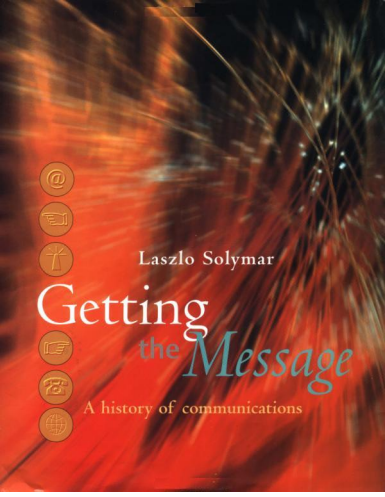




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Getting the Message

A History of Communications

Laszlo Solymar

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To the great communicators of the future
Georgina and Tanya

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Oxford
October 1998

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Part I
The First Thirty-Six Centuries



CHAPTER
ONE

Introduction

The history of communications is a branch of the history of technology but, strictly speaking, it is in a category of its own. The goods produced by technology, whether a piece of machinery, a piece of clothing or a piece of furniture, are tangible; they perform some useful function. The goods produced by communications are messages. They are mostly useless but when they are useful they can be very, very useful. For that reason communications has always been regarded as a good thing by all peoples at all times. Even in prehistoric times a tribal chief of average intelligence would have easily appreciated both the military and economic implications. He would have dearly loved to receive reports like 'Scores of heavily armed Mugurus sighted at edge of Dark Dense Forest' or 'Buffalo herd fording Little Creek at Mossy Green Meadow'.

The idea was there but the means of sending messages were rather limited until very recent times. The same limitation did not apply to human imagination. A god in Greek mythology could contact any of his fellow gods without much bother and could cover the distance from Mount Olympus to, say, the battlefields of Troy in no time at all. Communications between gods was, of course, not possible in monotheistic religions. On the other hand the single god could easily send messages to any chosen individual. A possible method was first to call attention to impending communications (e.g. by a burning bush) and then deliver messages in a clear, loud voice. Oral communications was nearly always the preferred method but there is also an example of coded written communications in the Book of Daniel. The occasion is a feast given by Belshazzar, King of Babylon. Belshazzar draws upon himself the wrath of Jehovah by drinking with his wives and concubines from the holy vessels plundered earlier from the Temple in Jerusalem. Thereupon a message appears on the wall, MENE, MENE, TEKEL, UPHARSIN. This message is decoded by Daniel, as saying: 'God has numbered thy kingdom and finished it. Thou art weighed in the balances, and art found wanting'. By next morning Belshazzar was dead. This unique example of instantaneous written communications may be seen in Fig. 1.1 in Rembrandt's interpretation.

Besides appealing to human imagination, communications have a number of other distinguishing features. Its rate of progress over the last century and a half has been conspicuously faster¹ than that of any other human activity, and shows no sign of letting up. Let me make a few comparisons. In 1858 it took 40 days for the news of the Indian Mutiny to reach London.² By 1870 there were several telegraph lines

¹This claim may be rightfully challenged by computer enthusiasts but it will be discussed in Chapter 16. Communications and computers are no longer separate subjects.

²To be exact, to reach Trieste, because by that time there was a telegraph connection between Trieste and London.



Fig. 1.1 *Belshazzar's feast* by Rembrandt.

connecting India to Europe. Transmission time depended mainly on the speed of retransmission from station to station, four hours being a good estimate. The progress in 12 years from 1000 hours down to 4 hours represents an improvement by a factor of 250. For the Atlantic route the advent of the submarine cable in 1866 reduced the time for sending a message from a couple of weeks to practically instantaneous transmission. The figures are no less daunting if we talk about the capacity of a single line of communications then and now. In the 1840s when electrical telegraphy started to become widespread, information could be sent at a rate of about 4 or 5 words per minute. Today, the full content of the *Encyclopaedia Britannica* could be transmitted on a single strand of optical fibre in a fraction of a second. A similar increase in, say, shipping capacity would mean that a single ship would now be capable of transporting ten thousand billion tons of goods, i.e. more than a thousand tons for every man, woman and child on Earth.

A third possible measure is the cost of information, not when we send information in bulk—that is less tangible—but when we want a leisurely chat with a friend in America. In 1927, when the trans-Atlantic telephone service was opened (relying on radio waves), a three-minute telephone call cost £15. Today, it might cost 50p. In nominal prices the reduction is by a factor of 30 which, in comparison to the figures quoted previously, is perhaps less striking, but since we are talking about money in our pocket its effect on everyday life is much more significant. It needs to be added of course that prices have risen considerably since 1927. A loaf of bread, for example, cost about 3d (1.25p in decimal currency) at the time, whereas today it costs something like 50p. So while the price of bread went *up* by a factor of 40, the price of a trans-Atlantic telephone call went *down* by a factor of 30. In real terms, to make that call is now cheaper by an amazing factor of 1200. And this is not an anomaly. We would arrive at similar figures whichever aspect of communications was chosen for comparison. The benefits are obvious. In 1927 only the richest people could afford a social telephone call across the Atlantic; today it is within the reach of most people in Europe or America.

What else is so extraordinary about communications? Its significance for conducting affairs of state. Governments which were quite happy leaving the manufacture of guns and battleships in private hands were determined to keep communications under their control. Perhaps the most forward-looking one was the French Government. As early as 1837, before the appearance of the electric telegraph, the Parliament approved the proposal that:

Anyone who transmits any signals without authorization from one point to another one whether with the aid of mechanical telegraphs or by any other means will be subject to imprisonment for a duration of between one month and one year . . .

This law was repealed only in the last decade when France, following cautiously the example set by the United Kingdom, started on its privatization program.

Having made a case for communications being a subject worthy of study, I would like to add that there is no chance whatsoever of doing it justice in a single book. Of necessity the subject must be restricted. The kind of communications I shall be concerned with is first of all fast—faster than the means of locomotion at the time, i.e. faster than a horse or a boat in ancient times, faster than a train in the last century, and faster than an aeroplane in the present century. Secondly, it is long distance communications, meaning that messages are to be delivered at a distance well out of earshot. Thirdly, it is concerned with communications from point A to point B. This last distinction has only become significant in recent times. If, say, a Roman Emperor wanted to send a

message to a provincial Governor he sent a messenger. If the Emperor wanted to send the same message to a dozen Governors he sent a dozen messengers. The techniques for sending to one and sending to many were the same. However modern methods of reaching the many differ considerably from those set up for establishing communications between two persons. In technical jargon the first one is known as broadcasting and the second one as point-to-point communications. I shall keep away from broadcasting (it has too many different facets) and concentrate on the latter, asking the question: how, starting from the earliest evidence, did man manage to send information from point A to point B, far away, without physically delivering the message?

Having limited the subject to be discussed I shall now broaden it. The availability of fast communications has made such an impact upon all aspects of human life that it is impossible to ignore the political and social consequences. I shall discuss them in detail whenever I have a chance. The last and possibly the most important thing I wish to do is not only to describe what happened in the last 4000 years but also to explain the underlying principles as new inventions and new discoveries came along. One might think that the subject of modern communications is far too complicated for the layman to understand. I disagree. Surely communications must be an easier subject than genetics which is concerned with life, the most complicated phenomenon on earth, and it is bound to be easier than cosmology, the most complicated phenomenon in the heavens. In both cases excellent attempts have been made in the recent past to make them intelligible to the layman. I shall try to do the same thing for communications.

2

CHAPTER TWO

The beginnings of communications

The principal aim of this chapter is to present some evidence for the existence of early communications systems. At the same time, faithful to the dual purpose of the book, the concept of communications will also be discussed starting at the very beginning. Terms like 'binary arithmetic' and 'bit' will be liberally used, and the two digits 0 and 1 will be introduced in the sense used by communications engineers.

In order to emphasize the simplicity of the basic principles it might be worth starting in the world of nursery rhymes. It may be assumed that Jack needs a pail of water but owing to an accident on the previous day he is confined to bed and his head is still wrapped up with vinegar and brown paper. Jill, who lives next door, would be willing to go up the hill on her own and fetch the aforesaid pail of water but she has no idea whether the water is needed or not.

Jack can call attention to his need in several ways. He can, for example, shout or he can send a brief note. However, Jill's house, particularly when the windows are shut, may be too far away for oral communications, and there may be nobody about to fulfil the role of the messenger. So Jack may decide to send a signal. How to send a signal? Anything that has been previously agreed would do. Using artifices easily available for someone lying in a bed he could, for example, put one of his slippers in the window. According to his agreement with Jill, no slipper could mean 'water is not needed', whereas the presence of a slipper would indicate desire for a pail of water. It is a case of YES or NO; yes, water is needed or no, water is not needed. In the communications engineer's jargon one bit of information needs to be transmitted. YES may be coded by 1, and NO by 0. In the particular communications system set up by Jack and Jill, the presence of a slipper in the window is coded by 1, and the absence of the slipper by 0.

In times less demanding than ours, being able to obtain one bit of information was regarded as quite substantial, particularly in matters of defence. The question most often asked was 'Are hostile forces approaching? Yes or no?' The practical realization of such an early warning system was quite simple. Watchmen were posted at suitable vantage points in the neighbourhood of the city: the watchmen then sent signals whenever they could observe enemy movements. The usual way of sending a signal was by lighting a fire. Lack of fire meant, 'No, no enemy forces are approaching'. The presence of fire meant, 'Yes, enemy forces are approaching'.

Next suppose that the fire lit by the men on watch is not directly

visible from the city where the information is required. There might be a mountain in between as shown in Fig. 2.1. So what is the solution? Post watchmen both on mountain A and mountain B. Those on mountain A will first see the enemy and light a fire. Those on mountain B will light another fire in turn, and that will be seen in the city. The idea is to have a relay, and there is of course no reason why the relay could not have many more elements—5 or 10 or perhaps 100. In principle, it makes no difference how many elements there are. In practice, there is a higher chance of failure if there are too many of them. At one particular post there might be a flood which makes lighting any fire impossible, at another post the watchmen might play dice instead of paying due attention. The various reasons for failures in communications will be discussed at several places in this book.

It would be of interest to know when fire signals were first used. Presumably, as soon as men could confidently ignite a fire, and had acquired some elementary command structure. Documentation is another question. Only a minority of our ancestors were fond of documentaries—and most of those ever written must have perished in the frequently occurring disasters. How far one can go back seems to depend on the diligence of archaeologists and on the ingenuity of those who can decipher odd-looking symbols. It is quite possible that a lot of evidence is still hidden in some unexcavated palaces. As it is, the earliest evidence comes from the middle of the nineteenth century BC.

The city where the evidence comes from is called Mari. Once upon a time it lay on the banks of the Tigris, somewhere halfway down its journey to the Arabian Gulf. It disappeared from history before the close of the century when Hammurabi's forces razed it to the ground. It reappeared in the 1930s thanks to the efforts of a group of French archaeologists. They found an amazing amount of information about the city and about all those with whom the Kings of Mari kept up a regular correspondence. The various chambers of the excavated palace yielded over 20 000 clay tablets written in Akkadian. They are particularly informative because in that period the letters were written (using

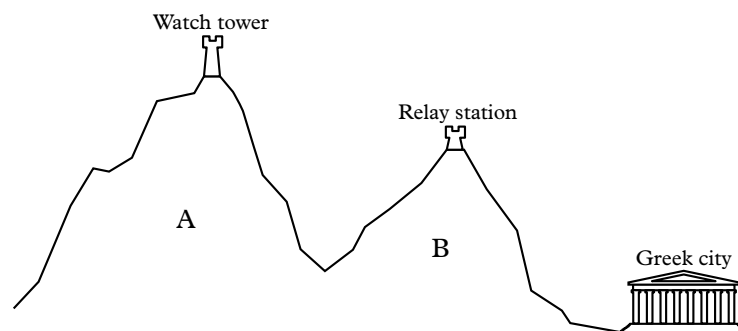


Fig. 2.1 A relay station is needed when those on watch cannot directly communicate with the city.

cuneiform writing which had a symbol for each syllable) in the living language. They give accounts of all kinds of activities, for example: register of people obtained from the last census, records of incoming and outgoing goods (including such disparate items as garlic and gold), legal documents on various disputes, commercial transactions, correspondence with foreign rulers, and reports on administrative and political problems, on the state of the roads, on weather conditions, and (luckily for this book) on fire signals.

One might expect that there would be no need to write reports when the signalling system worked smoothly. Letters written to the King would more likely be concerned with difficulties encountered. The following two letters (see Stephanie Dalley, *Mari and Karana, two old Babylonian cities*. Longman, London, 1984) are indeed of that genre:

Yesterday I went out from Mari and spent the night in Zurubban; and the Yamanites all raised torches: from Samanum to Ilum-muluk, from Ilum-muluk as far as Mishlan. All the towns of the Yamanites in the district of Terqa raised their torches in reply. Now, so far I have not managed to find out the reason for those torches, but I shall try to find out the reason and I shall write to my lord the result. But let the guards of Mari be strengthened, and may my lord not go out of the gate.

The second letter has a similar message:

Speak to Yasmah-Addu, thus Habil-kenum. My lord wrote to say that two torch signals were raised; but we never saw two torch signals. In the upper country they neglected the torch signal, and they didn't raise a torch signal. My lord should look into the matter of torch signals, and if there is any cause for worry, an official should be put in charge.

Unfortunately, we do not know whether an official was ever appointed and if so whether his intervention improved the communications network. There is no doubt however that fire signals were used, erratically perhaps, in that part of Mesopotamia some 4000 years ago.

The letters found in Mari clearly show how our civilization, which we like to refer to as Western civilization, had one of its roots in those fertile grounds between the Tigris and the Euphrates. Hammurabi's forces soon put an end to Mari's prosperity. The city disappears from the stage of history by the end of the 20th century BC. The fall of Mari did not of course mean that torch signals fell into disuse. Various forms of fire signals were no doubt used for the next twelve centuries, although no detailed descriptions have survived.

Moving westwards towards Asia Minor and Greece, our next stop is at the beginning of the seventh century BC when, quite likely, the works of the great Homer were first written down. It would be reasonable to expect in those epics a story about a beleaguered city which managed to summon help by fire signals at some time or another. My classicist

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