BOOKS & ARTS

When computers take over

What if the current exponential increase in information-processing power could continue unabated?

The Singularity is Near: When Humans Transcend Biology
by Ray Kurzweil
Viking/Duckworth: 2005. 672 pp.
$29.95/£14.99

Paul Davies

I recall reading a statistic from my student days to the effect that if physics journals continued to grow at the same rate, then by the end of the twentieth century, library bookshelves would have to expand at the speed of light to accommodate them. This absurdity is an illustration of what one might call the exponential-growth fallacy. Examples drawn from technology are legion. The Moon landing in 1969 was widely touted as the first small step on an escalator to the stars, with Arthur C. Clarke predicting huge lunar bases and a Jupiter expedition by 2001. The rapid uptake of robotics in the manufacturing industry after the Second World War led to predictions of cyborg servants and android armies within a few decades. In the event, these technologies became stuck or even slid backwards.

The key point about exponential growth is that it never lasts. The conditions for runaway expansion are always peculiar and temporary (with the possible exception of the expanding Universe). But this sobering fact has not stopped futurologist and author Ray Kurzweil from invoking exponential, and even hyper-exponential, growth in the realm of information processing. There is no doubt that the rise and rise in computing power has dazzled us all. Gordon Moore, co-founder of Intel, famously predicted about 30 years ago that computer processing power would double every 18 months, and so far his prediction has come true. Kurzweil invokes 'Moore's law' as if it were a law of nature, and extrapolates from it into a not-so-distant future in which burgeoning information processing transforms and transcends life as we know it. He refers to his culmination point, at which familiar human culture is obliterated by a tidal wave of unrestrained computation, as the 'singularity'. The word is loosely analogous to the mathematician's singularity, at which the rate of change of a quantity becomes infinite.

If the sky's the limit when it comes to processing information, it isn't hard to think of startling applications. Tired of deciding what to eat? Let a swarm of sensors patrol your innards and order the right nutrients automatically through your personal wireless network. Concerned about dying? Then achieve immortality by flooding your body with smart nanobots to monitor and maintain your failing biosystems. Or better yet, 'upload' your mind into cyberspace, where you can have more fun, untrammelled by a material body.

RONALD GRANT ARCHIVE

A giant leap: will increased computing power allow machines to take over, as in films like *The Matrix*?

The question is not whether these wild ideas should be taken seriously, but whether the premise on which they are founded — unbounded exponential growth in information-processing power — somehow escapes the strictures that eventually curtail all other cases of headlong expansion. One obvious reason why accelerating growth in computation might stall concerns the availability of resources. What happens when the Earth's entire surface has been converted into a gigantic information-garnering, bit-churning system? Kurzweil is ready with the answer: we move into space. ("We" here is a generic term. The sentient beings that will soon wrest control from humans, and which are destined to supervise the cosmic phase of development, will be some sort of superdupercomputers.) But by the remorseless logic of exponentiation, pretty soon thereafter the resource-hungry system will find itself spreading across the galaxy so fast it hits the speed of light. Like the physics journals on the bookshelves, exponential growth stops here. Or does it? Kurzweil toys with the idea that the speed-of-light barrier is there to be broken, which opens up the giddy prospect of the entire Universe being taken over by an omniscient superintelligence within just a few centuries.

Such exhilarating speculation is great fun to read, but needs to be taken with a huge dose of salt. The biggest lacuna in Kurzweil's argument is the tacit assumption that if we liberate enough information-processing power, then nature will succumb to all our desires. Control the Solar System? Just double the bit rate a few times and it will be within our grasp. Create life? Simulate consciousness? It all boils down to making a cheaper, faster processor. Unfortunately, the laws of physics may well dictate otherwise. Technology can harness physical laws but it can't bend them. No amount of information processing will suspend the law of gravity or create perpetual-motion machines.

When it comes to discussing the physics that underpins his predictions, Kurzweil is apt to be vague or even misinformed. The stupendous power demands implied by the rampant growth in computation and nanotechnology will be met by a concomitant 'law of accelerating returns' in power-generation technologies, such as fuel cells and high-temperature superconductors. And if these run into technical

problems, well, just send in the nanobots to sort them out. "All technologies," claims Kurzweil, "will essentially become information technologies, including energy."

On the vexed issue of the speed of light, Kurzweil cites evidence that the fine-structure constant, which expresses the strength of the electromagnetic force and contains the speed of light as a factor, may have increased very slightly over the past 6 billion years. The primary evidence comes from an analysis of quasar spectral lines by John Webb of the University of New South Wales in Australia and his collaborators, not from a study of the Oklo natural nuclear reactor in Gabon, as Kurzweil states. Furthermore, even if the observations opened the way to manipulating the value of the fine-structure constant, that is not the same as increasing the speed of light and leaving everything else unchanged. Indeed, the manipulation would involve a reduction of the fine-structure constant, which would slow the rate of information processing at the atomic level, and so prove self-defeating.

These technical hiccups are irritating, but the book should not be read as a scientific treatise. Rather, it is a futuristic and somewhat breathless romp across the outer reaches of technological possibility, limited only by human imagination. Kurzweil coins the horrible term 'singularitarian' for someone who embraces his vision with alacrity. If Kurzweil is to be believed, we will all be singularitarians in just 29 years' time. Hang in there. ■

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A taste of a rotten past

Sacred Cow, Mad Cow: A History of Food Fears
by Madeleine Ferrières
Columbia University Press: 2005. 416 pp. $29.50

W. F. Bynum

Among the formidable list of modern anxieties, those related to food safety loom large. Mad cow disease, genetically modified crops, factory farming, residual pesticides, additives — we read about them daily and are reminded of them when we shop by labels assuring us that we don't need to worry when buying this particular product. We are, after all, what we eat; or more to the point, we are defined by what we do not eat.

All these contemporary concerns give Madeleine Ferrières' monograph a powerful topicality. To her credit, she never panders to the worried well, but sticks to a rich and well-exploited range of historical sources: advice manuals, legal records, statutes, court cases, medical textbooks and imaginative literature. Her running theme is boldly stated: food fears are perennial, although they take different forms depending on the cultural milieu. But the subsidiary theme is also amply demonstrated: fear about food quality varies inversely with fear about food quantity, both temporally and through social strata. If your belly is empty, you don't worry too much about additives or saturated fatty acids.

The title of the original French edition highlights the book's chronological coverage, which ranges from the Middle Ages to the beginning of the twentieth century. So there is nothing about mad cow disease here, despite the allusion in the title of the English version. Instead, in earlier generations, domestic animals with tuberculosis, trichinosis, foot-and-mouth disease and a variety of other ailments made their weary way to the butchers, and thence to dinner tables. Many would have been especially weary, having been driven hundreds of miles to urban markets. If they couldn't make it under their own steam, they were not permitted to be sold. Those that could walk the last mile would be inspected, slaughtered and consumed quickly. The idea of allowing meat to age after slaughter is a recent luxury. So is the tendency to eat younger animals, rather than those past their capacity to provide milk or wool.

Ferrières also considers other foodstuffs, notably fruit, vegetables and grain. These invoked their own fears, especially unripe fruit and mouldy bread, but most legislation revolved around meat, which was a central part of diets half-a-millennium ago. Economic circumstance determined whether one ate tripe or rotten meat with one's bread, not whether vegetable stew was the main dish. The poor were often given, or sold cheaply, animals deemed unfit for commercial consumption.

Social fears often generate fantasies of a golden age, when football hooliganism was unknown, crime was low, nuclear families feasted on wholesome food, and everyone got on well with their neighbours. There is none of that in this volume: the poor struggled, ate badly and died young. Ferrières argues convincingly, I think, that the nineteenth century created the modern food dilemma. Canning, transportation and, eventually, refrigeration extended the food chain. People who would traditionally have seen, touched and smelled the food they were buying now needed only to read the labels. Instead of trusting themselves, they had to trust others. Food inspection declined as political and economic liberalism grew. At the same time, more widespread affluence put a premium on taste, often at the expense of safety. Miasmatic theories of disease and bourgeois sensibilities ensured that the slaughtering was done outside the city centres. Animals no longer had to be able to walk to their destinies.

Ferrières concentrates primarily on France, although there are insights into other cultural experiences, including the persisting British policy of stamping out disease using wholesale slaughter, which is a clumsy tool of disease control. She has a fine sense of the dramatic, faithfully conveyed in the translation, which is sometimes literal at the expense of easy fluency. Away from France, some of the details become fuzzy: a London suburb appears as Issington, rather than Islington, and George Barker has transmuted into someone called Thomas Halwek.

This book is not for the squeamish, but those interested in the culture of the table, or the historical intersections of health, taste and diet, will find plenty here to satisfy their appetites. ■

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Food to die for? Good food was available to previous generations, but not all of it reached this standard.