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BEFORE COMPUTERS

On Information Technology from Writing to the Age of Digital Data

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4. Spreading the word

At the beginning of Chapter 2, I talked about writing things down in order to communicate with many other people. We might describe this as *broadcasting*. For much of recorded history, the notion of broadcasting was strongly distinguished from point-to-point messaging. If the originator (a) wants many people to receive the communication, and (b) does not know who all the people might be, the message needs to be thrown out in some sense, like seeds being spread on a field. We will see at the end of this chapter how this distinction might be blurring or even disappearing, and younger people brought up in the era of social media might even find it a little strange or unfamiliar. But its historical importance is huge.

Further, the word *broadcast* is usually associated with radio, and its derivative, television, because of the way the medium of radio is, by its nature, broadcast into the ether. But long before the discovery of radio, a number of technologies were harnessed to the task of spreading messages among many people.

A proclamation read by a crier in a town square is a form of broadcasting (it may be more or less effective in that role, depending on the environment and social structure). Another method that was used extensively in the Middle Ages and for much longer was the pulpit. This mechanism provided not only for broadcasting to a local community, but also allowed a well-organised church to co-ordinate its message across a country or region.

A latter-day form of proclamation, which broadcasts a message to a local community, many of whom might be expected to visit the church or town square, is the poster on a wall. Since the twentieth century, particularly in the west, we have associated posters with commercial advertising, but in some environments they have acquired quite different connotations of public debate. For example, during the cultural revolution in China in the 1960s, major political arguments were conducted through the medium of posters

on walls.

However, this mode requires a community in which literacy is widespread. During that much longer period of human history in which literacy was a relatively specialised accomplishment, broadcasting via writing took various forms.

The library

The first great mechanism, device, technology that was brought to bear on the problem of broadcasting was the library.

Nowadays we see libraries in various lights—as repositories or archives, as a form of entertainment, as part of the system of education, and so on. Fundamental to these ways of understanding the notion of a library is that libraries, over time, make written information available to many people.

This is, indeed, a major technology. A piece of writing in the precomputer world can, by its very nature, normally be read by, at most, one person at a time (of course a huge poster may be read by several people at once, but this is the exception). Furthermore, writing on paper is normally in the possession of one person. That person may read it more than once, or may lend it or pass it on to a friend or acquaintance—but this is a very limited form of broadcasting. If broadcasting is seen as desirable, a much more efficient mechanism is required. Given that, in the era we are discussing, we do not yet have the technology for multiple reproduction of a written text, we need to establish a place where people may come and consult different writings, and then to make sure that that place contains all the texts that people might want to consult. Placing a book in a library is broadcasting it—making it available to many people over its potential lifetime, people you do not know.

Libraries have been around for quite a while—in particular, for at least two millennia prior to Gutenberg's invention of movable metal type and the start of the mass printing of books. Indeed, in some sense, libraries were all the more important because there were no mass-produced copies of books. A well-organised archive of clay tablets dating from around 2250 BCE was found at Elba in Syria. We know that there was a library in Assur-bani-pal's palace at Nineveh, in the Tigris-Euphrates basin, when it was sacked in 612 BC—more of that below, as of the Royal Library of the Ptolemys at Alexan-

dria. The House of Wisdom in Baghdad, which I mentioned in the first chapter in connection with the Hindu/Arabic numbering system, was essentially a library and a meeting-place that scholars from all over that world came to visit.

The model that I shall take for my description of the functioning of libraries as broadcasting devices is that of the medieval monasteries in Europe. In the period (the very early Middle Ages, or as they used to be called, the Dark Ages) after the fall of the Roman empire and before the recovery of European civilisation, the monastery system provided the major repository of knowledge and the resources for its spread—the universities came along a little later. But first, a bit about attitudes to libraries.

Burning the library

When Nineveh was overrun (as with Elba more than a millennium earlier), the invaders who sacked the palace also burned down the library it contained. Almost certainly, they had no knowledge that what they were burning was a library—the palace was the seat and symbol of power, but the library was simply part of the palace. As it happens, the burning of the library turned out to be one of the greatest acts of cultural preservation in history. The books in the library used the medium of the time and place—clay tablets. Thousands of these clay tablets were baked hard in the fire, and then buried in ash and sand, and as a result can be seen to this day, in the British Museum. We have, from that event, among many other treasures, the best version of the earliest known written story, the Epic of Gilgamesh. This story was old already, probably a millennium or more, but the survival of the Nineveh version is one of those extraordinarily valuable accidents of history.

By, say, half a millennium or so later, library burning had acquired an altogether different character and meaning. The first emperor of China, in the second century BCE, systematically burnt books because of the subversive ideas they contained—a mode of behaviour repeated many times over the following centuries, including most famously the library at Alexandria. The notion of a library had changed: it had become a repository of knowledge, not a building or an administrative archive, and furthermore the technologies of the time (such as papyrus) were very susceptible to fire.

If you happened to regard knowledge as a bad thing, subversive in some sense—any knowledge or just some of the particular knowledge held in the library—then one recourse open to you was to burn it.

The story goes that the library at Alexandria was subject to this kind of attack, possibly more than once in the early Christian era (a time when subversion of established ideas was not treated lightly). By this time the perpetrators would have known perfectly well what they were burning. Apart from burning down the building, they would (still according to the story) form vigilante patrols to seek out books that had somehow escaped or been rescued from the flames, and burn them as well. This brings to mind Ray Bradbury's *Fahrenheit 451*, about a future world in which the function of 'firemen' is exactly to root out and burn books. This may be fiction, but some of the attitudes it represents have existed in the real world for a couple of millennia.

Actually, the current consensus is that the story of the burning of the Alexandria library is essentially myth. But even as myth, it supports my argument. It was told (certainly from the very early Christian era) as a cautionary tale—burning a library is at the very least an act of cultural vandalism. At its worst, it is an attack on knowledge itself.

The medieval scholar

In Europe, scholarship was associated with religious life. If you wanted to study, you would join a monastic order and seek in that environment the teachers and teachings you would need. And while personal teaching is, of course, as necessary as it has always been, many of the teachings since classical times now reside in books. Your monastery library would contain copies of some of these books.

But every single one has been laboriously copied by hand. While you might eventually hope to write a book yourself, other duties associated with the spread of knowledge may intervene. You may have to undertake arduous journeys to other monasteries to consult books that your library does not hold. And above all, you may have to copy out books by hand, and transport them to other places. For many monks, indeed, copying out other books would be the nearest they would ever get to writing a book.

The business of copying books by hand and carrying them from one li-

brary to another was a major occupation of medieval scholarship. At some places and times it acquired an almost industrial flavour. The normal way of copying a book ties up both the original being copied and the monk-scribe for a considerable period, and only produces one extra copy. In one or two monasteries, possessing particularly valuable and sought-after books and many scribes, it was possible to go in for a form of mass-production. A single reader would read the book aloud, and a number of scribes would take it down as dictation. Thus many copies could be produced simultaneously.

So when, in the fifteenth century, Gutenberg's form of printing came along, in some sense the western world was ready and waiting.

Printing and publishing

The ability to reproduce written material exactly, in multiple copies, by mechanical means, was the second great invention to change the face of broadcasting utterly. Once again, I am indebted to John Man's *The Gutenberg Revolution* for this account.

Gutenberg is credited with this invention in Europe, with the proviso that many aspects of printing had previously been invented in the Far East (Gutenberg was probably not aware of this work). From the ninth century, documents were being printed in China, at first with a specially carved wooden printing block for each page, but later with a system of movable type. Individual characters were carved or modelled in clay and stocks of the common characters were built up; rarer characters had to be specially made for a page. In one system in use in the eleventh century, the characters chosen to make up a page were temporarily fixed in resin in a metal frame.

We may note the characteristics of Chinese versus European languages, which might help or hinder this process. Chinese characters are all of the same size, with no breaks between words. Thus the arrangement in the frame is simple—each printed line contains the same number of characters, and the sequence may be broken anywhere for a new line (the same applies if the characters are arranged in columns rather than horizontal lines).

However, the Chinese language suffers one considerable disadvantage compared to European languages: the lack of an alphabet. Chinese has tens of thousands of distinct characters. Even though the number in daily use

is somewhat smaller, there is little possibility of building sufficient stocks of characters that every new page can simply be made from stock. And certainly the creation of a mould, from which many new instances of a character can be cast in metal as required, would have made no sense in the Chinese context. Both of these were characteristics of the Gutenberg system.

We can think of printing in economic terms, in a way that may help us to see its revolutionary status. At the core of the industrial revolution is the notion of investing in machinery—to enable the cheap reproduction of goods for which people will pay. The Chinese system of printing involves a lot of investment in the individual printed object—the book or whatever—and might gain a little from a generic investment in printing characters, but not a lot. Gutenberg's system involves a significant prior investment, in the moulds from which the individual characters of type are cast. This makes the typesetting of different books (as well as different pages of a long book) very much cheaper.

This precursor of the industrial revolution is remarkable, not only for being approximately three centuries early, but also for being devoted to the production of information rather than of more material goods. Well, that's an overstatement—books are of course material goods. Nevertheless, their primary value lies in their content rather than their physical nature.

But the mechanical process of printing was only part of the invention. The other part was the system of publishing. The real Gutenberg revolution was to make it possible for the first time for people outside of monasteries or governments to obtain books, build libraries, and take full part in intellectual life and the construction of mankind's fund of knowledge. Publishing joined libraries as a core mechanism for the broadcasting of information.

Publishing

Publishing was not a single datable invention in the way that we might see printing. On the contrary, the idea of publishing started out as a not-very-radical extension of what had been common practice before printing. But the notion has been growing and changing ever since.

When books have to be individually copied, the copies are often (usually) allocated, their destinations predetermined, before they come into existence. In the early days of printing, a book would be prepared for a prede-

fined list of 'subscribers': people who expected, and probably paid upfront, to receive a copy. The idea of printing a large number of copies speculatively, hoping to be able to sell them, emerged only gradually. Also the idea of subscription was transformed, over several centuries, into periodical publications. In the seventeenth century, scientific journals began. If you subscribed to such a publication, you would not know exactly what to expect, but you would have some confidence that it had gone through some selection process before it got into print. Newspapers and other periodical publications eventually followed. Even without subscriptions, the publisher would put out new issues according to some regular schedule, and could reasonably expect many people to buy regularly.

This model has at different times been used for many kinds of publication, not necessarily those we would associate with it today. For example, both the novels of Dickens and the Oxford English Dictionary first appeared in serialised form. Indeed, the model applies at different levels. If you like reading novels, there is some chance that you will try a new novel; if you like Dickens, there is a fair chance that you will try a new Dickens; if you liked the last instalment of *Bleak House*, there is a very high chance that you will try the next.

Far from settling down into some steady state, models of publishing continue to change radically, as we shall see further below.

Cinema

I will later be considering the technologies associated with images and their development over the period of slightly less than two centuries since the invention of photography. However, the role of film as a method of broadcasting belongs here.

Photography itself is no more a natural broadcasting medium than writing. The analogue of the library is the art exhibition or gallery, which has been around for a time and to which photography can contribute. Later, when it becomes feasible to print them in a similar fashion to the printing of text, photographs become part of the publishing world. But film is something different.

In order to see a film, you have to put aside some time and not only reserve that copy of the film for that period, but also have exclusive use of

some equipment—including a screen, which means an entire room. The film is equally available to everyone in the room; there is no problem about some people reading faster than others, because the timing is fixed. So it becomes not only feasible but desirable to have a number of people watching at the same time.

The model for bringing people together in this way has existed for millennia already, in the form of the popular show—think, to name but two, of the great playwrights of classical Greece or the Elizabethan theatre. This notion gave birth to the cinema show, one of the dominant broadcasting methods of the early twentieth century. That you can persuade people in large numbers to congregate at fixed times for the purposes of information and entertainment, not knowing exactly what they are going to see and hear, is one of the great social discoveries, repeated over the ages. We can argue that the great populist politicians of the same period, Hitler included, made full and effective use of this discovery, and that the church had previously achieved a similar effect by very different means. But it took the church several centuries, and required a village culture that was receptive to this method of communication.

Although cinema is still around as a method of broadcasting, it is clear that other media such as television not to mention DVDs, the web, and streaming, which do not require people to gather in one place, have challenged and largely overcome its domination. In fact exactly the same might be said of the political rally.

Radio and television

When radio was first developed for communication at the tail end of the nineteenth century, the fact that it was essentially a broadcast medium (that is, if you transmit, anyone within range and with a receiver can hear you) was seen, at least by some people, as a disadvantage. Despite the existence of broadcasting and broadcasting methods for centuries, for many people, the model of communication that came most readily to mind was that of the point-to-point message. The extraordinary success of the telegraph over the previous 50 years no doubt contributed to this view.

Radio was then, and is now, used for point-to-point communication. But the medium of radio had a huge effect on the notion of broadcasting. In one

sense, the history of the twentieth century is the history of the development of broadcasting—embracing cinema, radio and television.

Once again, for both radio and television, we require an audience—people who listen or watch speculatively, on the grounds that this particular source has informed, interested or entertained us in the past. This is a little like the traditional notion of a subscriber, though modified for the times. To such an extent has mass communication, broadcasting in all its guises, taken hold in our society that many people spend much of their lives actively or passively open to incoming communication. We expect, all the time, to be aurally or visually entertained.

Copying and printing

Meanwhile, at the turn of the nineteenth century and for about three-quarters of the twentieth, the technologies associated with making multiple copies of documents proceeded apace. In some respects they went in the opposite direction from the printing press and the typewriter—instead of breaking down text into characters, they moved towards the holistic treatment of pages of printable material.

For example, a method of reproducing architects' plans was invented in 1842 and widely used towards the end of the century. This was the *blueprint*, and it has given us a metaphor that has lasted to this day. Original drawings were made on translucent paper, and were reproduced using a simplified photographic process (no camera or lens involved). The wax stencil duplicator was invented in the 1880s—in this case, the original wax stencil was normally prepared on a typewriter although it was also possible to do simple line drawings with a stylus. Given the developments in photography (to be explored further in Chapter 7), it was possible to photograph a document and then make single or multiple prints of it (in the traditional optical-and-chemical photographic method of printing). In the early twentieth century, a photostat machine was developed to make single copies automatically. In this case, the copy was in negative—an original in black type on white paper became a copy in white type on black paper.

But the major development of the twentieth century in document copying was the xerographic process. The main principle was patented in 1942, though the first commercial machine not till 1960. However, it soon made

major inroads into the world of business, becoming a ubiquitous presence in offices around the world. The key was another use of electricity—making an electrostatic image on a photosensitive plate, from an original document on paper. The electrostatic image is transferred to paper; black toner particles stick to the charged areas, and are heat-fused onto the paper. No chemical processes were involved, and prints were made on ordinary paper.

Although the Xerox machine printed a single copy at a time, it was very fast, and could easily be used to print multiple copies of an original. Similar techniques were developed for small printing presses, in a process known as offset lithography. Lithography itself as a method of printing, using a prepared flat stone as a printing plate, has a venerable history, having been discovered at the end of the eighteenth century, and used for example by the artist Goya to reproduce pictures, in the nineteenth. But offset litho uses a metal printing plate, normally produced photographically from a paper original.

Both the xerographic process and offset litho have thrived in the digital age. Laser printers use a laser to build an electrostatic image on a printing drum, for printing directly to paper. Similar methods can be used to make a printing plate that can be used for longer print runs. In both cases, the starting point is a computer file, rather than a paper original. Now, of course, in the digital age, virtually all digital objects themselves (in the form of computer files) are indefinitely and accurately copyable, at the touch of a button.

The web

About a century after the development of radio, we discovered a new medium. This is the internet: the vast international network of connected computers. At first glance, the point-to-point wires that make up the internet seem entirely unsuited to broadcasting, in just the same way that radio seems unsuited to point-to-point messages. But just as we have succeeded in subverting the medium of radio to serve many different purposes, including point-to-point messages, we have also subverted the wire-based communication of the internet to devise many new ways of broadcasting.

Of course not all internet connections are wire-based. In fact more and more use is made of radio and other wireless media, to connect computers

and other electronic devices, on any scale from centimetres (infrared and Bluetooth) to metres (wi-fi) to thousands of kilometres. But the almost universal arrangement is *first* to subvert the broadcasting medium of wireless to serve a point-to-point function between two computers (which might be your phone and the exchange), and *then* to subvert the multiple point-to-point connections between multiple computers to serve a broadcasting purpose.

The most obvious manifestation of this technology is the World Wide Web. But we have to pay particular attention to the type of system that has emerged as a core component of the web: the search engine. Although the interlinked nature of the web contributes a great deal to its use as a publishing medium, general search engines like Google and Yahoo! and a whole host of specialist search systems have turned out to be critical to its success.

We now seem to be entering a new phase of broadcasting. In the web environment, the reader/listener/viewer/user who used to have to choose a channel and then take a relatively passive role, is suddenly given vastly more control over the communication process. This potential recipient can actively seek out desired information, using a combination of the power of the search engine, the ability to follow links from one page to another, and the ability to recognise what is wanted or needed when it appears on the screen in front of him or her. None of these means is perfect or infallible, but in combination they are very powerful indeed.

The existing publishers or broadcasters, the owners or controllers of the older media, have been having great difficulty in coming to terms with this new medium and its inherent transfer of the locus of control. One battleground in which this conflict is most apparent is that of intellectual property. In the older publishing environments, publishers liked to think they could retain control over the uses of their 'products' even after they had been sold to their customers. This view was already somewhat divorced from reality in the second half of the twentieth century with the arrival of cheap and easy copying facilities (the photocopier as discussed above, the tape recorder, the VCR, the CD/DVD, and finally computer files themselves). But the web has multiplied the opportunities, and therefore the threats to intellectual property, a thousandfold.

Blurring the boundaries

The distinction with which I started Chapter 2, between sending a message to a specific recipient and broadcasting it to anyone who would listen, was a convenient way to discuss a range of different ideas in communication. But it was a somewhat loose distinction, which does not stand up well to detailed examination. The variety of communication methods that we now have at our disposal make the boundary between the two look even more fuzzy.

For example, I can write messages for sending to lists or mailgroups. A mailing list may be something I have created for myself (my siblings, the members of a committee that I run, etc.). Or it can be a list whose membership I know exactly; one whose membership I mostly know but which might include some new members I don't know; a public list or mailgroup where I do not expect to know everyone. It might be a list controlled by one person or one that anybody can join. The knowledge of its existence and/or eligibility for membership may be restricted or widespread. I can post on a blog, which, like depositing my book in a library, opens my message to anyone who finds it in the future. I can tweet a message that might go only to a very few people, or might be picked up by someone with a large following and rebroadcast to a cast of thousands.

If I put a page up on the web, it might be for a particular audience or for general interest. I may link it to some other page that I know is widely accessed, in order to encourage anybody who is interested to visit. I may, in various ways, help the general search engines to find it and to index it in ways I think appropriate, so that a particular but unknown audience can find it easily. Or I may put up a page in order to make it available to a small number of people, those whom in general I would expect to be able to identify. I may, in fact, want to restrict access to those people; this I may try hard to do, by putting serious obstacles in the way of anyone not in that group trying to access this page; or I may try this only in a minor way or not at all.

A similar variety of possibilities arises in the world of printed paper documents. I can easily make any number of copies of anything, from one to a thousand or a million (depending on my resources); I can give them or send them to individuals or to a (paper) mailing list; I can leave copies of a leaflet in some public space, for a limited or a broad audience.

All of these possibilities represent forms of communication somewhere in the no-man's-land between one-to-one communication with another individual and broadcasting.

The connected world—two

The huge variety of communication methods that are now available to us, to which I referred at the end of the last chapter, extend into the realm of broadcasting and into the hinterland just described. Few old media have died: we still have books and journals and newspapers, and radio and television, as well as the web. We have an extraordinary range of devices and methods to help us construct, display, transmit, publish, locate, and access messages of all sorts. Our communication activities, both sending and receiving, can be highly focussed or widely spread or anything in between.