed to day-dream and create. But they do show how the creative force, so frequently despised before, is creeping into the mainstream, oven if in a contained rummer Very contained, in fact.

So where to begin? Dayqtreamt, or fantasizing to discouraged in children, so that by the time they are adults it has been completely removed. While one would not want to have all children sitting around in a kind of hypothyroidic haze of day-dreaming bliss, those most naturally inclined to it should be given space to dream and their ability nurtured. Creativity comes out of the unusual and needs apace, in fact lots of space, to develop. Yet, life is based on mediocrity and

so society demands that creative flair be knocked out of someone when they are young so that they can conform.

As adults. then, it is by and large more difficult to day-dream in general. The hesitations have been sot by othms early on and by subtle reminders to keep people in place. Individuals in clanged deviating from the norm are kept In their place by e permanent flow of seemingly innocent comments designed to induce conformity (I don't like that.' That won't work.') quite often delivered subconsciously. Foilunately, the die-herd day. dreamers/creators manage to struggle through.

Dreaming spots

For some of us, coffee shops, pubs or public places when people are moving around are ideal spots for day-dreaming. Or, indeed somewhere where these Ii running wales, by a river or stream. The constant movement seems to stimulate thought and ideas in a way that perhaps library or the solitude of a study does not. It may not be possible to hone the finished text sitting around in a noisy cafe, but the challenge of holding together thoughts against adversity, as it were, is a great galvanizing force.

In the peace of one’s home there are even more distractions like the TV and the phone. People who are not familiar with the creative process may find it hard to accept that places like coffee bars are a source of stimulation. But why certain places and things motivate the creative individual and others do not is difficult to fathom.

Is day-dreaming an innate ability or something that can be taught? While I personally am prepared to accept that inheritance of ability does play a significant role in the process, I am more inclined to the idea that the environment, and perhaps chance, play a much greater role. It is said that genius is 10 per cent inspiration and 90 per cent perspiration. The coffee shop experience bears this out: a place of turmoil to engender the ideas and then back to the nest to flesh them out. The 90 per cent is a notional figure. If one looks at the work of the great inventors and artists past or present, one can see that more than 90 per cent of perspiration, as it were, went into the execution of their work.