1 The Cult of Numbers

The idea of a society governed by information is inscribed, as it were, in the genetic code of the social project inspired by a blind belief in numbers. The idea arose long before the notion of 'information' appeared in modern language and culture. This social project, which took shape during the seventeenth and eighteenth centuries, enthroned mathematics as the model for reasoning and useful action. Thinking in terms of what is countable and measurable became the prototype for truthful discourse, and it determined the scope of their quest for the perfectibility of human society. The French Revolution marked a high point in the effort to give concrete form to the language of mathematical calculation, making it the yardstick for judging the quality of citizens and the values of universalism.

Organising thought

Algorithms

'If I were to choose a patron saint for cybernetics out of the history of science,' wrote Norbert Wiener, 'I would have to choose Leibniz. The philosophy of Leibniz (1646–1716) centres about two closely related concepts – that of universal symbolism and that of a calculus of reasoning.' The book from which this passage is taken laid the groundwork of this scientific discipline immediately after the Second World War (Wiener, 1948: 12). Indeed, the German philosopher-mathematician's thinking on the nature of logic marked an essential step in developing the idea that it is possible for thought to manifest itself in a machine. Leibniz came close to automating the thinking process by developing binary arithmetic and a *calculus ratiocinator* or 'arithmetic machine', which was a more efficient calculator than the one devised by Blaise Pascal. For Leibniz, the discovery of a 'starting point' in relation to which everything would fall into place was the guiding principle in his search for a 'new compass of knowledge'. His idea of compressing information with a view to economising on thought was also at work in the indexes and catalogues he envisaged as a tabular space with multiple entry points.

Leibniz's mathematics, which included subsets as well as relations, constituted the first theory of complexity and the first philosophical treatment of 'complication'; in other words, the multiplicity and variety of numbers and beings can be organised, classified and arranged into a hierarchy (Serres, 1968). Leibniz (and Newton, independently of him) developed differential calculus and integral calculus by reducing the fundamental operations of infinitesimal calculus to an algorithmic approach. Algorithms are orderly series of elementary operations taken from a finite repertory of operations that can be performed within a given time. They could not, however, be converted into the concept underlying automated data processing until they could be expressed in algorithmic writing. This was to be the contribution of the Irishman George Boole in 1854, who laid the foundations of the autonomous discipline of computer science that came into being a hundred years later.

For Leibniz and his contemporaries, more rapid methods of calculation were needed to meet the requirements of modern capitalism in its formative stages. With the expansion of overseas trade, a market emerged for the collection, storage, bureaucratic processing and dissemination of data intended for merchants, financiers and speculators. The growth of maritime navigation called for improved shipbuilding. The calculation of longitude became a key laboratory for developing a theory of production of regular motion and 'automatic machines to measure time' (pendulum clocks, watches, marine chronometers), the remote ancestors of computers. The new attitude towards time and space spread to workshops, trading counters, armies and public administrations.

Bacon's project for useful science

'The virtues of ciphers are three: that they be not laborious to write and read; that they be impossible to decipher; and, in some cases, that they be without suspicion' (Bacon, 1996: 232). This enigmatic observation dates from 1605 and is taken from the argument put forth by Francis Bacon (1561–1626), a philosopher and future chancellor of England, in favour of a science of facts. The theoretician of the experimental method was referring here to innovations achieved in 'the art of ciphering and deciphering'. His interest in cryptography dates from the period 1576–1579, when he was an adviser at the embassy in France. During this period of upheaval due to the wars of religion, Bacon developed a secret binary language for sending diplomatic messages. Each letter of the alphabet was converted into a simple combination of two symbols and each symbol corresponded to a different form of typography. The science of secret languages would prove to be a recurring factor in the history leading up to the development of intelligent machines in the twentieth century.

Francis Bacon never abandoned his obsession with secrets. His project for a 'Great Restoration', a far-reaching intellectual reform that would break away from the scholastic view of the world and from prejudices that could not stand up to experimentation, was combined with an imperative of national security (*securitas publica*). He held this view despite the fact that his manifesto in favour of the 'increase of science' opened with a call for constant, uninterrupted progress towards the aim of general understanding and universal harmony, and thus for efforts to achieve the happiness of all by 'liberating man from his condition'. In Bacon's writings, the word 'information' meant *intelligence* in the sense of information gathering. In a posthumous work entitled *New Atlantis* (1627), Bacon developed his plan to reorganise all knowledge in utopian fashion; the 'inquiry' designed to establish the 'cosmography' of the countries he visited could be assimilated to espionage. On the isle of Bensalem, no fewer than nine categories of scientists were at work, in accordance with a strictly hierarchical division of labour, collecting, classifying and processing information. In the organisation chart conceived to plan useful science, the members of only one of the categories, the twelve 'Merchants of Light', were allowed to leave the country and travel about the world in search of 'books, and abstracts and patterns of experiments'. They were told to 'gather Enlightenment wherever in the world it may grow' by gleaning everything concerning the sciences, the arts, techniques and inventions. Moreover, they could travel only if they hid their origins 'under the names of other nations (for our own we conceal)'. Access to the island was prohibited to foreigners or, at the very least, strictly regulated, in order to protect its inhabitants' knowledge and skills, which were far superior to those of the rest of the world. A testimony to this high level of scientific expertise was the acoustic laboratory, which had invented an *inanimatus nuncius*, that is, a 'means to convey sounds in trunks and pipes, in strange lines and distances'.

In 1662, Bacon's plan for the reorganisation of knowledge was given concrete form with the founding of the Royal Society of London for Improving Natural Knowledge by Experiments, at the initiative of the merchants of the City of London. To many, the House of Solomon, where the sages of the utopian island of Bensalem dwelled, foreshadowed this academy of the sciences. In 1666, France set up a Royal Academy of the Sciences, and an astronomical observatory a year later. The geodesists of the time were busy trying to determine whether or not the earth flattened out at the poles, which they linked to the search for an invariable, universal standard of length. A solution for calculating the arc of the earth's meridian, based on the metre, would have to wait until the French Revolution. In 1676, the Royal Observatory of Greenwich became the symbol of England's control of the seas.

A universal language

Leibniz's project for automating reason was only one facet of the search for an ecumenical language. It was in keeping with his philosophy, which bore the stamp of cosmopolitical humanism, and inscribed in his religious thought. Leibniz wanted to help bring people closer together, to unify not just Europe but 'the entire human species', because, he wrote, 'I consider Heaven to be the Fatherland and all people of good will to be fellow citizens of that Heaven.' In explaining the mechanism he had just invented for reducing numbers to their basic principles, such as the two digits of 0 and 1, he noted that a similar binary system had already been used in China four thousand years earlier, formulated by Fuxi, China's first philosopher, the creator of its monarchism and author of the *Book of Changes* better known as *I Ching* (Fuwei, 1996). He emphasised the similarity of form, transcending geographical boundaries, to justify his theory that only a language of signs could resolve the imperfections of natural languages, which are sources of discord and pitfalls for communication. He also dreamed of arousing the interest of the Chinese in the *Respublica Christiana.*

Francis Bacon thought there could be no restoration of the sciences without a critique of the 'idols of the public realm', the false ideas – religious or otherwise – conveyed by words or common language. The desire to be free from these *idola* was an incentive to search for a universal language. The dream arose of an 'a priori' philosophical language, able to function as an 'alphabet of human thought', or a language capable of organising and encompassing all knowledge. After all, hadn't Descartes himself come up with the idea of a new language in 1629, which he developed using a decimal numbering system? The increase in trade, along with the decline of Latin as the lingua franca, the downfall of which was definitively assured by the Treaty of Westphalia in 1648, also contributed to fuelling the search for a universal language.

The archetype of all universal language projects appeared in 1668 in *An Essay towards a Real Character and a Philosophical Language* by John Wilkins (1614–72). Wilkins, a clergyman who taught at Oxford and was the first secretary of the Royal Society, was spurred by reading an unknown (or apocryphal) Chinese encyclopaedist to construct an 'analytic language'. To do so, he divided the universe into forty categories or classes, which were then subdivided into sub-classes, which in turn were subdivided into species. He assigned a two-letter monosyllable to each class, a consonant to each sub-class, and a vowel to each species. For example, *de* meant 'element'; *deb*, the first element, fire; *deba*, a part of the element fire, or a flame.

Three centuries later, while tracking down 'arbitrary imaginings' or attempts to solve the chaos of knowledge by 'classifying the universe', Jorge Luis Borges unearthed and wrote about John Wilkins' project and his original model borrowed from the Chinese encyclopaedist. Borges' essay, published in a collection entitled *Inquisiciones*, was, in turn, to become the 'birthplace' of Michel Foucault's' work, *Les Mots et les choses* (Words and Things). Indeed, as he himself indicates, it was after reading the Argentine writer's commentaries that Foucault undertook his 'archaeological inquiry' into the historic moment, which he places at the turn of the eighteenth and nineteenth centuries, when the *episteme* or configuration of knowledge characterising Western culture shifted as a result of the break between words and things. At that moment, a 'new positivity' came into being. 'Tabular' thought made it possible to 'set up an order' among beings and a 'division into classes'. The taxonomy proposed by this thinking led to 'words' and 'categories that lack all life and place'. The coherence between the theory of representation and the theory of language dissolved and words ceased to merge with the world.

> Language as the spontaneous *tabula*, the primary grid of things, as an indispensable link between representation and things, is eclipsed in its turn; a profound historicity penetrates into the heart of things, isolates and defines them in their own coherence, imposes upon them the forms of order implied by the continuity of time; the analysis of exchange and money gives way to the study of production, that of the organism takes precedence over the search for taxonomic characteristics, and, above all, language loses its privileged position and becomes, in its turn, an historical form coherent with the density of its own past. (Foucault, 1993: xxv)

The project for achieving universal knowledge and rationality was a new way of thinking about both reason and words, fuelling the belief in perfectly transparent meaning.

Territorial organisation

Statistics: the science of the state and of trade

Probability theory, the foundations of which were laid down by Pascal and Huygens around 1660, became a new means of objectivising human society. It offered a method for choice in the event of uncertainty. Statistics and arithmetic or political anatomy opened up a new territory for practical science.

In Germany, the pioneers of statistics were confronted by the new reality created by the Treaties of Westphalia (1648). These treaties signalled the beginning of the concept of the modern nation-state and its corollary, stable borders, and confirmed the break-up of the empire into a multitude of microstates. From 1660, *Staatkunde*, or 'state knowledge', promoted the development of nomenclature and tried to meet the needs of state organisation. In keeping with this pragmatic tradition, the notion of ‘statistics’ was first defined by Gottfried Achenwall (1719–1772) as the ‘state science’ or *Staatswissenschaft*. It was aimed at ‘illustrating the excellencies and deficiencies of a country and revealing the strengths and weaknesses of a State’. His method of ‘multiple entry tables’ (*Tabellen*) was similar to systematic cataloguing and provided an overview of the various states classified in a row, according to a set of comparable characteristics (Lazarsfeld, 1970). Beginning in 1725, the procedure for conducting a census of the population drew scientific legitimacy from the bureaucratic practices of Prussia under absolutism. For a long time, England resisted the idea of a general census in the name of individual rights, which explains the use of the first random samplings. The tools of statistical observation developed within the conceptual framework of political arithmetic. In 1662, John Graunt made a systematic analysis of the registers of baptisms, marriages and deaths in London parishes. It was one of the first studies presented to the Royal Society, which saw in it a ‘new light for the world’. In 1693, the astronomer Edmund Halley published his mortality tables. A new social role was starting to take shape, that of the ‘expert’ offering a fully developed language for the use of governments; these were people trained in practical knowledge who came from a variety of professions (Desrosières, 1993). There seemed to be no limit to the possible fields of application. Statistical techniques not only contributed to the new relationship between the monarchical state and the various social classes engendered by the bourgeois revolution, but was inextricably linked to a new form of commercially oriented rationality. One of Halley’s major aims in developing mortality tables was to provide actuarial techniques to assess life insurance schedules. From now on, calculation would allow people to protect themselves against the future.

Geostrategic transformation

France was undoubtedly the country in which mathematical reasoning was most widely used in the sciences aimed at the strategic control of the 'body of the earth'. Sébastien Le Prestre de Vauban (1633–1707), the famous fortifications engineer of Louis XIV, played a leading role. One of his biographers has written that this 'man of the soil' was a 'great mover of earth who knew the contours of France the way a sharecropper knows the slope of his fields' and that as he built its fortified towns, he was also building the fortress of the nation-state (Halévy, 1923). In an age when wars dragged on and on, the 'frontiers' where he built his 'great immobile machines' were, indeed, the front lines of combat. Historians of military strategy agree that Vauban was the prototype of the geometrical mind. The period during which he built fortresses coincided with the 'military revolution' between 1670 and 1680 led by the Marquis de Louvois, Secretary of War under Louis XIV. The main revolutionary changes within the army included systematically applying science to war (and its corollary: creating a corps of engineers); setting up a civilian administration of war with its own *ad hoc* ministry, ending the hiring of mercenaries and introducing professionalism and discipline in the ranks; stabilising the military population in barracks; drawing up a promotion grid stipulating the rules of advancement by seniority; developing improved firearms and knives (that is, generalising the use of flintlocks and abandoning pike in favour of the familiar bayonet with a sleeve or socket that held the blade at the side of the barrel) (Guerlac, 1986).

Vauban's thinking about territory and how to organise it was given full expression in his conception of a 'fortification system'. His overriding concerns, namely his determination to build a continuous border held together by a ‘chain of forts’, linked by canals or a network of canalised streams or rivers, his overall, in-depth vision of defence and his requirement that fortresses serve not only for defence but also as a base for offensive operations – all required a thorough knowledge of the terrain on which the fighting would take place. Fortified towns had to be situated in such a way as to control the routes on their own territory and facilitate access to enemy territory. Fortification projects were accompanied by statistical monographs describing the local population and living conditions, along with the activities and resources of the fortified city and the surrounding countryside. The actual construction of the fortified town called for ‘relief maps’ (historians of war simulations have identified the relief map as a precursor of war games played on maps drawn to scale of actual sites where battles might take place, which did not come into widespread military use until the eighteenth century). Relief maps reproduced on a scale of 1/600th entire cities with their fortifications and surroundings, particularly routes and bridges, over a wide area, up to twenty times that of the town itself. The relief map was a genuine synthesis of information for defenders of a town, sometimes serving as a *model* and sometimes as a *portrait*, since building fortifications and drawing maps went hand in hand (Parent, 1982). To connect the links of the chain, Vauban gave priority, wherever possible, to water routes rather than land routes.

Nothing escaped his quantitative method. Vauban is considered, along with the Englishmen Robert Hooke and Edmund Halley, one of the pioneers of meteorology. He was the first to gauge the size of mine craters. He began the systematic measurement of the time required for cannon fire, as well as for the excavation of a fortified town, from which he derived principles for the organisation of labour. A century later, these would be applied rigorously for the first time to the manufacture of firearms.

Vauban believed in the possibility of 'escaping from chaos and confusion' through 'behaviour governed by calculation'. His concerns clearly went well beyond the battlefield. In the repeated journeys he undertook to inspect fortified towns and armies he acquired a stereoscopic vision of the realm and was, in fact, one of the few advisors of Louis XIV who had actually travelled it widely. He worried about obstacles to the circulation of goods and manpower, in particular the poor condition of routes and rivers. He showed the same concern about the number of customs stations and sought to 'relegate internal customs stations to the borders'. Here again, he showed a preference for waterways, conducting a detailed inventory of France's rivers and attempting to calculate their degree of navigability. With the same aim of unifying the nation, Vauban developed a 'General and easy method for population census' and suggested a model form in table format. He tried to link the population census project to the issue of tax reform, a suggestion that was so bold as to bring him into disgrace. By the second decade of the eighteenth century, the first geographers and the first Ponts et Chaussées engineers, entrusted with the building and maintenance of bridges, roads, canals, rivers and ports, drawn from the corps of fortification specialists, began systematic mapping of French territory (Mattelart, 1994).

In Vauban's treatise on how to take and defend fortified towns, he referred to the 'branch system', another term for networks. Although he did not invent the word 'network', Vauban is indeed the one who introduced the reticular perspective into the vision of strategic use of territory. In his time, the network metaphor was confined to the language of medical experimentation. Around 1665, referring to the 'reticular body of the skin', the Italian anatomist and naturalist Marcello Malpighi (1628–94), a precursor of histology or the science of tissue, transposed the word, previously used to designate the warp of fabric, net or lace, to the field of anatomy. It was no accident that Vauban's biographer, Pierre-Alexandre Allent (1772–1837), who was an officer in the engineering corps, should have been the one to ratify the use of the word 'network' in an essay on military reconnaissance in 1802. In this work, the hydrological network was compared to the branching of a tree. Thus, strictly speaking, the term 'network' did not come into use in military language until war ceased to be an affair of strategic position and siege, with mass conscription during the French Revolution in 1793 and with the fundamental change brought about by moving warfare, in which parallel lines and columns form, disband and redeploy. Half a century later, the expansion of the railway would speed up these changes.

Inventing a universal norm

The geometrical utopia of the revolutionaries

A norm or standard is that which allows the parts to be integrated into a whole. Whether technical or behavioural, norms and procedures determine the criteria of organisational efficiency.

> A norm establishes what is normal on the basis of a normative decision. . . . From the standpoint of standardisation, there is no difference between the birth of French grammar in the seventeenth century and the introduction of the metric system at the end of the eighteenth century. Richelieu, the *Conventionnels* and Napoleon Bonaparte were the

> successive instruments of the same popular demand. We began with grammatical norms and ended up with the morphological norms for the people and horses required for national defence, along with standards for industry and hygiene. (Canguilhem, 1966: 181)

The Enlightenment and the system

Denis Diderot and Jacques d'Alembert placed their grand project of a *Dictionnaire raisonni des sciences, des arts et des métiers*, also known as the *Encyclopédie*, under the auspices of Francis Bacon. In the entry for 'Art', they paid tribute to him for having braved the *non plus ultra* of the Ancients and glimpsed the limitless ability of science and technology to 'break through the columns of fatality'. By linking 'mechanical and practical arts' to philosophical principles, the encyclopaedists' enterprise, which came to fruition in 1772, contributed to the advancement of new technologies and methods. In the entry for 'System', Diderot seized upon the metaphor of the 'automated machine to measure time', the *machina machinarum*, to define the concepts of organisation, function and complication or complexity. Under 'Farmers' and 'Grain', the philosopher-physician François Quesnay (1694–1774), leader of the physiocrats, laid the foundations for the science of political economy. He also published the 'Economic Table', the first geometrical representation of the circulation of wealth. The fluidity of the movement of goods and people, and hence of communication routes, became the symbol of a doctrine that can be summed up in the maxim: '*Laissez faire, laissez passer*'. The entry 'Pin', in which a philosopher details the eighteen operations required to produce one, was to spur Adam Smith to provide a theoretical framework for the concept of the 'division of labour', a central principle in his project of a liberal economy (Smith, 1930).

At the time, the analogy of the machine was used alternately with that of the living organism to define the concept of 'system': 'The individual body is a huge clock; the collective body, a machine whose organisation responds to a mechanism of the same nature,' wrote the physician-philosopher Julien Offroy de La Mettrie (1709–51) in *L'Homme-machine* (Man, a Machine) in 1747. This organic vision of social mechanisms refers to the new 'anatomy of power' that confirmed the growing importance of panoptic prison and surveillance technologies, namely a set of minute disciplinary procedures designed to control and measure individuals. Michel Foucault wrote: 'La Mettrie's *L'Homme-Machine* is both a materialist reduction of the soul and a general theory of conditioning (*dressage*), at the centre of which reigns the notion of "docility", which joins the analysable body to the manipulable body' (Foucault, 1977: 136). Since 1738 the mechanical flute player, created by Jacques de Vaucanson (1709–82), has served as a mechanical representation of man-as-machine.

The term 'normal' was borrowed by the French revolutionaries in 1789 from the vocabulary of geometry and referred to the T-square and the level (Macherey, 1992). These two emblems of Equality are attributes of the goddess Philosophy, the incarnation of Reason. The term was first applied to France's newly created teachers' schools. The ideal of egalitarian 'levelling', or the equalisation of citizens, inspired the Declaration of Human Rights, the unification of the French language through elimination of local dialects, the adoption of the Civil Code and the introduction of a system of statistics. The same ideal governed the division of administrative territories into *départements* and the location of public schools. The revolutionaries themselves were divided over the construction of this latticework grid, conceived as a coherent, hierarchical space. Regarding the distribution of schools, for example, some mocked the 'mathematical rabies' afflicting the project authors and accused them of denying the reality of a landscape shaped by history. The 'geometrical utopia' was accused of being ignorant of life (Julia, 1981). In London, right from the start of the revolutionary process, the English liberal Edmund Burke drove the point home by challenging the new departmental division: 'It is boasted that the geometrical policy has been adopted, that all local ideas should be sunk, and that the people should no longer be Gascons, Picards, Bretons, Normans, but Frenchmen, with one country, one heart and one assembly. But instead of being all Frenchmen, the greater likelihood is, that the inhabitants of that region will shortly have no country. No man ever was attached by a sense of pride, partiality, or real affection, to a description of square measurement. He never will glory in belonging to Chequer No. 71, or to any other badge-ticket' (Burke, 1986: 315). This line of argument was ambivalent, because it also acknowledged the validity of liberal principles; in place of abstract regulation by numbers, Burke was, after all, vaunting the concreteness and spontaneity of the providential market. In *The Rights of Man*, published in 1791, Thomas Paine made this reply to the Englishman's tract: 'It is power, not principles, that Mr. Burke venerates.'

The French government decree imposing the decimal system of weights and measures represented a highly symbolic normative decision, since it ran openly against the grain of prejudices and traditions dating back to feudal times, when the lack of standard measurements was an instrument for commercial trickery, favouring the rich and powerful. The metre thus appeared as the fulfilment of the secular idea of openness in trade. Derived from Nature – Nature shared by everyone, as defined by the Enlightenment philosophers – the new unit of measurement was glorified as the fruit of emancipating reason. As the bearer of universal values, it was seen as bringing men closer together (Kula, 1984).

The age of probable history

The topic of a universal language returned to the agenda with the philosopher-mathematician Condorcet (1743–94) and his plan to develop a language offering ‘geometrical certitude’. The language of signs he proposed had to be able ‘to bring to bear on all the objects embraced by human intelligence, the rigour and accuracy required to make the knowledge of truth easy, and error almost impossible’ (Condorcet, 1794: 293). This language would make broad use of charts, tables, methods of geometrical representation and descriptive analysis. Following in the footsteps of Francis Bacon, whom Condorcet invoked as his inspiration, he wrote *Fragment sur l’Atlantide*, a utopian vision of the organisation of a republic of scientists one of whose tasks was to ‘establish a universal language’. The project was explicitly based on a new relationship to history, that is, a conception of history as necessity, closely related to the theory of the perfectibility of human society. In Condorcet’s view, if a new theory of history had become possible, it was because, by making use of past experience, in other words by observing the frequency with which events occurred, it was now possible to predict the future, at least in probable terms. On the eve of the events of 1789, he extrapolated from the argumentation of the Swiss

Jacques Bernouilli (1654–1709) concerning the abstract logic of probability theory, to determine more equitable methods of election to courts of assizes and representative assemblies, and to predict these bodies' concrete decisions. The experiment convinced Condorcet that he had discovered the philosopher's stone of a moral and political science as 'precise and exact' as the physical sciences. The future was no longer a field wide open to exploration, but had instead become predictable. Long-standing certitudes founded on temporal cycles and the repetition of events began to lose their hold. Unlike the island of old-fashioned utopias, Condorcet's depiction of the future of humankind embraced the larger world outside, indeed the whole planet.

The birth of redemptive discourse on long-distance communication

> Someone made a remark about the telegraph which seems to me infinitely correct, and which brings out its full importance, namely that, at bottom, this invention might suffice to make possible the establishment of democracy among a large population. Many respectable men, including Jean-Jacques Rousseau, thought that the establishment of democracy was impossible among large populations. How could such a people deliberate? Among the Ancients, all the citizens were assembled in a single place; they communicated their will. . . . The invention of the telegraph is a new factor that Rousseau did not include in his calculations. It can be used to speak at great distances as fluently and as distinctly as in a room. There is no reason why it would not be possible for all the citizens of France to communicate their will, within a rather short time, in such a way that this communication might be considered instantaneous.

The foregoing text dates from March 1795 and was written by a man of science, Alexander Vandermonde

(1735–96), who held the first chair of political economy created in France. In August 1794, the Ministry of War opened the first optical telegraph line (Paris–Lille).

This prophetic discourse on the democratic virtues of long-distance communication would soon be contradicted by the continuation of the embargo on codes and encrypted 'languages of signs' and by the refusal to authorise their use for civic purposes in the name of domestic security and national defence. This situation was to continue almost up to the arrival of the electric telegraph. No one but the person who transmitted the original and the final receiver knew the keys to the code formulated by the inventor of this technique, Claude Chappe. A star- or pyramid-shaped model would be used for the architecture of the network, which branched out from the top in Paris. Already employed for the national road network, it came into permanent use via the railroad and all later telecommunications networks.

Each new generation of technology revived the discourse of salvation, the promise of universal concord, decentralised democracy, social justice and general prosperity. Each time, the amnesia regarding earlier technology would be confirmed. All these methods – from the optical telegraph to underwater cable, the telephone, the radio, the television and the Internet – intended to transcend the spatial and temporal dimensions of the social fabric, brought back the myth of the recovery of the lost agora of Attic cities (Mattelart, 1994, 1999). Neither the often radically different historical conditions of their institutionalisation, nor the flagrant abandonment of their promises regarding their supposed benefits could make this millenarian world of technological images falter.

In the early days of the Enlightenment, the quarrel between the Ancients and the Moderns had already begun to transform the historical view of the process by which modernity took shape. The habit of viewing universal history in terms of ages, and hence of giving succinct names to present and future society, did not develop until the end of the eighteenth century, although there were illustrious precursors such as Giambattista Vico (1668–1744) or the physiocrat Anne Robert Turgot (1727–81). In a speech delivered at the Sorbonne entitled *Tableau philosophique des progrès successifs de l'esprit humain* (A Philosophical Portrait of the Successive Advances of the Human Mind), Turgot had indeed anticipated this practice by outlining the progress of knowledge in three phases: theological, metaphysical and scientific. He insisted on the decisive role of tools of communication – language, writing and printing – in the configuration of different types of society classified as at various stages along path of Enlightenment progress.

Condorcet, in turn, divided the methods of knowledge and their corresponding societies into historical periods in his *Esquisse d'un tableau historique des progrès de l'esprit humain* (Sketch for a Historical Picture of the Progress of the Human Mind), linking changes in transmission techniques to the shaping of institutions. He analysed the impact of printing on scientific development, the formation of democratic opinion and the growth of the ideal of equality. His vision of the benefits of communicating practical and theoretical knowledge and of increasing opportunities for scientific exchange, took the form of a determinist philosophy. Progress, characterised as an infinite, exponential process, was seen to accompany the irresistible ascension of the 'general illumination of minds'.

The ‘romanticism of numbers’, as the sociologist Max Weber called it, was to be put to the test by the pragmatic management of industrial society. People counted by numbers and, in the end, numbers alone would count.